Manual Edition 10/2005

Electropneumatic Positioner
SIPART PS2

6DR50xx, 6DR51xx, 6DR52xx, 6DR53xx

sipart

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SIPART PS2

6DR50xx
6DR51xx
6DR52xx
6DR53xx

Edition 10/2005

Manual

Electropneumatic Positioner for
Linear and Part-Turn Actuators

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Contents

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 a** pressurized explosion proof housing

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

Scope of delivery, see chapter 7, page 127.

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 immenently hazardous situation which, if not avoided, **will** result in death or serious inury.

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 the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

NOTICE

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 device may be used solely for the purposes described in this manual.

The instrument is designed for connection to functional and 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 rating 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 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 operating instructions are a constituent part of the enclosed CD ”sipartp ps2 POSITIONERS” (order number A5E00214567) and is 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.

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 7, page 127.

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 the Technical Data in Chapter 6, page 121).

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.

Introduction 1

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.

Purpose

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

- with linear actuator (figure 1-1, page 13) or
- with part-turn actuator VDI/VDE 3845 (figure 1-2, page 13)

Different mounting types are available for linear actuators:

- NAMUR or IEC 534
- 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 housing for single and double-acting actuators

Degree of protection

The device is designed with IP65/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 SIPART PS2 positioners in the variations 6DR501*, 6DR511*, 6DR521* and 6DR531* (i.e. with 0/4 up to 20 mA control signal in the single–acting design) 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/ IEC 61511–1. For this, the SIL safety instructions (see "SIPART PS2 SIL safety manual" A5E00442120) must be followed.

Options

The positioner can be expanded with various options modules (chapter 2.5, page 26). The following modules are available in all:

- J_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

Accessories

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

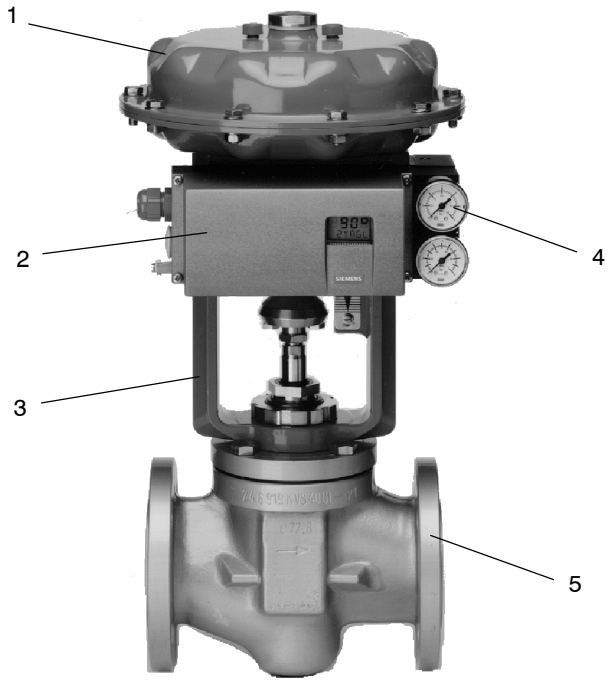
For decentralized installation of the positioner and position sensor:

- 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.

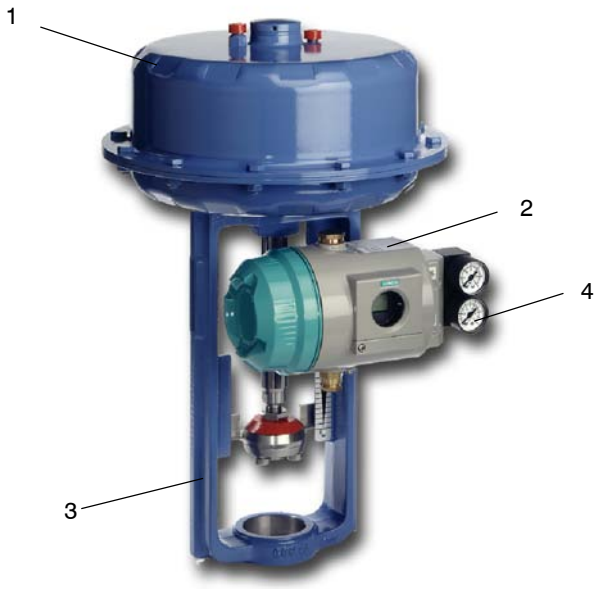


1	Actuator
2	Positioner, single-acting in metal housing
3	Lantern
4	Manometer block, single-acting
5	Valve

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

1	Positioner double-acting in plastic housing
2	Part-turn actuator
3	Manometer block, double-acting

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



1	Actuator
2	Positioner, single-acting in explosion proof housing
3	Lantern
4	Manometer block, single-acting

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

1	Positioner double-acting in explosion proof housing
2	Part-turn actuator
3	Manometer block, double-acting

Figure 1-4 **Explosion proof version** of the positioner mounted on **part-turn actuator** (double-acting)

Design and Method of Operation 2

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 actuator is detected by a servo potentiometer and fed back as actual value x. The setpoint and actual value are output simultaneously on the display.

The setpoint w is formed by a current fed to the positioner which at the same time serves to supply the positioner in two-wire operation. In 3 / 4-wire operation the supply comes from a 24 V voltage input.

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.

The standard controller has one digital input (DI1). This can be configured individually and can be used for blocking the operating modes for example.

With the J_y-option module, the current actuator position can be output as a two wire signal J_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 out-

puts 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.

Communication with the controller is possible via the optional HART interface.

To be able to use the positioner with a variety of different part-turn and linear actuators, it has a friction clutch and switchable gearing.

The switchable gearing allows you to adjust the positioner for small and large lifts. You can switch using the yellow switch (8, Fig. 2-1) between 33° (as delivered) and 90°.

The friction clutch (9, Fig. 2-1) 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.

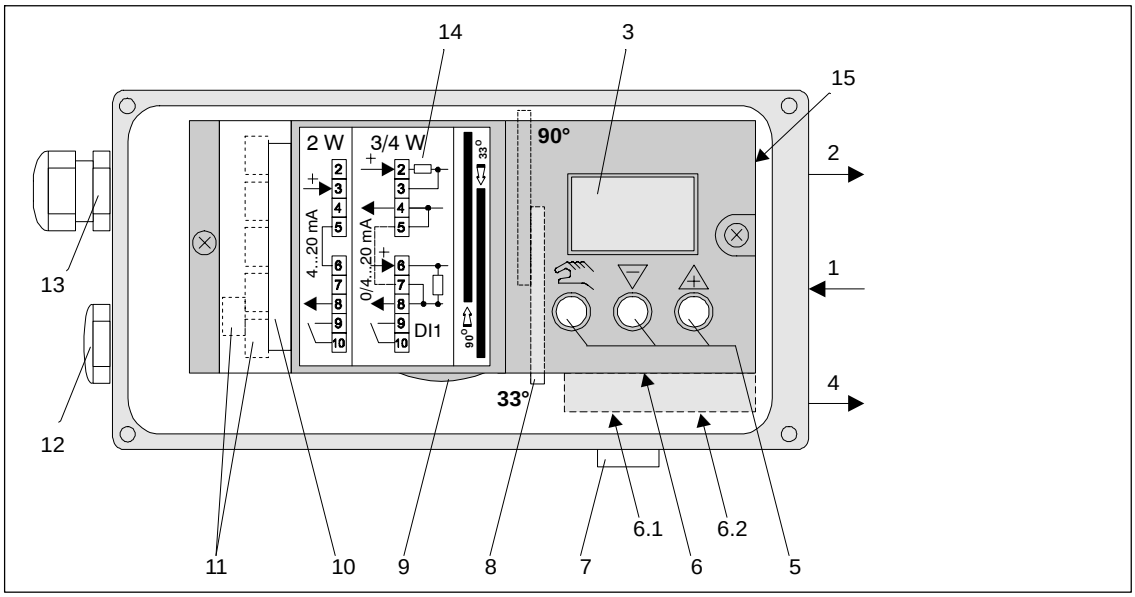
As it is not allowed to open the housing of an explosion–proof version in a potentially explosive atmosphere, the shaft has an externally fitted, additional friction clutch (8, Fig. 2-2, page 18).

NOTICE

for the explosion–proof version:

Only adjust the outer friction clutch (8, Fig. 2-2, page 18). The internal friction clutch (9, Fig. 2-1 page 17) is fixed and, for the explosion–proof version, must **not** be adjusted.

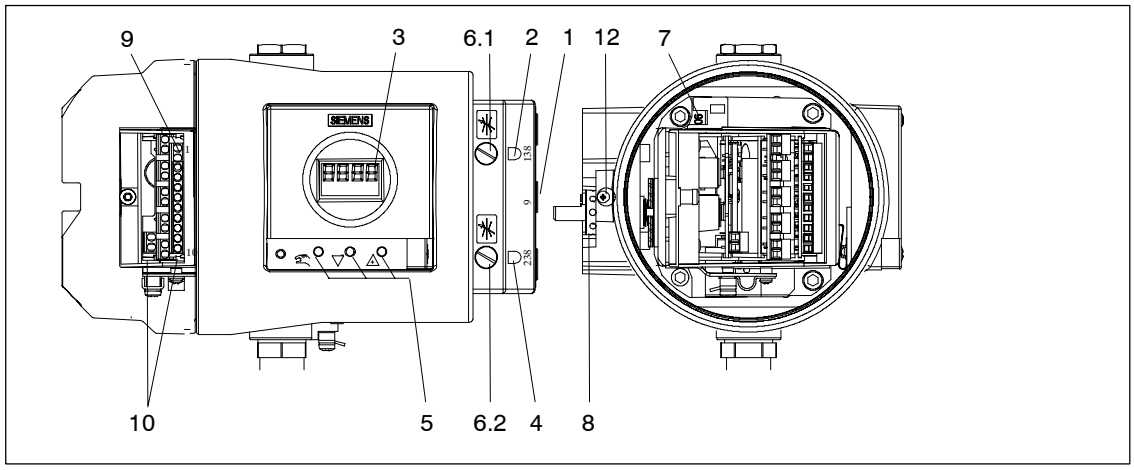
2.2 Instrument Components



1	Input: Supply air	7	Silencer
2	Output: Actuating pressure Y1	8	Transmission ratio selector
3	Display	9	Adjusting wheel for frichtion clutch
4	Output: Actuating pressure Y2 *)	10	Terminals options modules
5	Operating keys	12	Dummy plug
6	Restrictor	13	Screw–type cable gland
6.1	Restrictor Y1	14	Terminal plate on cover
6.2	Restrictor Y2 *)	15	Purging air switch

*) in double–acting actuators

Figure 2-1 View of the positioner in normal version (cover open)



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

*) in double–acting actuators

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

2.2.1 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.

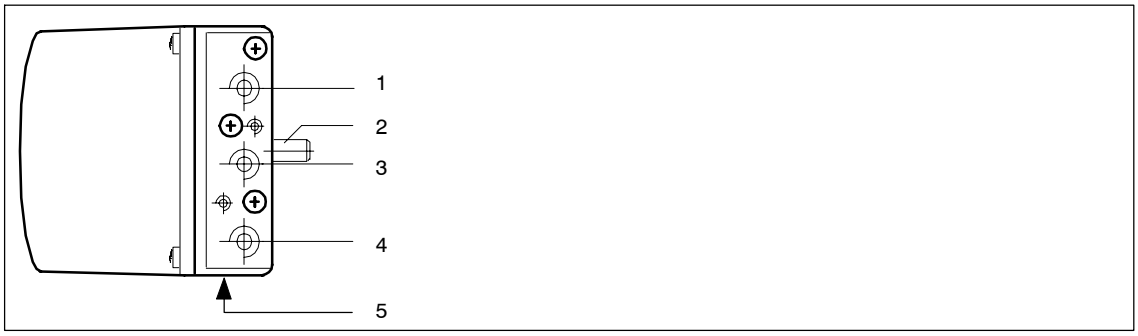
2.2.2 Electrical Connections

The terminals of the standard controller, the J_y- 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.

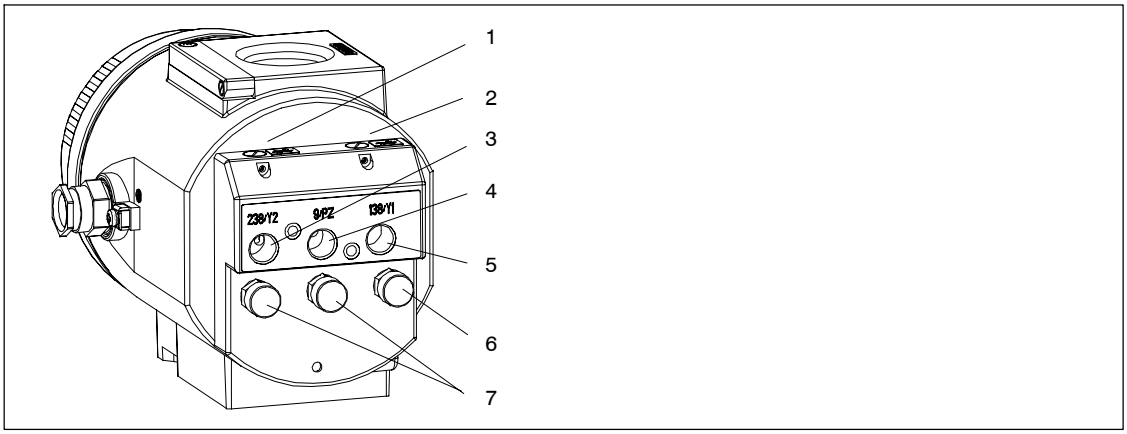
2.2.3 Pneumatic Connections

The pneumatic connections are on the right hand side of the positioner (figure 2-3 and figure 2-4).



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 2-3 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 2-4 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 35, figure 3-3, page 36 and figure 3-4, page 37).

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

Figure 2-5, page 21 shows the pneumatic connection variants for the different actuator types, the positioning action and the safety position after power failure.

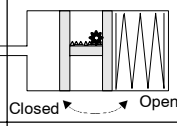
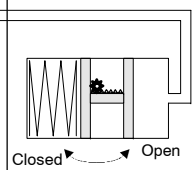
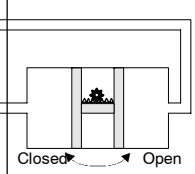
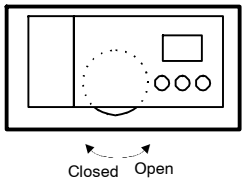
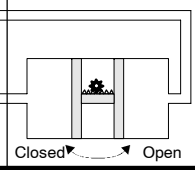
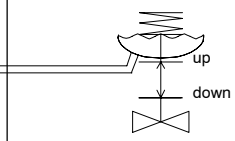
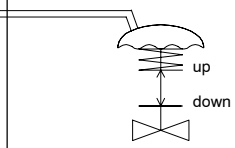
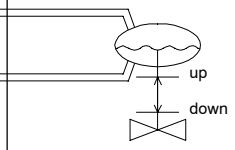
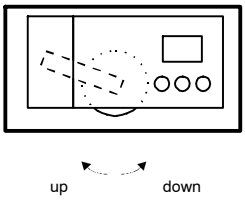
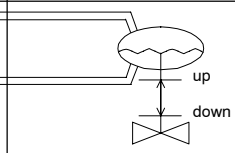
Positioning pressure Connection	Actuator type	Safety position after power failure electrical	pneumatic	
Y1		Closed	Closed	In part-turn actuators the direction of rotation counterclockwise looking onto the actuating shaft of the valve is usually defined as ”Open”.
Y1		Open	Open	
Y2 Y1		Open	Last position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

Figure 2-5 Pneumatic connection positioning

2.2.4 Mounting Kit

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

2.2.5 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 2-6). 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.

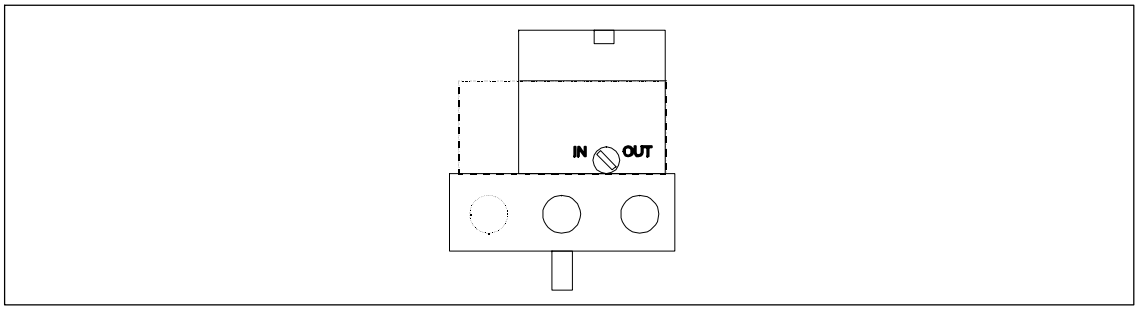


Figure 2-6 Purge air switch on the valve block, view of the positioner onto pneumatic connection side with cover open

2.2.6 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 2-7, in explosion proof version, see figure 2-4, page 19). By turning to the right 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).

In the case of double-acting valves make sure that both chokes are set approximately equal.

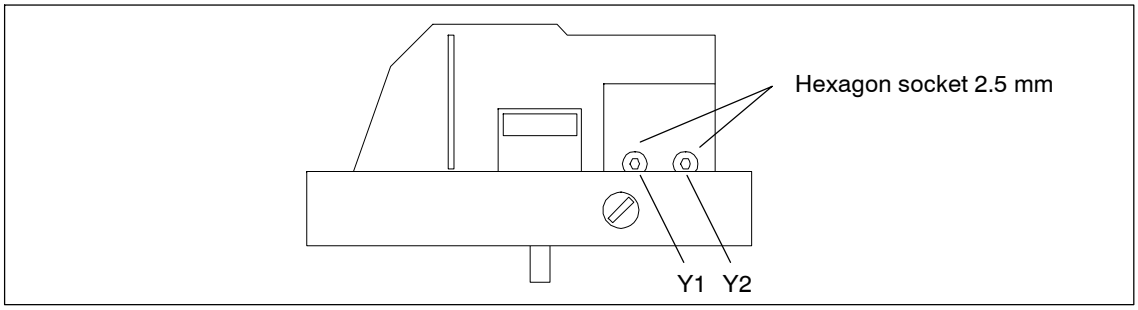


Figure 2-7 Restrictors

2.3 Method of Operation

The electropneumatic positioner SIPART PS2 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 part-turn actuators and the command variable w is the actuating current of a controller or a manual control station of 4 to 20 mA.

The stroke or part-turn 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.

This may correct the angle error of the stroke tap, compares the potemtiometer voltage as actual value x with the setpoint w fed in at the terminals 3 and 7 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. See the block diagram figure 2-9, page 25.

The control algorithm is an adaptive predictive five–point switch (see figure 2-8, page 24).

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 travel 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 PDM and 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.

Figure 2-9, page 25 shows the block diagrams for single– and double–acting actuators with the linear actuator as an example.

NOTE

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

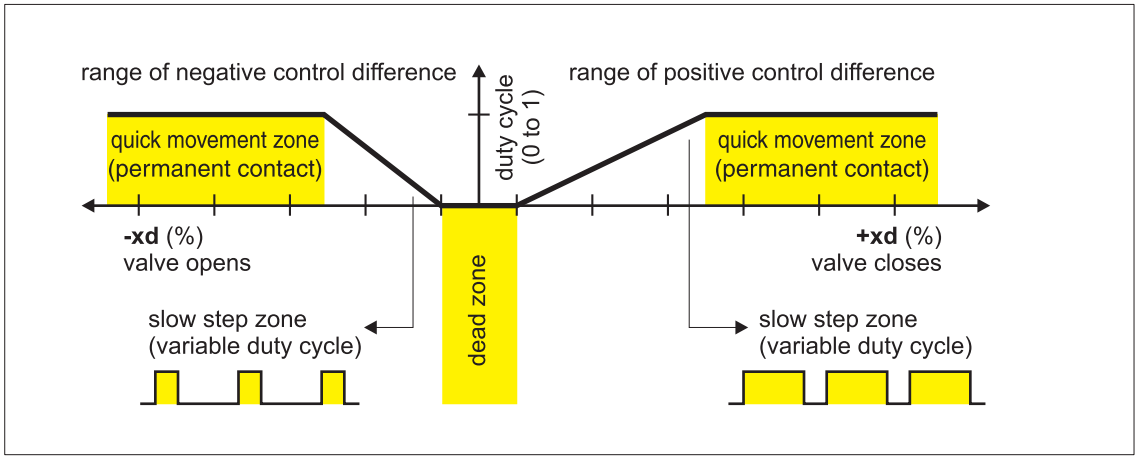
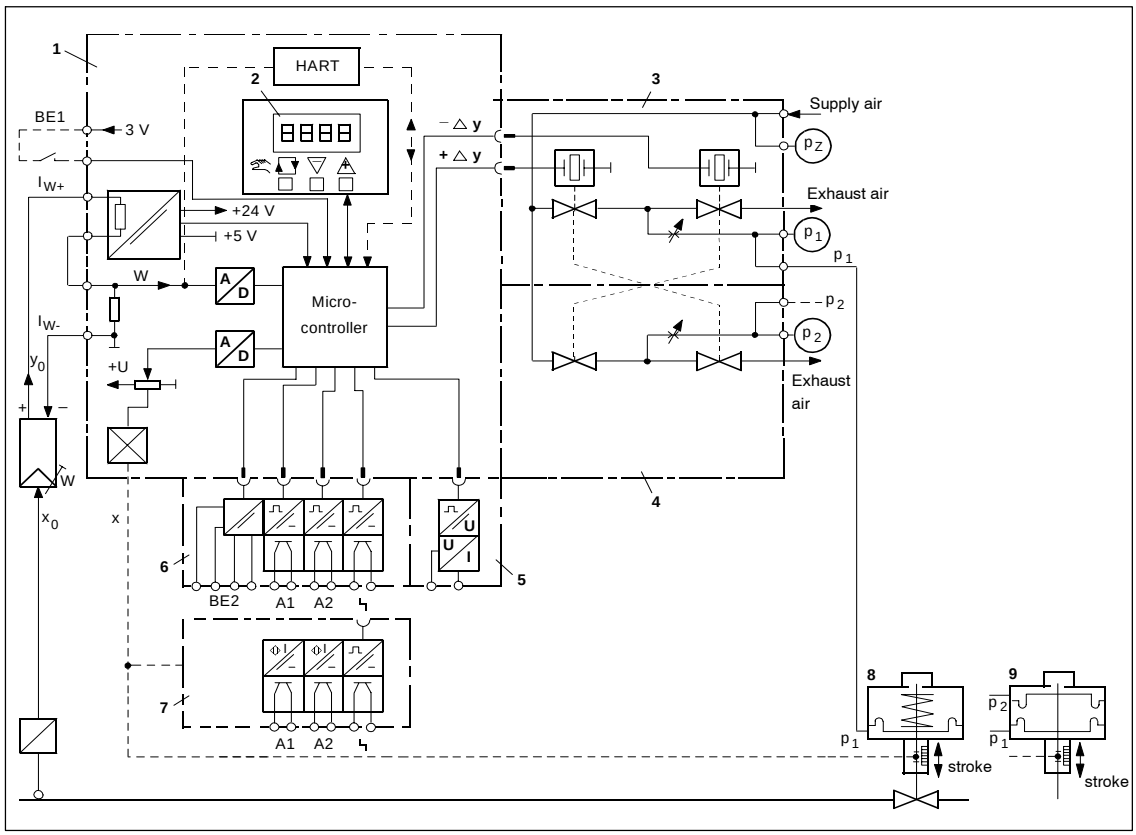


Figure 2-8 Method of operation five–point switch



1 Motherboard with microcontroller and input circuit
2 Control panel with LC-display and momentary action switch
3 Piezo–valve unit, always built–in
4 Valve unit with double-acting positioner always built–in
5 Iy-module for positioner SIPART PS2
6 Alarm module for three alarm outputs and one digital input
7 SIA-module (Slot Initiator-Alarm-module)
8 Spring–loaded pneumatic actuator (single-acting)
9 Spring–loaded pneumatic actuator (double-acting)

Figure 2-9 Block diagram of the electro-pneumatic positioner, functional diagram

NOTE

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

2.4 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.

2.5 Options modules

2.5.1 Options modules in normal and intrinsically safe versions

The options modules are protected and mechanically fixed by a module cover ((1), see figure 2-10, page 29 and figure 2-11, page 31).

☞ **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

J_y-module

Insert the J_y-module (3) in bottom pcb rails of the container, establish the electrical connection with the enclosed ribbon cable (6).

Alarm module

Insert the alarm module (4) in the top pcb rails of the container, establish the electrical connection with the enclosed ribbon cable (5).

SIA-module

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

1. Remove all the electrical connections from the basic electronics (2).
2. Loosen the two fixing screws (2.1) of the basic electronics.
3. Snap out the basic electronic board 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 (11) 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 basic electronics board 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 basic electronics board 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.
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.
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.

---

13. Drive the actuator to the first desired mechanical position.
14. Adjust the top actuating disc (7.2) by hand until the output signal on terminals 41 and 42 changes.

15. Drive the actuator to the second desired mechanical position.
16. Adjust the bottom actuating disc (7.3) by hand until the output signal on terminals 51 and 52 changes.

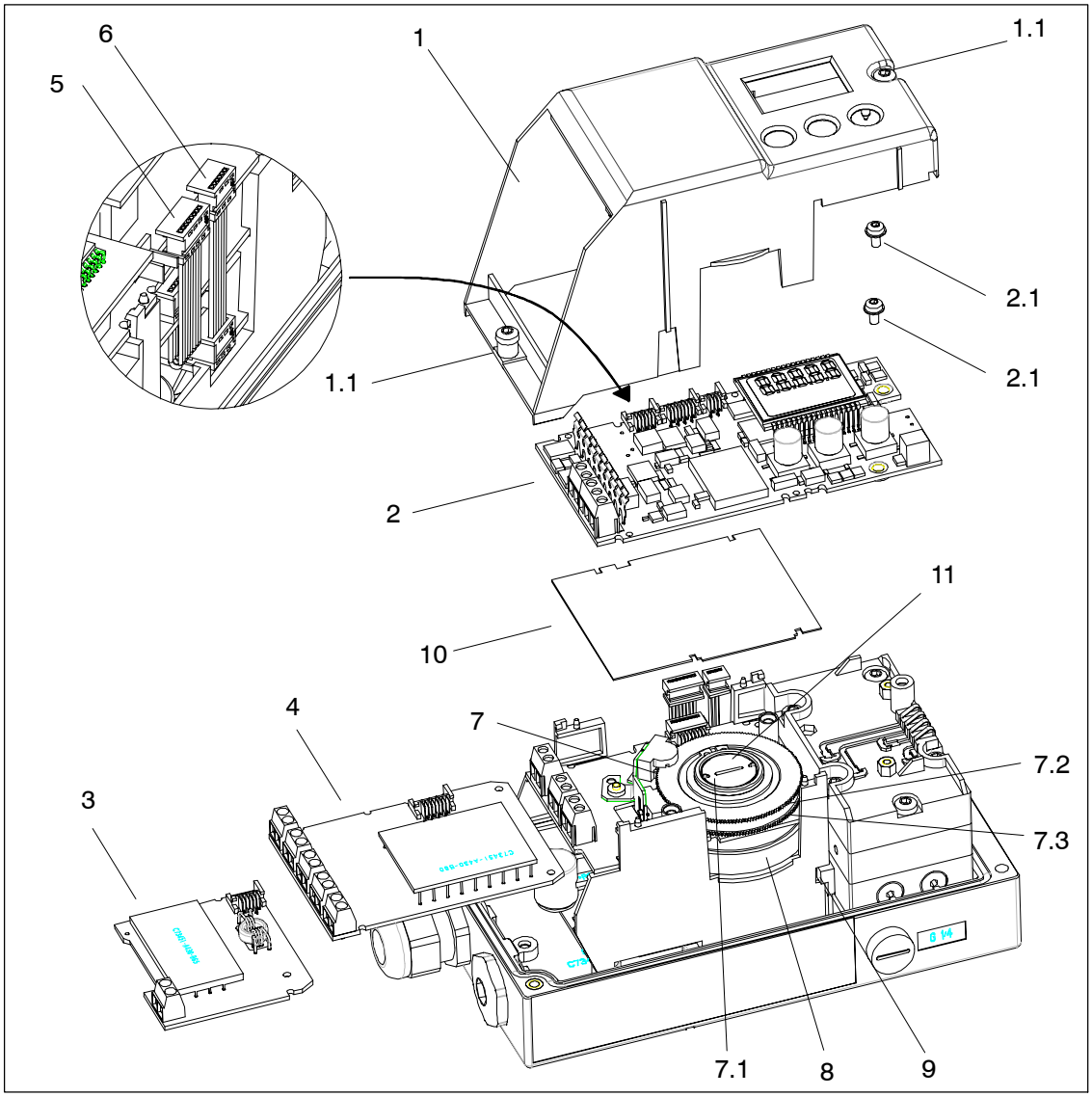
NOTE

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.

EMC filter module for connection of external position sensor

The positioner can also be driven by an external position sensor (potentiometer or NCS) (see page 40 ”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.



1	Module cover	7	SIA-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	J_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 Jy-module	11	Actuating disc bearings

Figure 2-10 Installation of Options Modules

2.5.2 Options modules in explosion proof version

The options modules are protected and mechanically fixed by a module cover ((1), see figure 2-11, page 31).

NOTE

The housing must be opened to install the options modules. The degree of protection IP65/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–though 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

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.

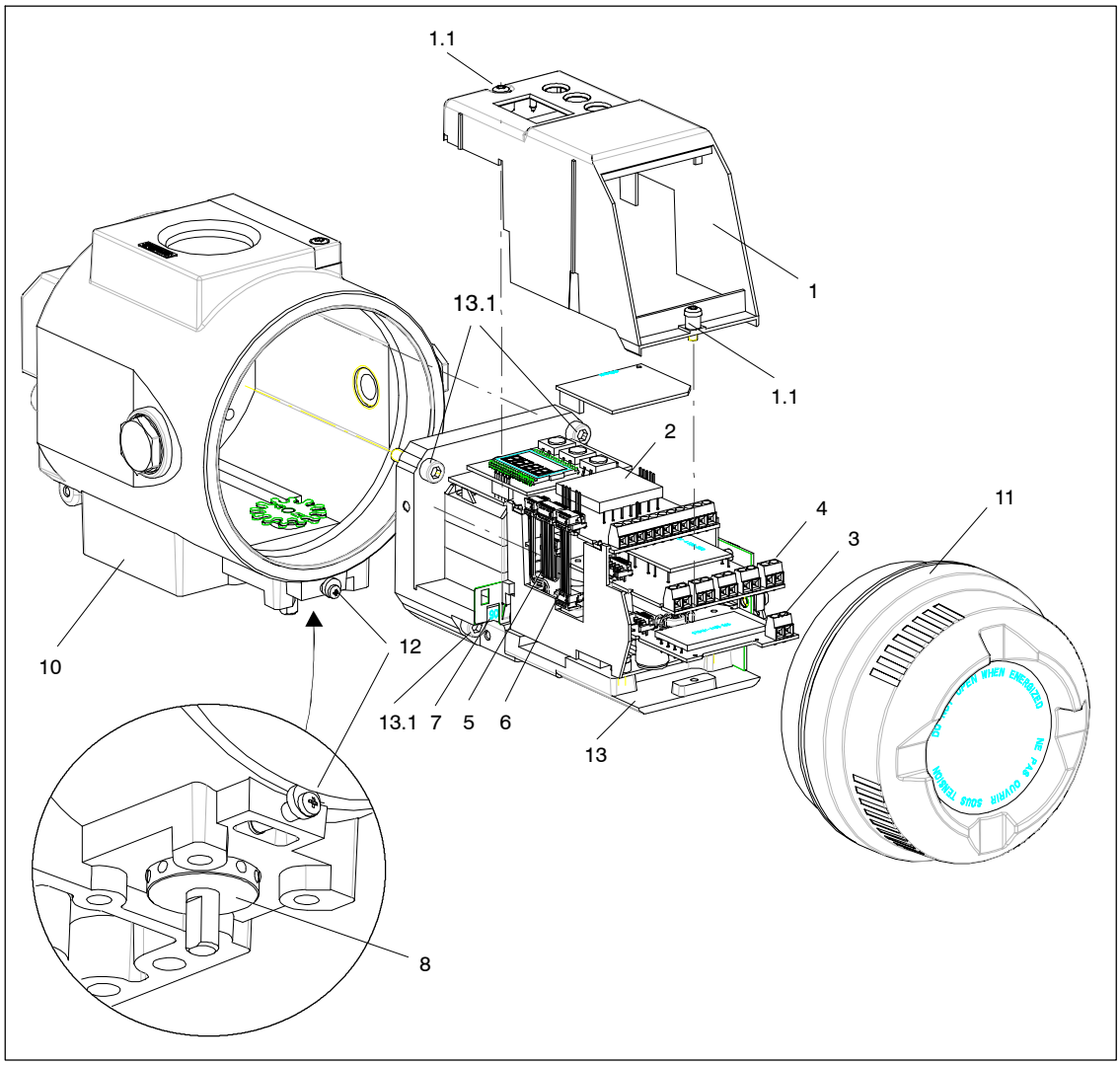
After loosening the four fixing screws (13.1) the complete rack (13) can be removed. The actuator may have to be turned so that the clutch can be easily disengaged.

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	J_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 J_y module	13.1	Fixing screws

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

2.5.3 HART-function

Function

The positioner is also available with built–in HART-functions. The HART protocol allows you to communicate with your instrument with a handheld communicator®, PC or programming unit. This enables you to configure your instrument comfortably, save configurations, call diagnostic data, display online measured values and much more. Communication takes place as frequency modulation over the existing signal lines for the command variable from 4 to 20 mA.

The SPART PS2 is integrated in the following parameterization tools:

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

NOTE

Operation on the positioner has priority over the settings via the HART inetrface.

Communication is aborted by a power failure at the positioner.

2.5.4 Alarm module

Function

The alarm module contains

- 3 digital outputs and
- 1 digital input

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.

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.

The alarm module is available in two versions:

- explosion protected for connecting to switching amplifier DIN 19234
- non–explosion protected for connection to voltage sources with a maximum 35 V

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.

The outputs are potentially isolated from the basic circuit and each other.

The digital input is double.

- one potential isolated for voltage level
- one not potential isolated for floating contacts

These two inputs are designed as logic OR links.

Installation

The alarm module 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 29).

2.5.5 Jy-module

Function

With the J_y-option module, the current actuator position can be output as a two wire signal J_y= 4 to 20 mA – potentially isolated from the standard controller. The dynamic control of the J_y-module makes it also error self–reporting.

Installation

The J_y- module 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 29).

2.5.6 SIA module

The SIA module contains:

- a digital output for outputting a group fault message (see alarm module)

  The floating digital output is implemented as a self error reporting semiconductor output.

- two digital outputs for reporting two mechanically adjustable limit values (L1, L2) by slot initiators.

  These two outputs are electrically independent of the rest of the electronics.

2.5.7 Accessories

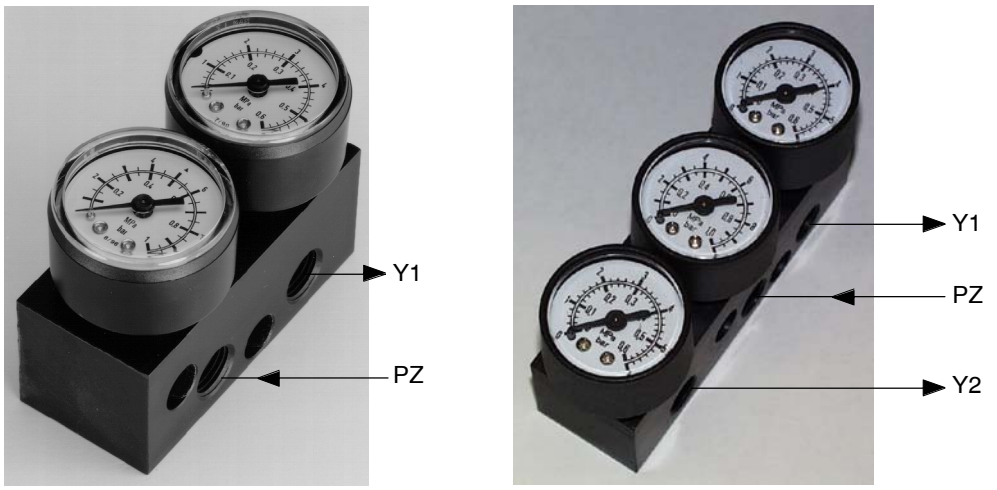


Figure 2-12 Manometer block (left for single-acting, right for double-acting actuators)

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 7.2, page 129.

Installation of any modules required is described in chapter 2.5, page 26 of this technical manual.

3.2 Dimensional drawings

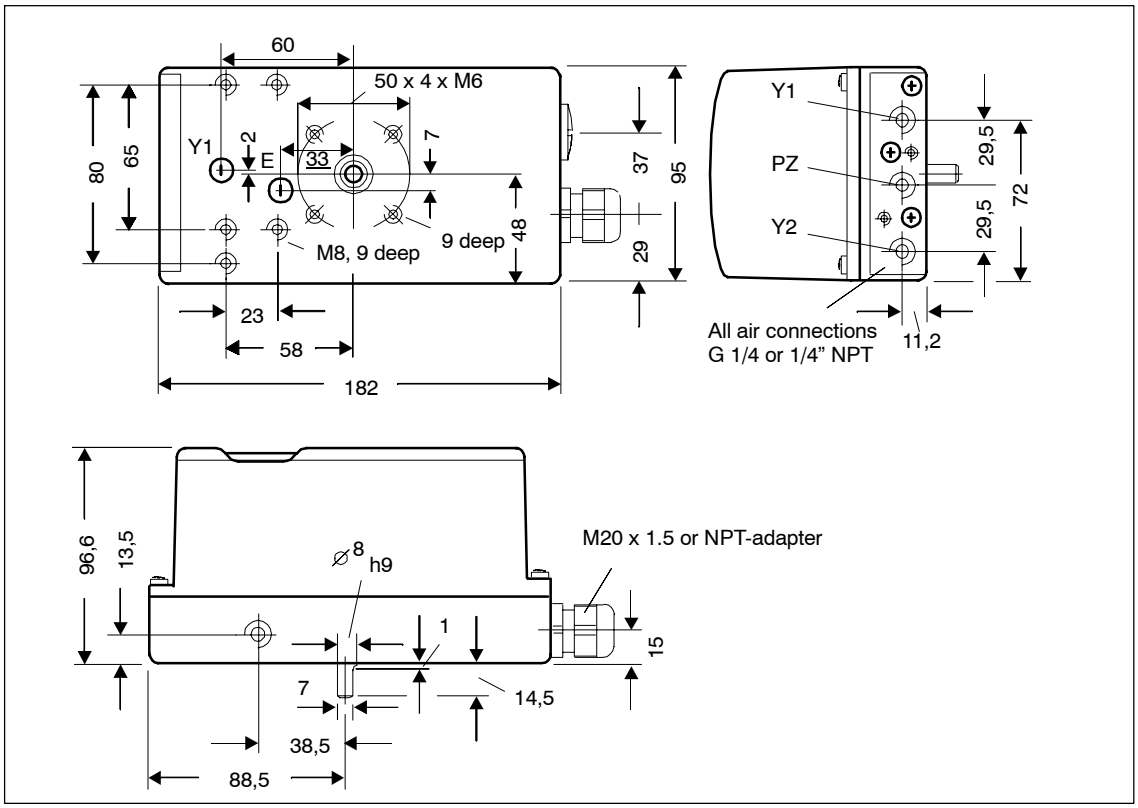


Figure 3-1 Dimensional drawing version plastic housing 6DR5xx0

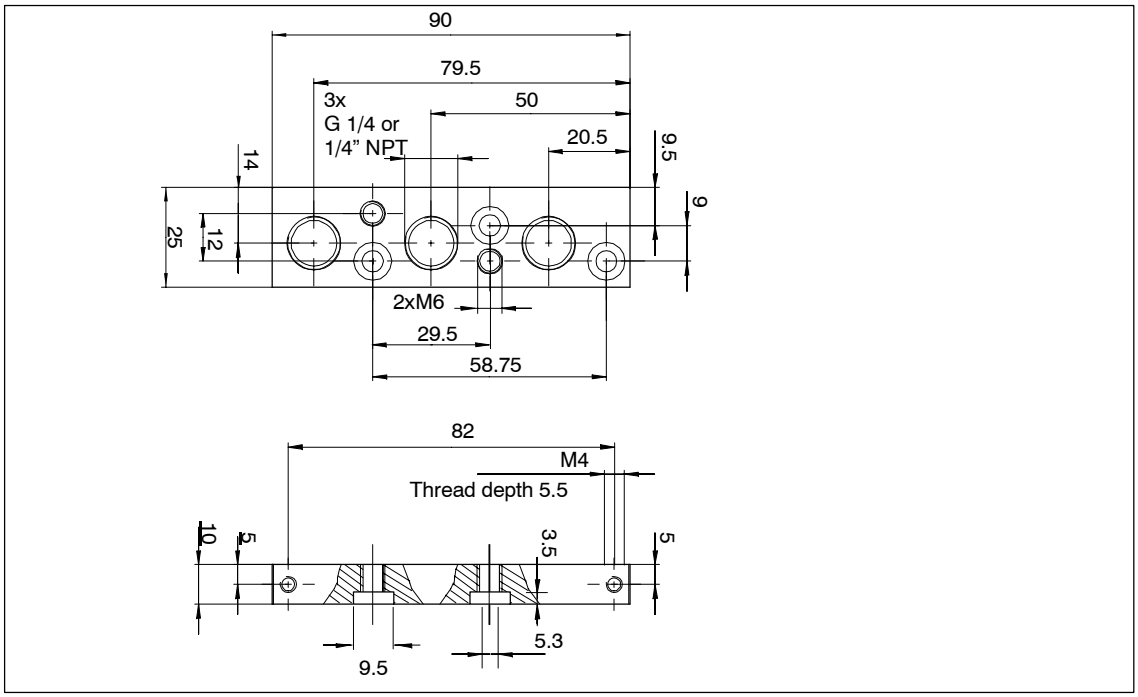


Figure 3-2 Dimensional drawing terminal strip for plastic housing

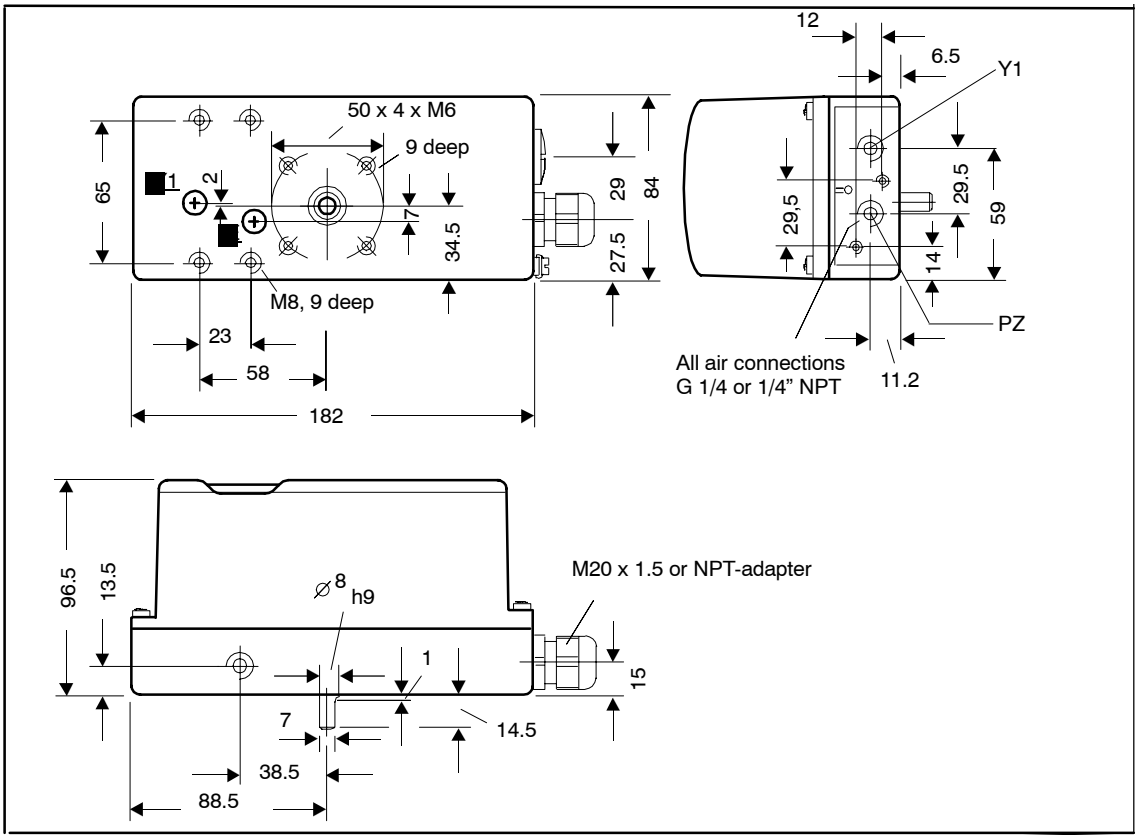


Figure 3-3 Dimensional drawing version metal housing 6DR5xx1

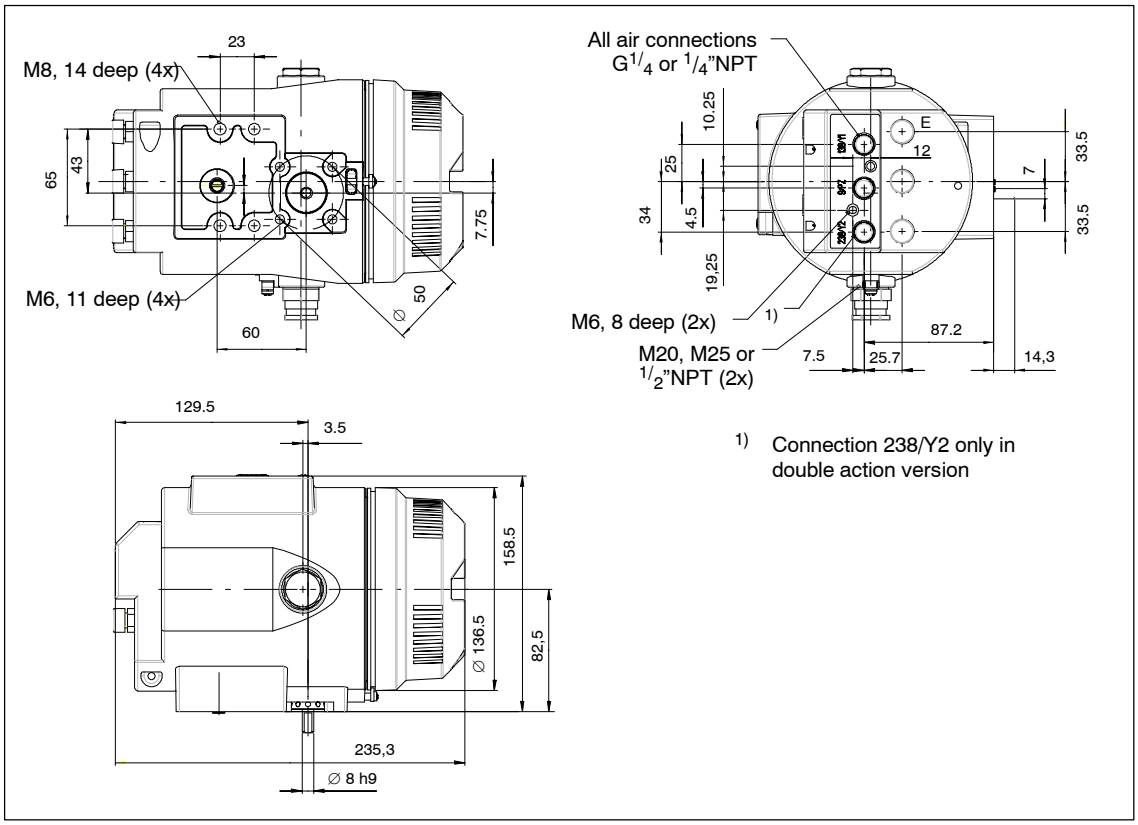


Figure 3-4 Dimensional drawing for positioner with metal housing in explosion proof version 6DR5xx5

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. 51
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 52!

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 part-turn 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.

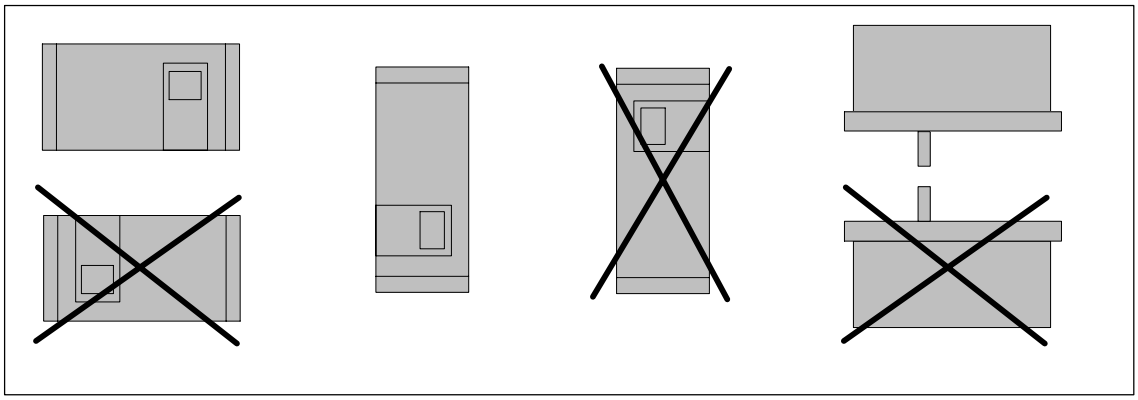


Figure 3-5 Favorable and unfavorable installation positions

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 IP65 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 strong accelerations or vibrations

NOTICE

for explosion–proof versions:

Only adjust the outer friction clutch (8, Fig.2-11, page 31). The internal friction clutch (8, Fig.2-10 page 29) is fixed and, for the explosion–proof version, must **not** be adjusted.

The electro–pneumatic positioner SIPART PS2 has a friction clutch and switchable gearing and can thus be used universally for part-turn and linear actuators. This means that, for part-turn actuators you don't have to worry about the zero point and for linear actuators, you don't have to worry about symmetrical mounting, as you can adjust the working range after installation, with the help of the friction clutch. The switchable gearing allows you to also adjust the positioner for small or large lifts.

Occasionally it can happen, that in the rough environment of process systems (e.g. due to incorrectly fitted valves or if "steam pulses" occur) that the shaft to monitor the position of the SIPART PS2 positioner is exposed to extreme acceleration, which far exceeds its specified load limits, and which could result in an unwanted shift in the friction clutch or in the gears in the position monitoring jumping briefly out.

For cases like this, as standard, the SIPART PS2 positioner is fitted with a locking device for the friction clutch and you can also lock the setting of the transmission ratio selector. This means that an unwanted change to the position monitoring due to the above mentioned effects can be reliably prevented.

Both of these locking options are labeled via additional tags inside the device (see Figure 3-6, page 41). Note that these locks are only required if extreme acceleration or strong vibration might be present within your process.

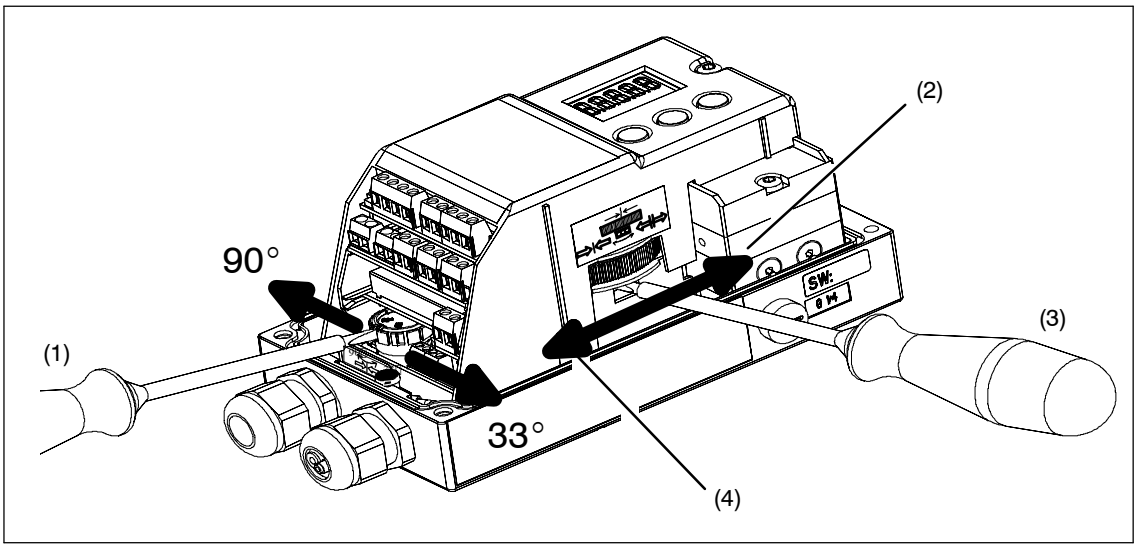
Procedure

After you have installed the positioner and put it fully into operation, you can set the torque for the friction clutch as follows:

- On the module cover, insert an ordinary 4 mm wide screwdriver into a slot on the yellow wheel.
- Now use the screwdriver to move the yellow wheel to the left, until you can feel that it clicks in. This increases the torque of the friction clutch.
- You can recognize a locked friction clutch by an approx. 1 mm wide gap between the yellow and black wheels.
- If you have to set the zero pint e.g. after exchanging the actuator, first reduce the torque by turning the yellow wheel to the right until you hit the stop. After setting the zero point, you can refix the friction clutch as described above.

Starting from the neutral setting (as delivered), you can lock the transmission ratio selector as follows:

- Adjust the yellow wheel underneath the terminals with an ordinary 4 mm wide screwdriver to correspond to the setting that you would like (33° or 90°), turning to the left or right, until you can feel that it clicks in.
- Please note that you can only adjust the transmission ratio selector after releasing the fixing.
  For this reason you first have to put the yellow ring into the neutral position, if you have to adjust the transmission ratio selector e.g. after exchanging the actuator).



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

Figure 3-6 Locking and fixing mechanisms

External position displacement sensor

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 external 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 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 should always be used for the controller unit when any actuator-mounted potentiometer (resistance 10 kΩ) is to be used instead of the position detection system C73451–A430–D78.

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 45):

Ser. no.	pieces	Designation	Note
1	1	NAMUR mounting kit bracket IEC 534	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 with roll (5) 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

Table 3-1 Scope of delivery of the mounting kit “linear actuator”

3.3.4 Assembly procedure (see figure 3-7, page 45)

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 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 axis 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. It must be guaranteed that the horizontal lever position is passed through within the stroke range.

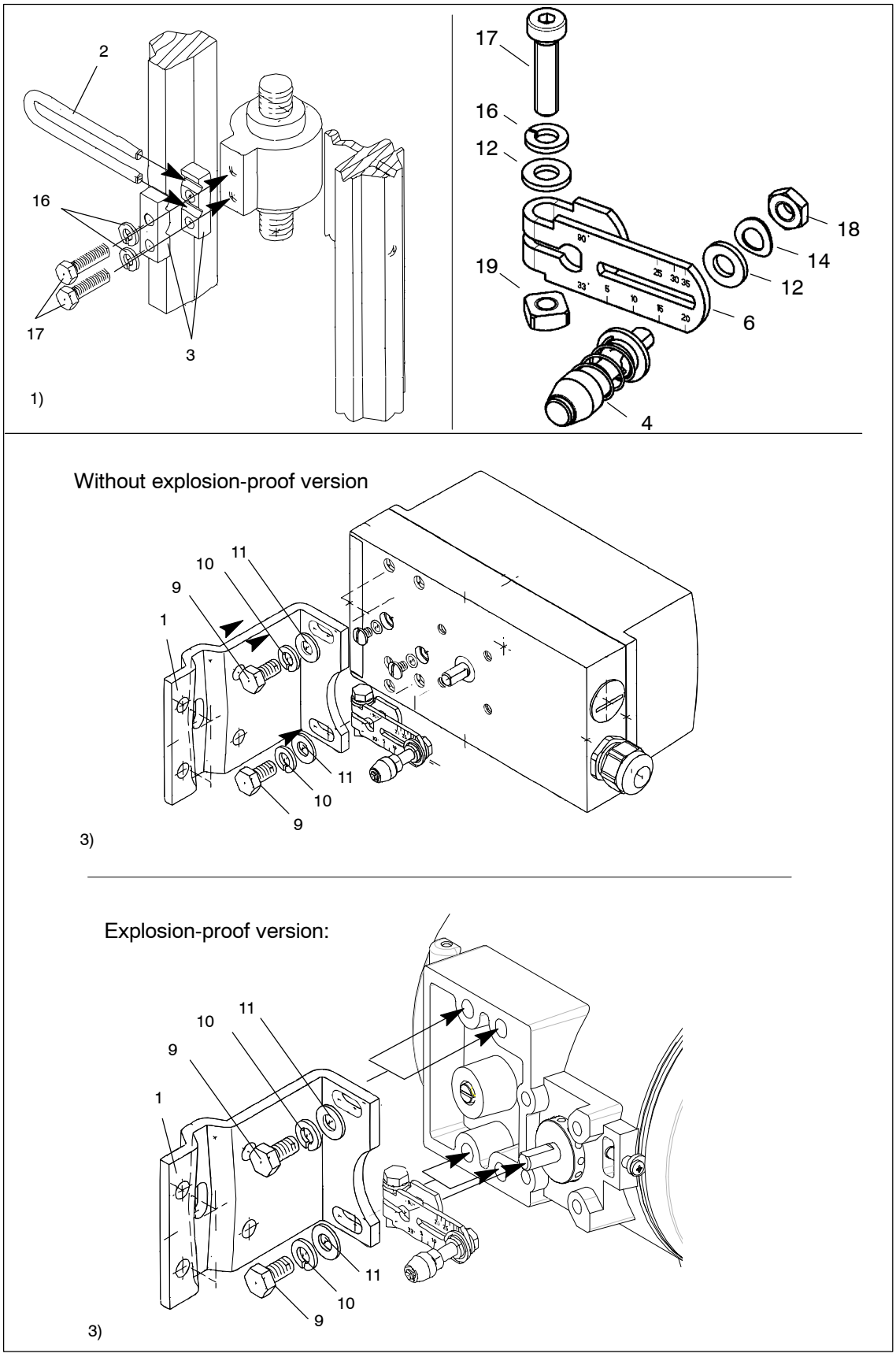


Figure 3-7 Assembly procedure (linear actuator)

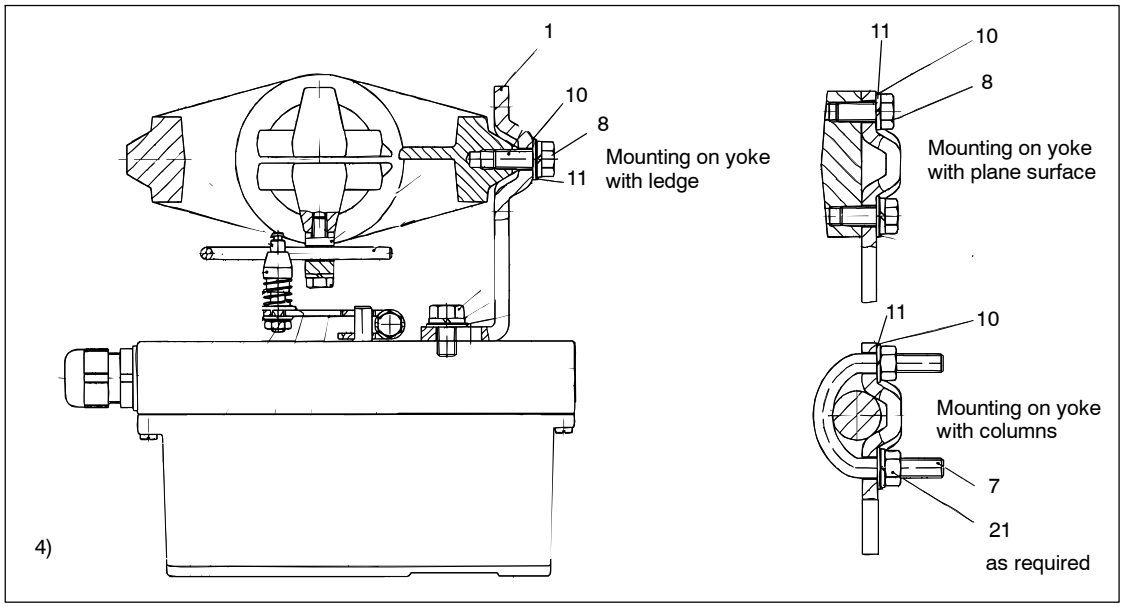


Figure 3-7 Assembly procedure (linear actuator) *continued*

3.3.5 Mounting kit ”part-turn actuator” 6DR4004-8D

The *scope of delivery of the mounting kit* ”part-turn 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

Table 3-2 Scope of delivery of the mounting kit “part-turn actuator”

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 axis, 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 actuator.
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 part-turn actuator.
   The scale is self–adhesive!

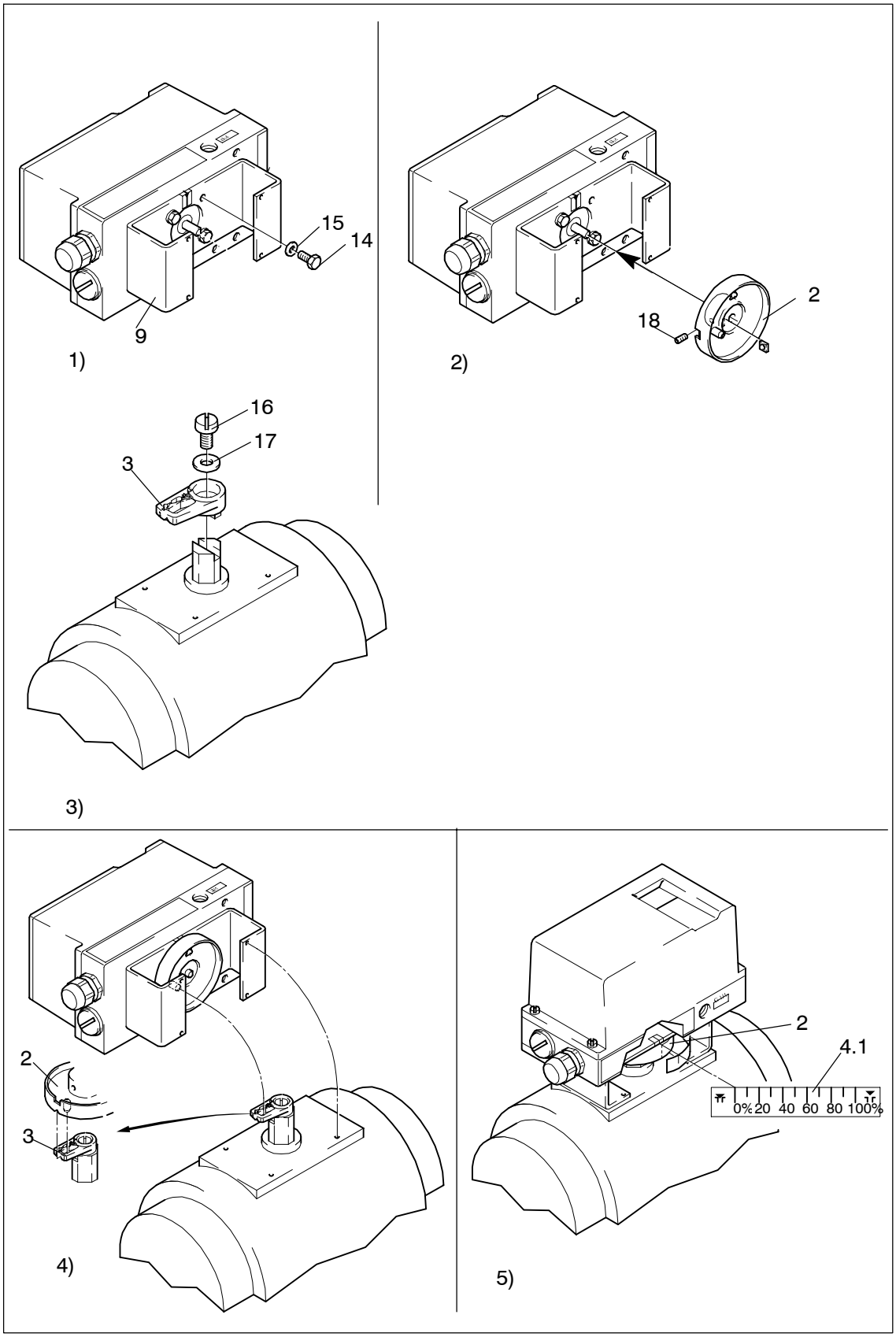


Figure 3-8 Assembly procedure (part-turn actuator)

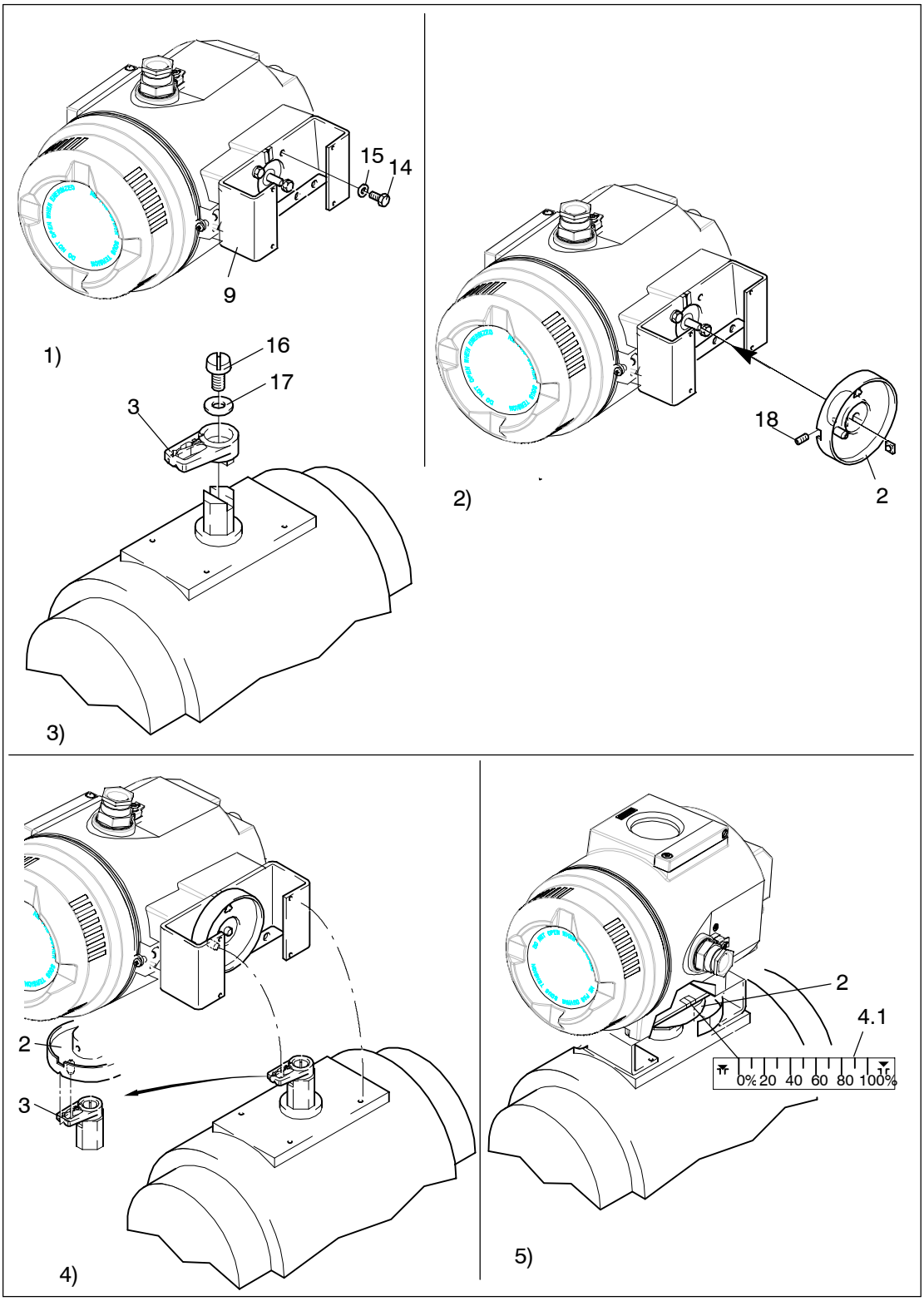
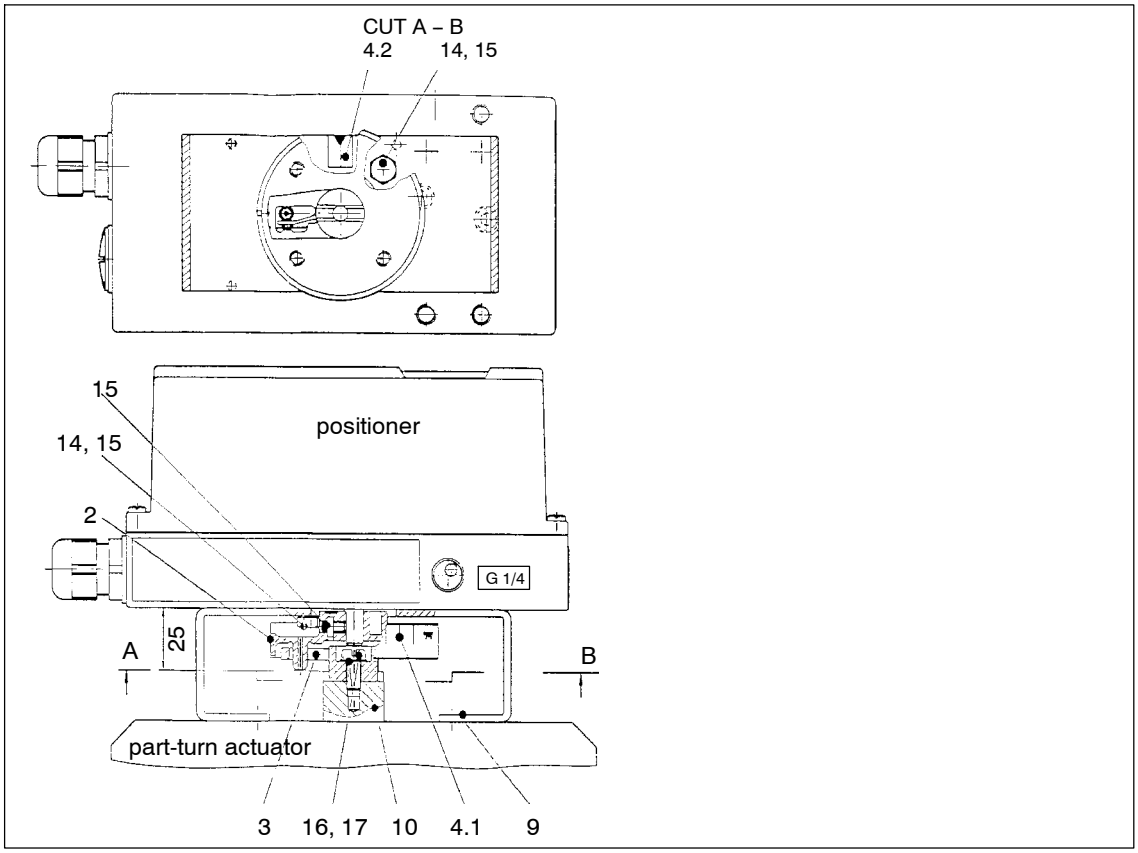


Figure 3-9 Assembly procedure for **explosion proof version** (part-turn actuator)



2	Coupling wheel	10	Feedback shaft
3	Carrier	14	Hexagon head screw M6 x 12
4	Multiple plate	15	Lock washer S6
4.1	Scale	16	Fillister head screw M6 x 12
4.2	Pointer mark	17	Washer
9	VDI/VDE 3845-mounting bracket	18	Hexagon socket head screw

Figure 3-10 Mounted positioner for part-turn actuator

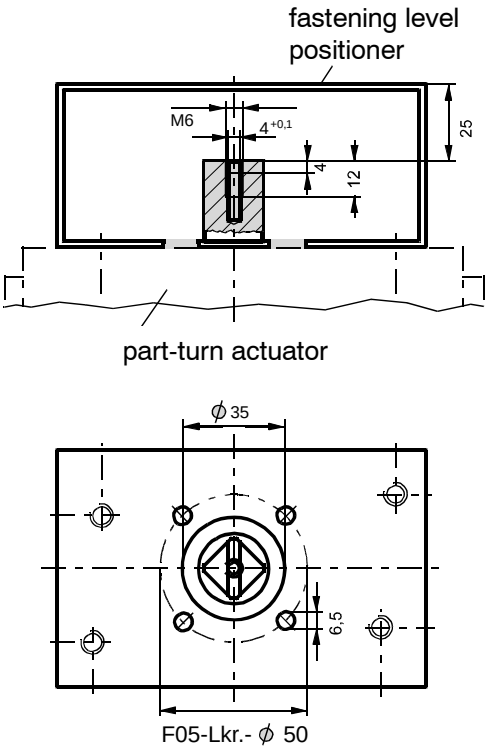


Figure 3-11 Attachment of part-turn actuator, mounting console (scope of delivery actuator manufacturer), dimensions

3.4 Electrical Connection

NOTE

Any necessary options modules must be installed before electrical connection (see chapter 2.5, page 26).

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

WARNING

The specifications of the examination certificate valid in your country must be observed.

Electrical connection in hazardous areas

The national directives and laws which apply in your country for hazardous areas, must be followed for electrical installations. 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).
- The EC type examination certificates

WARNING

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-though 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 52.

Please bear in mind that this protection can only be effective if you connect at least one of these bushes with grounded fittings by electrically conductive (blank) mounting parts.

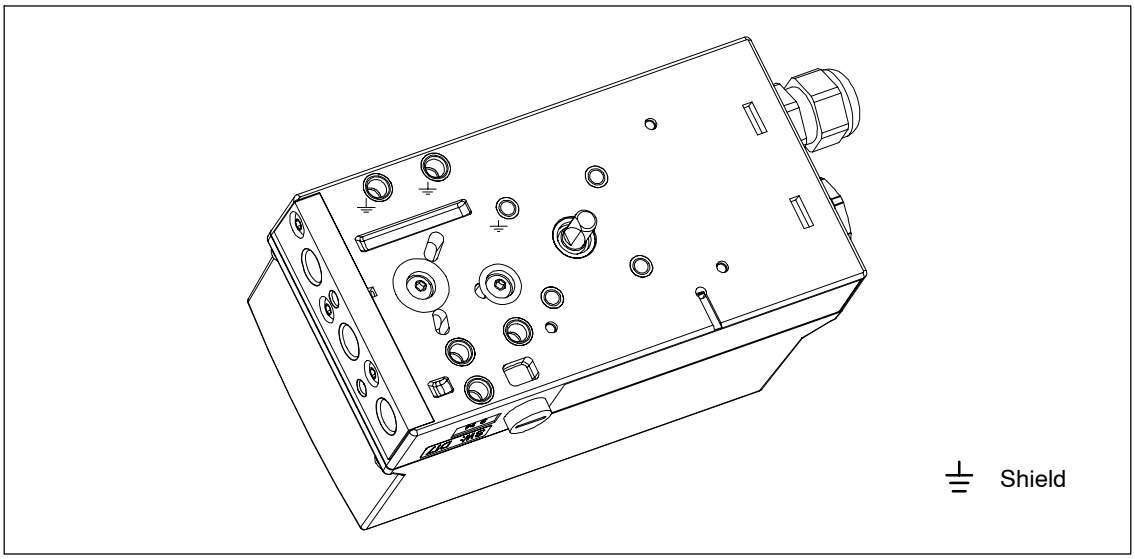


Figure 3-12 Base plate

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.

For the NPT version, the positioner will be delivered with an adapter. Make sure that when fitting a part into the adapter, that the maximum permissible torque of 10 Nm is not exceeded.

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).

NOTE for use in two-wire systems:

Never connect the current input (terminal 6 and 7) to a voltage source as this could destroy the positioner.

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

To maintain the power supply, the input current must be ≥3.6 mA.

3.4.1 Connection in non-intrinsically safe and explosion proof version

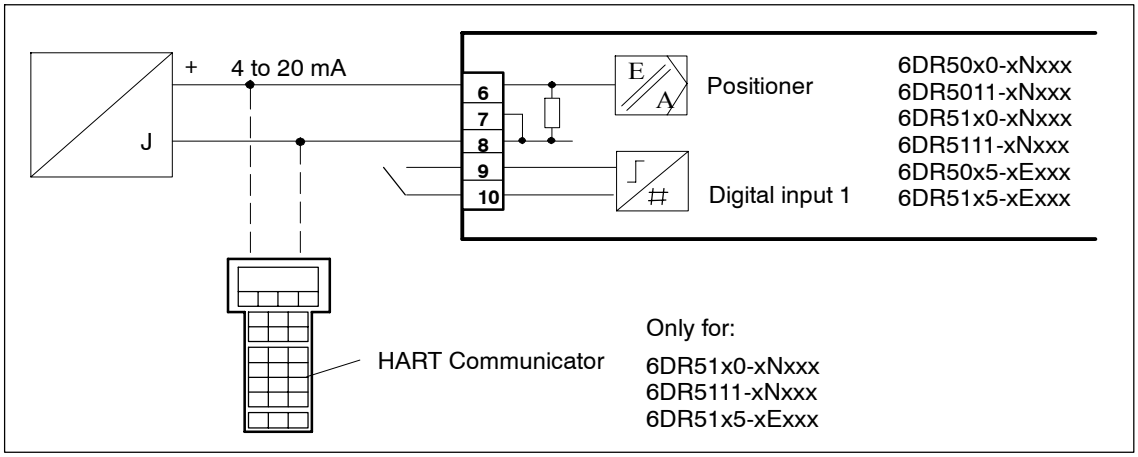


Figure 3-13 Two-wire connection

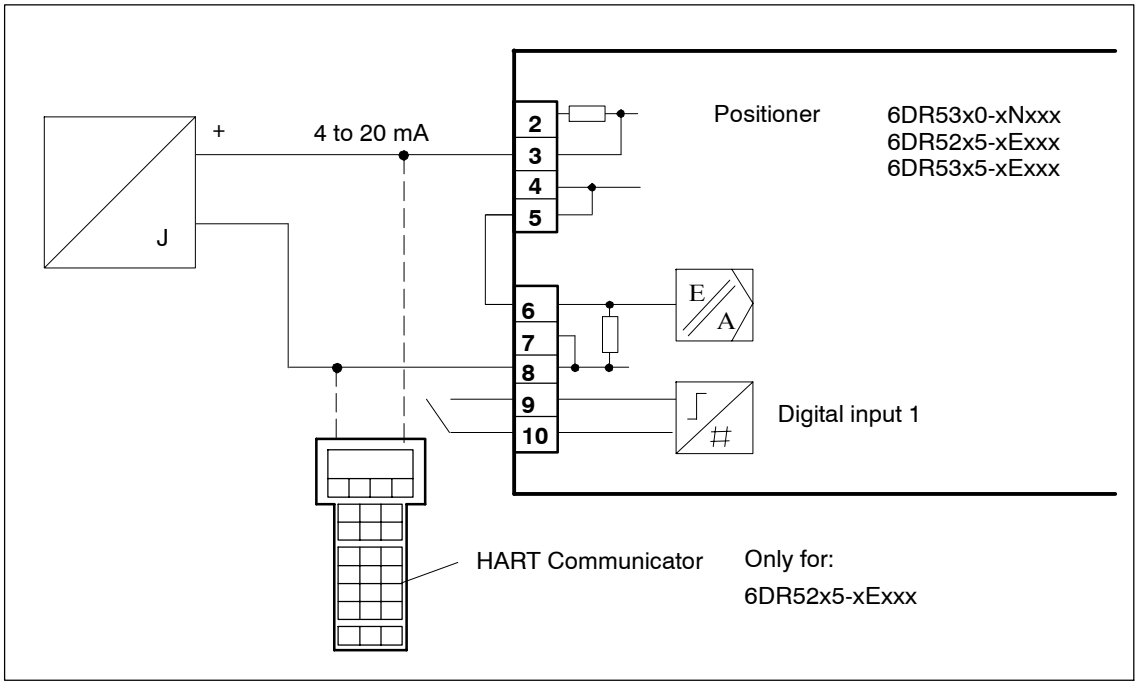


Figure 3-14 Two-wire connection

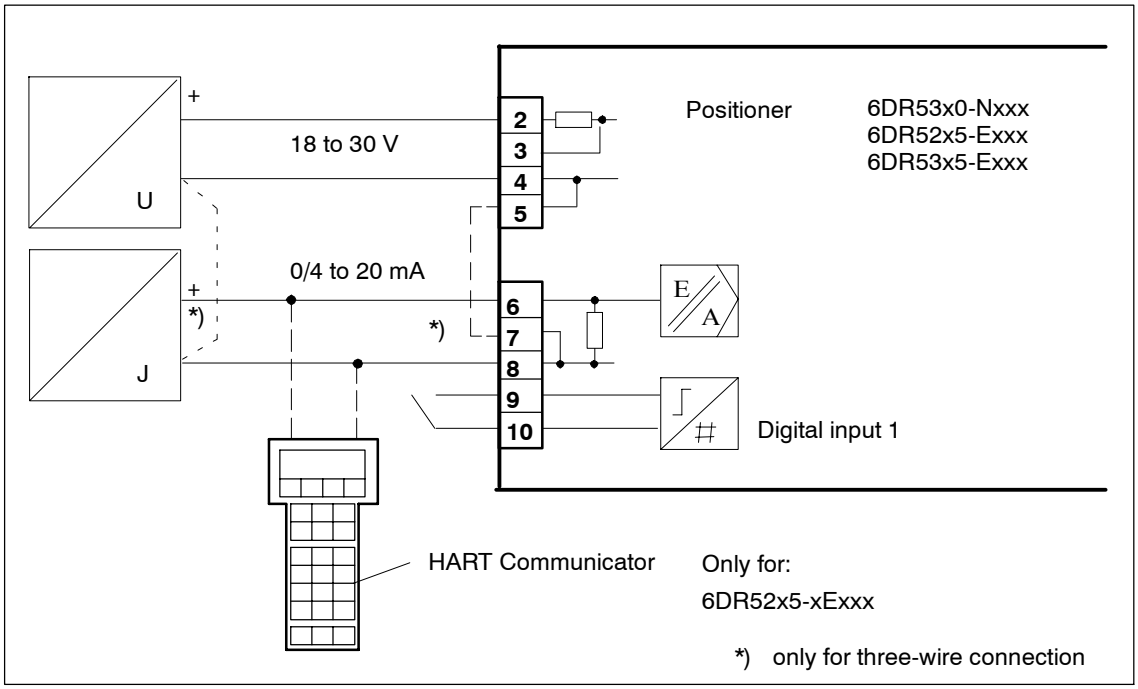


Figure 3-15 Three-/four–wire connection

Current output

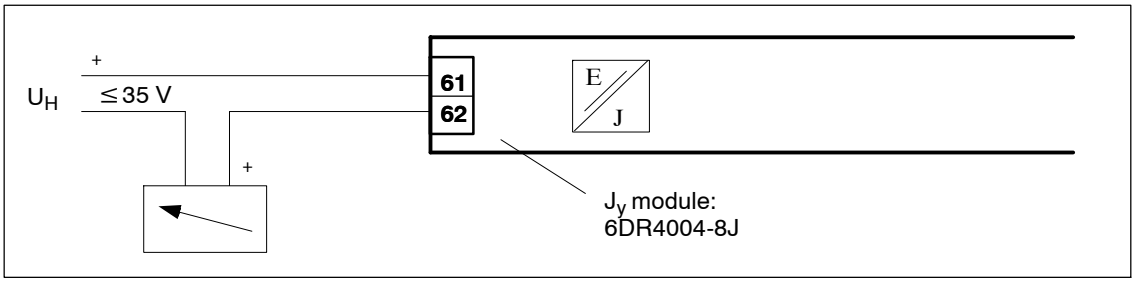


Figure 3-16 J_y-module 6DR4004-8J

Digital inputs and outputs

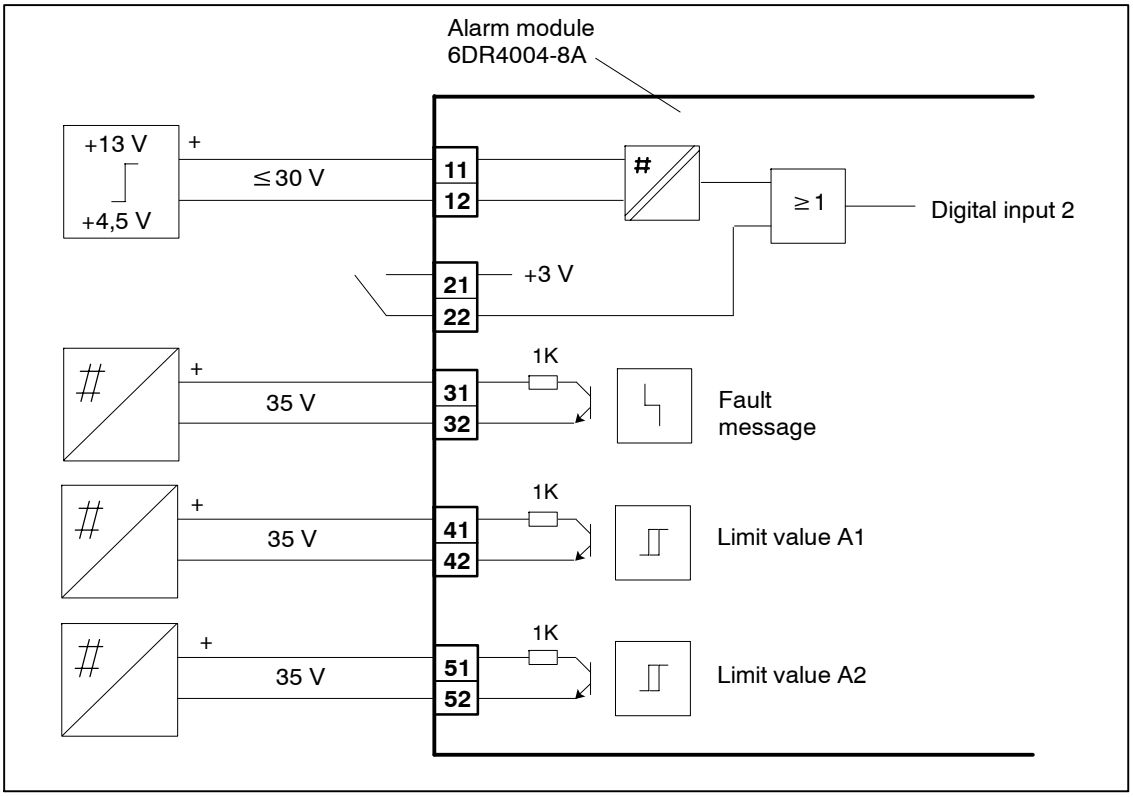


Figure 3-17 Alarm module 6DR4004–8A

SIA module

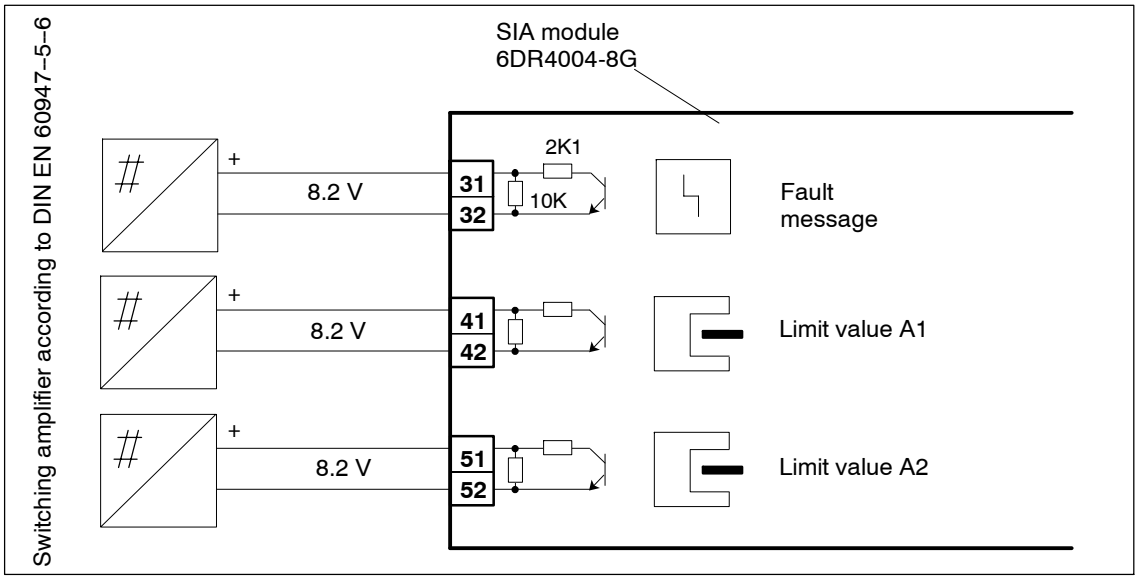


Figure 3-18 SIA module 6DR4004-8G

3.4.2 Connection in intrinsically safe version

NOTE

Only certified intrinsically safe circuits may be connected as power supply, control and signal circuits.

Standard controller

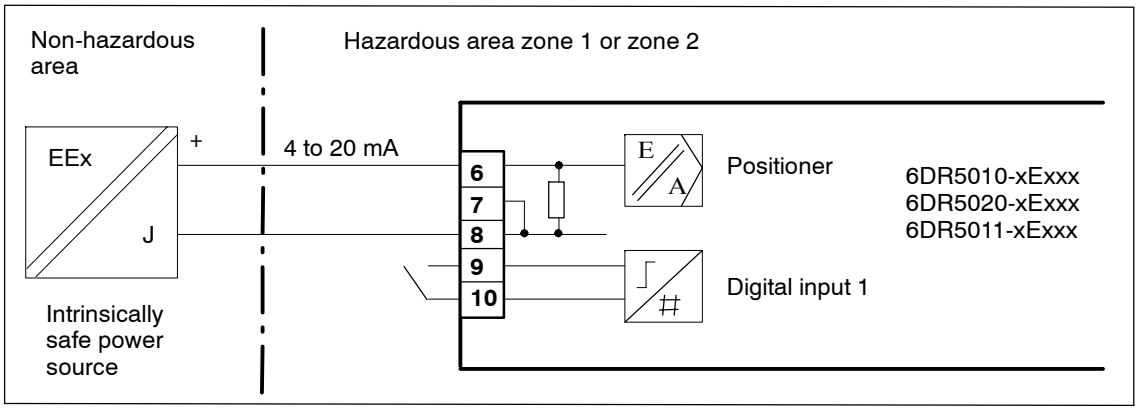


Figure 3-19 Two-wire connection, EEx i

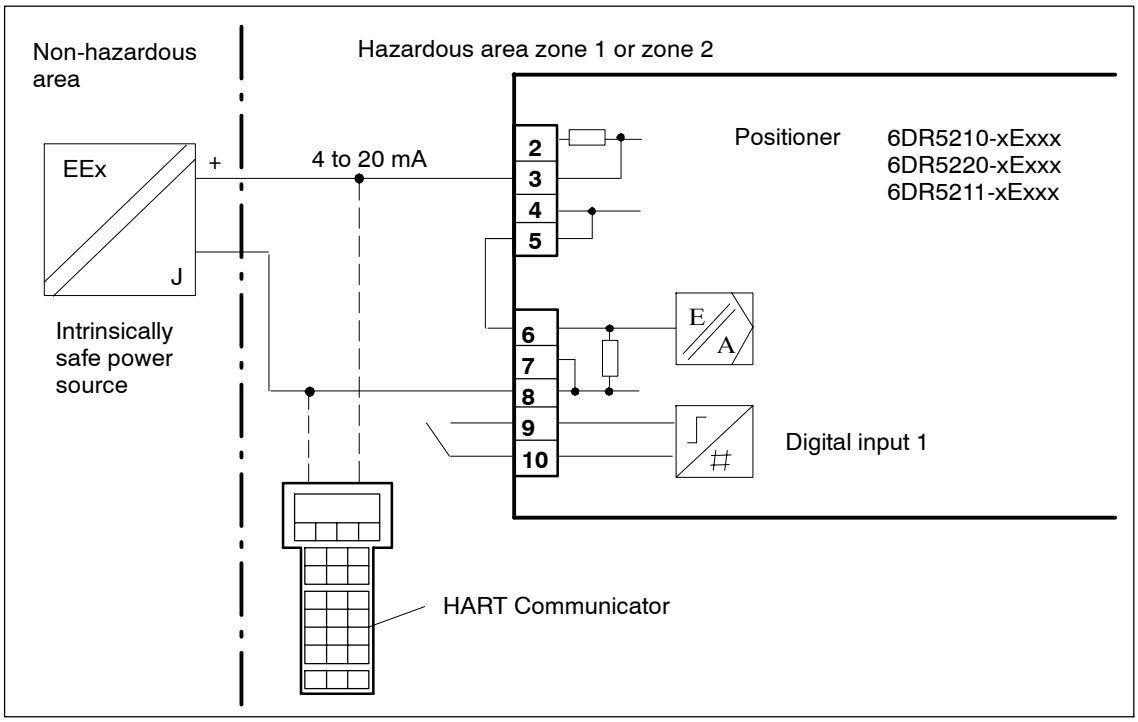


Figure 3-20 Two-wire connection, EEx i

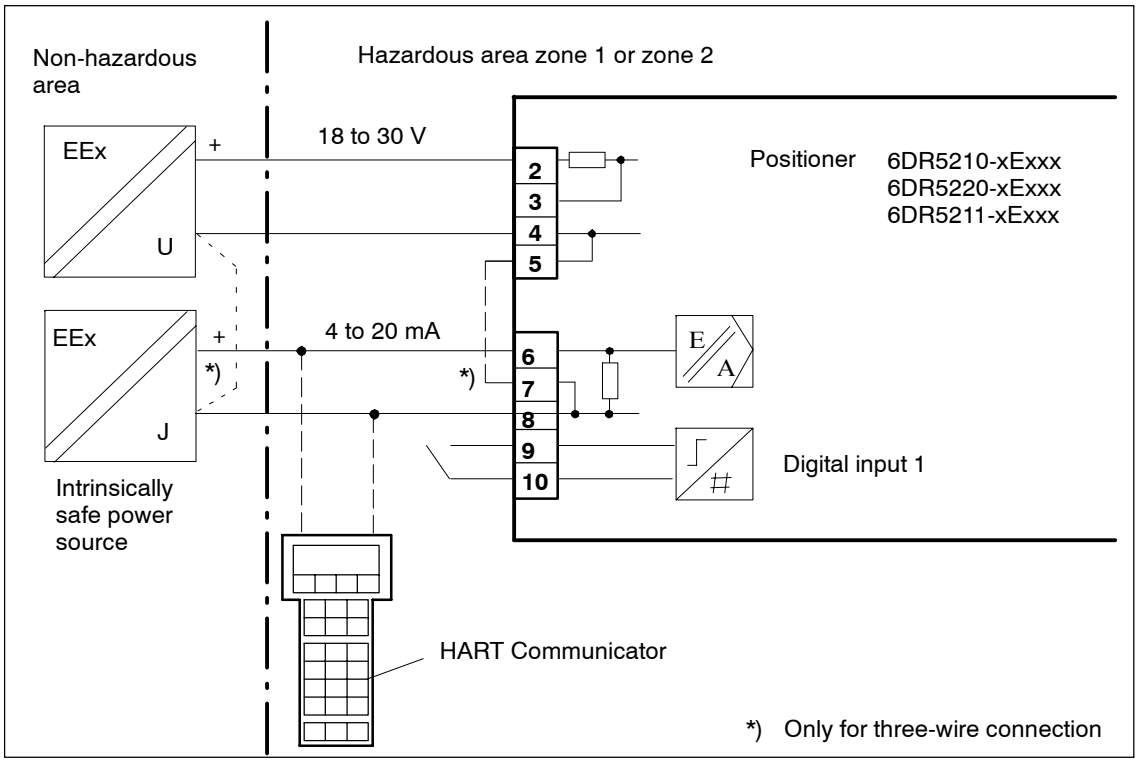


Figure 3-21 Three-/four–wire connection, EEx i

Split-range

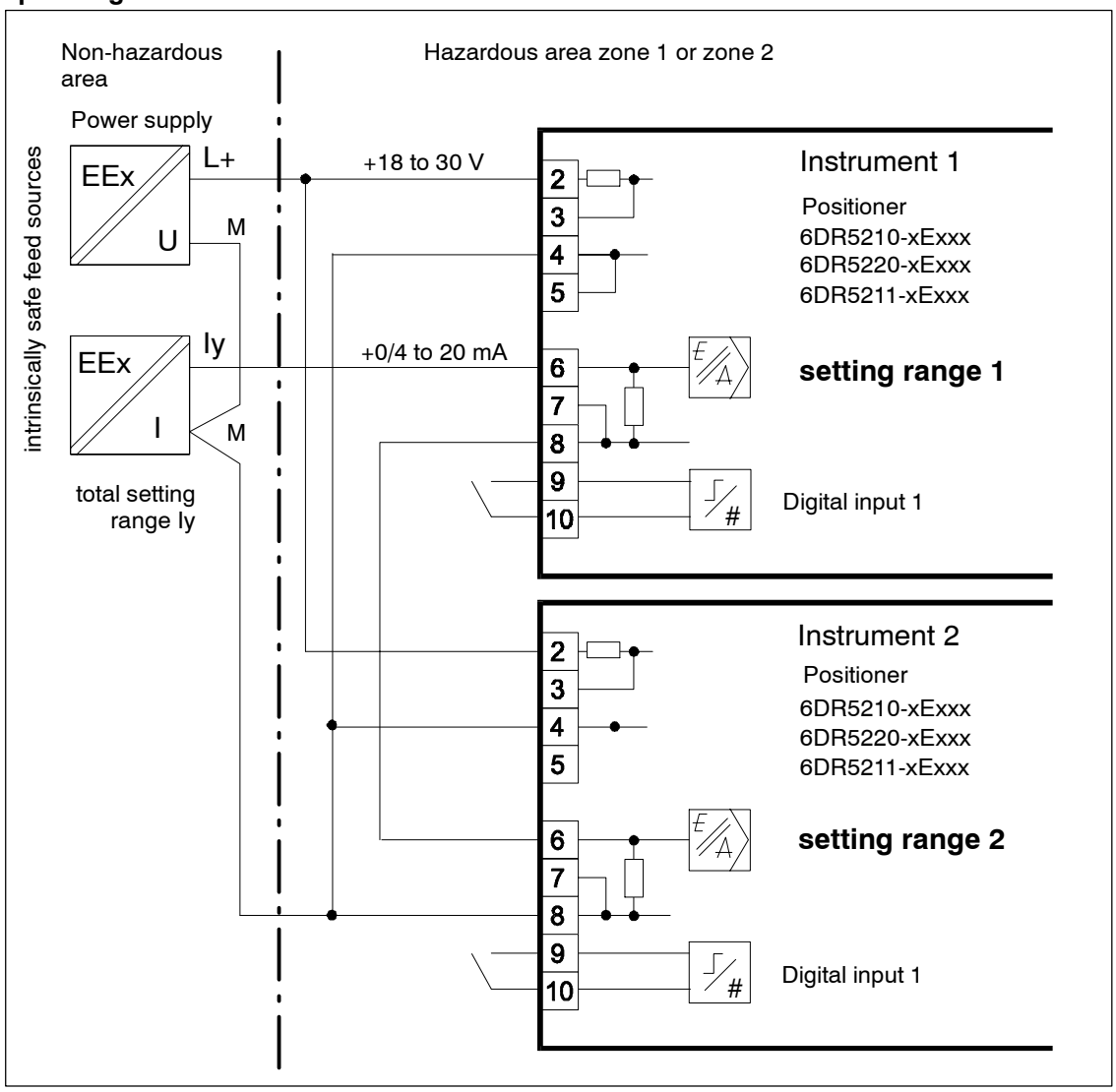


Figure 3-22 Series circuit of two positioners, e.g. split range (separate power supply), EEx i

Current output

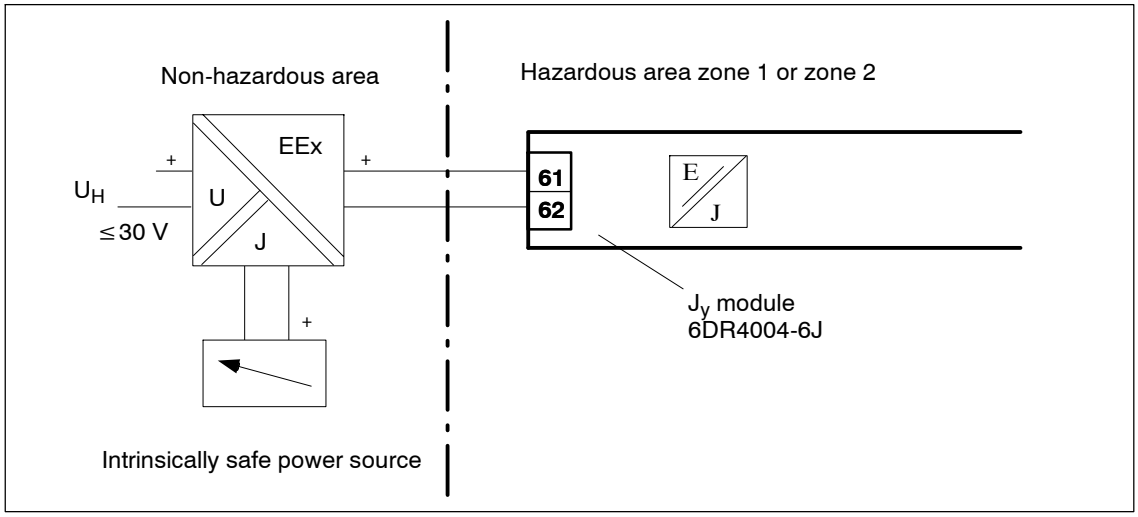


Figure 3-23 J_y-module 6DR4004-6J, EEx i

Digital inputs and outputs

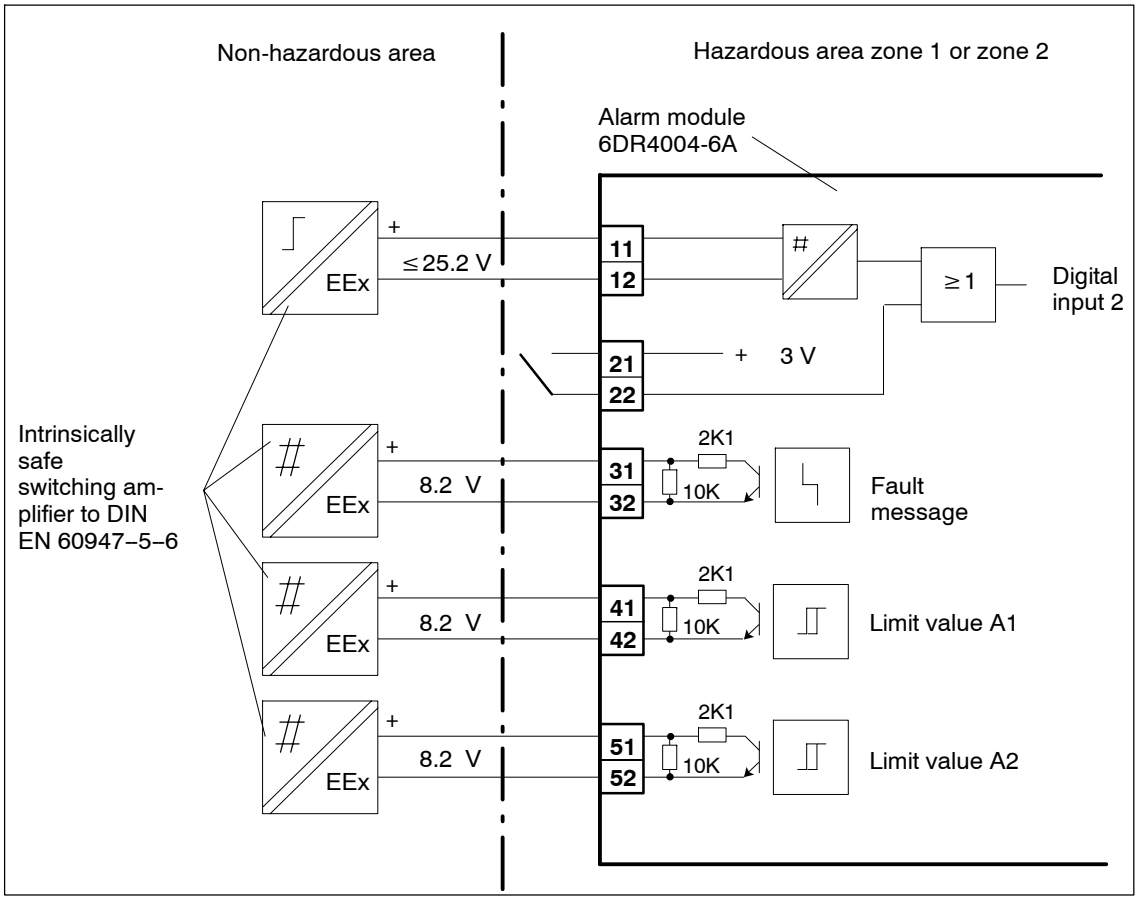


Figure 3-24 Alarm module 6DR4004-6A, EEx i

SIA module

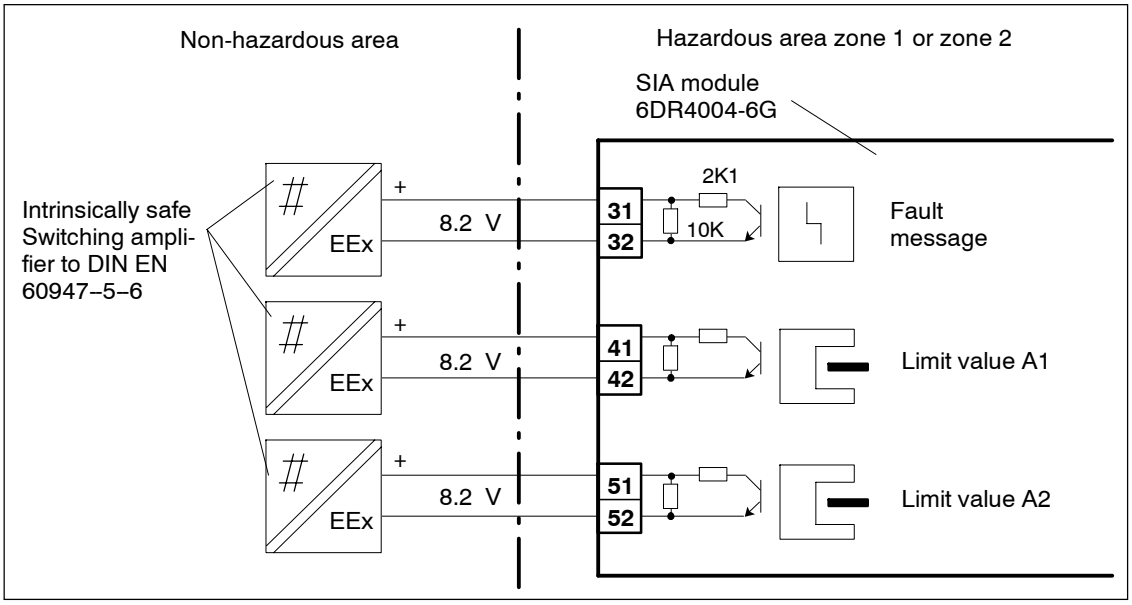


Figure 3-25 SIA module 6DR4004-6G, EEx i

3.4.3 Connection in type of protection “n” version

Standard controller

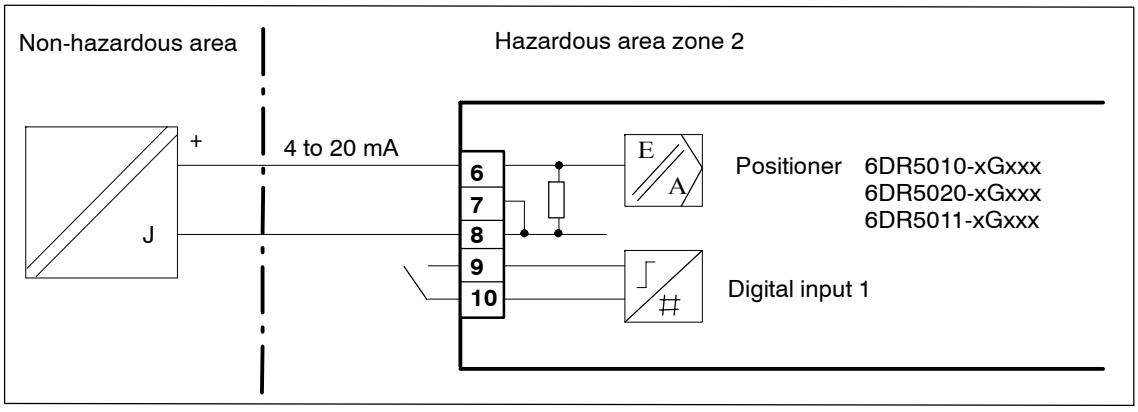


Figure 3-26 Two-wire connection, EEx n

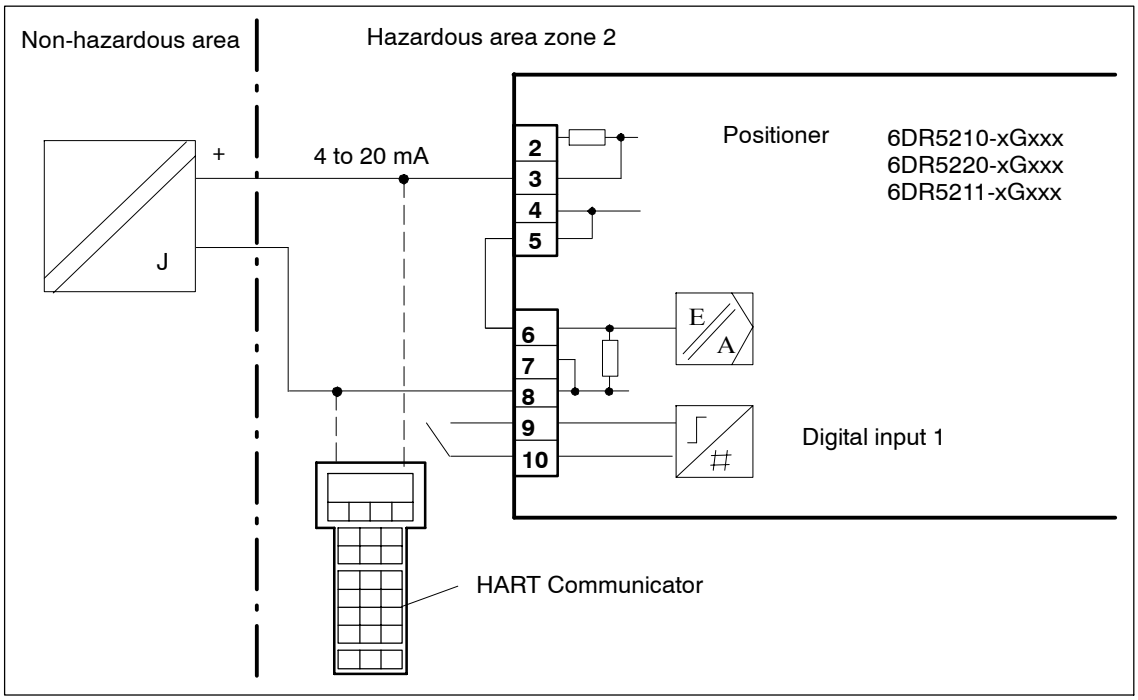


Figure 3-27 Two-wire connection, EEx n

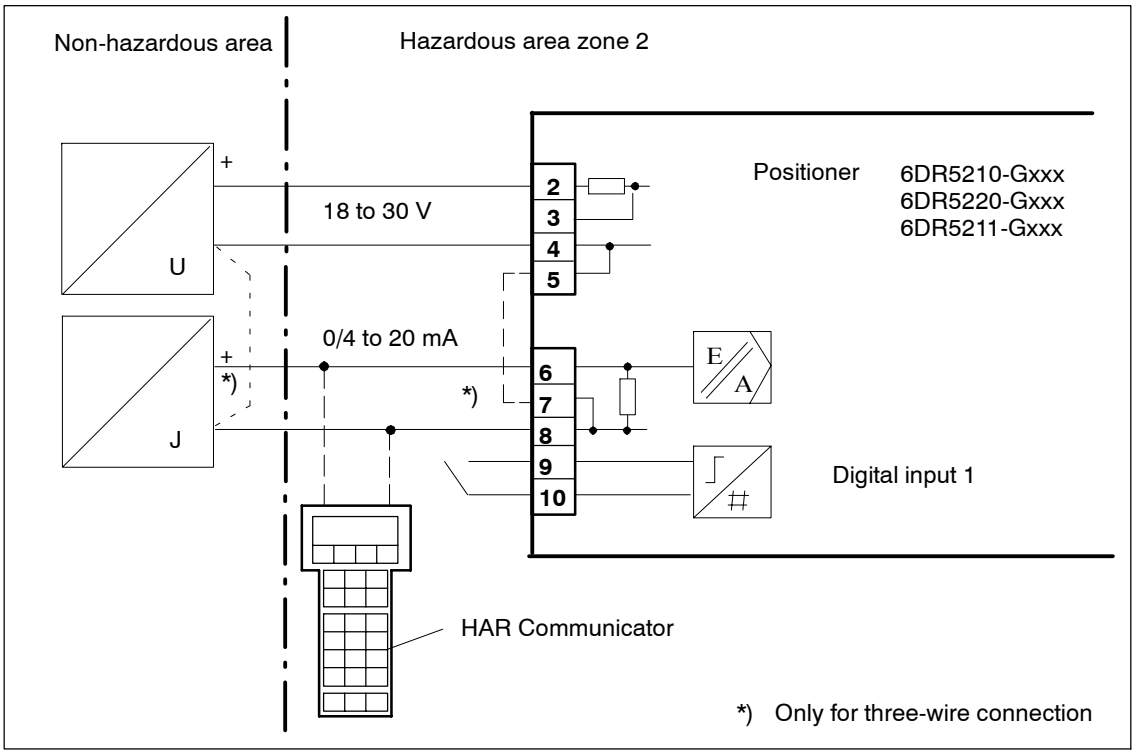


Figure 3-28 Three-/Four-wire connection, EEx n

Current output

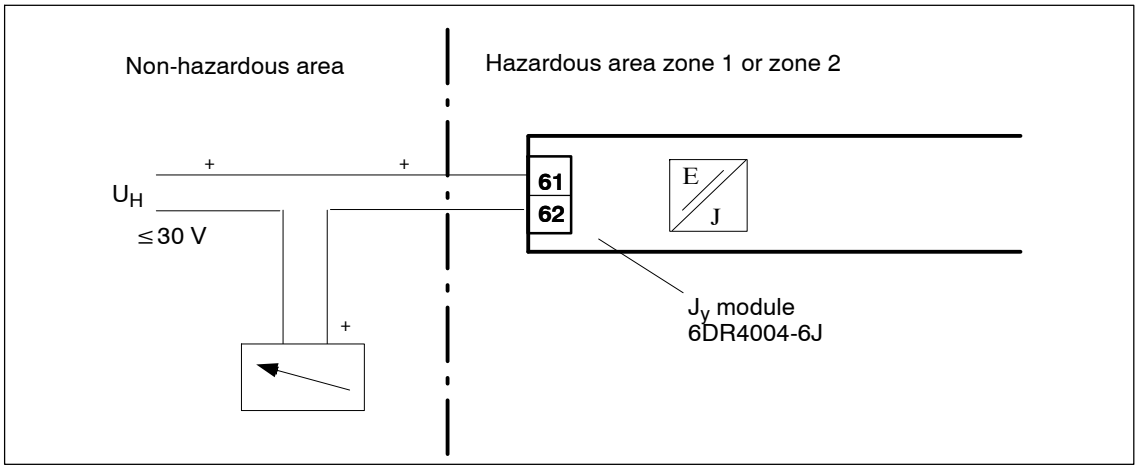


Figure 3-29 J_Y-module 6DR4004-6J, EEx n

Digital inputs and outputs

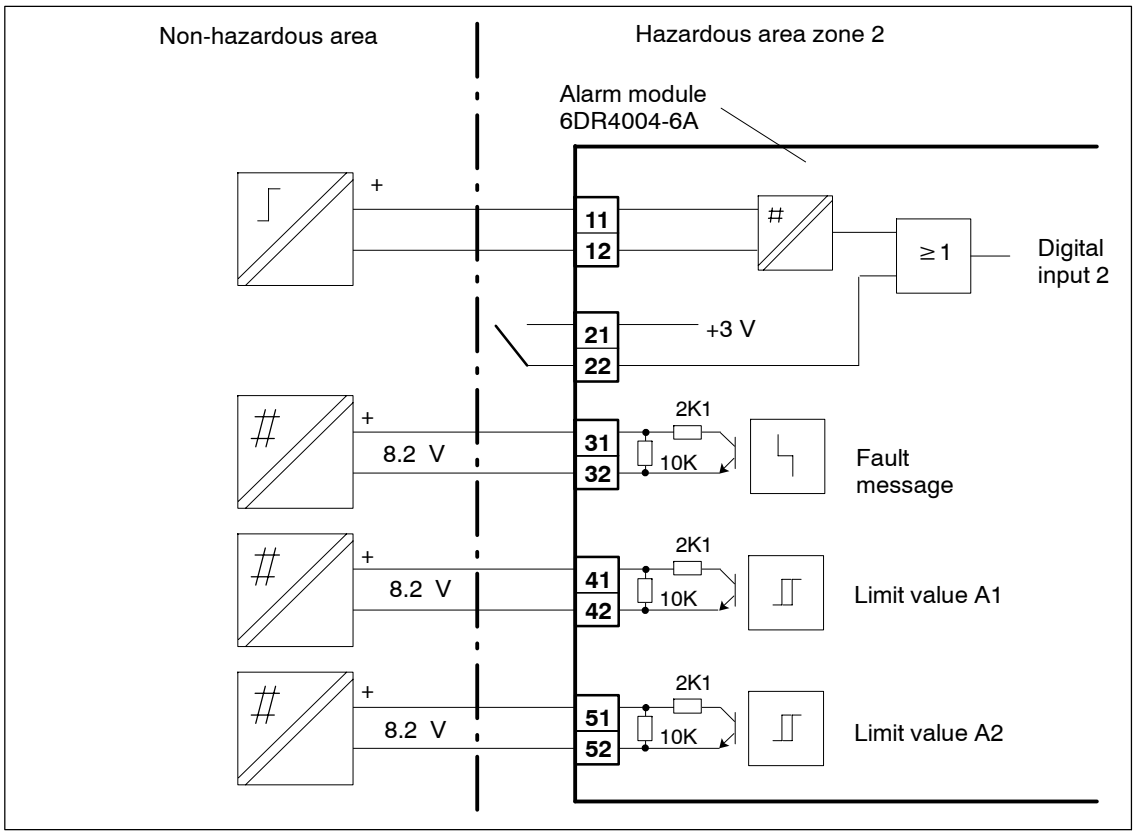


Figure 3-30 Alarm module 6DR4004–6A, EEx n

SIA module

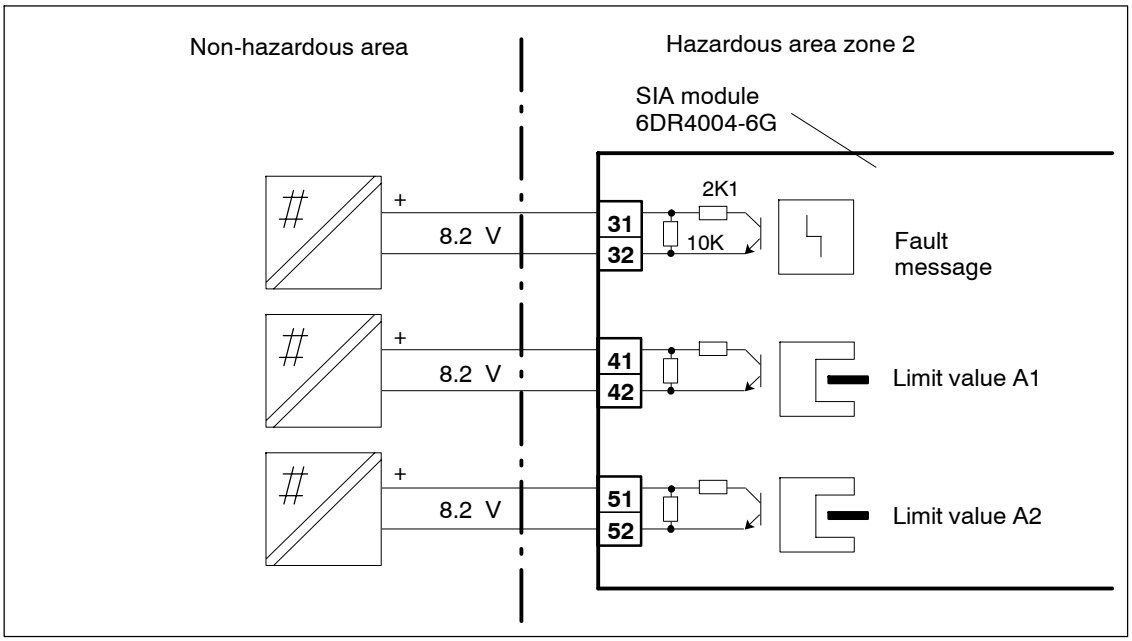


Figure 3-31 SIA module 6DR4004-6G, EEx n

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 level 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 127).

- 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 2-3 and 2-4, page 19.

- .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 travel, 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.

Then you can then adapt the position controller to the respective actuator by parameterizing and initializing it.

Mode" operating mode (which can also if necessary be attained by "PRST") – "NOINI" will flash.

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 travel and the angle of rotation, the travel 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)**
  In the devices with HART function 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 ”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 (8, figure 2-1, page 17) 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 45) 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 2-3 and 2-4, page 19).
4. Connect a suitable current or voltage source (see figure 3-13, page 53 and figure 3-19, page 56).
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 ⊕ 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 friction clutch (8, figure 2-10, page 29 or in frameproof enclosure 8, figure 2-11, page 31) until "**P50.0**" is displayed with a horizontal lever. The more accurately you hit this value, the more exactly the positioner can determine the path.

NOTICE

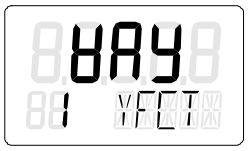
for the explosion–proof version:

Only adjust the outer friction clutch (8, Fig. 2-2, page 18). The internal friction clutch (9, Fig. 2-1 page 17) is fixed and, for the explosion–proof version, must **not** be adjusted.

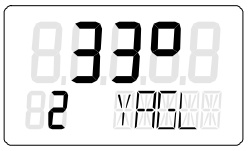
3.6.2 Automatic initialization of linear actuator

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 mode.
   Display:



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



or

NOTE

It is vital that this value corresponds to the setting of the transmission ratio selector (8, figure 2-1, page 17) (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:

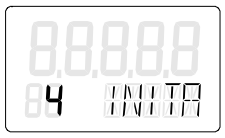
During the initialization phase ”**RUN1**” to ”**RUN5**” appear one after another in the bottom display (see also structograms figure 3-33, page 75 to figure 3-36, page 78).

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** 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 travel 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 travel 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 mode.
   Display:

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

or

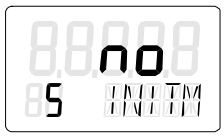
NOTE

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 friction 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 travel and the position 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 key and decrement key. Then press the operation mode key. 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 travel and the position 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 briefly. This brings you back to the Configuration operating mode.

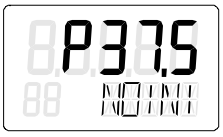
To exit the Configuration mode, press the operation mode key for longer than 5 seconds. The software version is displayed after about 5 seconds. The instrument is in manual operation after releasing the operation mode key.

3.6.4 Preparations for part-turn actuator

NOTE

Very important: Switch the transmission ratio selector in the positioner (8, figure 2-1, page 17) to position 90° (normal angle for part-turn actuator).

1. Mount the positioner with the appropriate mounting kit (see chapter 3.3.5, page 46).
2. Connect the actuator and the positioner with the pneumatic lines and supply pneumatic power to the positioner (figure 2-3 and 2-4, page 19).
3. Connect a suitable current or voltage source (see figure 3-13, page 53 and figure 3-19, page 56).
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 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.

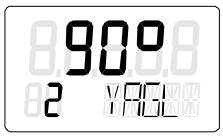
3.6.5 Automatic initialization of part-turn actuator

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

2. Set the parameter with the -key to ”turn”
   Display:

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



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 in figure 3-33, page 75 to figure 3-36, page 78).

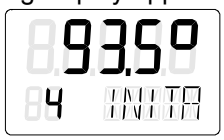
NOTE

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 briefly:



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”.

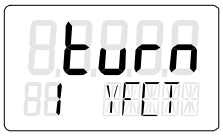
3.6.6 Manual initialization of part-turn actuators

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 travel are set manually. The other initialization steps (optimization of the control parameters) run automatically as in automatic initialization.

Manual initialization procedure in part-turn actuators

1. Make preparations as described in chapter 3.6.4, page 71 for part-turn actuators. In particular, make sure by manually driving the whole travel 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 YFCT to “turn” with the decrement ▽ key.
   Display:

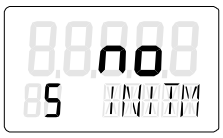


4. Switch to the second parameter by pressing the operation mode key briefly.
   Display:

☞ **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 part-turn 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 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)

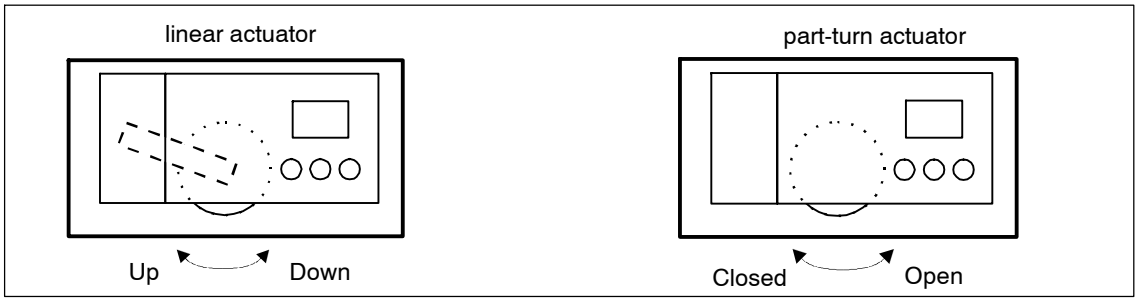


Figure 3-32 Direction of action of the actuators

The initialization procedure should be taken from the following structogram (figure 3-33 to figure 3-36). The terms Open/Closed and up/down in the structogram refer to the direction of action of the actuators as illustrated in figure 3-32.

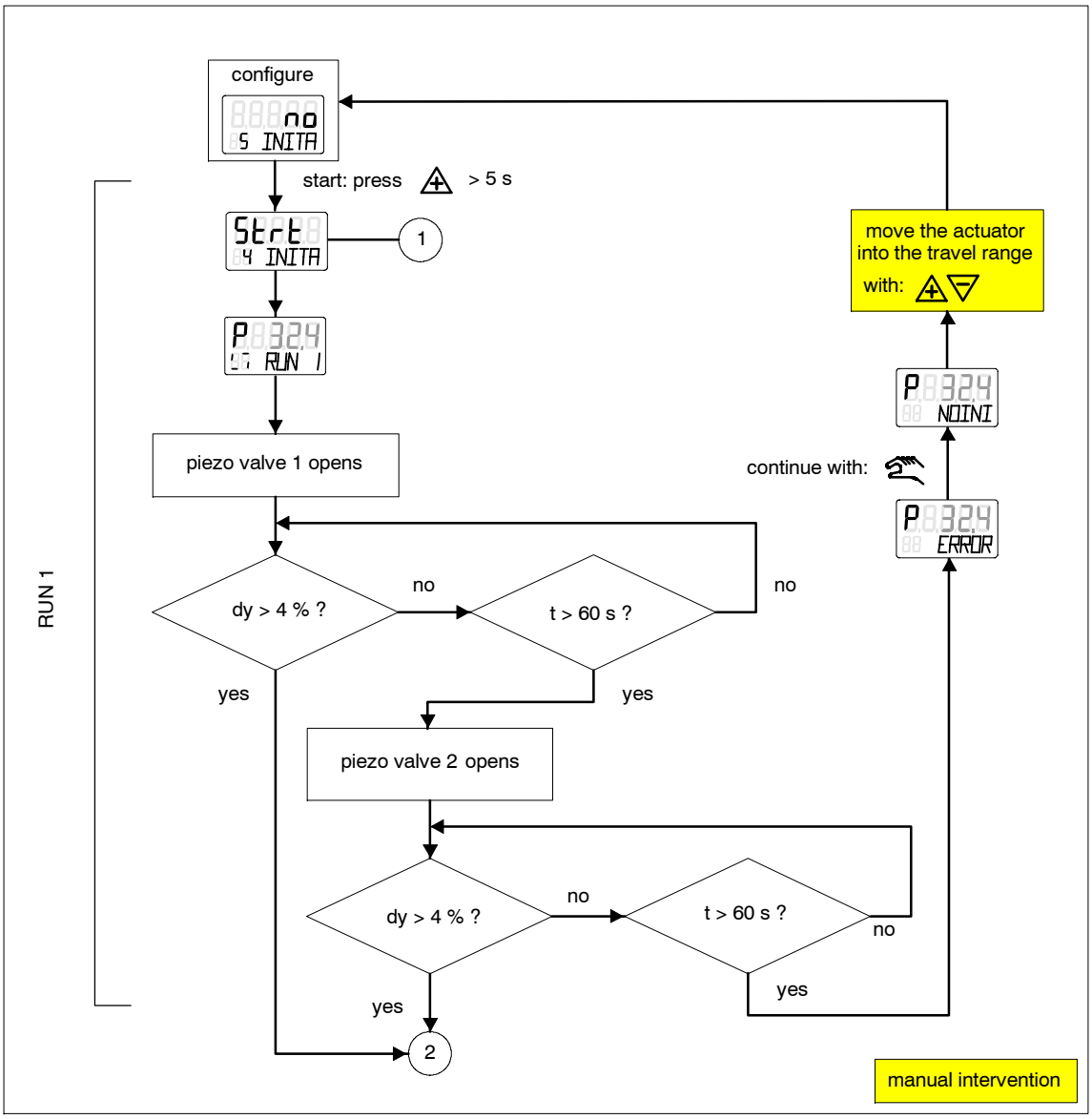


Figure 3-33 Automatic initialization, part 1

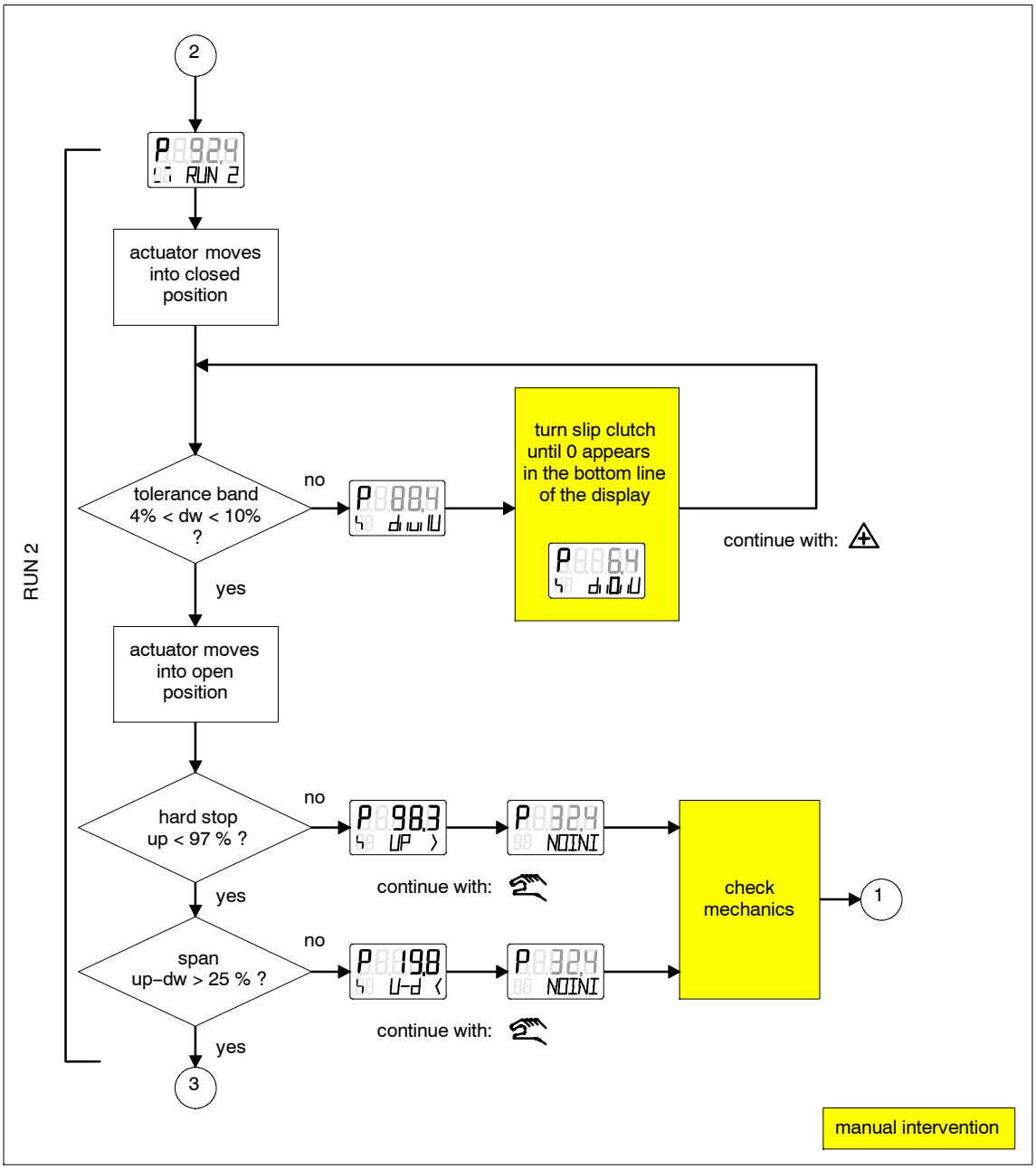


Figure 3-34 Automatic initialization part 2 (in part-turn actuators)

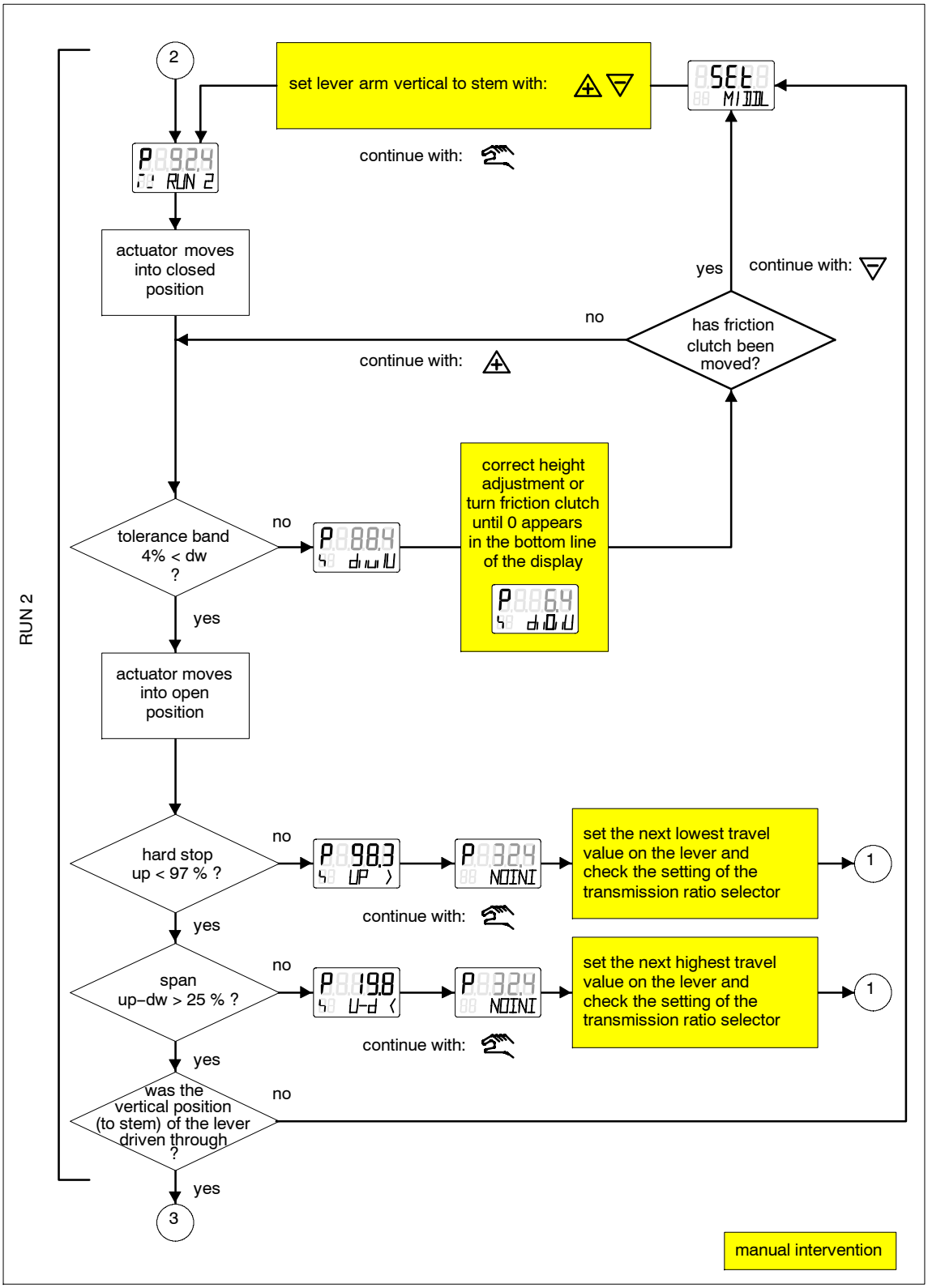


Figure 3-35 Automatic initialization part 2 (in linear actuators)

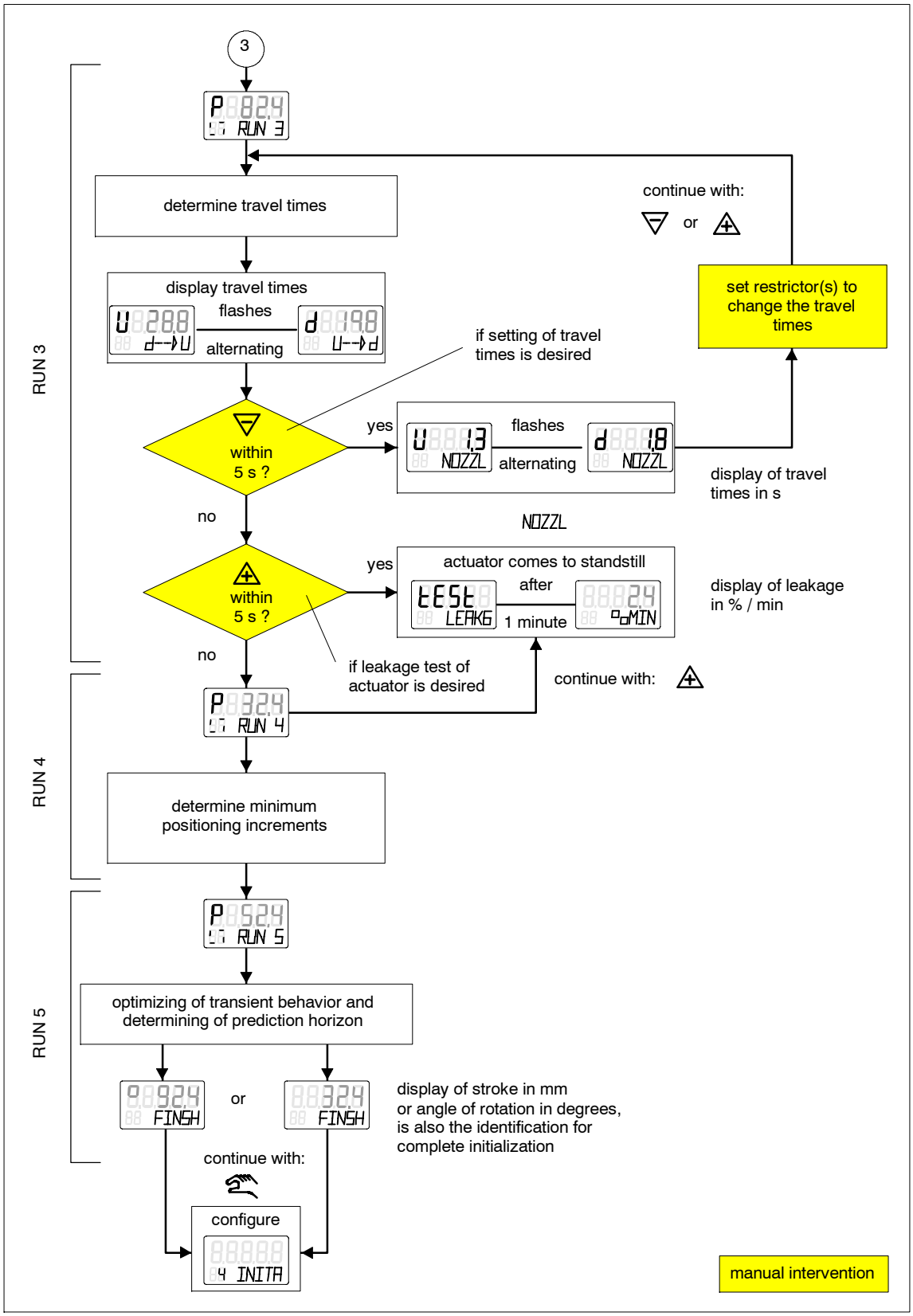


Figure 3-36 Automatic initialization, part 3

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.

Data are transmitted from the positioner to be replaced to the replacement instrument via the HART®- communication interface.

The following steps must be performed to exchange a positioner:

1. Read in and save instrument parameters and initialization data (determined in initialization) of the instrument to be replaced with PDM (**P**rocess **D**evice **M**anager). This step is unnecessary if the instrument has been parameterized with PDM and the data have already been stored.
2. Fix the actuator in its momentary position (mechanical or pneumatic).
3. Read and note the current position actual value of the positioner to be changed. 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 fitting. Move the transmission ratio selector to the same position as the defective instrument. Copy the instrument data and initialization data from the PDM or handheld.
5. If the displayed actual value does not match the noted value of the defective positioner, set the correct value with the friction clutch.
6. 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.

Operation 4

The following chapter describes the operation of the positioner.

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 °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 113.

4.2 Input keys

The positioner is operated by three keys (figure 4-2) 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 IP65/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.

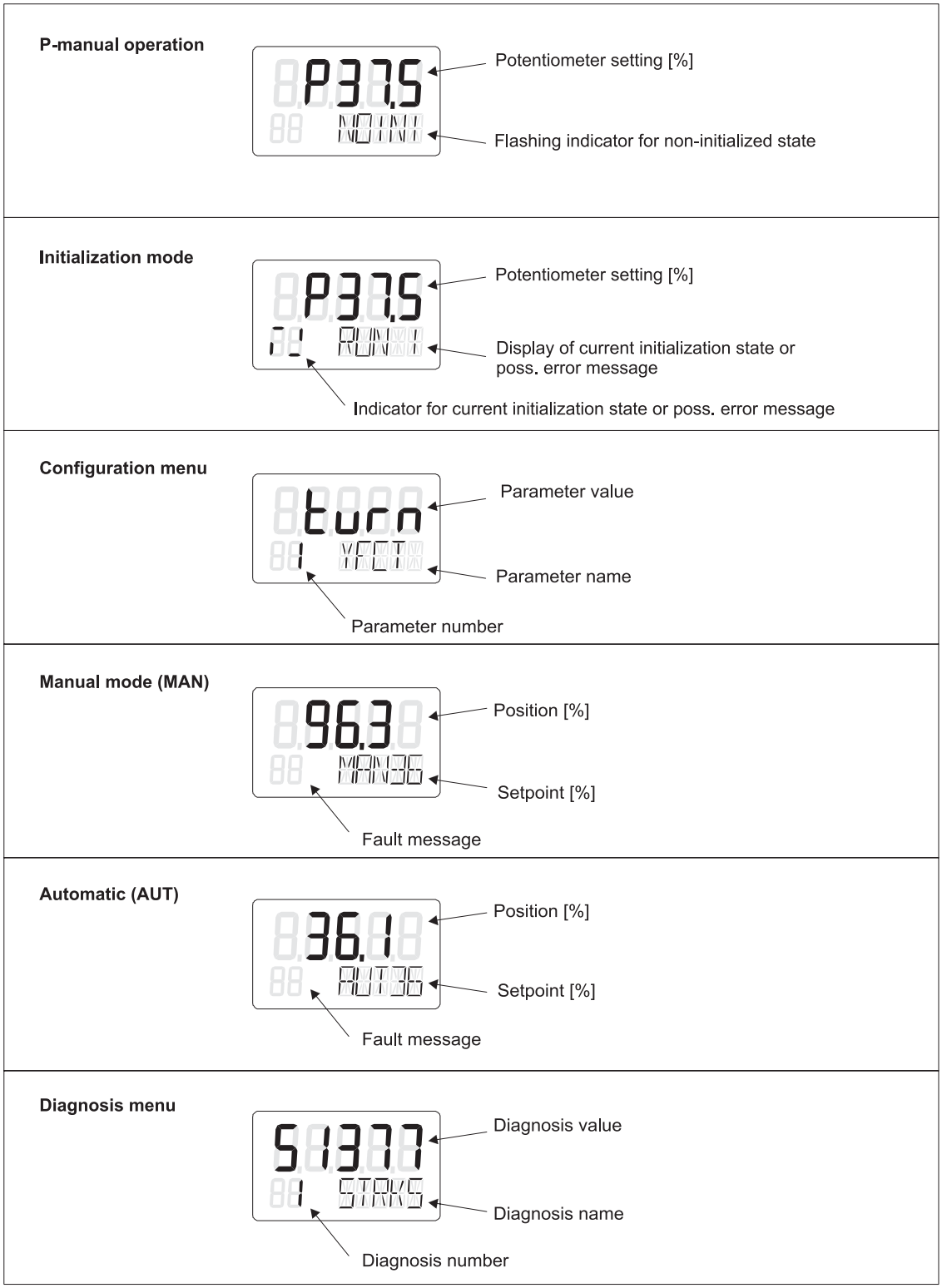
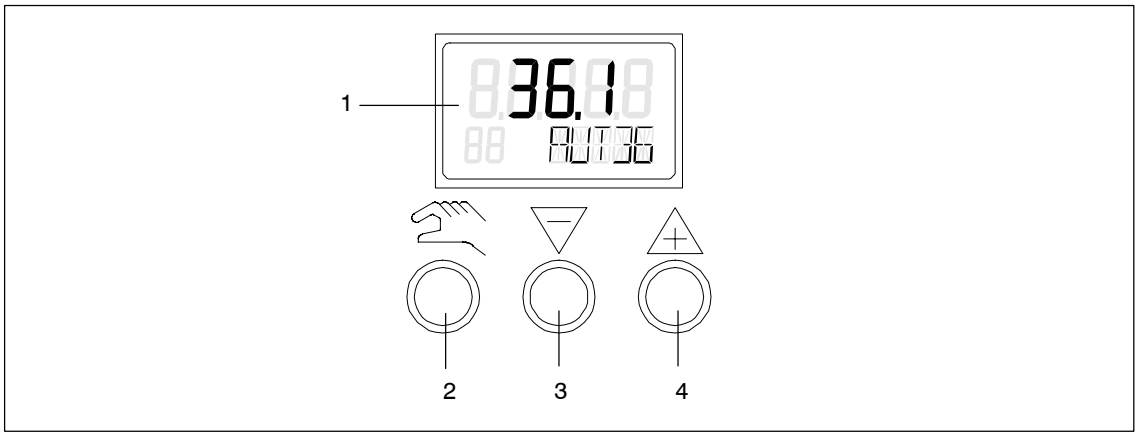


Figure 4-1 Meaning of the various display options

NOTE

The degree of protection IP 65/NEMA4x is not guaranteed as long as the positioner is open.



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.

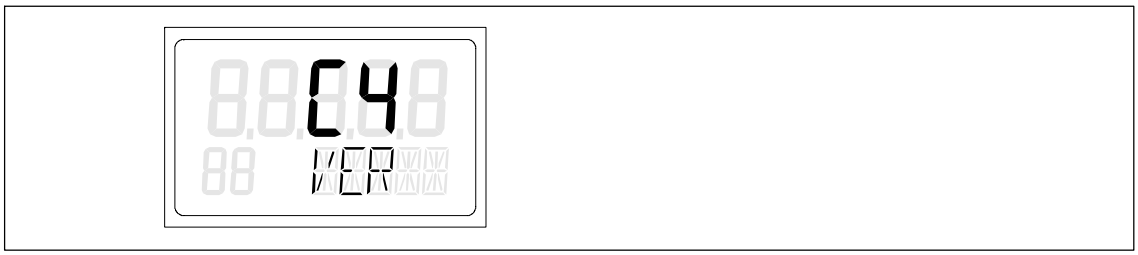


Figure 4-3 Firmware version, example: C4

4.3 Operating modes

The positioner can be operated in five operating modes.

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

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

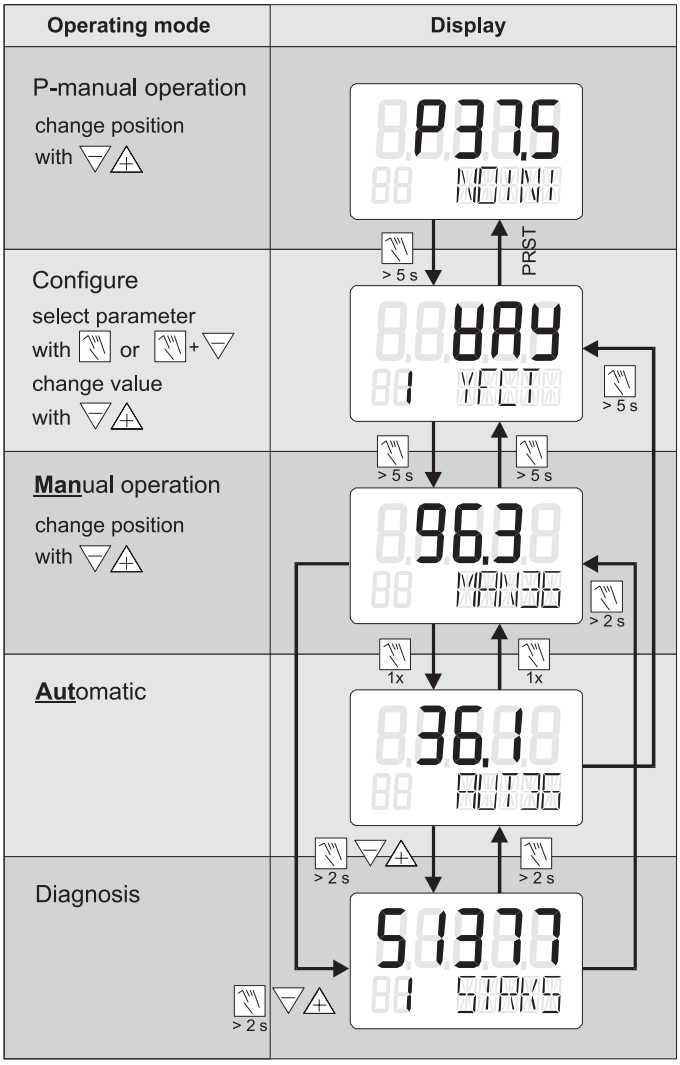


Figure 4-4 Change between the operating modes

P-manual mode (ex–factory state)

The display of the positioner shows you the current potentiometer setting in the top line and ”NOINIT” flashes in the second line. You can move the actuator with the decrement and increment key. 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”.

Output of alarms and position feedback is possible after successful initialization.

Configuration and initialization

To go to the Configuration menu, press the operation mode key 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. You can block the Configuration menu against manipulation by an appropriately parameterized and activated digital input. 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.

NOTE

If the electric power supply fails during configuration, the positioner switches back to the first parameter after recovering the power supply, values which have already been parameterized are retained. When doing this, please note that the new value will only be saved when leaving the configuration menu or when another parameter is selected. Without a power failure you re-enter the configuration menu at the point you exited it when you call the Configuration menu again.

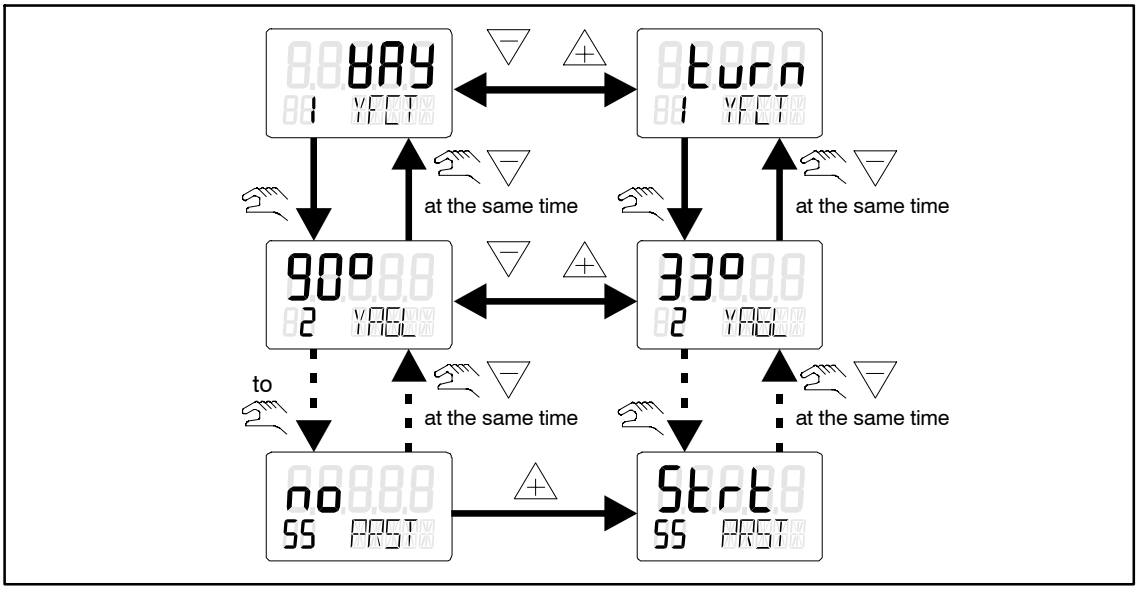


Figure 4-5 Overview: Configuration

Manual mode (MAN)

In this operating mode you can move the actuator with the decrement (▽) and increment keys (△) 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 (AUT)

The automatic mode is the normal mode. In this mode the positioner compares the setpoint current with the current position and moves the actuator until the control deviation reaches the parameterizable dead zone. Error messages are output if this is not possible for various reasons.

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, page 103).

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 102 for further information.

NOTE

The respective operating mode (MAN or AUT) 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 of the positioner 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, the physical unit and the factory setting of the parameters are shown.

Parameter name	Display	Function	Parameter values	Unit	Factory setting	Customer setting
1.YFCT	01 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)		WAY	
2.YAGL [1]	02 YAGL	Rated angle of rotation of feedback **Set transmission ratio selector (7) appropriately (see view of device)**	90° 33°	Degrees	33°	
2) 3.YWAY	03 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	04 INITA	Initialization (automatically)	noini | no / ###.# | Strt		no	
5.INITM	05 INITM	Initialization (manually)	noini | no / ###.# | Strt		no	
6.SCUR	06 SCUR	Current range of setpoint 0 to 20 mA / 4 to 20 mA	0 MA 4 MA		4 MA	
7.SDIR	07 SDIR	Setpoint direction rising / falling	riSE FALL		riSE	
8.SPRA	08 SPRA	Setpoint for start of split range	0,0 to 100,0	%	0,0	
9.SPRE	09 SPRE	Setpoint for end of split range	0,0 to 100,0	%	100	
10.TSUP	10 TSUP	Setpoint ramp up	Auto 0 to 400	s	0	
11.TSDO	11 TSDO	Setpoint ramp down	0 to 400	s	0	
12.SFCT	12 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	
13.SL0 14.SL1 usw. bis 32.SL19 33.SL20 3)	13 SL0 (example)	Setpoint turning point at 0% 5% to 95% 100%	0,0 to 100,0	%	0,0 5.0 etc. to 95.0 100.0	
34.DEBA	34 DEBA	Dead zone of controller	Auto 0,1 to 10,0	%	Auto	
35.YA	35 YA	Start of manipulated variable limiting	0,0 to 100,0	%	0,0	
36.YE	36 YE	End of manipulated variable limiting	0,0 to 100,0	%	100,0	
37.YNRM	37 YNRM	Standardization of manipulated variable: To mech. travel / To flow	MPOS FLOW		MPOS	
38.YDIR	38 YDIR	Direction of manipulated variable for display: Rising / Falling	riSE FALL		riSE	
39.YCLS	39 YCLS	Tight closing with manipulated variable: Without / Top only / Bottom only / Top and bottom	no uP do uP do		no	
40.YCDO	40 YCDO	Value for tight closing, bottom	0,0 to 100,0	%	0,5	
41.YCUP	41 YCUP	Value for tight closing, top	0,0 to 100,0	%	99,5	
42.BIN1 [4]	42 BIN1	Function of BI 1: 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	
43.BIN2 [4]	43 BIN2	Function of BI 2: None / Only message / Drive valve to position up / Drive valve to position down / Block movement	OFF NO contact: on, uP, doWn, StoP NC contact: -on, -uP, -doWn, -StoP		OFF	
44.AFCT [5]	44 AFCT	Alarm function: Without / A1=min. A2=max / A1=min. A2=min / A1=max. A2=max	OFF normal: n1 nA, n1 n1, nA nA inverted: -n1 -nA, -n1 -n1, -nA -nA		OFF	
45.A1	45 A1	Response threshold of alarm 1	0,0 to 100,0	%	10,0	
46.A2	46 A2	Response threshold of alarm 2	0,0 to 100,0	%	90,0	
47.LFCT [5]	47 LFCT	Function of alarm output: on fault / Fault + not automatic / Fault + not automatic + BI ("+" means logical OR operation)	normal: L, LnA, LnAb inverted: -L, -LnA, -LnAb		L	
48.LTIM	48 LTIM	Monitoring time for fault message "control deviation"	Auto 0 to 100	s	Auto	
49.LLIM	49 LLIM	Response threshold for fault message "control deviation"	Auto 0,0 to 100,0	%	Auto	
50.LSTRK	50 LSTRK	Limit for stroke integral	OFF 1 to 1.00E9		OFF	
51.LDCHG	51 LDCHG	Limit for direction change	OFF 1 to 1.00E9		OFF	
52.LZERO	52 LZERO	Limit for end stop monitoring, bottom	OFF 0,0 to 100,0	%	OFF	
53.LOPEN	53 LOPEN	Limit for end stop monitoring, top	OFF 0,0 to 100,0	%	OFF	
54.LDEBA	54 LDEBA	Limit for dead zone monitoring	OFF 0,0 to 10,0	%	OFF	
55.PRST	55 PRST	Preset (factory setting) "no" nothing activated "Strt" start of factory setting after pressing key for 5 s "oCAY" display following successful factory setting CAUTION: preset results in "NO INIT"	no Strt oCAY			

1) If "turn" is selected, you cannot set 33°
2) Parameter does not appear if 1.YFCT=turn has been selected
3) Turning points only appear wih selection 12.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

The following configuration block diagram shows the effects of the parameters.

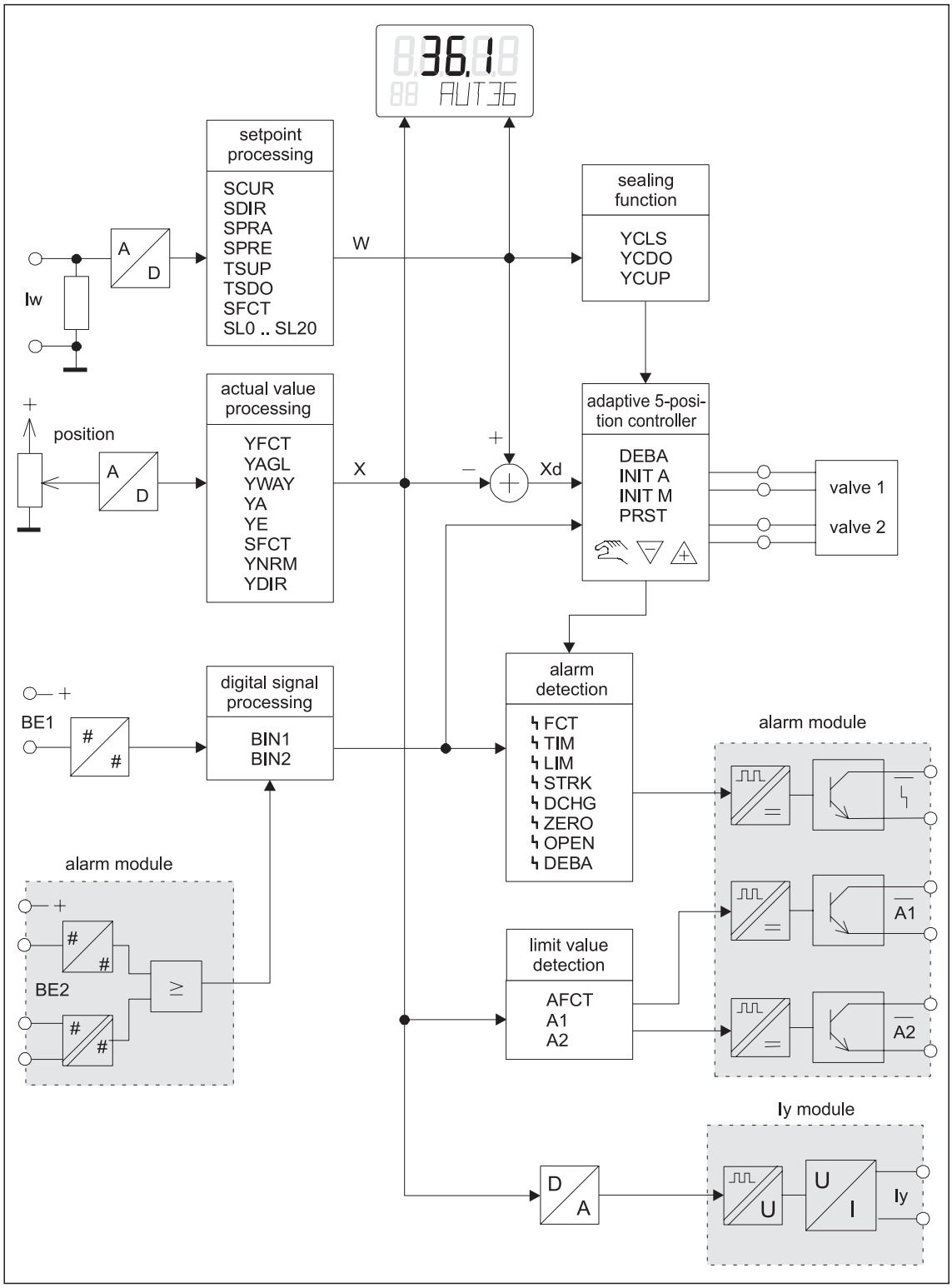


Figure 4-7 Configuration block diagram

Normally adjustment of the first three following parameters is completely sufficient to enable a positioner to be operated by an actuator. If you wish to become familiar with all details of the positioner, try out incrementally the effects of the remaining parameters by selective trials.

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. Only in this way can the positioner matching process start from known conditions. The parameter ”51 PRST” is provided for this purpose.

This is also recommended if multiple parameters have been changed in a single session, the effects cannot be assessed and unintended consequences may result.

1.YFCT Positioning actuator type

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 part-turn 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 part-turn 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 part-turn actuators with reverse direction of control action.

- YFCT = ncSt

  Use this when an NCS is fitted to a part-turn actuator.

- YFCT = –ncSt

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

- YFCT = ncSL

  This must be set when an NCS is used with a linear actuator.

☞ **NOTE**

After ”LWAY, ncSt, –ncSt or ncSL” have been adjusted, both the following parameters ”2. YAGL” and ”3. YWAY” will not be displayed.

2.YAGL Rated angle of rotation of the feedback shaft

In part-turn 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 2-1, page 17 and figure 2-2, page 18) **must** correspond to the angle value selected under “2.YAGL”.

3.YWAY 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 Automatic initialization (see chapter 3.6, page 64)

By selecting “Strt” and pressing the increment key ⧋ for at least 5 seconds, automatic initialization is started. The initialization process is displayed by “RUN 1” to “RUN 5” (see figure 3-33, page 75 to figure 3-36, page 78).

5.INITM Manual initialization

By selecting “Strt” and pressing the increment key ⧋ 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 73.

☞ **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 5 s.

6.SCUR Current range of the setpoint

The selection of the current range depends on the connection type. ”0mA” (0 to 20 mA) is only possible in three-/four–wire connections (see figure 3-22, page 58).

7.SDIR Setpoint direction (see figure 4-8, page 93)

The setting of the setpoint direction serves to reverse the direction of action of the setpoint. It is used mainly for the split range mode and in single–acting actuators with the safety position “up”.

8.SPRA Split range start (see figure 4-8)
and
9.SPRE Split range end (see figure 4-8)

The parameters “8.SPRA” and “9.SPRE” in connection with the parameter “7.SDIR” serve to restrict the active setpoint range. In this way split range tasks can be solved with the following characteristics.

- rising / falling
- falling / rising
- falling / falling
- rising / rising

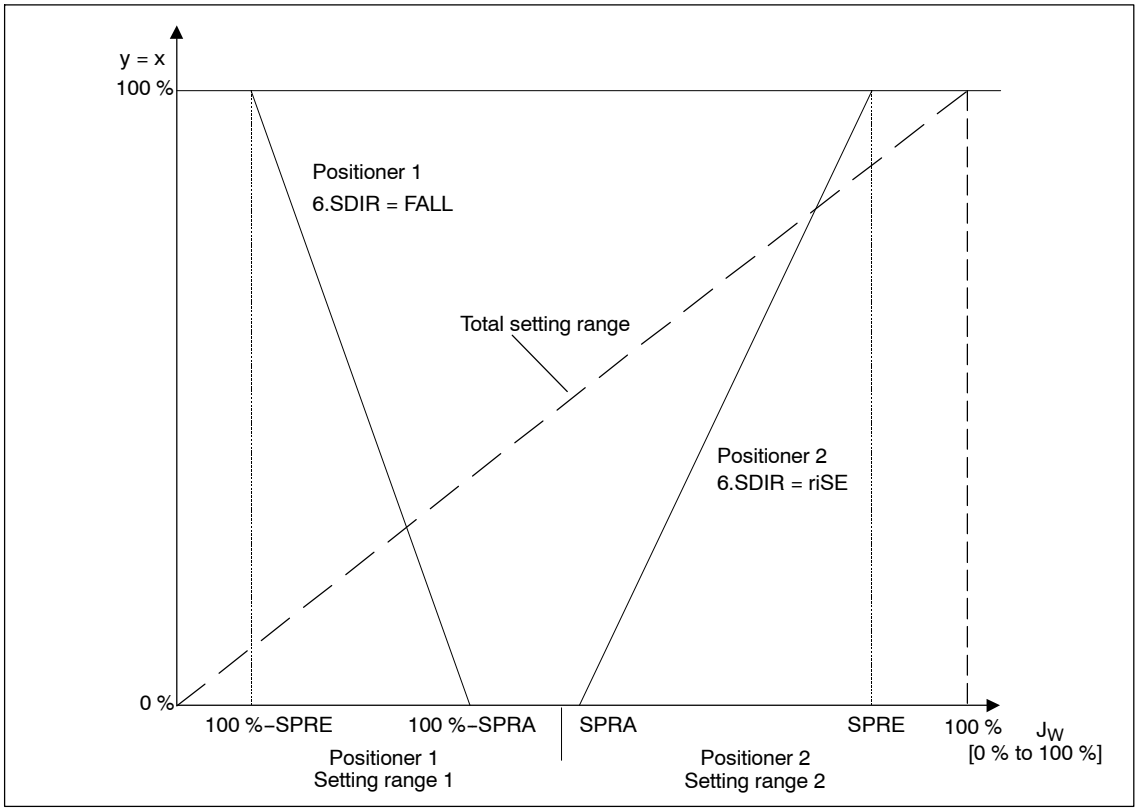


Figure 4-8 Example: Split range-operation with two positioners

10.TSUP Setpoint ramp UP
and
11.TSDO 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.

12.SFCT Setpoint function (see figure 4-9, page 94)

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 (12.SFCT = Lin, factory setting)
- equal percentage 1 : 25 (12.SFCT = 1:25)
- equal percentage 1 : 33 (12.SFCT = 1:33)
- equal percentage 1 : 50 (12.SFCT = 1:50)
- inverse equal percentage 25 : 1 (12.SFCT = n1:25)
- inverse equal percentage 33 : 1 (12.SFCT = n1:33)
- inverse equal percentage 50 : 1 (12.SFCT = n1:50)
- freely adjustable (12.SFCT = FrEE)

13.SL0 to 33.SL20 Setpoint turning points

A flow parameter can be assigned to the respective setpoint turning value 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.

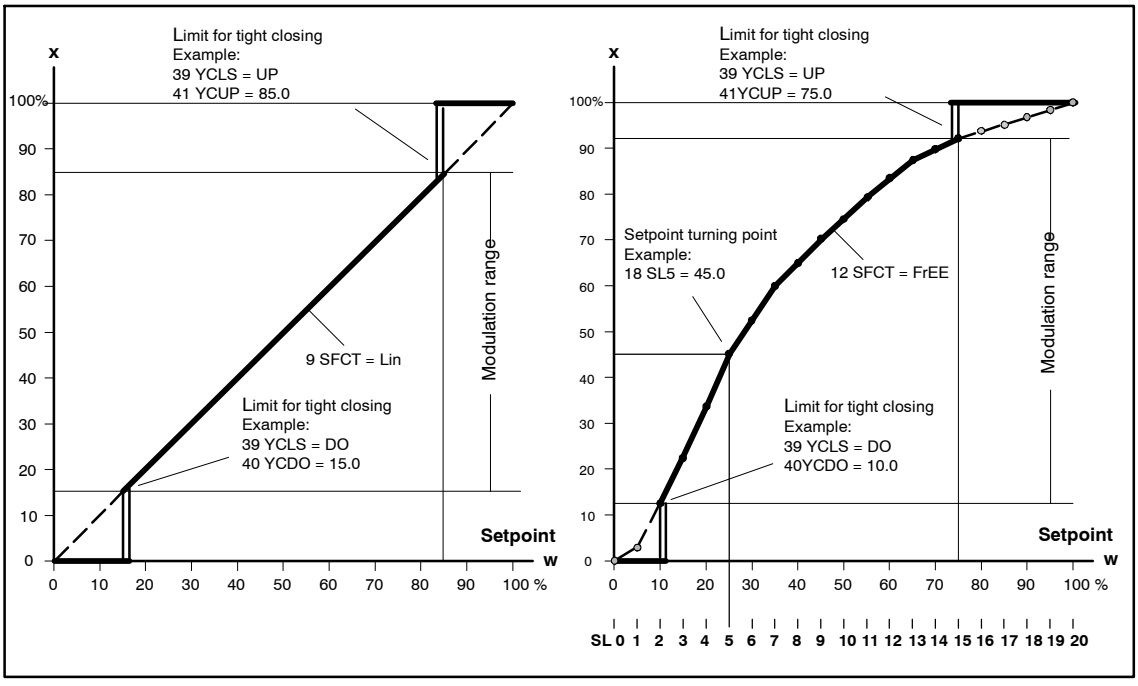


Figure 4-9 Setpoint characteristic, manipulated variable standardization and tight closing function

The setpoint vertex values can only be input at 12.SFCT=FrEE. You may only enter a strictly monotonous characteristic, and two consecutive vertex values must differ by at least 0.2 %.

34.DEBA Dead zone of the controller

At dEbA = AUto the dead zone in automatic operation is adapted continuously to the requirements of the control circuit. The dead zone 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 dead zone.

35.YA Manipulated variable limiting start (see figure 4-9 and 4-10)
and
36.YE Manipulated variable limiting end (see figure 4-9 and 4-10)

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.

37.YNRM Manipulated variable standardization (see figure 4-9 and 4-10)

With limiting of the manipulated variable (by “35.YA” and “36.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 “35.YA” and “36.YE”. The parameters “35.YA” and “36.YE” are displayed in the MPOS-scale.

The FLOW-scale is the standardization (0 to 100%) to the range between “35.YA” and “36.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 ly.

To calculate the control difference, the setpoint is also shown in the appropriate scale on the display.

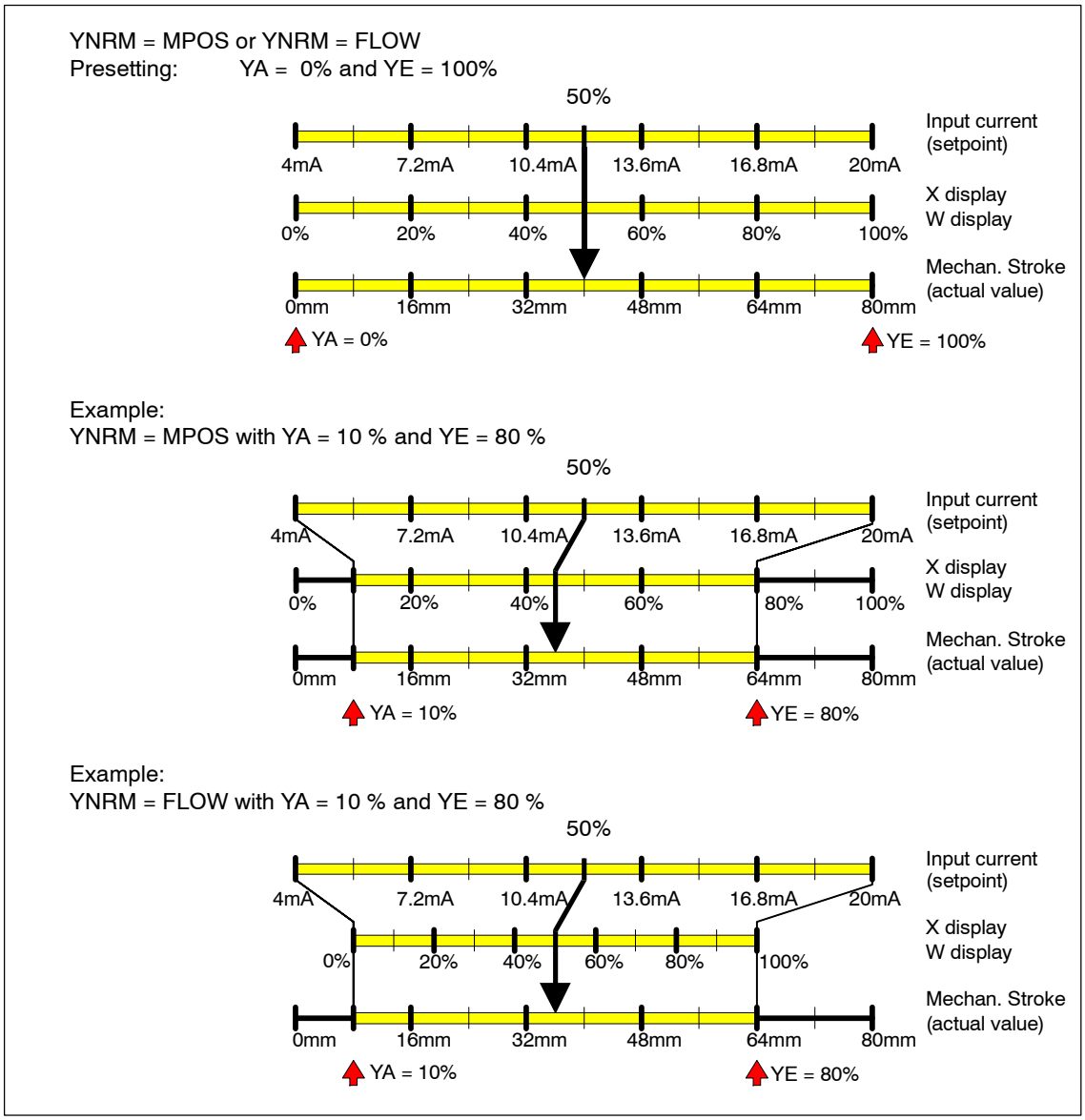


Figure 4-10 Dependence on the stroke of standardization and on YA and YE in the example of an 80 mm linear actuator

38.YDIR Manipulated variable direction of action

The direction of action (rising or falling) of the display and the position feedback (Iy) can be set with this.

39.YCLS Tight closing with manipulated variable (see figure 4-9, page 94)

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. YCLS becomes active when the setpoint is below the value set with parameter “YCDO” or above that set with parameter “YCUP”.

☞ **NOTE**

If the control function to close tightly is activated, for parameter ”49. 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 ”52. ϟZERO” and ”53. ϟOPEN”.

40.YCDO Value for tight closing, bottom
and
41.YCUP Value for tight closing, top

☞ **NOTE**

“40.YCDO” must always be set to less than “41.YCUP”. The tight closing function has a fixed hysteresis of 1 %. ”40.YCDO” and ”41.YCUP” relate to mechanical stops and are independent of the settings of ”7.SDIR” and ”38.YDIR”.

42.BIN1 Function digital input 1 (see figure 4-6, page 88)
and
43.BIN2 Function digital input 2 (see figure 4-6)

The parameters “BIN1” and “BIN2” can be set individually depending on the purpose. The direction of action can be adapted to an NCC or an NOC.

- BIN1 or BIN2 = on or –on

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

- BIN1 = bLoc1

  The Configuration operating mode is locked to prevent it being adjusted (e.g. by a wire jumper between terminals 9 and 10).

- BIN1 = bLoc2

  If digital input 1 has been activated, manual operation is also locked in addition to the Configuration operating mode.

- BIN1 or BIN2 = uP or doWn (contact closes) or –uP or –doWn (contact opens).

  The actuator drives the linear actuator to the upper or lower stop when the digital input is activated with continuous contact.

- BIN1 or BIN2 (contact closes) = StoP or –StoP (contact opens).

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

- BIN1 or BIN2 = oFF (factory setting)

  no function

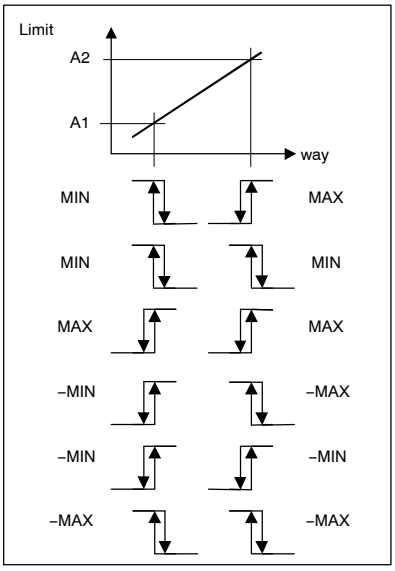
  special function of DI1: If the digital input 1 is activated in P manual operation by a jumper between terminals 9 and 10, , when the operating mode key is pressed the firmware version will be displayed. line of the display.

If one of the above named functions is selected with the parameters “BIN1” and “BIN2” simultaneously, then “Blocking” has priority over “Up” and “Up” priority over “Down”.

44.AFCT Alarm function

The actuator can report the exceeding (max.) or dropping below (min) of a specified stroke or angle of rotation. The response of the alarms (limit contacts) is related to the MPOS-scaling (see figure 4-10, page 96). The alarms are reported by the alarm module (order no. 6DR4004-6A or -8A). In addition the alarms can be read out through the HART interface (optional).

The direction of action of the digital outputs can be adapted from high active to low active sequence systems.



	Alarm module A1	A2
A1 = 48 / A2 = 52	AFCT = MIN / MAX	
Travel = 45	Activated	
Travel = 50		
Travel = 55		Activated

A1 = 48 / A2 = 52	AFCT = –MIN / –MAX	
Travel = 45		Activated
Travel = 50	Activated	Activated
Travel = 55	Activated	

A1 = 52 / A2 = 48	AFCT = MIN / MAX	
Travel = 45	Activated	
Travel = 50	Activated	Activated
Travel = 55		Activated

A1 = 52 / A2 = 48	AFCT = –MIN / –MAX	
Travel = 45		Activated
Travel = 50		
Travel = 55	Activated	

45.A1 Response threshold alarm 1
and
46.A2 Response threshold alarm 2

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

47. ↯FCT

Function of the fault message output

The fault message output serves as a group message for following faults:

- Control error (e.g. by actuator fault, valve fault, compressed air failure) with the parameters “48.↯TIM” and “49.↯LIM”
- Positioner not in automatic mode
- Digital input activated (see parameter “42.BIN1” and “43.BIN2”)
- Exceeding of a limit value (e.g. way integral or valve seat, see parameter 50 to 54)

It also responds at:

- Power failure
- Processor fault

The direction of action of the digital outputs can be adapted from high active to low active sequence systems.

For more information on error messages, see chapter 4.5.3 Online–Diagnosis, page 107.

48. ↯TIM

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 “49.↯LIM”.

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

NOTE

If the control function to close tightly is activated, for parameter ”49. 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 ”52. ZERO” and ”53. OPEN”.

For more information on error messages, see chapter 4.5.3 Online–Diagnosis, page 107.

49. ↯LIM

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 48 and 49 are both set to ”Auto” (factory setting), the fault message is set if the short step zone is not reached within a certain time. This time is 5 times the initialization travel time within 5 to 95% of the travel and 10 times this time outside 10 to 90% of the travel.

50. ↳STRK Limit value for monitoring the way integral

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 102.

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

51. ↳DCHG Limit value for monitoring the changes of direction

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 function enables a preventive maintenance of the fitting, see also chapter 4.5 “Diagnostics”, page 102.

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

52. ↳ZERO 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 then 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 “39.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 102.

53. ↳OPEN 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 (parameter “39.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).

NOTE

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

54. ↳DEBA 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 (optional) is activated.

Prerequisite for this function is the setting of the parameter“34.DEBA” = Auto. This monitoring function can be deactivated with the OFF setting (factory setting).

55.PRST Preset

Establishing the factory setting and resetting the initialization.

NOTE

The positioner must be re–initialized after ”Preset”. All previously determined maintenance parameters are cleared.

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 following table shows an overview of the displayable values.

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.
1	STRKS	Number of strokes	0 to 4.29E9	–	x
2	CHDIR	Changes of direction	0 to 4.29E9	–	x
3	ϟCNT	Fault counter	0 to 4.29E9	–	x
4	A1CNT	Alarm counter 1	0 to 4.29E9	–	x
5	A2CNT	Alarm counter 2	0 to 4.29E9	–	x
6	HOURS	Operating hours	0 to 4.29E9	Hours	
7	WAY	Determined travel	0 to 130	mm or °	
8	TUP	Travel time up	0 to 1000	s	
9	TDOWN	Travel time down	0 to 1000	s	
10	LEAK	Leakage	0.0 to 100.0	%	
11	P0	Potentiometer value lower stop (0 %)	0.0 to 100.0	%	
12	P100	Potentiometer value upper stop (100 %)	0.0 to 100.0	%	
13	IMPUP	Impulse length up	2 to 100	ms	
14	IMPDN	Impulse length down	2 to 100	ms	
15	DBUP	Dead Band Up	0.1 to 100.0	%	
16	DBDN	Dead Band Down	0.1 to 100.0	%	
17	SSUP	Short step zone up	0.1 to 100.0	%	
18	SSDN	Short step zone down	0.1 to 100.0	%	
19	TEMP	Current temperature	–40 to 85	°C	
20	TMIN	Minimum temperature (”drag pointer”)	–40 to 85	°C	
21	TMAX	Maximum temperature (”drag pointer”)	–40 to 85	°C	
22	T1	Number of operating hours in temperature range 1	0 to 4.29E9	Hours	
23	T2	Number of operating hours in temperature range 2	0 to 4.29E9	Hours	
24	T3	Number of operating hours in temperature range 3	0 to 4.29E9	Hours	
25	T4	Number of operating hours in temperature range 4	0 to 4.29E9	Hours	
26	T5	Number of operating hours in temperature range 5	0 to 4.29E9	Hours	
27	T6	Number of operating hours in temperature range 6	0 to 4.29E9	Hours	
28	T7	Number of operating hours in temperature range 7	0 to 4.29E9	Hours	
29	T8	Number of operating hours in temperature range 8	0 to 4.29E9	Hours	
30	T9	Number of operating hours in temperature range 9	0 to 4.29E9	Hours	

No.	Abbreviation	Meaning	Displayable values	Unit	Rest poss.
31	VENT1	Number of cycles pre–controlvalve 1	0 to 4.29E9	–	
32	VENT2	Number of cycles pre–controlvalve 2	0 to 4.29E9	–	
33	STORE	Store current values as ”last maintenance” (press increment key for 5 s)	–	–	
34	PRUP	Prediction up	1 to 40	–	
35	PRDN	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
44	mA	Current setpoint	0.0 to 20.0	mA	

Table 4-1 Overview diagnostic values

4.5.2 Meaning of the diagnostic values

1 STRKS Number of strokes

The actuator movements during operation are totaled and can be read here as number of strokes. Unit: 100% stokes The value is written every 15 minutes in a non–volatile memory. It can be reset to zero with the increment key .

2 CHDIR Number of direction changes

Every change in direction leaving the dead zone is noted in the controller and added to the number of changes of direction.

The value is written every 15 minutes in a non–volatile memory. It can be reset to zero with the increment key  .

3 ↳CNT 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  .

4 A1CNT Alarm counter 1
and
5 A2CNT Alarm counter 2

Responses of alarm 1 and alarm 2 are counted with these two counters. The prerequisite is the activation of the alarms with the parameter “44.AFCT”. The counters can be reset to zero with the increment key  .

6 HOURS Operating hours

The operating hours counter is updated every hour as soon as the positioner has been supplied with electrical power.

7 WAY Determined actuating way

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”.

8 TUP Travel time up
and
9 TDOWN travel time down

These values show the travel times which have been determined during initialization. The unit is seconds.

10 LEAK Leakage

If a leakage message has been output during initialization, the value of the leakage can be read here in %/min.

11 P0 Potentiometer value bottom stop
and
12 P100 Potentiometer value top stop

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.

13 IMPUP Impulse length up
and
14 IMPDN Impulse length down

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.

These two parameter can be used for special applications (see chapter 4.7 page 117).

15 DBUP Dead zone up
and
16 DBDN 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“34.DEBA” or the value adapted automatically by the instrument when “DEBA” has been set to ”Auto”.

17 SSUP Short step zone up
and
18 SSDN 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 117).

19 TEMP 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 Minimum temperature (drag pointer)
and
21 TMAX 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 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 of cycles pre–control valve 1
and
32 VENT2 Number of cycles pre–control valve 2

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

33 STORE Store maintenance data

A store function is triggered by pressing the increment key△ 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 PDF, menu item Instrument→Store maintenance info. It is possible to compare the data of the last maintenance with the current data via PDM.

34 PRUP Prediction up
35 PRDN Prediction down
see chapter 4.7 page 117).

36 WT00 to **43 WT95** Number of operating hours in distance class WT00 to WT95

If the positioner is in automatic mode, statistics are constantly kept for how long a valve or a flap has been operated in which section of the setting range. To do this, the total setting range (0 to 100%) is divided into 8 sections (distance classes). The positioner continuously registers the current position and increments the operating hours meter assigned to the corresponding section (distance class) every hour. This allows returns to previous operating conditions and is particularly used to evaluate the control properties of the control circuit or the entire fitting.

The setting range is divided as follows:

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

You can collectively set the 8 operating hours meters to zero by pressing the increment key (for at least 5 seconds).

TIP: As the distance classes at the end of the diagnostic menu have the numbers 36 to 43, in addition to the operating mode key press the decrement key repeatedly. This takes you quickly to the diagnostic numbers 36 to 43.

44 MA Setpoint

You can display the current setpoint in mA here.

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.

Table 4-2, page 108 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. The instrument status which also contains all fault messages can be called via HART with the command #48.

Error code	Event	Parameter setting	Fault message disappears when ...	Possible causes
ϟ1	Remaining control error	always active	... the control error has disappeared again	Compressed air missing, actuator fault, valve fault (e.g. blockade).
ϟ2	Instrument not in automatic mode	47.ϟ FCT= ϟnA or = ϟ nAB	... the instrument is brought into automatic mode	The instrument is configured or is in manual operation.
ϟ3	Digital input DI1 or DI2 active	47.ϟ FCT= ϟnAB and digital function BIN1 or BIN2 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).
ϟ4	Limit value Number of strokes exceeded	50.ϟSTRK≠OFF	... the stroke counter is reset or the limit value increased	The total distance traveled by the actuator exceeded the set limit value.
ϟ5	Limit value change of direction exceeded	51.ϟ 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.
ϟ6	Limit value bottom hard stop exceeded	52.ϟZERO≠OFF 39.YCLS = do or up do	... 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, friction clutch maladjusted.
ϟ7	Limit value top hard stop exceeded	53.ϟOPEN≠OFF 39 YCLS = up or up do	... 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, friction clutch maladjusted.
ϟ8	Limit value dead zone adaptation exceeded	54.ϟDEBA≠OFF 34.DEBA = Auto	... the limit value is dropped below again	Increased stuffing box friction, mechanical lots of the position feedback

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

Explanations of column “Error codes”:

1 Monitoring of control error

In automatic operation 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 48.ϟ TIM, monitoring time for setting the fault messages and 49ϟLIM, 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 “47.ϟFCT”. 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 **Digital input DI1 or DI2 active**

A fault message is generated when the digital input is activated at the the corresponding setting of the parameter “47.␣FCT”, function of the fault message output and the parameter “42.BIN1”, function digital input 1. This may be a switch for stuffing box monitoring, a temperature switch or a limit value switch for example.

Digital input 2 (on the alarm module option) can be configured in the same way.

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 “50.␣STRK” and “51.␣DCHG”. 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 “52.␣ZERO” has a value≠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 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 “39.YCLS”) 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 (“52.␣ZERO”=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 ␣. Activation of the tight closing top function (parameter “39.YCLS”) 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 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 (”54.ϟDEBA”, limit value for dead zone monitoring) which activates the fault message output when it is exceeded.

4.5.4 Fault correction

Diagnostics indicator

see	Table			
In which operating mode did the fault occur?				
• Initialization	**1**			
• Manual mode and automatic mode	**2**	**3**	**4**	**5**
Under which circumstances and conditions did the fault occur?				
• Wet environment (e.g. heavy rain or constant condensation)	**2**			
• Vibrating fittings	**2**	**5**		
• Under impact or shock (e.g. steam jets or breakaway flaps)	**1**			
• Damp (wet) compressed air	**2**			
• Dirty (contaminated with solid particles) compressed air	**2**	**3**		
When does the fault occur?				
• Constantly (reproducibly)	**1**	**2**	**3**	**4**
• Sporadically (not reproducible)	**5**			
• Usually after a certain operating period	**2**	**3**	**5**	

Fault description (symptoms)	Possible cause(s)	Corrective actions
• SIPART PS2 comes to a halt in RUN 1	• Initialization started from the final stop and • Reaction time of max. 1 min. not waited • Network pressure not connected or too low	• Up to 1 min. waiting time required • Do not start initialization from an end stop • Confirm network pressure
• SIPART PS2 comes to a halt in RUN 2	• 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 2)	• Check settings: • See leaflet: Figure Device view (7) and parameters 2 and 3 • Check stroke setting on the lever • see Table 2
• SIPART PS2 comes to a halt in RUN 3	• Actuator positioning time too long	• Open restrictor fully and/or set pressure PZ(1) to the highest permissible value • Use booster if necessary
• SIPART PS2 comes to a halt in RUN 5, does not reach FINISH (waiting time > 5 min)	• Play in the positioner, actuator, fittings system	• Linear actuator: Check seating of the stud screw of the coupling wheel • Part-turn actuator: Check seating of the lever on the positioner shaft • Correct any other play between the actuator and the fittings

Table 1

Fault description (symptoms)	Possible cause(s)	Corrective actions
• CPU test blinks in the display of the SIPART PS2 (ca. every 2 secs) • Piezo valve(s) do not switch	• Water in the valve manifold (from wet compressed air)	• 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: Repair (see Chapter 5, page 119)
• Actuator cannot be moved in manual or automatic mode, or only in one direction	• Dampness in the valve manifold	
• Piezo valve(s) do not switch (no soft clicking can be heard when the + or – keys are pressed in manual mode)	• Screw between cover hood and the valve manifold is not tight or the hood is jammed	• Tighten screw, or release cause of jamming when necessary
	• Dirt (swarf, particles) in the valve manifold	• Repair (see Chapter 5, page 119) or new device with integrated fine filter which can be replaced and cleaned
	• Deposits on the contact(s) between the electronics board and the valve manifold can occur from abrasion through continuous stresses from strong vibrations	• Clean all contact surfaces with alcohol: when necessary bend the valve manifold contact springs back into place

Table 2

Fault description (symptoms)	Possible cause(s)	Corrective actions
• Actuator does not move	• Compressed air < 1.4 bar	• Set inlet air pressure to > 1.4 bar
• Piezo valve(s) do not switch (although a soft clicking can be heard when the + or – keys are pressed in manual mode)	• Restrictor(s) closed down (screw(s) at the right end stop)	• Open restrictor screw(s) (see leaflet, Figure “View of device (6)”) by turning to the left
	• Dirt in the valve manifold	• Repair (see Chapter 5, page 119) or new device with integrated fine filter which can be replaced and cleaned
• One piezo valve constantly switches in stationary automatic mode (constant setpoint) and in manual mode	• Pneumatic leak in the positioner, actuator system, start leak test in RUN 3 (Initialization) !!!	• Fix leak in the actuator and/or supply line • If the actuator and supply line are intact: Repair (see Chapter 5, page 119) or new device
	• Dirt in the valve manifold (see above)	• See above

Table 3

Fault description (symptoms)	Possible cause(s)	Corrective actions
• The two piezo valve constantly switch alternately in stationary automatic mode (constant setpoint), actuator oscillates around a middle point	• Static friction on the packing glands of the fittings or actuator too high	• Reduce static friction or increase dead zone of SIPART PS2 (parameter dEbA) until the oscillating movements stop.
	• Play in the positioner, actuator, fittings system	• Linear actuator: Check seating of the stub screw of the coupling wheel • Part-turn actuator: Check seating of the lever on the positioner shaft • Correct any other play between the actuator and fittings
	• Actuator too fast	• Increase positioning times by means of restrictor screws • If fast positioning times are required, increase dead zone (parameter dEbA) until the oscillating movements stop.
• SIPART PS2 does not drive the valve up to the end stop (at 20 mA)	• Supply pressure too low • Load of the supply controller or system output too low; required load potential.	• Increase supply pressure • Intermediate burden converter • Select 3/4 wire operation

Table 4

Fault description (symptoms)	Possible cause(s)	Corrective actions
• Zero point shifts sporadically (> 3 %)	• Such high accelerations have occurred through impact or shock that the friction clutch has shifted (e.g. through steam jets in the steam pipelines)	• Shut off the cause of the shocks • Reinitialize the positioner
• Device function breaks down totally: no display	• Insufficient electrical supply	• Check electrical supply
	With very high continuous stresses by vibrations, the following can occur: • Screws of the electrical terminals can loosen • The electrical terminals and/or electronic modules can be shaken loose	• Tighten screws and secure with sealing varnish • Repair at (see Chapter 5, page 119) • Prevention: Mount the SIPART PS2 on rubber metal

Table 5

4.6 Meanings of other display texts

Notes on the tables:

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

Reports before initializing (first commissioning):

	Upper line	Lower line	Meaning/Cause	Actions
CPU START	x	x	Report after connecting the electrical auxiliary power	•· Wait
P *nnn.n*	x		Potentiometer voltage for non-initialized positioner (P manual mode) (Setting actual value in % of measurement range)	• Check using the ”+” and ”–” keys whether the overall 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 travel	• Set transmission ratio selector to 90 degrees, in particular for part-turn actuators • Match effective arm length for linear actuators to measurement range
NOINI		x	Positioner not initialized	• 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)	• Wait
RUN 2		x	Initialization part 2 active (travel check and determination of the end stops)	• Wait
RUN 3		x	Initialization part 3 active (determination and display of positioning times)	• Wait
RUN 4		x	Initialization part 4 active (determination the minimum positioning increment length)	• Wait
RUN 5		x	Initialization part 5 active (optimization of the behavior on transients)	• Wait until "FINSH" is displayed (initialization completed successfully) • Press "operating mode" key briefly to acknowledge or longer to quit configuration mode
YEND1		x	only during manual initialization first end position can be moved to	• Move to first end position using the "+" or "–" key • Press "operating mode" key to acknowledge
YEND2			only during manual initialization second end position can be moved to	• Move to second end position using the "+" or "–" key • Press "operating mode" key to acknowledge
RANGE		x	only during manual initialization End position or measurement span are outwith the permitted measurement range	• Using "+" and "–" keys move to the other end position and press "operating mode" key to acknowledge, or • Adjust friction 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 travel and position sensing
ok			only during manual initialization permitted measurement range for end positions reached	• 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	• Ensure compressed air is sufficient • Open any choke(s) • Re-start initialization
ϟ d___U		x	Bar display of the zero point Zero point is outwith the tolerance range	• With friction clutch set to "**P 4.0**" to "**P 9.9**" (>0<) • Continue using the "+" or "–" key
SEt MIDDL	x	x	Friction clutch misaligned; "P 50.0" no displayed when arm horizontal	• For linear actuators, 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)

	Upper line	Lower line	Meaning/Cause	Actions
ϟ UP >		x	”UP” – tolerance range exceeded or inactive zone of potentiometer entered	• Match effective arm length for linear actuators to measurement range, or set transmission ratio selector to 90 degrees • Press ”operating mode” key briefly to acknowledge • Re-start initialization
ϟ90_95		x	Only applies to part-turn actuators: travel is not within range 90 to 95%	• Use the ”+” and ”–” keys to move into the range of 90 to 95% • Press ”operating mode” key briefly to acknowledge
ϟ U–d>		x	Measurement span ”Up–Down” is insufficient	• Reduce effective arm length for linear actuators or set transmission ratio selector 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”	• Wait, or • To change the travel 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”	• Wait, or • To change the travel 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)	• Travel 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 **LEAKG**	x	x	Leakage test active initialization interrupted with the ”+” key during travel-speed display)	• Wait 1 minute • Continue with the ”+” key
nn.n **°oMIN**	x	x	Value and units of results of the leakage test	• Remove leakage if value is too high. • Continue with the ”+” key
nn.n **FINSH**	x	x	Initialization completed successfully, with display of the travel or positioning angle as appropriate	• Press ”operating mode” key briefly to acknowledge or longer to quit configuration mode

Reports on leaving "configuration" operating mode:

	Upper line	Lower line	Auto-matic	Manual mode	P manual mode	Meaning/Cause	Actions
Cn **VER**	x	x				Software version	• Wait
Error SL*nn*	x	x				Monoticity transgression of the free characteristic line at support point "n"	• Correct value

Reports on leaving "configuration" operating mode:

	Upper line	Lower line	Auto-matic	Manual mode	P manual mode	Meaning/Cause	Actions
CPU START	x	x				Message after applying auxiliary electrical power	• Wait
HW / ERROR		x				Fault in the hardware	• Exchange electronics
NOINI		x			x	Positioner not initialized	• Start initialization
nnn.n	x		x	x		Setting actual value [in %] for initialized positioners. Flashing decimal point indicates communication with a class 2 master	
AUT*nn*		x	x			Automatic mode (nn = setpoint)	
MANnn				x		Manual mode (nn = setpoint)	• Press operating mode key to change to automatic mode
oFL / 127.9	x		x	x		Display range exceeded. Possible causes: • Friction clutch or • Transmission ratio selector changed or • Positioner installed without reinitialization, having previously been fitted to another actuator	• Adjust friction clutch so that when moving the actuator the actual value display remains within 0.0 to 100.0 or • Change transmission ratio selector 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	
HTCNF		x	x	x	x	HART configuration is running	

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
14 Pulse length down

This determines for any sense of actuation the smallest drive movement pulse length. The optimum value depends heavy on the volume of the actuator. Small values will lead to small actuation increments and frequent actuator movements. Note that if the value is too small no movement will result. If actuator 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 actuators.

17 Short step zone up
18 Short step zone down

The short step zone is the range in which the deviation from setpoint varies between the fast step zone and the dead band. In this zone the actuator 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.

34 Prediction up
35 Prediction down

These parameters modify the damping factor, changing the control dynamics.

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

During setup it is recommended that an automatic initialization is performed first, later changing positioner parameters to match 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.

Service and Maintenance 5

The positioner is largely maintenance–free. The positioners are fitted with filters in the pneumatic connections as protection against coarse particles of dirt. If the pneumatic energy supply contains particles of dirt, 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

6

General data for basic device 6DR50xx
6DR51xx
6DR52xx
6DR53xx

(see following pages)

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
Degree of protection	IP65 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)	GK AlSi12
- 6DR5..2-... (stainless steel)	Austenitic stainless steel mat. No. 1.4581
- 6DR5..5-... (metal, pressure-proof)	GK AlSi12
• Pressure gauge block	Aluminium AlMgSi, coated

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/s² (321.84 ft/s²), 27 ... 300 Hz, 3 cycles/axis
• Bumping (half-sine) to DIN EN 60068-2-29/03.95	150 m/s² (492 ft/s²), 6 ms, 1000 shocks/axis
• Noise (digitally controlled) to DIN EN 60068-2-64/08.95	10 ... 200 Hz; 1 (m/s²)²/Hz (3.28 (ft/s²)²/Hz)
	200 ... 500 Hz; 0.3 (m/s²)²/Hz (0.98 (ft/s²)²/Hz)
	4 hours/axis
• Recommended continuous duty range of the complete fitting	≤ 30 m/s² (≤ 98.4 ft/s²) 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 Dimension drawing
Climate class to DIN EN 60721-3-4	To IEC 721
• Storage [1]	1K5, but -40 ... +80 °C (1K5, but -40 ... +176 °F)
• Transport [1]	2K4, but -40 ... +80 °C (2K4, but -40 ... +176 °F)
• Operation [2]	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)
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 [3]	
- 2 bar (29 psi)	4.1 Nm³/h (18.1 USgpm)
- 4 bar (58 psi)	7.1 Nm³/h (31.3 USgpm)
- 6 bar (87 psi)	9.8 Nm³/h (43.1 USgpm)
• Outlet air valve [3]	
- 2 bar (29 psi)	8.2 Nm³/h (36.1 USgpm)
- 4 bar (58 psi)	13.7 Nm³/h (60.3 USgpm)
- 6 bar (87 psi)	19.2 Nm³/h (84.5 USgpm)
Valve leakage	$< 6 \cdot 10^{-4}$ Nm³/h (0.0026 USgpm)
Throttle ratio	Adjustable up to ∞ : 1
Power consumption in the controlled state	$< 3.6 \cdot 10^{-2}$ Nm³/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) During commissioning at ≤ 0 °C (≤ 32 °F) make sure that the valves are flushed long enough with the dry medium.

2) At ≤ -10 °C the display refresh rate of the LCD is limited. Only T4 is permissible when using I_y module.

3) With EEx d version (6DR5..5-...) the values are reduced by approx. 20%

SIPART PS2	Basic device without Ex protection	Basic device with EEx-d protection (flameproof casing)	Basic device with EEx ia/ib protection	Basic device with EEx n protection
Explosion protection to EN 50014, EN 50020 and EN 50021	Without	EEx d II 2 G EEx d II C T6	EEx ia/ib II 2 G EEx ia/ib II C T6	EEx n II 3 G EEx nA L [L] II C T6
Mounting location		Zone 1	Zone 1	Zone 2
Permissible ambient temperature for operation (for basic devices with EEX ia/ib and EEx n protection the following applies: At ≤ -10 °C (+14 °F) the display refresh rate of the LCD is limited. Only T4 is permissible when using I_y module.)	-30 ... +80 °C (-22 ... +176 °F)	T4: -30 ... +80 °C (-22 ... +176 °F) T5: -30 ... +65 °C (-22 ... +149 °F) T6: -30 ... +50 °C (-22 ... +122 °F)		
Electrical data				
Input				
2-wire connection (terminals 6/8)				
Rated signal range	4 ... 20 mA	4 ... 20 mA	4 ... 20 mA	4 ... 20 mA
Current to maintain the power supply	≥ 3.6 mA	≥ 3.6 mA	≥ 3.6 mA	≥ 3.6 mA
Required load voltage U_B (corresponds to Ω at 20 mA)				
• Without HART (6DR50..)				
- Typical	≤ 6.36 V (corresponds to 318 Ω)	≤ 6.36 V (corresponds to 318 Ω)	≤ 7.8 V (corresponds to 390 Ω)	≤ 7.8 V (corresponds to 390 Ω)
- Max.	≤ 6.48 V (corresponds to 324 Ω)	≤ 6.48 V (corresponds to 324 Ω)	≤ 8.3 V (corresponds to 415 Ω)	≤ 8.3 V (corresponds to 415 Ω)
• Without HART (6DR53..)				
- Typical	≤ 7.9 V (corresponds to 395 Ω)	–	–	–
- Max.	≤ 8.4 V (corresponds to 420 Ω)	–	–	–
• With HART (6DR51..)				
- Typical	≤ 6.6 V (corresponds to 330 Ω)	≤ 6.6 V (corresponds to 330 Ω)	–	–
- Max.	≤ 6.72 V (corresponds to 336 Ω)	≤ 6.72 V (corresponds to 336 Ω)	–	–
• With HART (6DR52..)				
- Typical	–	≤ 8.4 V (corresponds to 420 Ω)	≤ 8.4 V (corresponds to 420 Ω)	≤ 8.4 V (corresponds to 420 Ω)
- Max.	–	≤ 8.8 V (corresponds to 440 Ω)	≤ 8.8 V (corresponds to 440 Ω)	≤ 8.8 V (corresponds to 440 Ω)
• Static destruction limit	± 40 mA		–	–
Internal capacitance C_i				
• Without HART	–	–	≤ 22 nF	–
• With HART	–	–	≤ 7 nF	–
Internal inductance L_i				
• Without HART	–	–	≤ 0.12 mH	–
• With HART	–	–	≤ 0.24 mH	–
For connection to power circuits with	–	–	intrinsically safe U_o ≤ 30 V DC I_k ≤ 100 mA P ≤ 1 W	U_i ≤ 30 V DC I_i ≤ 100 mA

SIPART PS2	Basic device without Ex protection	Basic device with EEx-d protection (flameproof casing)	Basic device with EEx ia/ib protection	Basic device with EEx n protection
3-/4-wire device (terminals 2/4 and 6/8) (6DR52.. and 6DR53..)				
• Power supply U_H	18 ... 35 V DC	18 ... 35 V DC	18 ... 30 V DC	18 ... 30 V DC
• Current consumption I_H	(U_H - 7.5 V)/2.4 kW [mA]	(U_H - 7.5 V)/2.4 kW [mA]	(U_H - 7.5 V)/2.4 kW [mA]	(U_H - 7.5 V)/2.4 kW [mA]
• Internal capacitance C_i	–	–	≤ 22 nF	–
• Internal inductance L_i	–	–	≤ 0.12 mH	–
• For connection to power circuits with	–	–	intrinsically safe U_o ≤ 30 V DC I_k ≤ 100 mA P ≤ 1 W	U_i ≤ 30 V DC I_i ≤ 100 mA
Current input I_W				
Rated signal range	4 ... 20 mA	4 ... 20 mA	4 ... 20 mA	4 ... 20 mA
Load voltage at 20 mA	≤ 0.2 V (corresponds to 10 Ω)	≤ 0.2 V (corresponds to 10 Ω)	≤ 1 V (corresponds to 50 Ω)	≤ 1 V (corresponds to 50 Ω)
Internal capacitance Ci	–	–	≤ 22 nF	–
Internal inductance (Li)	–	–	≤ 0.12 mH	–
For connection to power circuits with	–	–	intrinsically safe U_o ≤ 30 V DC I_k ≤ 100 mA P ≤ 1 W	U_i ≤ 30 V DC I_i ≤ 100 mA
Electrical isolation	between U_H and I_W	between U_H and I_W	between U_H and I_W (2 intrinsically safe circuits)	between U_H and I_W
Test voltage	840 V DC (1 s)			
Connections				
• Electric	Screw terminals 2.5 AWG28-12 Cable gland M20 or ½“ NPT	Screw terminals 2.5 AWG28-12 EEx d certified cable gland M20x1.5, ½“ NPT or M25x1.5	Screw terminals 2.5 AWG28-12 Cable gland M20 or ½“ NPT	Screw terminals 2.5 AWG28-12 Cable gland M20 or ½“ NPT
• Pneumatic	Female thread G1/4 DIN 45141 or ¼“ 18 NPT			
External position sensor (potentiometer or NCS; as option)				
• U_o	–	–	< 5 V	< 5 V
• I_o	–	–	< 75 mA	< 75 mA
• I_s	–	–	<160 mA	<160 mA
• P_o	–	–	<120 mW	<120 mW
Maximum permissible external capacitance C_o	–	–	< 1 µF	< 1 µF
Maximum permissible external inductance L_o	–	–	< 1 mH	< 1 mH

Option modules	Without Ex protection	With Ex protection	
Ex protection to EN 50 014 and EN 50 020	–	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 (T4: -22 ... +176 °F) T5: -30 ... +65 °C (-22 ... +149 °F) T6: -30 ... +50 °C (-22 ... +122 °F)	
Electrical data			
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) Signal status Low* (responded) (* Low is also the status when the basic device is faulty or has not electric power supply)	Active, R = 1 kΩ, +3/-1%* Disabled, I_R < 60 µA (* When used in the flameproof casing the current consumption is limited to 10 mA per output.)	≥ 2.1 mA ≤ 1.2 mA (Switching threshold with supply to DIN EN 60947-5-6: U_H = 8.2 V, R_i = 1kΩ)	≥ 2.1 mA ≤ 1.2 mA (Switching threshold with supply to DIN 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 DIN 19234 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	2-wire connection	2-wire connection
Ex protection	Without	II 2 G EEx ia/ib IIC T6	II 2 G EEx nA L [L] IIC T6
Connection	2-wire system to DIN 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 DIN 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	The 3 outputs are electrically isolated from the basic device	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

Accessory modules	Without Ex protection	With Ex protection	
Electrical data			
Explosion protection to EN 50014 and EN 50020	–	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) T5: -30 ... +65 °C (-22 ... +149 °F) T6: -30 ... +50 °C (-22 ... +122 °F)	
I_y module	6DR4004-8J (without Ex protection)	6DR4004-6J (with Ex protection)	6DR4004-6J (with Ex protection)
DC output for position feedback	2-wire connection	2-wire connection	2-wire connection
Nominal signal range i	4 ... 20 mA, short-circuit-proof	4 ... 20 mA, short-circuit-proof	4 ... 20 mA, short-circuit-proof
Total operating range	3.6 ... 20.5 mA	3.6 ... 20.5 mA	3.6 ... 20.5 mA
Power supply U_H	+12 ... +35 V	+12 ... +30 V	+12 ... +30 V
External load R_B [kW]	≤ (U_H [V] - 12 V) /i [mA]	≤ (U_H [V] - 12 V) /i [mA]	≤ (U_H [V] - 12 V) /i [mA]
Transmission error	≤ 0.3%	≤ 0.3%	≤ 0.3%
Temperature effect	≤ 0.1%/10 K (≤ 0.1%/18 °F)	≤ 0.1%/10 K (≤ 0.1%/18 °F)	≤ 0.1%/10 K (≤ 0.1%/18 °F)
Resolution	≤ 0.1%	≤ 0.1%	≤ 0.1%
Residual ripple	≤ 1%	≤ 1%	≤ 1%
Internal capacitance C_i	–	≤ 11 nF	–
Internal inductance L_i	–	Negligible	–
For connection to power circuits with		Intrinsically safe: U_i ≤ 30 V DC I_i ≤ 100 mA; P_i ≤ 1 W (only T4)	U_i ≤ 30 V DC I_i ≤ 100 mA; P_i ≤ 1 W (only T4)
Electrical isolation	Electrically isolated from the basic device	Electrically isolated from the basic device	Electrically isolated from the basic device
Test voltage	840 V DC, 1 s	840 V DC, 1 s	840 V DC, 1 s
NCS sensor			
(not for EEx d version)			
Position range			
• Linear actuator	3 ... 130 mm (0.12 ... 5.12 inch), to 200 mm (7.87 inch) on request	3 ... 130 mm (0.12 ... 5.12 inch), to 200 mm (7.87 inch) on request	3 ... 130 mm (0.12 ... 5.12 inch), to 200 mm (7.87 inch) on request
• Part-turn actuator	30° ... 100°	30° ... 100°	30° ... 100°
Linearity (after correction by SIPART PS2)			
• Linear actuator	± 1%	± 1%	± 1%
• Part-turn actuator	± 1%	± 1%	± 1%
Hysteresis	± 0.2%	± 0.2%	± 0.2%
Continuous working temperature	-40 ... +85 °C (-40 ... +185 °F), extended temperature range on request	-40 ... +85 °C (-40 ... +185 °F), extended temperature range on request	-40 ... +85 °C (-40 ... +185 °F), extended temperature range on request
Degree of protection of casing	IP68/NEMA 4X	IP68/NEMA 4X	IP68/NEMA 4X

Scope of Delivery

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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.

7.1 Ordering data

Selection and Ordering Data	Order No.
SIPART PS2, PS2 PA und PS2 FF electropneumatic positioner	6 D R 5 ▢▢▢ - 0 ▢▢▢ - ▢▢ A ▢
Design	
Two-wire	
• without HART (4 to 20 mA) ▶	0
• with HART, without explosion protection (except EEx d) ▶	1
Two-wire, three-wire, four-wire	
• with HART, with explosion protection ▶	2
• without HART, without explosion protection ▶	3
PROFIBUS PA connection (not with explosion protection on version PROFIBUS plug M12)	5
Foundation Fieldbus connection	6
For actuator	
single-action ▶	1
double-action ▶	2
Housing	
Plastic ▶	0
Aluminium; only single-action ▶	1
Stainless steel; not for EEx d version: not FM/CSA ▶	2
Aluminium; EEx d casing (flameproof)[1]	5
Explosion protection	
Without ▶	N
With explosion protection EEx ia/ib or EEx d (CENELEC/FM/CSA)[1]	E
With explosion protection EEx n (CENELEC)	G
Connection thread electric/pneumatic	
M20 x 1,5 / G1/4“ ▶	G
1/2“ NPT / 1/4“ NPT	N
M20 x 1,5 / 1/4“ NPT	M
1/2“ NPT / G1/4“	P
M25 x 1,5 / G1/4“ (EEx d version only)[1]	Q
With PROFIBUS plug M12 / G1/4“	R
With PROFIBUS plug M12 / N1/4“	S
VDI/VDE 3847	V
Limit monitor built-in, incl. 2nd cable gland	
Without ▶	0
Alarm module; electronic (6DR4004-.A)	1
SI module; slot initiators (6DR4004-.G); not with EEx d version	2
Option modules built-in, incl. 2nd cable gland	
Without ▶	0
ly module for position feedback (4 ... 20 mA) (6DR4004-.J)	1
EMC filter module for external position sensor (C73451-A430-D23), not with EEx d version	2
ly module and EMC filter module for external position sensor, not with EEx d version	3

Selection and Ordering Data	Order No.
SIPART PS2, PS2 PA und PS2 FF electropneumatic positioner	6 D R 5 ▢▢▢ - 0 ▢▢▢ - ▢▢ A ▢
Customer-specific design	
Without ▶	0
Instruction manual	
German/English ▶	A
French/Spanish/Italian	B
Attached gauge block assembly	
Without ▶	0
Single G¼	1
Double G¼	2
Single NPT	3
Double NPT	4

▶ Available ex stock

[1] without cable gland

7.2 Scope of delivery of standard controller

Versions	Housing	Valve	Ex-protection	Order numbers
SIPART PS2 2L without HART	Plastic housing	single action	non Ex	6DR5010-xNxxx-0AA0
	Plastic housing	double action	non Ex	6DR5020-xNxxx-0AA0
	Metal housing	single action	non Ex	6DR5011-xNxxx-0AA0
SIPART PS2 2L without HART	Plastic housing	single action	CENELEC/FM	6DR5010-xExxx-0AA0
	Plastic housing	double action	CENELEC/FM	6DR5020-xExxx-0AA0
	Metal housing	single action	CENELEC/FM	6DR5011-xExxx-0AA0
	Explosion proof housing	single action	CENELEC/FM	6DR5015-xExxx-0AA0
	Explosion proof housing	double action	CENELEC/FM	6DR5025-xExxx-0AA0
SIPART PS2 2L with HART	Plastic housing	single action	non Ex	6DR5110-xNxxx-0AA0
	Plastic housing	double action	non Ex	6DR5120-xNxxx-0AA0
	Metal housing	single action	non Ex	6DR5111-xNxxx-0AA0
SIPART PS2 4L with HART	Plastic housing	single action	CENELEC/FM	6DR5210-xExxx-0AA0
	Plastic housing	double action	CENELEC/FM	6DR5220-xExxx-0AA0
	Metal housing	single action	CENELEC/FM	6DR5211-xExxx-0AA0
	Explosion proof housing	single action	CENELEC/FM	6DR5215-xExxx-0AA0
	Explosion proof housing	double action	CENELEC/FM	6DR5225-xExxx-0AA0
SIPART PS2 4L without HART	Plastic housing	single action	non Ex	6DR5310-xNxxx-0AA0
	Plastic housing	double action	non Ex	6DR5320-xNxxx-0AA0
	Metal housing	single action	non Ex	6DR5311-xNxxx-0AA0

2L corresponds to two-wire operation
4L corresponds to four–wire-operation
–x stands for sub–variant

7.3 Scope of delivery of options

Option	Order number
SIA module non Ex	6DR4004-8G
SIA module Ex (CENELEC / FM)[1)2)]	6DR4004-6G
Alarm module non Ex	6DR4004-8A
Alarm module Ex (PTB)[1)] Alarm module Ex (FM)[2)]	6DR4004-6A 6DR4004-7A
J_y-module non Ex	6DR4004-8J
J_y-module Ex (PTB)[1)] J_y-module Ex (FM)[2)]	6DR4004-6J 6DR4004-7J

1) EC-type examination certificates
2) Approval Reports of Factory Mutual System

7.4 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 part-turn 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 not explosion protected explosion-protected cable length 6 m for part-turn actuators for linear actuators up to 14 mm	6DR4004-_ N_ _ 0 6DR4004-8N 6DR4004-6N 6DR4004-_NN 6DR4004-_N_10 6DR4004-_N_20
EMC filter module	C73451-A430-D23
External position detection system	C73451-A430-D78
Operating software SIMATIC PDM	on request

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Appendix 9

9.1 Literature and catalogs

Nr.	Title	Issue by	Order no.
/1/	Industrial Communication for Automation and Devices Catalog IK PI · 2005	Siemens AG	E86060–K6710–A101–B4–7600
/2/	Field Instruments for Process Automation Catalog FI 01 · 2005	Siemens AG	E86060–K6201–A101–A6–7600
/3/	SIMATIC PCS 7 Process Control System Catalog ST PCS 7 · 2005	Siemens AG	E86060–K4678–A111–A9–7600

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