Electropneumatic Positioner
Type 763
Type 3763

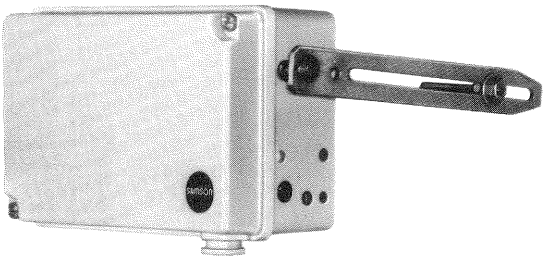


Fig. 1 · Type 763

1. Assembly and method of operation

The electropneumatic positioner produces the preselected relationship between valve stem position (controlled variable) and controller output signal (signal input). The positioner Type 3763 is, contrary to Type 763 suitable for application in hazardous areas (type of protection EEx ib IIC); see Appendix for Certificate of Conformity and also SEV certification 93.100906.02.

The positioner consists of an electropneumatic converter unit E and the pneumatic part P with lever (1), shaft (2) and measuring spring (3), and the control system with nozzle (7), flapper (6) and amplifier (8).

Edition September 1993

Mounting and operating instruction

EB 8353 E

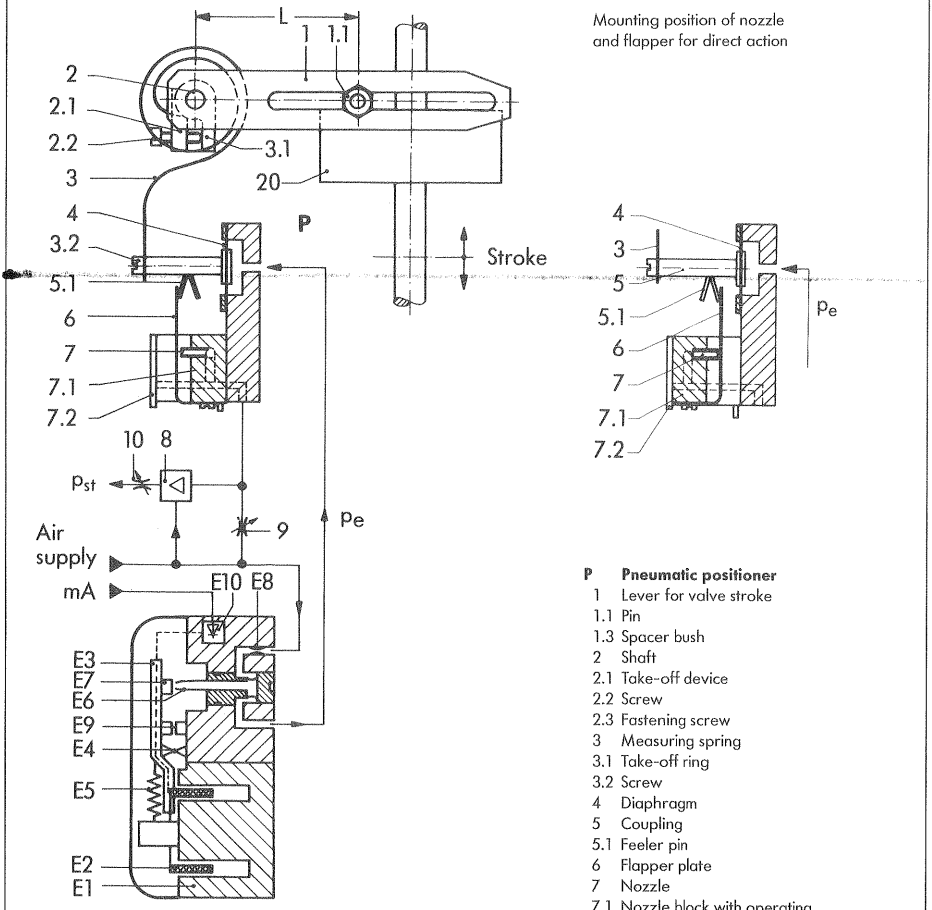


Fig. 2 · Functional diagram

P Pneumatic positioner

1 Lever for valve stroke
1.1 Pin
1.3 Spacer bush
2 Shaft
2.1 Take-off device
2.2 Screw
2.3 Fastening screw
3 Measuring spring
3.1 Take-off ring
3.2 Screw
4 Diaphragm
5 Coupling
5.1 Feeler pin
6 Flapper plate
7 Nozzle
7.1 Nozzle block with operating direction symbol
7.2 Cover plate
8 Amplifier
9 X_p-adjustment (gain)
10 Volume adjustment
11 Mounting screw
20 Plate for attachment to the actuator or plug stem of the control valve

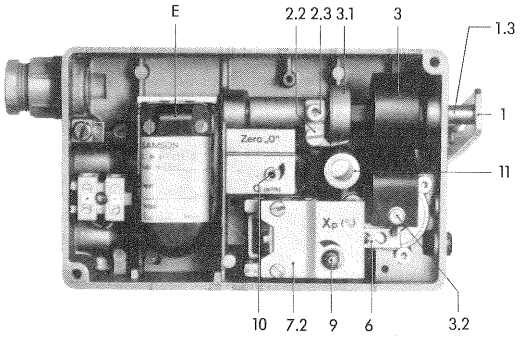


Fig. 3 · Interior view

E i/p converter

E1 Permanent magnet
E2 Coil
E3 Beam
E4 Cross spring pivot
E5 Spring
E6 Nozzle
E7 Flapper
E8 Restriction
E9 Damping
E10 Prot. diodes

The d.c. control signal i (4 to 20 mA or 0 to 20 mA) is supplied by the controller and fed to the coil (E2) in the field of the permanent magnet (E1). At the beam (E3) the force of the coil, which is proportional to the current i, is balanced to the force of the air pressure p_e produced at the flapper (E7).

The air pressure p_e supplied to the control system varies proportionally with the current signal.

The air pressure p_e in turn produces a positioning force at the measuring diaphragm (4), which is compared to the force of the measuring spring (3).

The motion of the measuring diaphragm (4) is transmitted to the flapper by the feeler pin (5.1), and the nozzle (7) is activated. Changes in the control signal p_e or in the valve stem position produce a pressure change in the amplifier (8) downstream of the nozzle, and the signal pressure p_{st} supplied by the amplifier causes the plug stem to assume a position corresponding to the input signal.

The adjustable volume adjustment (10) and X_p adjustment (9) are used for optimization of the position-control-loop.

The measuring spring (3) fits the nominal valve travel and the nominal span of the input signal and can be exchanged.

1.1 Technical Data

Positioner	Measuring spring		1	2		3**
Controlled variable (valve travel)* mm	Standard version	Nominal travel	15	30	15	3
		Lever I	8 to 20	14 to 36	8 to 20	14 to 36
	Special version	Nominal travel	20	30 - 50	20	30 - 50
		Lever II	14 to 26	26 to 50	14 to 26	26 to 50
Input-signal w	Signal span * [1]	mA	16 (20)	16 (20)	8 (10)	8 (10)
	Signal range [1]	mA	4...20 (0...20)	4...20 (0...20)	4...12 (0...10) to 12...20 (10...20)	
	Coil resistance R: at 20 °C [3]	approx.	Type 763: 200 Ω ±7,5% for R_t		Type 3.763: 200 Ω ±7,5% for R_t	effect. inductivity ≈0 mH
	Input circuit	Ex	Type 763: –		Type 3.763: intrinsic safety [2]	
Supply			Supply air from 1.4 to 6 bar or 20 to 90 psi			
Output pressure p_{st}			0 to 6 bar or 0 to 90 psi maximum			
Characteristic			Linear characteristic of input and output. Terminal based non-conformity: less than 1.5%			
Hysteresis			<0.5%			
Dead band			<0.1%			
Operating direction			See Figs. 7 to 10			
Proportional band X_p			0.7 to 6% (proportional action factor K_p: 143 to 17			
			with supply of 1.4 bar		with supply of 6 bar	
Steady-state air consumption			0.15 m_n^3/h		0.5 m_n^3/h	
Air delivery			2.5 m_n^3/h		7 m_n^3/h	
Permissible ambient temperature:			– 20 to + 80 °C [2]			
Effects			Supply 0.3%/0.1 bar – Temperature 0.03%/°C			
Degree of protection			according to IP 54			
Weight		approx. kg	without gauge: 1.2; with gauge: 1.4			

* On request for other valve travels and signal spans.

1) Values in brackets for versions for signal range 0...20 mA

2) Input circuit in type of protection "intrinsically safe EEx ib IIC", details (also permissible temperatures, capacity and inductivity) see PTB-certificate

3) Coil material Cu, T_K = 4%/10 K

Important: The positioners are delivered as version for 4...20 mA or 0...20 mA input signal (see name plate). Subsequent change is only possible by exchanging the whole i/p converter unit E.

2. Mounting

For mounting the positioner on valves of the cast-metal yoke type mounting hardware, product number 1400-5745, is used. For valves with spacer rods (stud bolts) additionally the mounting hardware kit, product number 1400-5342 is required.

Prior to mounting the positioner, the relationship between positioner and actuator shall be established, because the positioner can be mounted on the right side or left side of the valve. The applicable Figs. 7 to 10 in section 4 shall be observed.

2.1 Mounting on valve with cast-metal yoke (Fig. 4)

Screw the plate (20) to the coupling clamp (22) or to the valve by means of the screws (21). Unscrew the cover of the positioner and fasten the equipment to the yoke of the valve by means of the fastening screws (11).

2.2 Mounting on valve with spacing rods

Screw plate (20) with screw (21) in off-centre position on the travel indicator (24) of the valve stem (23).

Place the mount (28) and the clamp (26) onto the rod and shift it until the plate centre (20) and mount hold are in alignment at half valve travel. Mount the positioner with mounting screw (11) to the mount.

2.3 Casing cover

When the positioner has been attached, care shall be taken to see that, with the valve in the installed position, the vent plug in the casing cover faces downward.

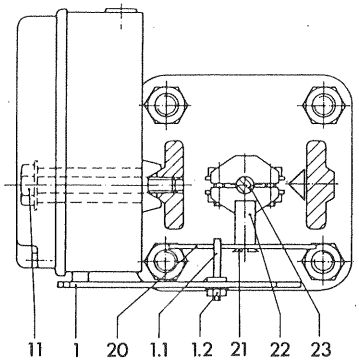


Fig. 4 · Mounting on valve with cast-metal yoke (e.g. Series 240)

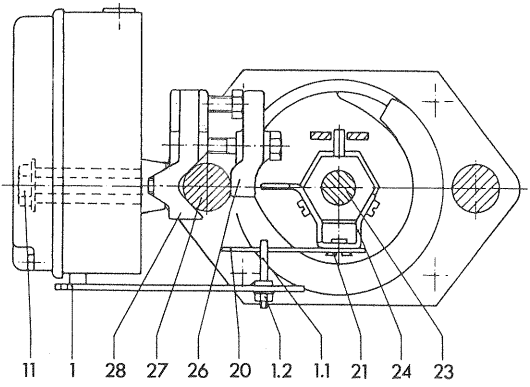


Fig. 5 · Mounting on valve with spacing rods

1 Lever
1.1 Pin
1.2 Nut
11 Fastening screw
20 Plate
21 Screw
22 Coupling (Clamp)
23 Plug stem
24 Travel indicator
26 Clamp
27 Valve spacing rod (stud bolt)
28 Mount

3. Connection

3.1 Air connection

The air connections are holes with NPT 1/4 thread (special version ISO G 1/4). The conventional screw joints for metallic pipe or plastic hoses can be used. Prior to connection, the air pipes shall be blown through thoroughly. The signal pressure (output) shall be connected to the actuator top or bottom side as shown in Figs. 6 through 9.

Important: The supply pressure should be set to 0.4 bar above the end value of output pressure range p_{st} of actuator (see serial plate of actuator)

3.2 Electrical connection

⚠ As far as the electrical installation of the instruments is concerned, the relevant VDE **regulations** and the accident prevention regulations of the employers' liability insurance association must be observed.

For installation in hazardous areas, the respective national regulations of the country in which the instrument is to be used must be observed. In Germany, this is VDE 0165.

For connection of the instrinsically safe circuits, the data stipulated in the certificate of conformity applies.

The wires for the input-signal i shall be connected through a PG 13.5 gland to the terminals + and – in the housing; connection to frame is outside or inside the housing.

PG 13.5 Plastic-Conduit for CSA approval instruments:

For the approved intrinsically safe electrical units – CSA # LR54227 – installed in **Division 1** the PG 13.5 (Plastic) conduits can be used. The installation must be camèd out according to the guidelines in the individual installation-and operation manuals. When installed in **Division 2**, the metal conduits must be with a "strain relief" if the units are installed in an non-intrinsically safe loop. In this case it is **not** allowed to use the blue plastic conduits!

4. Operation

4.1 Relationship between positioner and actuator

The relationship of actuator, signal range, operating direction and mounting position is shown in Figs. 6 through 9.
Every subsequent alteration such as, for instance, reversal of the operating direction of the position control loop or changing the actuator operation from "spring closes" to "spring opens" or vice versa also requires changing the mounting position of the positioner.

4.1.1 Setting and changing the operating direction (Figs. 6 through 9 and Fig. 10)

With increasing input signal i, the signal pressure p_{st} may be increasing (direct action >>) or decreasing (reverse action <>). The same applies to a decreasing input signal i: direct action >> results in a decreasing signal pressure; reverse action <> results in an increasing signal pressure. The marks on the pin of the nozzle support (7.1) indicate the operating direction.
If the operating direction required by the function (Figs. 6 through 9) does not coincide with the visible symbol or if the operating direction is to be changed, proceed as follows:
Remove screws (7.3) from the cover plate whilst holding the nozzle block. Take off the cover plate. Turn nozzle block (7.1) by 180°. Reinstall it with cover plate, and secure it with screws. Make sure that the nozzle block with flapper is installed properly, i.e. that the flapper is located on the right side of the feeler pin of the coupling, as shown in Fig. 10.
If the operating direction is to be changed after it has been set, the positioner must be fastened on the other side of the valve; the position of the lever (1) and plate (20) shall be observed (Figs. 6 through 9).

4.2 Start of operation and signal range

When the positioner is adjusted, the travel must be adapted to the electric signal and vice versa. With an electric signal of 4...20 mA, for example, the travel also must pass the entire range 0...100% (Fig. 12).
The start of operation is defined with regard to the closed position. According to the version of the actuator (FA or FE) and operating direction of the positioner (> > or < >), it can be represented by the lower or the upper range value (4 e.g. 20 mA) of the electric signal.
The travel of the control valve is determined by the range of the electric signal and thus by the upper range value. With split-range operation (Fig. 13), the control valves operate with smaller electric signals. The controller signal used for controlling two control valves is divided such that the valves pass the complete travel range at half an input signal each (e.g. first control valve adjusted to 12...20 mA and second valve to 12...4 mA). To avoid interference, take into account a dead band of ± 0.5 mA according to Fig. 13.

The start of operation is set with the zero adjustment screw (2.1) and the span (and thus the end value) is set by adjustment of the pin (1.1).

For detailled adjustment procedure see section 4.3.
Connect the terminals for the input signal to a suitable d.c. current source.

Turn on the air supply.

Note:

If the positioner is set by a computer whose signal is restricted to 4...20 mA, it is recommended to adjust the positioner to a range of 5...20 mA. Only this way ensures that with a computer signal of 4 mA the valve is completely closed.

In the case of reversed operating direction (< >) accordingly adjust the range to 4...19 mA.

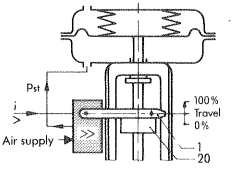


Fig. 6 · "Actuator: actuator stem extends FA"
Left hand mounting, operating direction >>

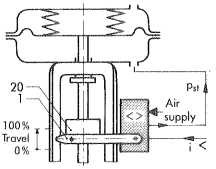


Fig. 7 · "Actuator: actuator stem extends FA"
Right hand mounting, operating direction < >

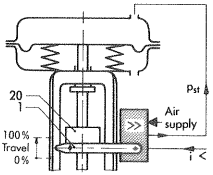


Fig. 8 · "Actuator: actuator stem retracts FE"
Right hand mounting, operating direction >>

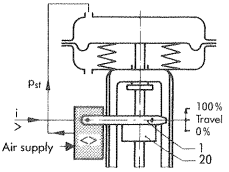
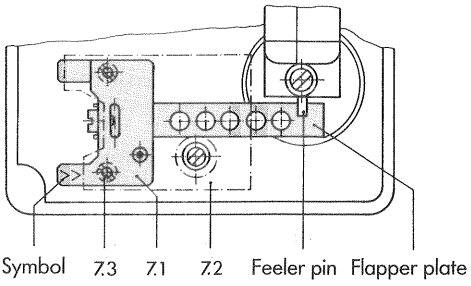


Fig. 9 · "Actuator: actuator stem retracts FE"
Left hand mounting, operating direction < >

Operating direction increasing/increasing
(direct action >>)
Flapper plate below feeler pin

7.1 Nozzle block
7.2 Cover plate
7.3 Screw



Operating direction increasing/decreasing
(reverse action <>)
Flapper plate above feeler pin

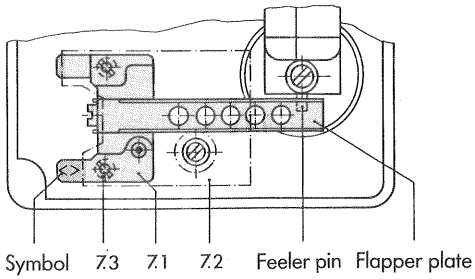


Fig. 10 · Reversal of nozzle block

Lever mm	Travel mm	Signal input mA		Measuring spring
		Signal span	Signal range	
I	8...20	16 (20)	4...20 (0...20)	1
		8 (10)	4...12 (0...10) 12...20 (10...20)	2
157	14...36	16 (20)	4...20 (0...20)	2
		8 (10)	4...12 (0...12) 12...20 (10...20)	3
	30...75	16 (20)	4...20 (0...20)	3
II	14...26	16 (20)	4...20 (0...20)	1
		8 (10)	4...12 (0...10) 12...20 (10...20)	2
210	26...50	16 (20)	4...20 (0...20)	2
		8 (10)	4...12 (0...10) 12...20 (10...20)	3
	55...100	16 (20)	4...20 (0...20)	3

4.3 Adjustment at the valve

4.3.1 Adjustment of the proportional band X_p and air delivery Q

First set the input signal to ~ 50% of its range, then turn the zero adjusting screw (2.2) until the valve travel is set on 50%.

When setting the X_p-adjustment, the dependence on the supply air pressure according to Fig. 11 must be observed. The normal setting should be X_p = 3%. With a supply air presure between 1.4 and 4 bar, for instance, the throttle should be opened by approx. one turn (n = 1).

The volume nozzle (10) for air delivery should be opened totaly in case of large actuators, for smaller ones (80...350 cm²) adjust to the middle.

Check the oscillation tendency and the time to travel full stroke of the valve by pressing the measuring spring (3) briefly against the mechanical stop.

If the valve should still overshoot, first throttle the air output of the positioner corresponding to the desired dynamic response of the valve. For this adjustment use the volume throttle Q (10). Then, if required, readjust the X_p-throttle, but under no circumstances beyond the maximum value shown in the diagram Fig. 12. Otherwise it could happen that the positioner does not vent sufficiently and the valve does not move into the zero position (e.g. closed position).

The X_p-and Q-adjustment must always be set before adjusting Zero (start of operation) and Span.

Subsequent change causes zero shift!

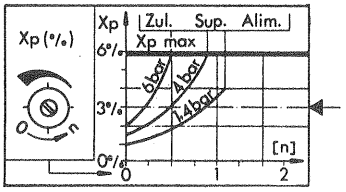


Fig. 11 · Adjustment of X_p-throttle

Important: Because the start of operation depends on the adjusted air supply, the **Zero** must be checked within the installation under operating conditions. Correct, if necessary.

4.3.2 Adjustment of start of operation (Zero) and signal range (Span) with actuator: actuator stem extends FA

Start of operation (Zero)
(Lower range value e.g. 4 mA)

Set input to lower range value 4 mA by means of the d.c. current source. Turn the screw (2.2) until the plug stem just begins to move from its resting position (watch plug stem with travel indicator). Remove the input signal at the source and increase it again slowly; check whether plug stem starts moving at exactly 4 mA; correct, if necessary.

Signal range (Span), (e.g. 4 to 20 mA)

When the start of operation (Zero) has been set, increase the input signal to 20 mA with the d.c. current source. When the end value is exactly 20 mA, the plug stem must be at rest and have passed through 100% travel. If the end value ist not correct, the pin (1.1) must be shifted for correction purposes as follows:

Shifting towards the lever and → stroke increases
Shifting towards the pivot → stroke decreases.

After correction, remove input signal and increase it again. First check the start of operation, then check the end value. Repeat correction procedure until both of the values are correct.

Attention: When Zero and Span have been adjusted, check if the actuator is without pressure (see pressure gauge indication of attachment block, otherwise connect a pressure gauge for testing in signal pressure line).

With an input signal 4 mA and with operating direction >> or with 20 mA and with operating direction <>, the pressure gauge must indicate 0 bar. Correct Zero accordingly.

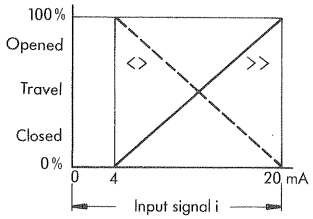


Fig. 12 · Normal operation

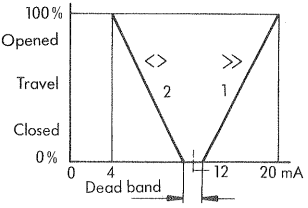


Fig. 13 · Split-range, two control valves of opposed operation

4.3.3 Adjustment of start of operation (Zero) and signal range (Span) with actuator: actuator stem retracts FE

Attention: With actuators **FE** and with upper value of the electric signal (20 mA) and operating direction >> or with lower value of the electric signal (4 mA) and operating direction <>, the diaphragm chamber must be provided with an output pressure large enough to shut the control valve tight when there is an upstream system pressure. (The required output pressure can be read off the label on the control valve).
The **required output pressure** is calculated as follows:

$$\text{required output pressure [bar]} = \frac{d^2 \cdot \pi \cdot \Delta p}{4 \cdot A} + F_{be} + 0.4$$

d = Seat diameter [cm]
Δp = Differential pressure $p_1 - p_2$ [bar]
A = Actuator area [cm^2]
F_{be} = Upper signal pressure range value of the actuator [bar]

If there are no specifications, calculate as follows: required output pressure = upper range value of signal pressure + 1 bar

Start of operation (e.g. 20 mA)
Set the input signal to 20 mA by the current source. Turn the zero screw (2.2) until the control valve is just leaving the initial position. Increase the input signal and slowly lower it to 20 mA. Check if the control valve starts moving with exactly 20 mA. Correct any deviations by the zero screw (2.2)

Signal range (Span)
Upper range value e.g. 4 mA
When the start of operation has been set, adjust the input signal to 4 mA by the current source. With exactly 4 mA, the plug stem must stand still and have passed the travel by 100 % (observe the travel indication at the valve!) If the upper range value is not correct, the pin (1.1) must be shifted for correction purposes.

After corrections have been made, set the input signal to 20 mA again. Turn the zero screw (2.2) once more until the pressure gauge at attachment block indicates the required output pressure. (If no attachment block is mounted, fit a test gauge into the signal pressure line)

4.4 Exchanging the measuring spring (Fig. 3)

If the range is to be changed or if conversion to split-range operation is required, the measuring spring must be exchanged as follows:

Remove the screw (3.2) from the measuring spring, then loosen screw (2.3). The lever shaft (2) may then be withdrawn.

Exchange the measuring spring and replace the lever shaft through the case, the measuring spring and bush with zero adjustment (2.4). Secure the measuring spring with the screw (3.2).

Adjust the shaft position until screw (2.3) mates with the flat on the shaft and tighten. Allow a total clearance between the spacer bush (1.3) and the case of 0.1 to 0.2 mm.

SAMSON AG · MESS- UND REGELTECHNIK
Weismüllerstraße 3 · D-60314 Frankfurt am Main
Postfach 10 19 01 · D-60019 Frankfurt am Main
Telefon (0 69) 4 00 90 · Telefax (0 69) 4 00 95 07

EB 8353 E