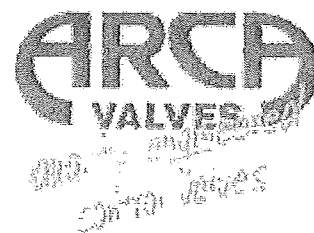
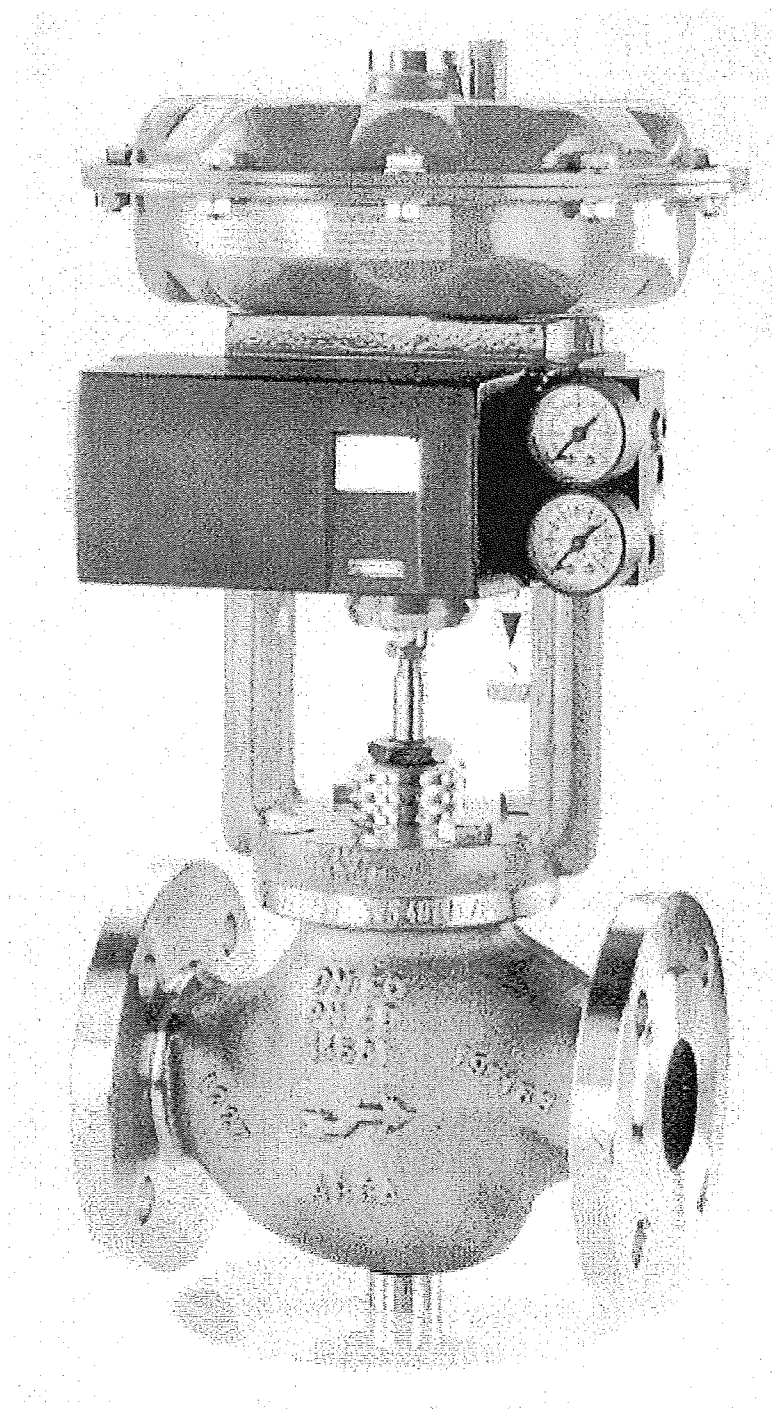


# ARCAPRO 827A.E/X\* - \*\*\* - \*\*\*



Electropneumatic Positioner for  
Linear and Rotary Valve Actuators  
Version without / with HART-Communication

## Operating Instructions



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# 1 Safety Instructions

## 1.1 Meaning of the Instructions



### **DANGER**

means that death, serious injury and/or considerable damage to property **will** occur if the corresponding preventive measures are not taken.



### **WARNING**

means that death, serious injury and/or considerable damage to property **can** occur if the corresponding preventive measures are not taken.



### **CAUTION**

with a warning triangle indicates that slight injury and/or damage to property can occur if the corresponding preventive measures are not taken.

### **CAUTION**

without a warning triangle signifies that damage to property can occur if the corresponding preventive measures are not taken.

### **ATTENTION**

indicates that some undesired event or condition can occur if the corresponding instructions are not observed.



### **NOTE**

indicates an important item of information about the product itself, how the product should be handled, or about the relevant part of the manual to which special attention should be paid.

## 1.2 Introduction

The basic steps required for assembly, connection and commissioning are described in these operating instructions.

These operating instructions do not replace the device manual for the ARCAPRO electropneumatic positioner. The device manual contains more extensive information on build standard, mode of operation and operating procedures.

The device manual can be obtained from us.

### Safe operation

This equipment has been supplied from the factory in a totally safe condition. To maintain this condition and to ensure safe operation of the equipment, the instructions and warnings in these operating instructions must be observed by the user.

### Qualified Personnel

in the context of these operating instructions are persons who are entrusted with the assembly, commissioning and operation of this product and who have the appropriate qualifications for their work activities, such as, for example:

- training or instruction or other entitlement to connect and disconnect, earth and identify electrical circuits and equipment in accordance with current technical safety standards,
- training or instruction in accordance with current technical safety standards in the maintenance and usage of appropriate safety equipment,
- training in First Aid;
- and who, in the case of devices with explosion protection, are trained, instructed or authorised to carry out work on the electrical equipment in plant subject to explosive hazard.



---

### WARNING

The device may only be assembled and commissioned by qualified personnel.

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

Electrical safety is determined entirely by the power supply devices.

High actuating forces are exerted by pneumatic actuators. To prevent injury, assembly and commissioning must be carried out whilst carefully observing the safety regulations for the actuator in use.

The necessity, when appropriate, of observing safety regulations for plant subject to explosive hazard is hereby explicitly emphasised.

---

Flawless and safe operation of this equipment presupposes proper transport, correct storage, installation and assembly as well as careful operation and maintenance.

## 2 Positioner delivery package

- Positioner in accordance with order and type key:

827A. \*\* - \* \* \* - \* \* \*

P	- for external potentiometer <sup>1)</sup>
1	- single-acting
2	- double-acting <sup>1)</sup> (apart from EEx d only plastic housings)
M	- metal housing
K	- plastic housing (not EEx d)
E	- stainless steel housing
0	- without communications
H	- HART
P	- PROFIBUS PA <sup>1)</sup>
F	- FOUNDATION FIELDBUS <sup>1)</sup>
0	- without binary outputs
B	- binary module
S	- slot initiator module
0	- without analogue output
A	- analogue module
2	- 2-wire
4	- 2/3/4-wire
E	- not explosion protected
X	- II2G EEx ia/ib IIC T6/T5/T4 <sup>2)</sup>
N	- II3G EEx nA L [L] IIC T6 <sup>1) 3)</sup>
D	- II2G EEx d IIC T6/T5/T4 <sup>1)</sup>

- Operating instructions in English

- Leaflet entitled "Operation –a short and concise description" in German and English (packed with the equipment)

<sup>1)</sup> The device type is not described in these operating instructions. Please find the specific device characteristics and technical data in the corresponding separate documentation.

<sup>2)</sup> Type 827A.X\*-A\*\*-\*\*\* only II2G EEx ia/ib IIC T4

<sup>3)</sup> Type 827A.N\*-A\*\*-\*\*\* only II3G EEx ia/ib IIC T4

## 3 Assembly

### 3.1 General



#### DANGER

The positioner and its optional modules can be supplied as separate units and in various versions. Positioners and optional modules are available for operation in potentially explosive areas and in areas that are not subject to such hazards. Each of these versions is marked by a special type plate.

When retrofitting various components, it is important to ensure that only positioners and option modules are combined that are permitted for use in the relevant area. This is of particular importance for safe operation of the positioner in areas where the atmosphere may become explosive (Zones 1 and 2). It is essential that the device categories (2 or 3) of the device itself and of its optional extras are observed here.



#### WARNING

It is essential that the following sequence is observed during assembly in order to avoid injury or mechanical damage to the positioner/mounting kit:

- |  |                                   |
|--|-----------------------------------|
| 1. Mechanically mount the positioner             | See section 3 (according to type) |
| 2. Connect the auxiliary electrical power supply | See section 5                     |
| 3. Connect the pneumatic auxiliary power         | See section 6                     |
| 4. Carry out the commissioning procedure         | See section 7                     |

It is also always necessary to ensure that water does not enter an open housing or threaded joint. This can, for instance, occur if the positioner is not immediately assembled and sealed in its final position on site.

Only dry compressed air may be used to operate the ARCAPRO. You should therefore make use of the usual water trap. In extreme cases it may even be necessary to use an additional dryer. This is of particular importance if the ARCAPRO will be operated at low ambient temperatures. In that case, please also set the purging air switch (on the valve block, above the pneumatic connections) into the "OUT" position.

For rotary actuators, use a sufficiently stable bracket (e.g. plate > 4 mm thick with reinforcements). On linear actuators, use the linear actuator mounting kit or the built-in fitting attachment.

### 3.1.1 Note on the Use of Positioners in Wet Environments

This information provides you with important notes on assembling the positioner in wet environments (frequent heavy rain and/or persistent tropical condensation) in which protection class IP 65 is no longer sufficient, in particular when there is a risk that the water might freeze.

In order to prevent water entering the device in normal operation (e.g. through the air outlet holes) or the display becoming hard to read, you should avoid the unfavourable installation positions shown in Figure 3-4.

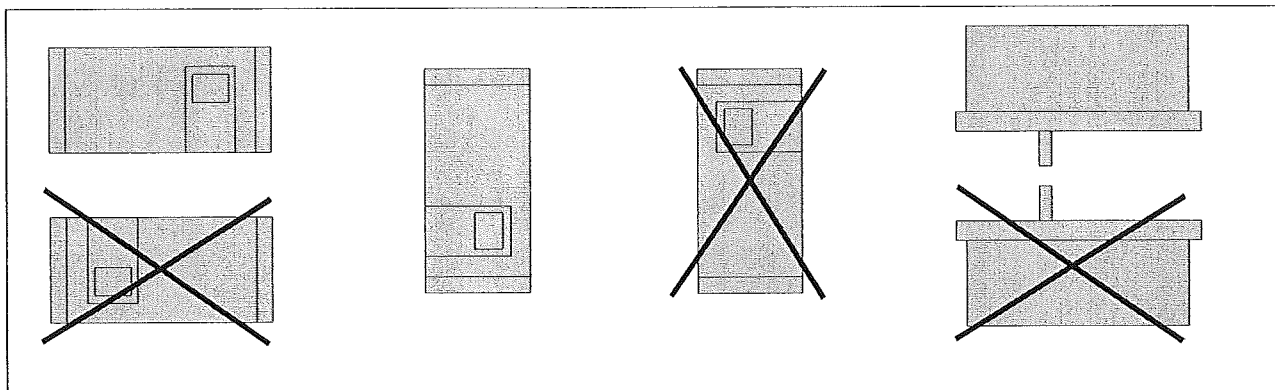


Bild 1 Favourable and unfavourable installation positions

If local conditions force you to operate the positioner in an unfavourable installation position, you can prevent the entry of water through additional measures.



#### CAUTION

Never clean the positioner with a high pressure cleaner. Protection class IP 65 is inadequate for this.

The steps necessary to prevent the entry of water depends on the installation position chosen. In certain cases you may need:

- Threaded joint with sealing rings (e.g. FESTO: CK -1 / 4-PK-6)
- Plastic hose, approx. 20 to 30 cm (e.g. FESTO: PUN- 8X1.25 SW)
- Cable ties (number and length depend on the local conditions)

#### Procedure

- Arrange the pipes in such a way that rainwater or condensation that runs along the length of the pipes can drop off before reaching the positioner's connection strip.
- Check that the seals for the electrical connections are correctly seated.
- Check that the seal of the housing cover is not damaged or soiled. Clean or replace it if necessary.
- If possible, mount the positioner in such a way that the sintered bronze silencer on the underneath of the housing is pointing downwards (vertical installation position). If this is not possible, the silencer should be replaced by a plastic hose using a suitable threaded joint.

### **Assembling the Threaded Joint with Plastic Hose**

- Unscrew the sintered bronze silencer from the exhaust air opening on the underside of the housing.
- Screw the threaded joint mentioned above into the outlet opening.
- Fit the plastic hose mentioned above to the threaded joint and check that it is tightly seated.
- Use a cable tie to fasten the plastic hose to the fittings in such a way that the opening is pointing downwards.
- Check that the hose is not kinked, and that the exhaust air can flow out easily.

### **3.1.2 Notes for the Use of Positioners Subject to High Acceleration or Vibration**

High acceleration forces occur on fittings that are heavily mechanically stressed, such as breakaway flaps, heavily shaking or vibrating valves or "steam hammer". These forces can be well outside the range specified in the technical data. In extreme cases this can result in displacement of the slip clutch.

In these cases the positioner is fitted as standard with a locking device for the slip clutch with which displacement as a result of the above-mentioned influences is inhibited.

The adjustment function is accessible beneath the black adjusting wheel of the slip clutch and recognisable on the yellow wheel with slots. The null point setting and slip clutch adjustment functions are marked with symbols on an auxiliary plate (see Figure 2).

#### **Procedure**

After the positioner has been fitted and fully set into operation, the slip clutch can be locked as follows:

1. Place a commercial screwdriver of about 4mm wide in a slot in the yellow wheel.
2. Turn the yellow wheel anti-clockwise with the screwdriver until it latches detectably. The slip clutch is thereby locked.
3. A locked slip clutch is to be recognised by an approximately 1mm wide gap between the yellow and black wheel.
4. If a null point setting is necessary, e.g. after a drive change, the locking is released by a clockwise rotation up to the stop of the yellow wheel. After the null point setting the slip clutch can be fixed again as described above.



Starting from the neutral position (as-delivered condition) the leverage ratio switch can be adjusted as follows:

1. Plug a conventional 4 mm wide screwdriver into a slot in the yellow wheel.
2. Then turn the adjustment wheel in accordance to the chosen gearing position (33° or 90°) clockwise or anti-clockwise until it snaps in audibly.
3. An adjusted fixed leverage ratio switch is recognizable from the asymmetric position of the adjustment wheel.
4. If you have to switch over the gearing, the adjustment has to be loosen by turning the adjustment wheel into neutral position first.

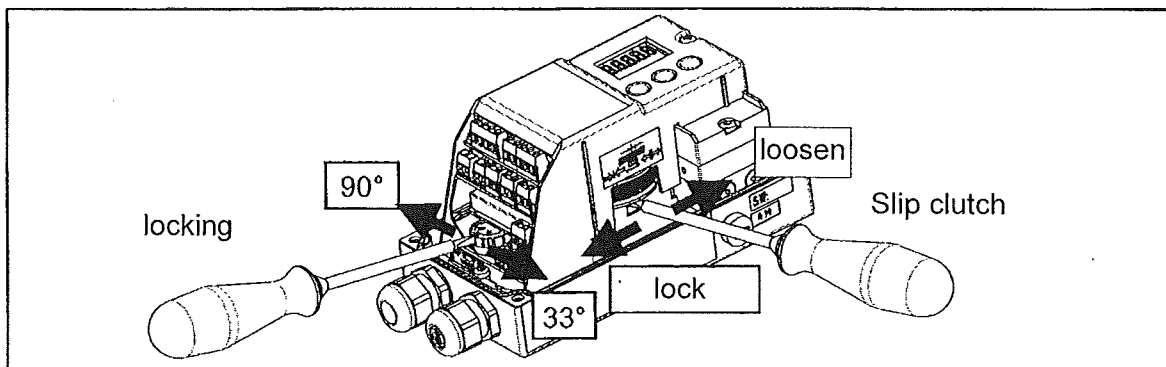


Figure 2 Locking the slip clutch and leverage ratio switch

### External Travel Acquisition

External travel acquisition is a possibility for those cases in which the measures described above are not sufficient, such as when vibration is heavy and persistent, at particularly high or low ambient temperatures, or in the presence of nuclear radiation. In this case the special positioner (see Type Key) is used at a distance from the fitting. For position measurement you can use an external potentiometer or a non-contact sensor (both available including extension kit as accessories).

The special version of the positioner should always be used for the regulation unit when, instead of the travel acquisition unit, some other potentiometer (with a resistance of 10 kΩ) mounted on the actuator is to be used.

### 3.2 Mounting Kit for "Integrated Fitting Linear Actuator"

Included with the "integrated fitting linear actuator" are (see Figure 3 for identifying numbers):

Serial no.	No. of items	Name	Note
1	1	Driver pin cpl. with roller	mounted on lever (2)
2	1	Lever	
3	2	Washer	B6.4 - DIN 125 - A2
4	1	Spring washer	A6 – DIN 137A- A2
5	1	Lock washer	A6 – DIN 127- A2
6	1	Cylinder head bolt	M6 x 25 DIN 7984 - A2
7	1	Hexagonal nut	M6 - DIN 934 - A4
8	1	Square nut	M6 - DIN 557 - A4
9	2	Cylinder head bolt	M8 x 65 - DIN 912 - A2
10	2	Lock washer	A8 - DIN 127 - A2
11	2	Screw plug	
12	1	O-ring	13 x 2.5

#### Assembly procedure (see Figure 2)

1. Adjust the pin (1) on the previously assembled lever to the value of the stroke range given on the actuator or, if this is not available as a scale value, at the next largest scale value. In case of uncertainty with regard to the real actuator stroke (pneumatic actuators often have a travel resource) you always have to choose the next large scale value. The centre of the pin must be positioned at the scale value. The same value can later be set during the commissioning under the parameter 3.YWAY, in order to display the displacement in mm after the initialisation.
2. Push the lever to the stop on the controller axis, and fix it with cylinder head screw (6).
3. Open the rear actuating pressure outlet by removing the screw (13) and the O-ring (14).
4. When fitting with spring chamber exhaust air supply open the exhaust air outlet by removing the screw (15) and the O-ring (16).
5. Seal the actuating pressure outlet with screw plug (11). When fitting with exhaust air supply remove exhaust air silencer and seal.
6. Insert the O-ring (12) in the intermediate bracket recess.
7. Locate the positioner on the actuator in such a way that the roller passes between the pins (17).
8. Align the controller horizontally at the intermediate bracket, and assemble it with the screws (9) and lock washers (10).

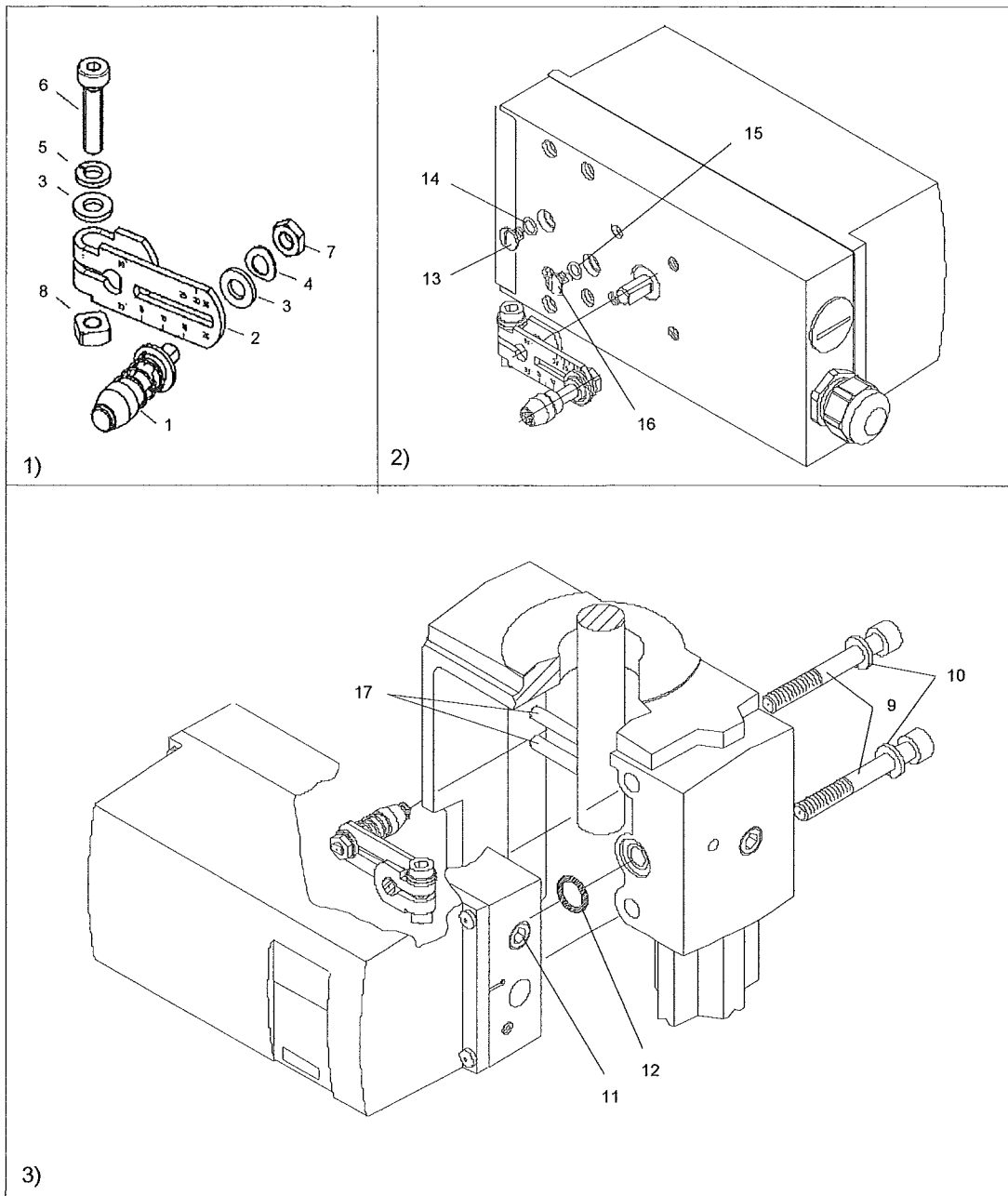


Figure 3 Assembly procedure for integrated fitting

### 3.3 "Linear Actuator IEC534" Mounting Kit

The "linear actuator IEC 534" mounting kit, stroke 3 mm to 35 mm, includes (see Figure 5 for identifying numbers):

Serial no.	No. of items	Name	Note
1	1	NAMUR fitting angle IEC 534	Standardised connecting location for fitting bracket with rib, column or flat surface
2	1	Sensing hoop	Guides the roller with the driver pin and turns the lever arm
3	2	Clamping piece	Assembly of the sensing hoop to the actuator's spindle
4	1	Driver pin cpl. with roller	Mounted on lever (5)
5	1	NAMUR lever	For stroke range 3 mm to 35 mm, or stroke range > 35 mm to 130 mm (order separately) see figure 4
6	2	U-bolts	Only for actuators with columns
7	4	Hexagonal screw	M8 x 20 DIN 933-A2
8	2	Hexagonal screw	M8 x 16 DIN 933-A2
9	6	Lock washer	A8 - DIN 127-A2
10	6	Washer	B 8.4 - DIN 125-A2
11	2	Washer	B 6.4 - DIN 125-A2
12	1	Spring washer	A6 - DIN 137A-A2
13	3	Lock washer	A6 - DIN 127-A2
14	3	Cylinder head bolt	M6 x 25 DIN 7984-A2
15	1	Hexagonal nut	M6 - DIN 934-A4
16	1	Square nut	M6 - DIN 557-A4
17	4	Hexagonal nut	M8 - DIN 934-A4

#### Assembly procedure (see Figure 5)

1. Assemble the clamping pieces (3) using the hexagonal screws (14) and lock washers (13) to the actuator spindle.
2. Push the sensing hoop (2) into the cut-outs in the clamping piece. Adjust to the required length, and tightened the screws so that it is still just possible to push the sensing handle.
3. Adjust the pin (4) on the previously assembled lever to the value of the stroke range given on the actuator or, if this is not available as a scale value, at the next largest scale value. The centre of the pin must be positioned at the scale value. The same value can later be set during the commissioning under the parameter 3.YWAY, in order to display the displacement in mm after the initialisation.
4. Push the lever to the stop on the controller axis, and fix it with cylinder head screw (14).
5. Assemble the fitting angle (1) with two hexagonal screws (8), lock washer (9) and washers (10) to the rear of the positioner. The choice of the hole row depends on the width of the actuator's intermediate bracket width. The roller should engage in the sensing hoop (2) as close to the spindle as possible, but must not touch the clamping piece.

6. Hold the positioner with the fixing angle to the actuator in such a way that the pin (4) passes inside the sensing hoop (2).
7. Tighten the sensing hoop.
8. Prepare the assembly parts in accordance with the actuator type:
  - Actuator with a rib: hexagonal bolt (7), washer (10) and lock washer (9).
  - Actuator with a flat surface: four hexagonal bolts (7) with washer (10) and lock washer (9).
  - Actuator with columns: two U-bolts (6), four hexagonal nuts (17) with washer (10) and lock washer (9).
9. Attach the positioner with the previously prepared assembly parts to the intermediate bracket.

#### NOTE



Adjust the height of the positioner so that the horizontal position of the lever is achieved as close as possible to the centre of the stroke. The actuator's lever scale provides orientation here. It is essential that the horizontal lever position is passed through within the range of the stroke.

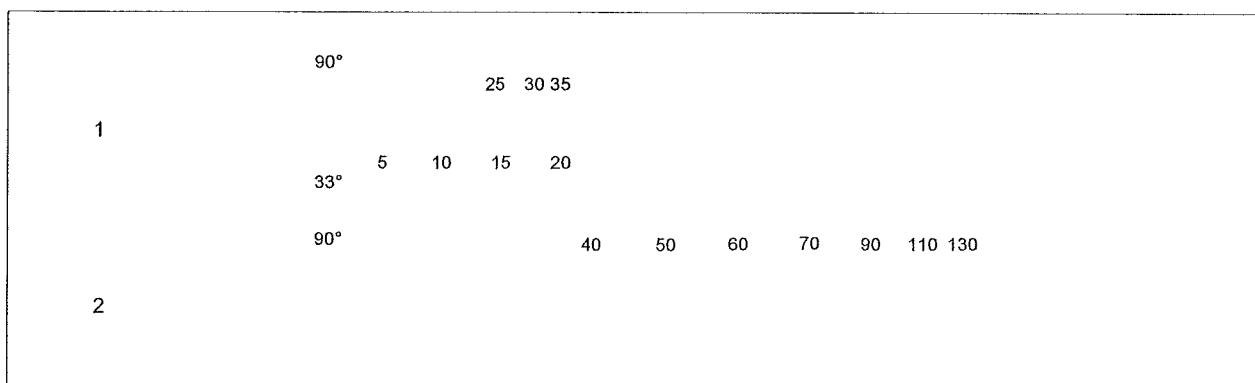


Figure 4 NAMUR lever 3 mm to 35 mm(1), NAMUR lever > 35 mm to 130 mm (2)

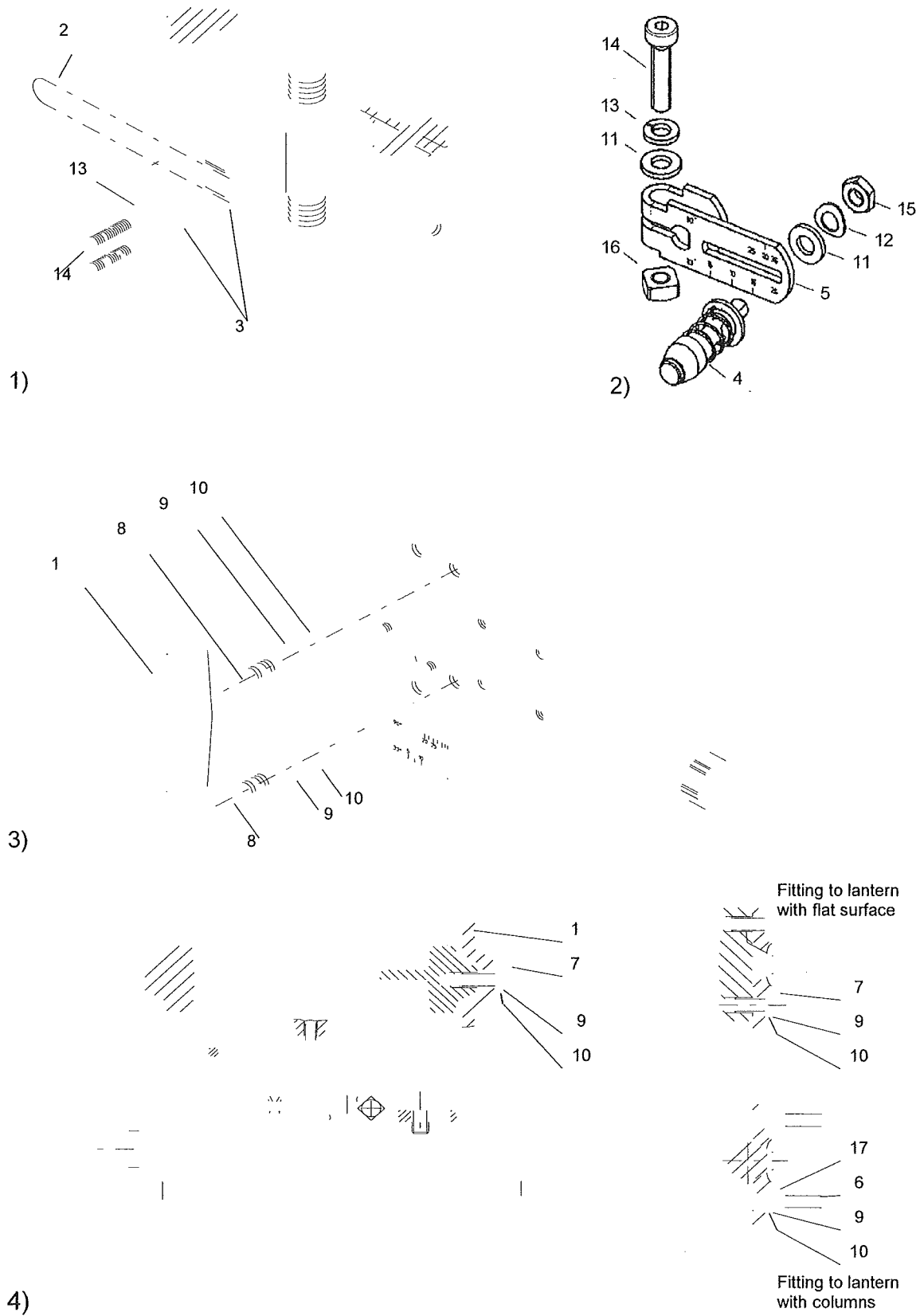


Figure 5 Assembly procedure for IEC 534 linear actuator

### 3.4 "Rotary Actuator VDI/VDE 3845" Mounting Kit

Included with the "VDI/VDE 3845 rotary actuator" mounting kit are (see Figure 6 for identifying numbers):

Serial no.	No. of items	Name	Note
2	1	Coupling wheel	Fitted to the position feedback shaft of the positioner
3	1	Driver pin	Fitted to the actuator's shaft stub
4	1	Labels	Display of the actuator position, consisting of: 4.1 and 4.2
4.1	8	Scale	Various divisions
4.2	1	Pointer	Reference point for scale
14	4	Hexagonal screw	DIN 933 - M6 x 12
15	4	Retaining washer	S6
16	1	Cylinder head bolt	DIN 84 - M6 x 12
17	1	Washer	DIN 125 – 6.4
18	1	Hexagonal socket bolt	Pre-assembled with coupling wheel
19	1	Hexagon key	For item 18

#### Assembly procedure (see Figure 6)

1. Attach the VDI/VDE 3845 fitting bracket ((9), actuator-specific, supplied by actuator manufacturer, see Figure 3-8) to the rear of the positioner, and fix it in place with the hexagonal screws (14) and retaining washers (15).
2. Stick the pointer (4.2) on the fitting bracket at the middle of the centring hole.
3. Push the coupling wheel (2) as far as it will go on the positioner axis, pull it back about 1 mm, and tighten the hexagonal socket bolt (18) with the supplied hexagonal key.
4. Place the driver pin (3) on the actuator's shaft stub and tighten it with cylinder head bolt (16) and washer (17).
5. Carefully place the positioner with the fitting bracket on the actuator so that the pin of the coupling wheel engages with the driver pin.
6. Align the positioner / fitting bracket centrally on the actuator, and screw tight (screws are not included with the supply, but are part of the actuator's fitting bracket!).
7. When commissioning according to Section 3.6 has been completed, take the actuator to its end position and stick the scale (4.1) on to the coupling wheel (2) according to the direction of rotation and the turning range. The scale is self-adhesive!

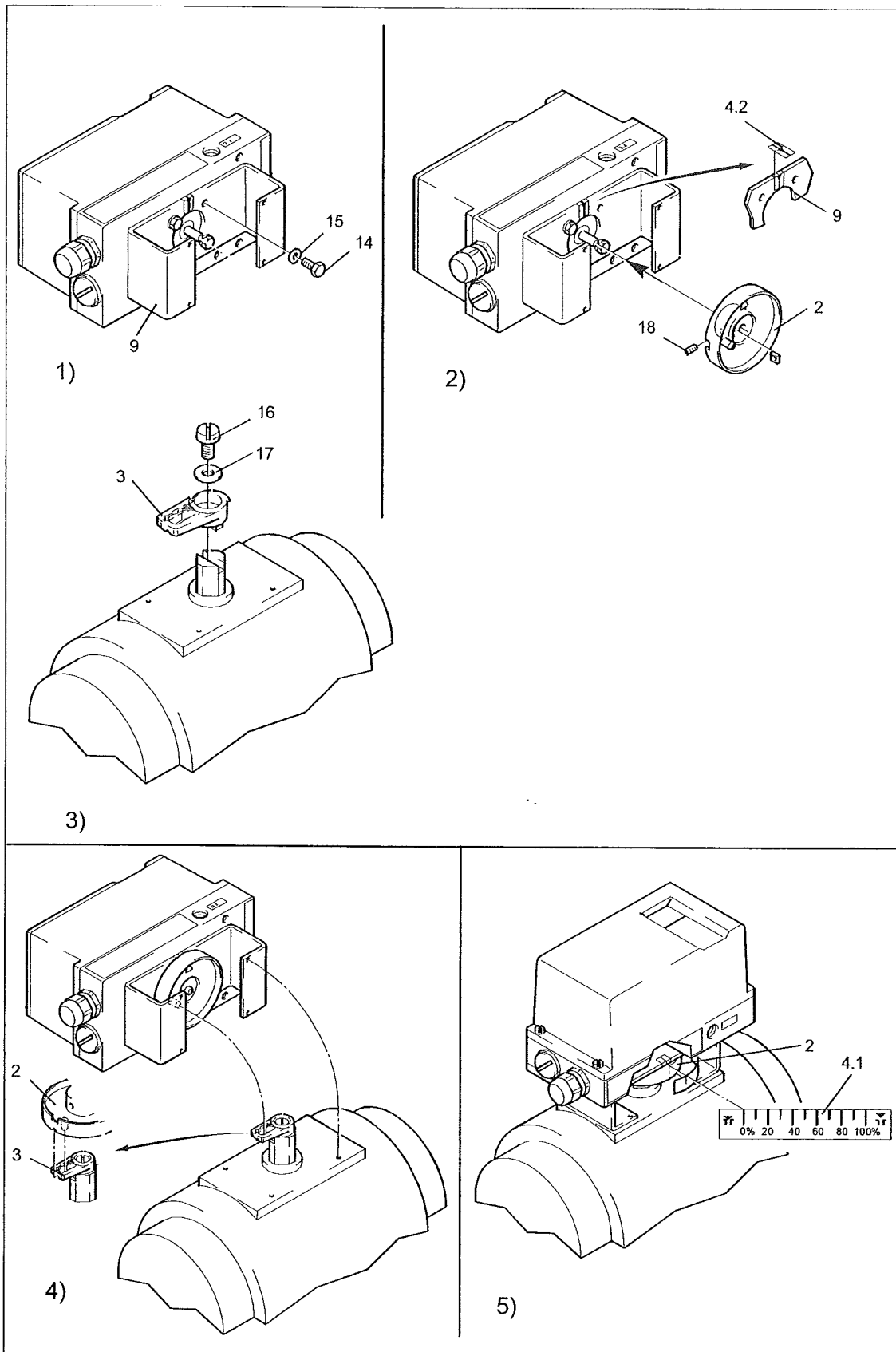


Figure 6 Assembly procedure for VDI/VDE 3845 rotary actuator



## 4 Fitting the optional modules (see Figure 7)

- Unscrew housing cover.
- Unscrew assembly cover (1).
- **Analog module:** Push the analog module (3) into the lower circuit board guides, complete electrical connection with the accompanying flat ribbon cable (6).
- **Binary module:** Push the binary module (4) into the upper circuit board guides of the container, complete electrical connection with the accompanying flat ribbon cable (5).
- **Slot Initiator Module**
  1. Remove all the electrical connections to the main electronics (2).
  2. Undo the motherboard's fastening screws (2.1).
  3. Disengage the motherboard by carefully bending the four brackets.
  4. Insert the slot initiator module (7) from above as far as the container's upper circuit board guides.
  5. Push the slot initiator module in the container's circuit board guide about 3 mm to the right.
  6. Screw the special screw (7.1) through the slot initiator module in to the positioner's axis, observing the following notes:

The pins that are pressed into the bearing of the adjusting wheel must be aligned with the special screw shortly before contact. As screwing in continues, it is then necessary for the bearing of the adjusting wheel and the special screw to be turned at the same time, so that the pins enter into the special screw.
  7. Place the insulating cover (10) over the slot initiator module on one side underneath the main electronic board's support surface at the container wall. The cut-outs in the insulating cover must engage with the corresponding ridges on the container wall. Place the insulating cover and on the slot initiator module by carefully bending the container walls.
  8. Engage in main electronic board in the four brackets, and screw it back down again with the two fastening screws (2.1).
  9. Make the electrical connections between the main electronic board and the optional modules with the enclosed ribbon cables, and between the main electronic board and the potentiometer with the potentiometer cable.
  10. Fasten the supplied assembly cover instead of the standard version, using the two screws.
  11. Select those labels from the enclosed label set that are already present on the standard version of the assembly cover. Stick the selected labels on to the fitted assembly cover in the same way as on the standard version.
  12. Make all the electrical connections.

### Adjust the two limit values:

13. Move the actuator to the first desired mechanical position.
14. Move the upper adjusting wheel (for output terminals 41-42) by hand until the output level changes.
15. Move the actuator to the second desired mechanical position.
16. Move the lower adjusting wheel (for output terminals 51-52) by hand until the output level changes.

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#### NOTE



If you continue to turn the adjusting wheel beyond the switching point until it reaches the next switching point, you can set a high/low or a low/high transition.

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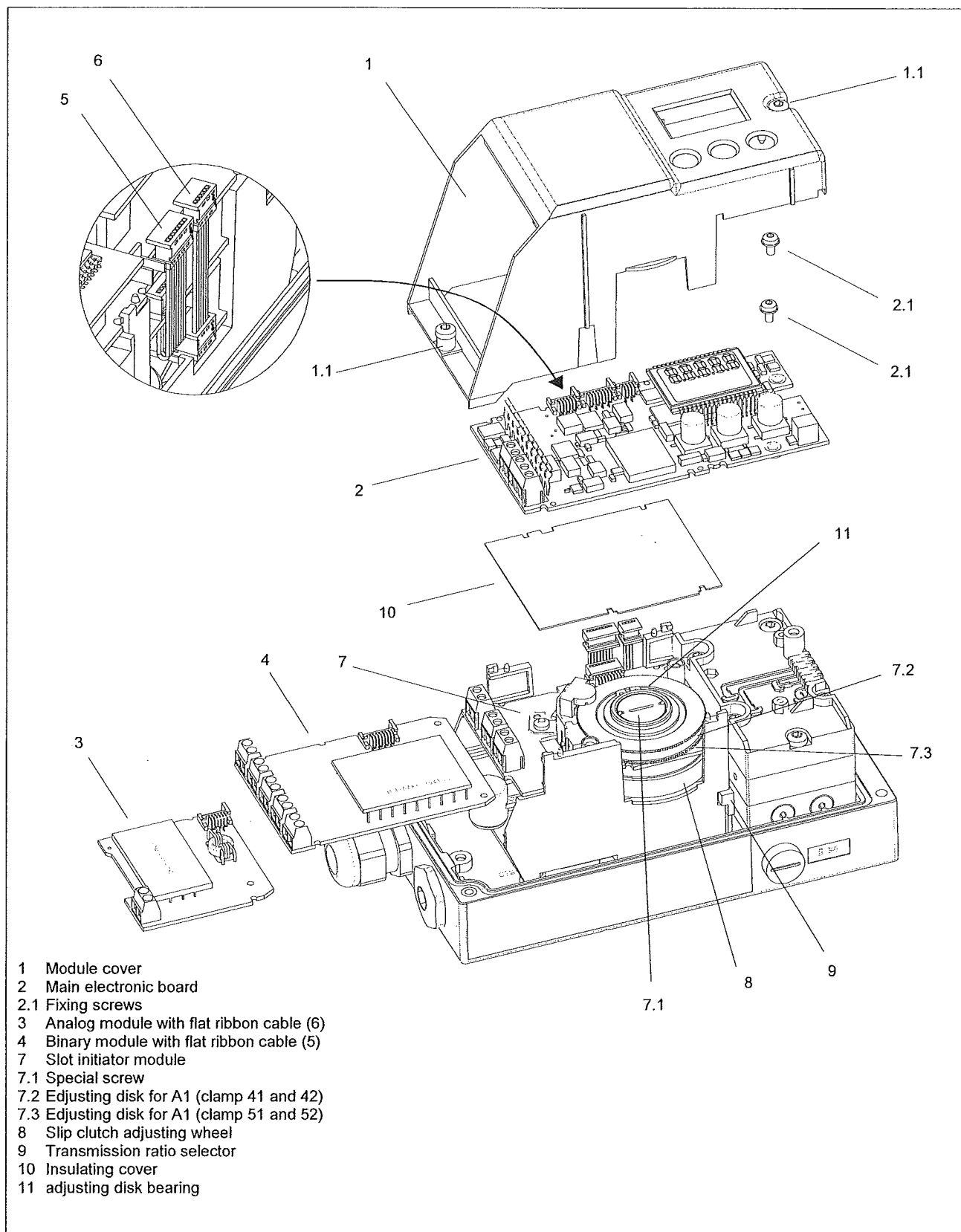


Figure 7 Fitting the option modules

## 5 Electrical Connections

Electrical connection: Screw terminals 2.5 mm<sup>2</sup>

Cable gland: M20 x 1.5

Signal range

Setpoint w: 4 to 20 mA

with 2-wire connection (see Figure 8 to 10)

0/4 to 20 mA

with 3- or 4-wire connection (see Figure 11)

Auxiliary power  $U_H$ : 18 V to 30 V



### WARNING

Observe the appropriate regulations when making the electrical installation; in potentially explosive regions, this particularly means the rules and regulations for areas of explosive hazard. In Germany, for instance these are Elex V, VDE 0165.

### ATTENTION

Never connect the current input (terminals 6 and 7) to a voltage source, otherwise the positioner can be destroyed. Always use a current source with a maximum output current of 20 mA.

Never connect the auxiliary voltage to terminal 3 for 3/4-wire connection, since this will also result in destruction of the positioner.

The plastic housing is metallised on the inside to increase electromagnetic compatibility (EMC) at high frequencies. An electrically conductive connection is made to this screen at the threaded sockets in the base plate.

Note that this protection is only effective if at least one of these sockets is joined by electrically conductive (bare metal) parts to earthed fittings.

### 5.1 Electrical connections for basic device

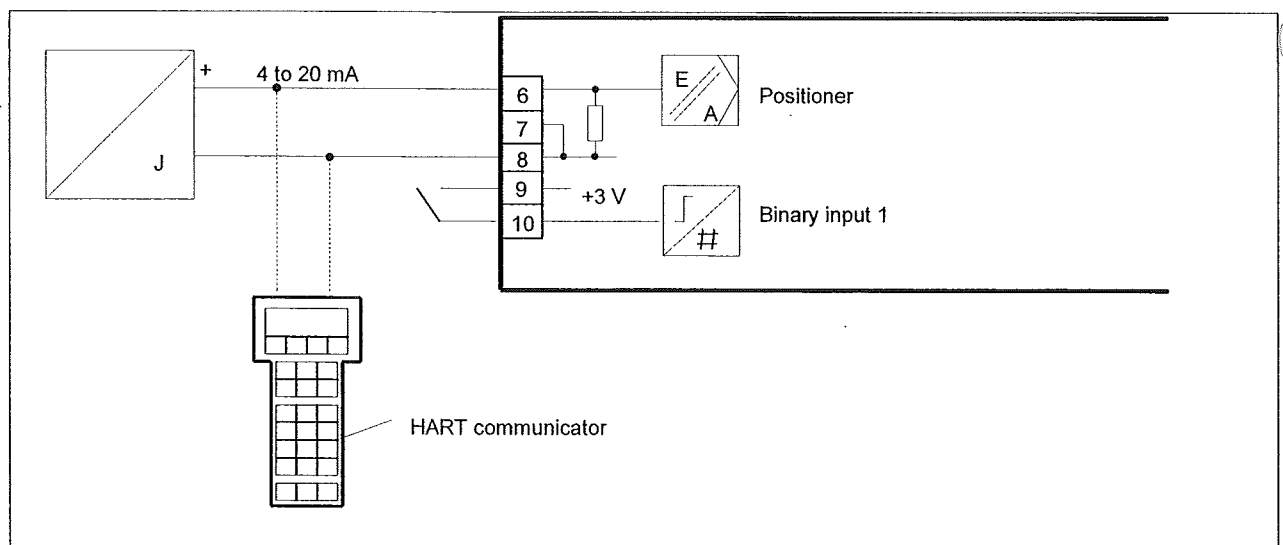


Figure 8 2-wire connection, not for explosive regions, Type 827A.E2

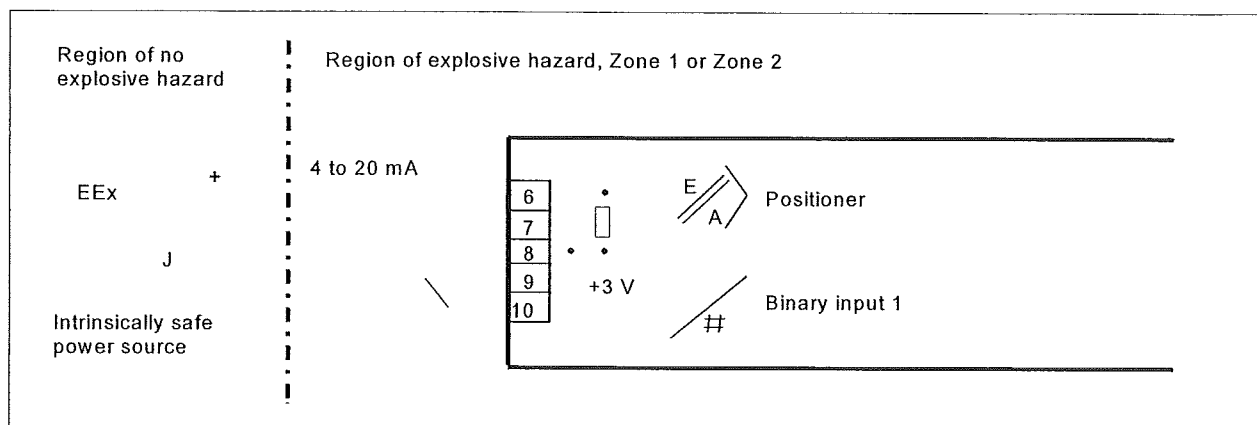


Figure 9 2-wire connection, for explosive regions, Type 827A.X2

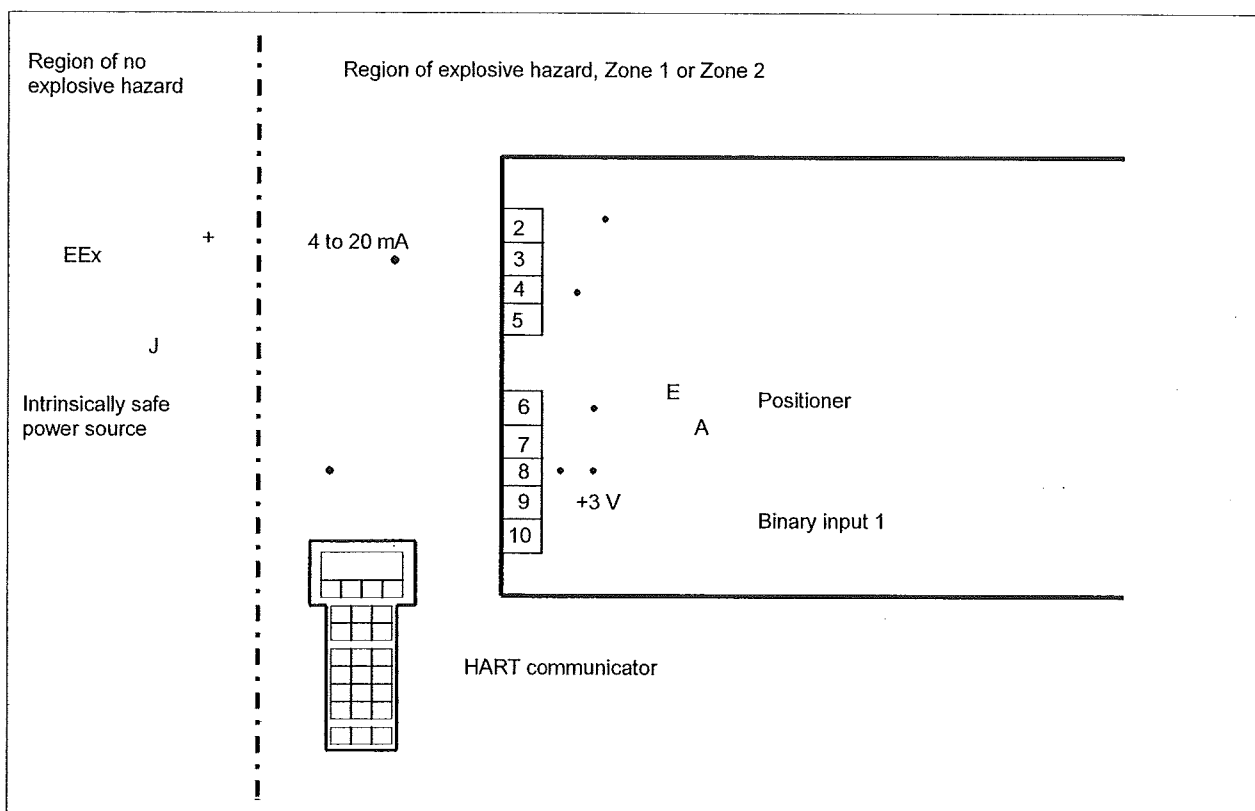


Figure 10 2-wire connection, for explosive regions, Type 827A.X4

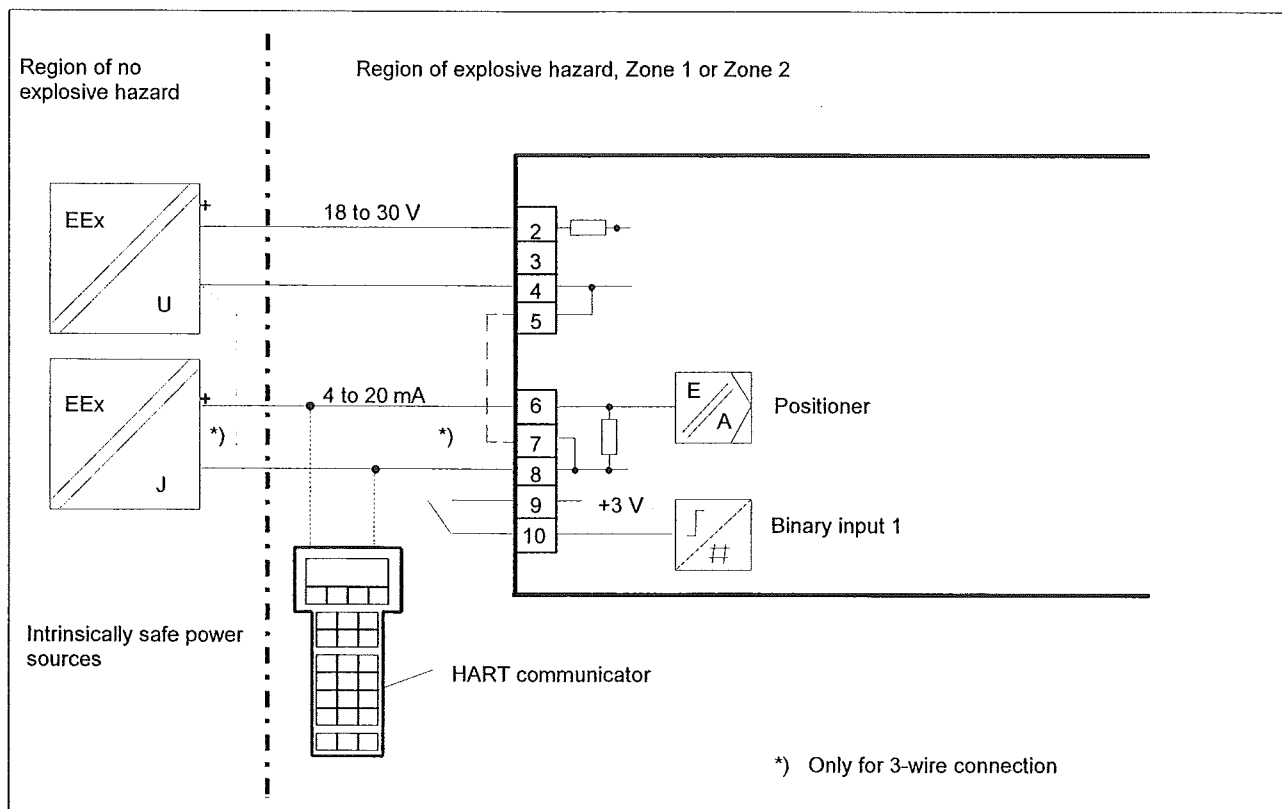


Figure 11 3/4-wire connection, for explosive regions, Type 827A.X4

## 5.2 Option Connections, Not Intrinsically Safe

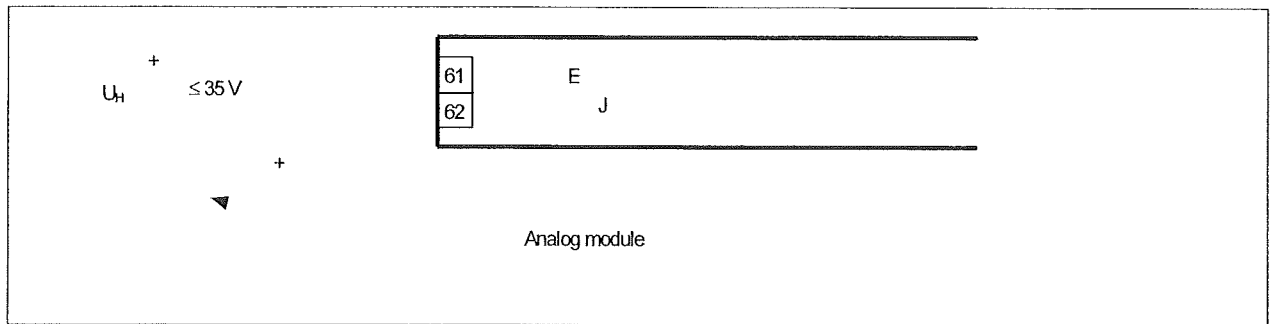


Figure 12 Analog module not for explosive regions

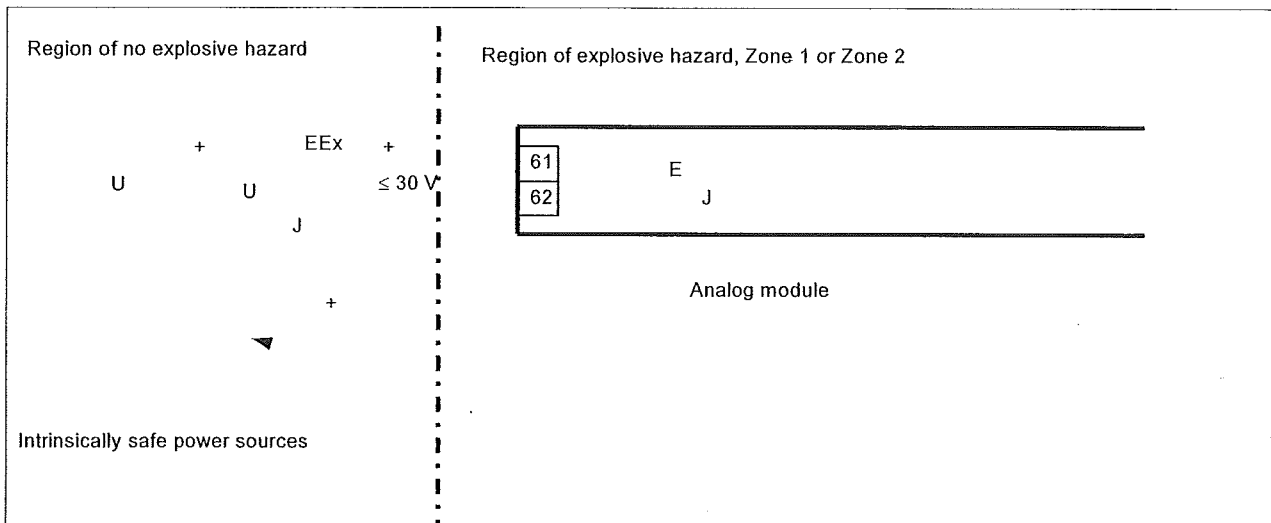


Figure 13 Analog module for explosive regions

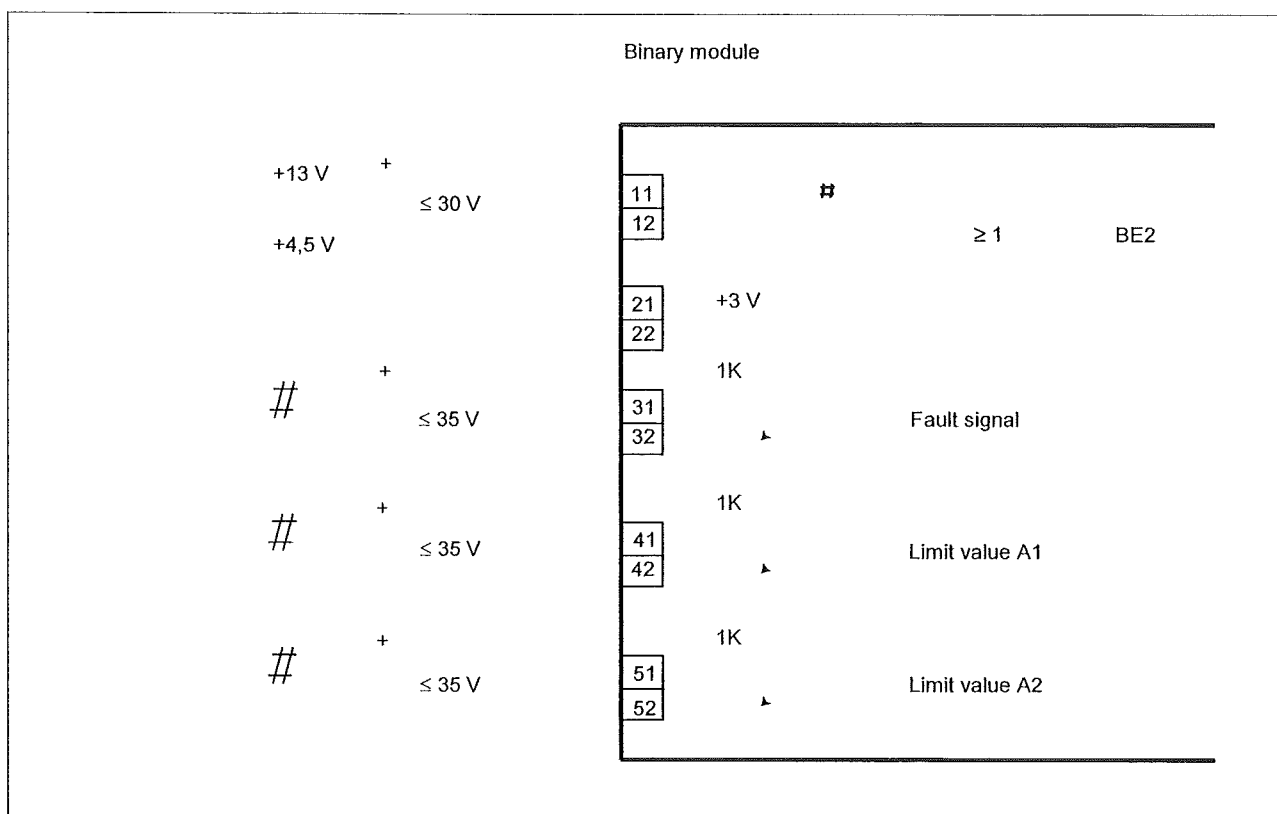


Figure 14 Binary module **not** for explosive regions

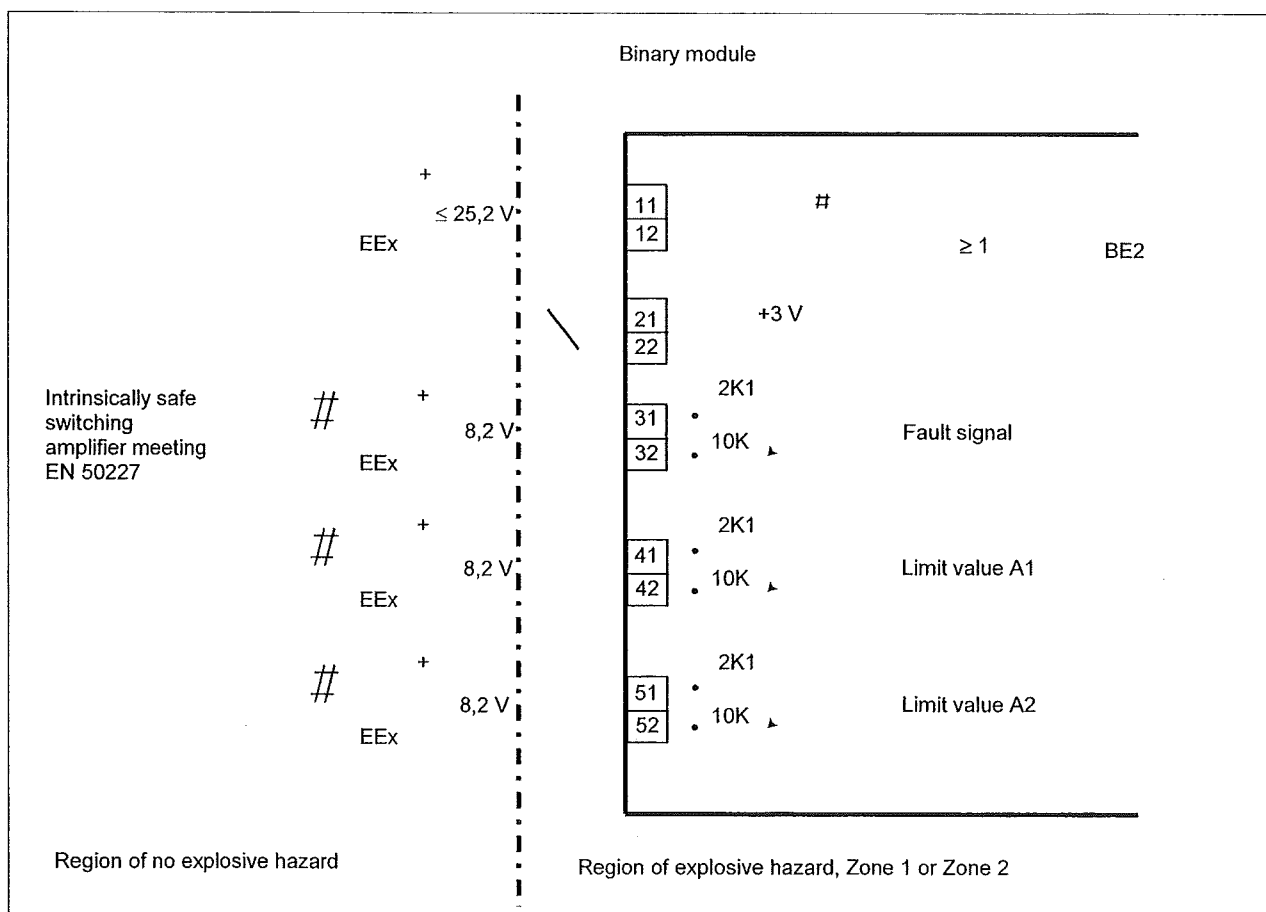


Figure 15 Binary module for explosive regions



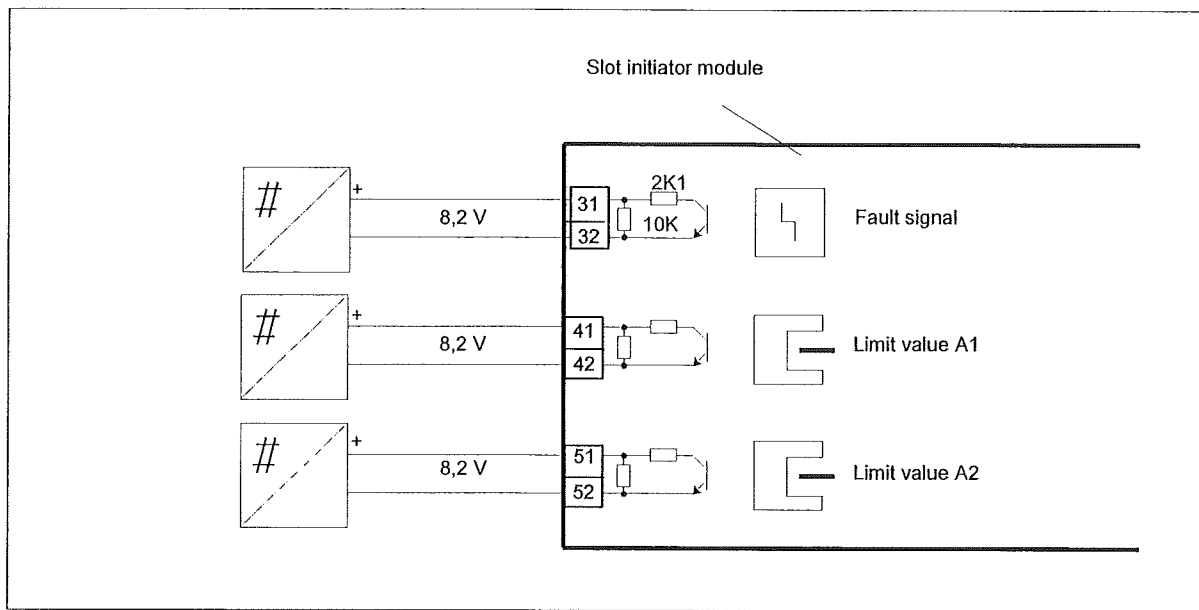


Figure 16 Slot initiator module **not** for explosive regions

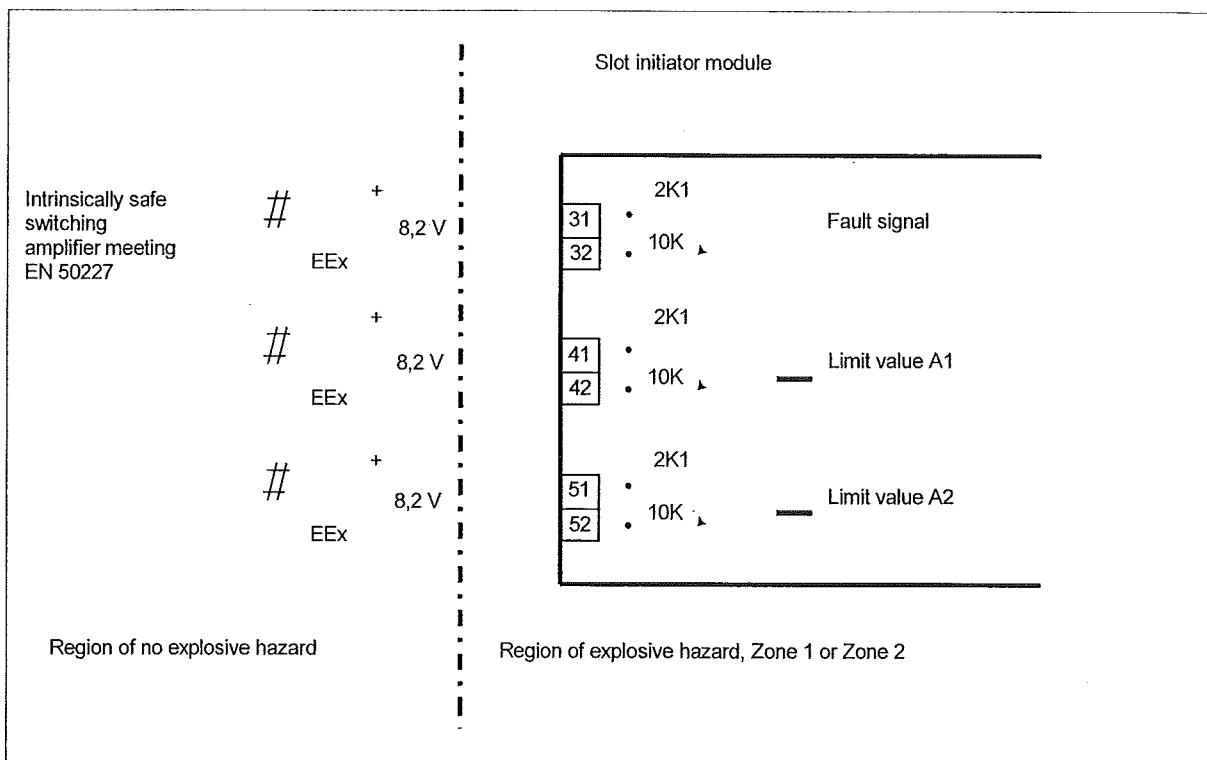


Figure 17 Slot initiator module for explosive regions

## 6 Pneumatic Connections



### WARNING

For reasons of safety, the auxiliary pneumatic energy should only be connected after assembly when, in the presence of an electrical signal, the positioner is switched to the P-manual operating level (delivery status, see leaflet "Concise operating notes").

### NOTE



Ensure correct air-quality! Oil-free, instrument quality air with no water or dust, solid material content max.  $1 \text{ mg/m}^3$  (standard atmospheric conditions), max. particle size  $1 \text{ }\mu\text{m}$ , oil content max.  $0.1 \text{ mg/m}^3$  (standard atmospheric conditions), pressurised dew point 20 K below the lowest ambient temperature.

When working on the compressed air system ensure that any contamination present such as water, oil, swarf, soldering material residues etc. are expelled by blowing out.

The pneumatic connections (G1/4) are located on the right-hand side of the positioner (Figure 18).

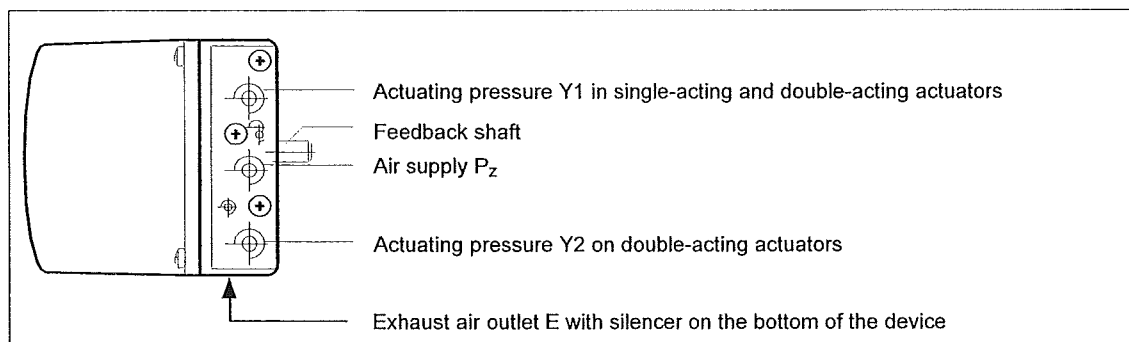


Bild 18 Pneumatic connections

In addition, the rear of the positioner has pneumatic connections for integrated fitting of single-acting linear actuators:

- actuating pressure Y1
- exhaust air outlet E

Except in cases of integrated ARCA fitting, these connections are closed by screws.

The exhaust air outlet E can be used to supply the sensing area and the spring chamber with dry, instrumentation-quality air to prevent corrosion.

### Procedure

- If appropriate, connect manometer block for air supply and actuating pressure.
- Connection via internal thread G 1/4 DIN 45141:

P <sub>Z</sub>	Air supply 1.4 to 7 bar
Y1	Actuating pressure 1 for single-acting and double-acting actuators
Y2	Actuating pressure 2 for double-acting actuators
E	Exhaust air output (remove silencer if necessary)

- Safety position at failure of auxiliary electrical power:
 

Single-acting:	Y1	Vents
Double-acting:	Y1	Max. actuating pressure (supply pressure)
	Y2	Vents
- Connect actuating pressure Y1 or Y2 (only on double-acting actuators) according to the desired safety position.
- Connect air supply to  $P_z$ .

#### NOTE



So that spring-loaded pneumatic actuators can reliably exploit the maximum possible travel, it is necessary that the supply pressure exceeds the maximum required final pressure of the actuator by a sufficient margin.

### 6.1 Purging Air Switch

The purging air switch is accessible when the housing is open above the pneumatic connection strip on the valve block (Figure 19). In the IN position the interior of the housing is flushed by very small quantities of clean, dry instrumentation-quality air. In the OUT position, the purging air is fed directly outside.

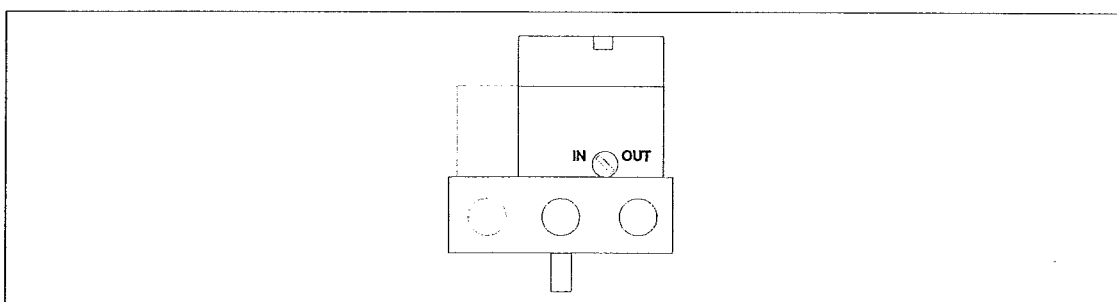


Figure 19 Purging air switch on the valve block, view of the positioner's pneumatic connections with open cover

### 6.2 Restrictors

In order to achieve floating times of  $> 1.5$  s on small actuators, it is possible to reduce the air power by means of the restrictors Y1 and Y2 (Figure 20). By turning to the right, the air power is reduced until it is completely blocked. In order to adjust the restrictors, it is recommended that they are closed and then slowly opened (see initialisation RUN3).

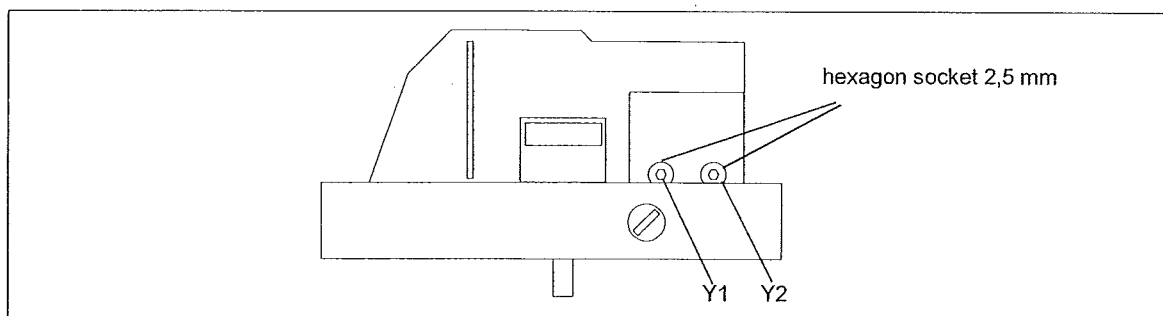


Bild 20 Restrictors

## 7 Commissioning

(see leaflet "Concise operating notes")

Because of the many ways in which it can be used, the positioner must be individually adjusted to the particular actuator (initialised) following assembly. This initialisation can be done in three different ways:

- **Automatic initialisation**

The initialisation takes place automatically. In this case, the positioner determines, one after another, the effective working direction, the travel distance or rotation angle and the actuator's adjustment times and adjusts the control parameters to match the dynamic behaviour of the actuator.

- **Manual initialisation**

The travel distance or rotation angle of the actuator can be set manually. The other parameters are automatically determined, just as in the case of automatic initialisation. This function is useful on actuators with soft end stops.

- **Copying Initialisation Data (Positioner Exchange)**



In devices with HART functionality, the initialisation data of one positioner can be read and copied into another positioner. This allows a faulty device to be exchanged, without having to interrupt a running process in order to carry out initialisation.

You only have to provide a few parameters to the positioner before initialisation. The others are pre-set in such a way that, under normal conditions, they do not have to be adjusted. If you observe the following points, you should have no problems with commissioning.

---

### NOTE



You gain access to the previous parameter by pressing the  and  buttons at the same time.

---

## 7.1 Preparations for Linear Actuators

1. Assemble the positioner with the appropriate mounting kit (see section 3).

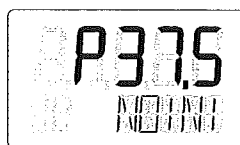
### NOTE





The position of the leverage ratio switch in the positioner is especially important.

Stroke	Lever	Position of the leverage ratio switch
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. Connect a suitable source of current or voltage.
3. Connect the actuator and the positioner to the pneumatic lines, and activate the positioner's auxiliary pneumatic power.
4. The positioner is now in the "**P-manual**" operating mode. The top line of the display now shows the current potentiometer voltage (P) in percent, e.g.: "**P37.5**", while "**NOINI**" flashes on the bottom line:



5. Check that the mechanics can move freely over the entire active range by moving the actuator with the  and  buttons as far as the end positions. The value P 5.0 may not be fallen below and P95.0 may not be exceeded. The difference of the two values must be greater than 25.0.

### NOTE




You can move the actuator quickly by pressing the other direction button while you hold the first direction button down.

6. Now move the actuator so that the lever is horizontal. The display should show a value between **P48.0** and **P52.0**. If this is not the case, make appropriate adjustments to the slip clutch. The closer you can get to the "**P50.0**" value, the more accurately the positioner can determine the travel.


### 7.1.1 Automatic Initialisation of Linear Actuators

When you can move the actuator correctly, leave it in a central position and start the automatic initialisation:

1. Hold the operating mode button  pressed for longer than 5 s. This will bring you to the configuration mode.

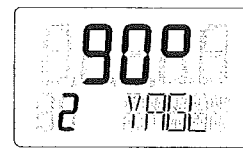
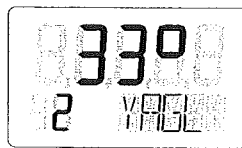
Display:



2. Switch to the second parameter by pressing the operating mode switch  briefly.

Display:


or

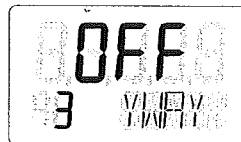


#### NOTE




It is essential that this value matches the setting of the transmission ratio selector (33° or 90°).

3. Use the operating mode switch  to move on to the following display:



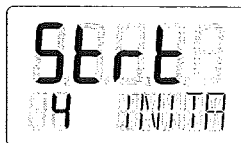
You only have to set this parameter if you want to have the total stroke determined displayed in mm at the end of the initialisation phase. To do this, you select the value in the display at which you have set the driver pin on the scale at the lever.

4. Use the operating mode switch  to move on to the following display:



5. Start the initialisation by pressing the  button for longer than 5 s.

Display:



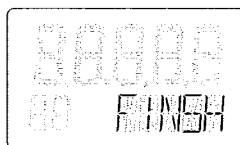
"RUN1" to "RUN5" appear in sequence in the lower display during the initialisation process.

#### NOTE

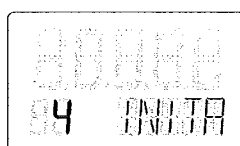



Depending on the actuator, the initialisation process can take up to 15 minutes.

The initialisation is completed when the following display appears:




The following display appears after briefly pressing the operating mode switch .



To leave the **Configuration** mode, press the operating mode switch  for longer than 5 s. The software status will be displayed after about 5 s. When the operating mode switch is released, the device will be in manual operation mode.

#### NOTE




You can interrupt a running initialisation at any time by pressing the  button. Your previous settings are still valid. Only after using preset, all parameters will be restored into factory setting.

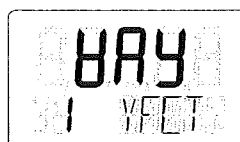
After successful initialisation slipping clutch and leverage ratio switch can be adjusted if necessary (see chapter 3.1.2).


### 7.1.2 Manual Initialisation of Linear Actuators

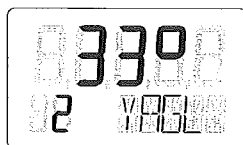
With this function the positioner can be initialised without having to move the actuator hard against the end stops. The start and end positions of the travel are set manually. When you can move the actuator correctly, leave it in a central position and start the manual initialisation: The other initialisation steps (optimisation and control parameters) are carried out in the same way as under automatic initialisation.

1. Hold the operating mode button  pressed for longer than 5 s. This will bring you to the configuration mode.

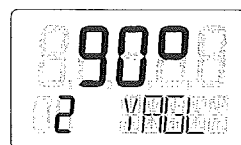
Display:



2. Switch to the second parameter by pressing the operating mode switch  briefly.  
Display:



or

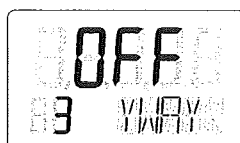


#### NOTE




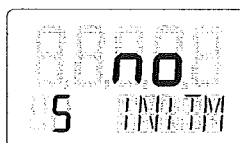
It is essential that this value matches the setting of the transmission ratio selector (33° or 90°).


3. Use the operating mode switch  to move on to the following display:

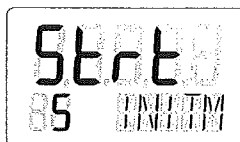


You only have to set this parameter if you want to have the total stroke determined displayed in mm at the end of the initialisation phase. To do this, you select the value in the display at which you have set the driver pin on the scale at the lever.

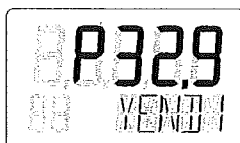
4. Press the operating mode switch  twice to move on to the following display:






5. Start the initialisation by pressing the  button for longer than 5 s.  
Display:



6. After 5 s the display changes to:



(The potentiometer settings shown here and below are only illustrative examples.)

Now use the  and  buttons to move the actuator to the position that you wish to define as the first of the two end positions. Then press the operating mode switch . This will register the current position as end position 1, and will move on to the next step.





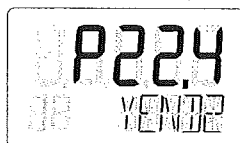
---

#### NOTE

If the message "RANGE" appears on the lower line, the selected end position is outside the permitted measurement range. There are a number of ways to correct this error:

- adjust the slip clutch until "OK" appears, then press the operating mode switch again, or
  - use the  $\triangle$  and  $\nabla$  buttons to move to a different end position, or
  - interrupt the initialisation by pressing the operating mode switch. You must then change to P-manual operation and correct the travel and the displacement accession in accordance with Step 1.
- 

7. When Step 7 has been successfully completed, the following display appears:



Now use the  $\triangle$  and  $\nabla$  buttons to move the actuator to the position that you wish to define as the second end position. Then press the operating mode switch  $\square$ . This will cause the current position to be registered as end position 2.

---



#### NOTE

If the message "RANGE" appears on the lower line, the selected end position is outside the permitted measurement range. There are a number of ways to correct this error:

- adjust the slip clutch until "OK" appears, then press the operating mode switch again, or
  - use the  $\triangle$  and  $\nabla$  buttons to move to a different end position, or
  - interrupt the initialisation by pressing the operating mode switch. You must then change to P-manual operation and correct the travel and the displacement accession in accordance with Step 1.
- 

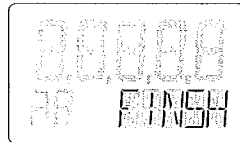


#### NOTE


If the message "Set Middl" appears, the lever arm must be moved to the horizontal position with the  $\triangle$  and  $\nabla$  buttons and then the  $\square$  button pressed. This sets the reference point of the sine correction for linear actuators.


---

8. The rest of the initialisation will now proceed automatically. "RUN1" to "RUN5" will appear in sequence on the lower line of the display. The following display appears when the initialisation has been completed successfully:



The first line also contains the stroke that has been determined, in mm, if the lever length has been given with the 3.YWAY parameter.

After briefly pressing the operating mode switch  the lower line will again show 5.INITM. You are then once more in the Configuration operating mode.

To leave the Configuration mode, press the operating mode switch  for longer than 5 seconds. The software status will be displayed after about 5 seconds. When the operating mode switch is released, the device will be in manual operation mode.

After successful initialisation slipping clutch and leverage ratio switch can be adjusted if necessary (see chapter 3.1.2).

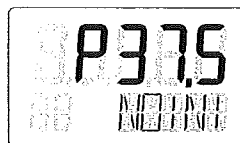
## 7.2 Preparations for Rotary Actuators





### NOTE

**Very important:** In the positioner, place the transmission ratio selector in the 90° position (the usual adjustment angle for rotary actuators).

1. Assemble the positioner with the appropriate mounting kit.
2. Connect a suitable source of current or voltage.
3. Connect the actuator and the positioner to the pneumatic lines, and activate the positioner's auxiliary pneumatic power.
4. The positioner is now in the "**P-manual**" operating mode. The top line of the display now shows the current potentiometer voltage (P) in percent, e.g.: "P37.5", while "NOINI" flashes on the bottom line:



5. Check that the mechanics can move freely over the entire active range by moving the actuator with the  and  buttons as far as the end positions. The value P 5.0 may not be fallen below and P95.0 may not be exceeded. The difference of the two values must be greater than 25.0.




### NOTE

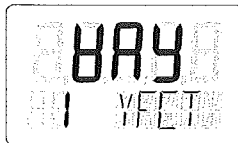
You can move the actuator quickly by pressing the other direction button while you hold the first direction button down.


### 7.2.1 Automatic Initialisation of Rotary Actuators

When you can move the actuator correctly through its range, leave it in a central position and start the automatic initialisation:

1. Hold the operating mode button  pressed for longer than 5 s. This will bring you to the configuration mode.


Display:



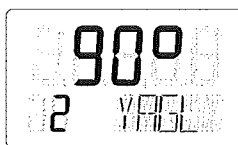
2. Use the  button to set the parameter to "turn".


Display:

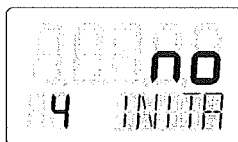


3. Switch to the second parameter by pressing the operating mode switch  briefly. This has automatically been set to 90°.

Display:

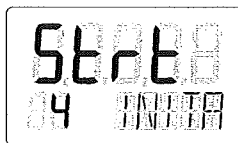


4. Use the operating mode switch  to move on to the following display:



5. Start the initialisation by pressing the  button for longer than 5 s.

Display:



"RUN1" to "RUN5" appear in sequence in the lower display during the initialisation process.

---

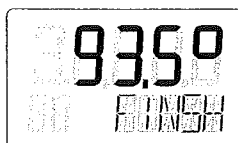
#### NOTE




Depending on the actuator, the initialisation process can take up to 15 minutes.

---

The initialisation is completed when the following display appears:




The upper value gives the actuator's full turning angle (e.g. 93.5°).

The following display appears after briefly pressing the operating mode switch :




93.50  
04 INIT

To leave the **Configuration** mode, press the operating mode switch  for longer than 5 s. The software status will be displayed after about 5 s. When the operating mode switch is released, the device will be in manual operation mode.

#### NOTE




You can interrupt a running initialisation at any time by pressing the  button. Your previous settings are still valid. Only after using preset, all parameters will be restored into factory setting.

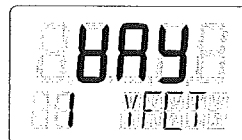
After successful initialisation slipping clutch and leverage ratio switch can be adjusted if necessary (see chapter 3.1.2).

### 7.2.2 Manual Initialisation of Rotary Actuators


With this function the positioner can be initialised without having to move the actuator hard against the end stops. The start and end positions of the travel are set manually. When you can move the actuator correctly, leave it in a central position and start the manual initialisation: The other initialisation steps (optimisation and control parameters) are carried out in the same way as under automatic initialisation.

1. Hold the operating mode button  pressed for longer than 5 s. This will bring you to the configuration mode.

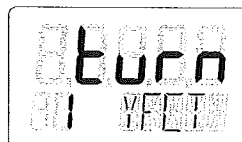
Display:




88.4  
01 YFCT

2. Use the  button to set the YFCT parameter to "turn".

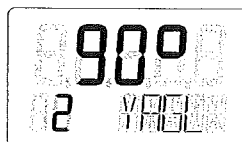
Display:



88.4  
01 YFCT

3. Switch to the second parameter by pressing the operating mode switch  briefly.

Display:




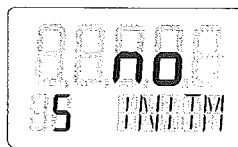
90.0  
02 YFCT

#### NOTE




Ensure that the transmission ratio selector is in the 90° position!


4. Press the operating mode switch  twice to move on to the following display:



The following steps are identical with step 5 for automatic initialisation of linear and rotary actuators.

Following successful initialisation, the pivoting range that has been determined is shown on the upper display in degrees.

After briefly pressing the operating mode switch  the lower line will again show 5.INITM. You are then once more in the Configuration operating mode.

To leave the Configuration mode, press the operating mode switch  for longer than 5 seconds. The software status will be displayed after about 5 seconds. When the operating mode switch is released, the device will be in manual operation mode.

After successful initialisation slipping clutch and leverage ratio switch can be adjusted if necessary (see chapter 3.1.2).

### 7.3 Copying Initialisation Data (Positioner Exchange)

This function provides you with a facility for commissioning a positioner without having to carry out the initialisation routine. It allows, for instance, a positioner to be exchanged on operating plant where the automatic or manual initialisation could not be carried out without interrupting the process.



#### ATTENTION

Initialisation (automatic or manual) should nevertheless be carried out as soon as possible, as that is the only way that the positioner can be optimally adjusted to match the mechanical and dynamic properties of the actuator.

The HART communication interface is used to transfer the data from the positioner needing replacement over to the substitute device.

The following steps are required to exchange a positioner:

1. The device parameters and initialisation data (determined at initialisation time) of the device needing replacement are read in and saved using SIMATIC PDM or HART Communicator. This step is not required if the device has been parameterised with SIMATIC PDM and the data already stored.
2. Fix the positioner in its current position (mechanically or pneumatically).
3. Read and note the current position value from the display of the positioner that is being replaced. If the electronics are faulty, find the current position by measurement at the actuator or valve.
4. Dismount the positioner. Fit the lever arm of the positioner to the replacement device. Mount the replacement device to the fittings. Put the transmission ratio selector in the same position as on the faulty device. Download the device data and initialisation data from the SIMATIC PDM or the handheld device.
5. If the actual value displayed does not accord with the value noted from the faulty positioner, set the correct value with the slip clutch.
6. The positioner is now ready for operation.

The accuracy and the dynamic behaviour may not be as good as they would be following a proper initialisation. In particular the position of the hard end stops and the associated servicing data may be inaccurate. An initialisation must therefore be carried out at the next opportunity.

## 7.4 Maintenance and fault removal

### 7.4.1 Maintenance

The positioner requires almost no maintenance. Filters are fitted to the pneumatic connections to protect the positioner against large particles of dirt. Dirt present in the input air can collect on the filter and then adversely affect the operation of the positioner (increased travel time). In such a case, the filters can be cleaned as follows:

#### Positioner in metal housing

1. Switch off the auxiliary pneumatic energy and disconnect the hose lines.
2. Carefully remove the metal filters from the holes and clean them (e.g. with compressed air).
3. Insert the filters.
4. Connect the hose lines again and turn on the auxiliary pneumatic power.

#### Positioner in plastic housing

##### Dismantling

1. Switch off the auxiliary pneumatic energy and disconnect the hose lines.
2. Unscrew the cover.
3. Remove the three screws from the pneumatic connection strip.
4. Remove the filters and O-rings from behind the connection strip.
5. Clean the filters (e.g. with compressed air).

##### Fitting

6. First place the filters in the recesses of the plastic housing, and then place the O-rings on top of the filters.
7. Align the pneumatic connection strip flush on the two spigots, and screw it down with the three self-tapping screws. Ensure that the existing thread tap is used again. Do this by turning the screws anti-clockwise until they can be felt to engage in the start of the thread. Only then should the screws be tightened.
8. Put on the cover and screw it down.
9. Connect the hose lines again and turn on the auxiliary pneumatic power.



---

#### DANGER

In potentially explosive environments it is essential to avoid electrostatic discharges. These could be caused, for instance, by cleaning of the positioner with a dry cloth.

---

## 7.4.2 Fault removal

### Diagnostic guide

	see Table			
<b>In which operating mode does the fault appear?</b>				
• Initialisation	1			
• Manual operation and automatic operation	2	3	4	5
<b>In what environment and under what boundary conditions does the fault appear?</b>				
• Wet environment (e.g. severe rain or constant condensation)	2			
• Vibrating (oscillating) fittings	2	5		
• Impact or shock loading (e.g. "steam hammer" or breakaway flaps)	5			
• Damp (wet) compressed air	2			
• Dirty compressed air (contaminated with solid particles)	2	3		
<b>When does the fault appear?</b>				
• Regularly (reproducible)	1	2	3	4
• Sporadically (not reproducible)	5			
• Mostly after a certain length of time of operation	2	3	5	

**Table 1**

Fault symptoms	Possible cause(s)	Remedial measures
Positioner remains in "RUN 1" mode.	<ul style="list-style-type: none"> <li>• Initialisation from end position started <u>and</u></li> <li>• Failure to wait for reaction time of max. 1 min.</li> <li>• Mains pressure not connected or too low.</li> </ul>	<ul style="list-style-type: none"> <li>• Up to 1 min waiting time is required</li> <li>• Do not start initialisation from end position</li> <li>• Check mains pressure</li> </ul>
Positioner remains in "RUN 2" mode.	<ul style="list-style-type: none"> <li>• Transmission ratio selector and Parameter 2 (YAGL) and also actual stroke are not in agreement.</li> <li>• Stroke on lever incorrectly adjusted.</li> <li>• Piezo valve(s) are not switching (see Table 2).</li> </ul>	<ul style="list-style-type: none"> <li>• Check settings: leverage ratio switch (9 in fig. 7) and parameter 2.</li> <li>• Check stroke on lever.</li> <li>• See Table 2.</li> </ul>
Positioner remains in "RUN 3" mode.	<ul style="list-style-type: none"> <li>• Actuator travel time too long</li> </ul>	<ul style="list-style-type: none"> <li>• Open restrictor completely and/or set P<sub>z</sub> pressure to highest permissible value.</li> <li>• If necessary use booster.</li> </ul>
Positioner remains in "RUN 5" mode, does not get to "FINISH" (waiting time > 5 min).	<ul style="list-style-type: none"> <li>• "Slack" (play) in the positioner – actuator – fitting</li> </ul>	<ul style="list-style-type: none"> <li>• Rotary actuator: Check that grub screw on the coupling wheel is tight.</li> <li>• Linear actuator: Check that lever on the positioner shaft is tight. Remove any other play between actuator and fitting.</li> </ul>



**Table 2**

<b>Fault symptoms</b>	<b>Possible cause(s)</b>	<b>Remedial measures</b>
<ul style="list-style-type: none"> <li>• "CPU test" flashes in the display (approx. every 2 sec).</li> <li>• Piezo valve(s) are not switching.</li> </ul>	<ul style="list-style-type: none"> <li>• Water in the valve block (caused by wet compressed air)</li> </ul>	<ul style="list-style-type: none"> <li>• In its early stages the fault can be removed by subsequent operation with dry air (if necessary in the dryer at 50 to 70°C)</li> <li>• Otherwise repair.</li> </ul>
<ul style="list-style-type: none"> <li>• Actuator will not move at all or only in one direction in both manual and automatic operating modes.</li> </ul>	<ul style="list-style-type: none"> <li>• Dampness in the valve block</li> </ul>	
<ul style="list-style-type: none"> <li>• Piezo valve(s) are not switching (also no soft "clicking" audible) if + or – key depressed in manual operating mode).</li> </ul>	<ul style="list-style-type: none"> <li>• Screw between cover and valve block not screwed tight or cover jammed.</li> </ul>	<ul style="list-style-type: none"> <li>• Tighten screw.</li> </ul>
	<ul style="list-style-type: none"> <li>• Dirt (chips, particles) in valve block</li> </ul>	<ul style="list-style-type: none"> <li>• Repair or new unit</li> </ul>
	<ul style="list-style-type: none"> <li>• Deposits on contacts between electronics board and valve block; these can occur as a result of abrasion from long-term loading caused by severe vibration.</li> </ul>	<ul style="list-style-type: none"> <li>• Clean all contact surfaces with spirit, if necessary bend valve block contact springs a little.</li> </ul>

**Table 3**

<b>Fault symptoms</b>	<b>Possible cause(s)</b>	<b>Remedial measures</b>
<ul style="list-style-type: none"> <li>• Actuator does not move</li> </ul>	<ul style="list-style-type: none"> <li>• Compressed air &lt; 1.4 bar</li> </ul>	<ul style="list-style-type: none"> <li>• Set incoming air pressure to &gt; 1.4 bar.</li> </ul>
<ul style="list-style-type: none"> <li>• Piezo valve(s) are not switching (however soft "clicking" audible) if + or – key depressed in manual operating mode).</li> </ul>	<ul style="list-style-type: none"> <li>• Restrictor valve(s) closed (screw(s) at the right-hand stop)</li> </ul>	<ul style="list-style-type: none"> <li>• Open restrictor screw(s) by turning to the left</li> </ul>
	<ul style="list-style-type: none"> <li>• Dirt in the valve block</li> </ul>	<ul style="list-style-type: none"> <li>• Repair or new unit</li> </ul>
<ul style="list-style-type: none"> <li>• In steady-state automatic operating mode (constant setpoint) and in manual operating mode one piezo valve is constantly switching.</li> </ul>	<ul style="list-style-type: none"> <li>• Pneumatic leakage in the positioner – actuator system. Begin leakage test in "RUN 3" (initialisation)!!!</li> </ul>	<ul style="list-style-type: none"> <li>• Remove source of leakage in actuator and/or feed</li> <li>• In the case where actuator is intact and feed is fully sealed: Repair or new unit</li> </ul>
	<ul style="list-style-type: none"> <li>• Dirt in the valve block (see above)</li> </ul>	<ul style="list-style-type: none"> <li>• Repair or new unit</li> </ul>

Table 4

Fault symptoms	Possible cause(s)	Remedial measures
<ul style="list-style-type: none"> <li>In steady-state automatic operating mode (constant setpoint) and in manual operating mode both piezo valves are constantly switching alternately; actuator oscillates about a mean value.</li> </ul>	<ul style="list-style-type: none"> <li>Static friction in the stuffing box of fitting or actuator too large.</li> </ul>	<ul style="list-style-type: none"> <li>Reduce static friction or increase dead zone (parameter dEbA) until the oscillating movement stops.</li> </ul>
	<ul style="list-style-type: none"> <li>Slack (play) in the positioner – actuator – fitting system</li> </ul>	<ul style="list-style-type: none"> <li>Rotary actuator: Check that grub screw on the coupling wheel is tight.</li> <li>Linear actuator: Check that lever on the positioner shaft is tight.</li> <li>Remove any other play between actuator and fitting.</li> </ul>
	<ul style="list-style-type: none"> <li>Actuator too fast</li> </ul>	<ul style="list-style-type: none"> <li>Increase travel times by means of restrictor screws.</li> <li>If fast travel time is necessary, increase dead zone (parameter DEBA) until the oscillating movement stops.</li> </ul>
<ul style="list-style-type: none"> <li>Positioner does not drive fitting up to the stop (with a 100% input signal)</li> </ul>	<ul style="list-style-type: none"> <li>Supply pressure too low</li> <li>Load voltage of the supply controller or system output is too low</li> </ul>	<ul style="list-style-type: none"> <li>Increase supply pressure</li> <li>Interpose load transformer</li> <li>Select 3/4-wire operation</li> </ul>

Table 5

Fault symptoms	Possible cause(s)	Remedial measures
<ul style="list-style-type: none"> <li>Null point moves about sporadically (&gt; 3 %).</li> </ul>	<ul style="list-style-type: none"> <li>As a result of impact or shock loading accelerations occur that are so high that the slip clutch is displaced (e.g. by "steam hammer" in steam pipework)</li> </ul>	<ul style="list-style-type: none"> <li>Remove causes of shock loading.</li> <li>Re-initialise positioner.</li> <li>Adjust slipping clutch and leverage ratio switch (see chapter 3.1.2)</li> </ul>
<ul style="list-style-type: none"> <li>Equipment functionality completely fails: also no indication in the display</li> </ul>	<ul style="list-style-type: none"> <li>Electrical auxiliary power source inadequate (&lt; 3,6 mA)</li> </ul>	<ul style="list-style-type: none"> <li>Check electrical auxiliary power source.</li> </ul>
	<ul style="list-style-type: none"> <li>With very high long-term loading caused by vibration (oscillations): <ul style="list-style-type: none"> <li>Screws on the electrical connecting terminals can work loose.</li> <li>Electrical connecting terminals and/or electronic components can be shaken loose.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Tighten screws and secure with sealant.</li> <li>Repair</li> <li>As a preventative measure mount positioner on rubber-metal mounts.</li> </ul>

## 7.5 Parametrisation Table

Parameter (code)	Symbol	Parameter	Parameter values	Unit	Factor (code)	Conversion factor
1) 1001	1 WET	Type of material	Material for 1001		Way	
2) 1002	2 WET	Material for 1002	Material for 1002		Way	
3) 1003	3 WET	Material for 1003	Material for 1003		Way	
4) 1004	4 WET	Material for 1004	Material for 1004		Way	
5) 1005	5 WET	Material for 1005	Material for 1005		Way	
6) 1006	6 WET	Material for 1006	Material for 1006		Way	
7) 1007	7 WET	Material for 1007	Material for 1007		Way	
8) 1008	8 WET	Material for 1008	Material for 1008		Way	
9) 1009	9 WET	Material for 1009	Material for 1009		Way	
10) 1010	10 WET	Material for 1010	Material for 1010		Way	
11) 1011	11 WET	Material for 1011	Material for 1011		Way	
12) 1012	12 WET	Material for 1012	Material for 1012		Way	
13) 1013	13 WET	Material for 1013	Material for 1013		Way	
14) 1014	14 WET	Material for 1014	Material for 1014		Way	
15) 1015	15 WET	Material for 1015	Material for 1015		Way	
16) 1016	16 WET	Material for 1016	Material for 1016		Way	
17) 1017	17 WET	Material for 1017	Material for 1017		Way	
18) 1018	18 WET	Material for 1018	Material for 1018		Way	
19) 1019	19 WET	Material for 1019	Material for 1019		Way	
20) 1020	20 WET	Material for 1020	Material for 1020		Way	
21) 1021	21 WET	Material for 1021	Material for 1021		Way	
22) 1022	22 WET	Material for 1022	Material for 1022		Way	
23) 1023	23 WET	Material for 1023	Material for 1023		Way	
24) 1024	24 WET	Material for 1024	Material for 1024		Way	
25) 1025	25 WET	Material for 1025	Material for 1025		Way	
26) 1026	26 WET	Material for 1026	Material for 1026		Way	
27) 1027	27 WET	Material for 1027	Material for 1027		Way	
28) 1028	28 WET	Material for 1028	Material for 1028		Way	
29) 1029	29 WET	Material for 1029	Material for 1029		Way	
30) 1030	30 WET	Material for 1030	Material for 1030		Way	
31) 1031	31 WET	Material for 1031	Material for 1031		Way	
32) 1032	32 WET	Material for 1032	Material for 1032		Way	
33) 1033	33 WET	Material for 1033	Material for 1033		Way	
34) 1034	34 WET	Material for 1034	Material for 1034		Way	
35) 1035	35 WET	Material for 1035	Material for 1035		Way	
36) 1036	36 WET	Material for 1036	Material for 1036		Way	
37) 1037	37 WET	Material for 1037	Material for 1037		Way	
38) 1038	38 WET	Material for 1038	Material for 1038		Way	
39) 1039	39 WET	Material for 1039	Material for 1039		Way	
40) 1040	40 WET	Material for 1040	Material for 1040		Way	
41) 1041	41 WET	Material for 1041	Material for 1041		Way	
42) 1042	42 WET	Material for 1042	Material for 1042		Way	
43) 1043	43 WET	Material for 1043	Material for 1043		Way	
44) 1044	44 WET	Material for 1044	Material for 1044		Way	
45) 1045	45 WET	Material for 1045	Material for 1045		Way	
46) 1046	46 WET	Material for 1046	Material for 1046		Way	
47) 1047	47 WET	Material for 1047	Material for 1047		Way	
48) 1048	48 WET	Material for 1048	Material for 1048		Way	
49) 1049	49 WET	Material for 1049	Material for 1049		Way	
50) 1050	50 WET	Material for 1050	Material for 1050		Way	
51) 1051	51 WET	Material for 1051	Material for 1051		Way	
52) 1052	52 WET	Material for 1052	Material for 1052		Way	
53) 1053	53 WET	Material for 1053	Material for 1053		Way	
54) 1054	54 WET	Material for 1054	Material for 1054		Way	
55) 1055	55 WET	Material for 1055	Material for 1055		Way	

112-1000 is missing. per record for 112-1000  
 212-1000 is not for 112-1000. It is for 112-1000.  
 312-1000 is not for 112-1000. It is for 112-1000.

[illegible]

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