

# Electropneumatic Positioner

(i/p Positioner)

## Type 763 Type 3763

samson

### Application

Single-acting positioner for mounting to pneumatic final control elements whose control inputs are standardized electric mA signals. The positioner ensures a preselected relationship between the valve stem position (controlled variable  $x$ ) and the controller output signal (signal input  $w$ ). It is combinable with an inductive, electric or pneumatic limit switch, a position transmitter, and a supply pressure regulator or a lock-up valve.



The instrument compares the output signal of a control device – a standardized d.c. current signal in the range of 4...20 (0...20) mA – to the control valve position and controls the output pressure (max. 6 bar or 90 psi) to the pneumatic actuator. The special features of the positioner are:

Input range of 4...20 (0...20) mA, low input resistance (approx. 200  $\Omega$ ) and accordingly a low internal voltage drop (approx. 4 V with 20 mA)

Good dynamic response, adjustable proportional band, and adjustable air output capacity. Very insensitive to mechanical vibrations  
Compact and low-maintenance construction, designed for installation in any position

Wide output pressure range from 0.2...1 bar (3 to 15 psi) up to approx. 0...6 bar (0...90 psi), applicable for normal and split-range operation

The direction of operating action is internally reversible

The method of attachment to control valves meets NAMUR recommendations

### Versions for use in non-hazardous areas

**Type 763** (Fig. 1), Positioner for supply pressures between 1.4 and 6 bar and input spans of 8 to 20 mA, with interchangeable measuring springs suitable for valves with strokes of 7.5 to 50 mm.

**Type 763/4746-1** (Fig. 2), Positioner with inductive limit switch

**Type 763/4746-3**, Positioner with electric limit switch

**Type 763/4746-4**, Positioner with pneumatic limit switch

**Type 763/4748**, Positioner with position transmitter

### Versions for use in hazardous areas

Electric circuit(s) in protection type EEx ib IIC

**Type 3763** (Fig. 3), Positioner (supply air, input signal spans and valve strokes as with Type 763)

**Type 3763/4746-2**, Positioner with inductive limit switch

**Type 3763/4746-4**, Positioner with pneumatic limit switch

**Type 3763/4748-1**, Positioner with position transmitter

Special versions approved by the Canadian Standards Association and Factory Mutual Research (CSA and FM) are available. Details on request.

On option all positioners are available with a stainless steel gauge for supply pressure indication as shown in Fig. 3 (scale 0...6 bar and 0...90 psi).

On request also available with a build-on pneumatic pressure regulator for air supply with a constant pressure adjustable between 1.4 and 6 bar (20...90 psi). Alternatively with lock-up valve for shutting off the signal pressure tube in case of supply air failure. For details see page 4.

For details see also T 8350 E.

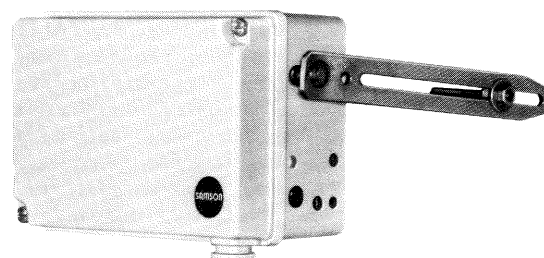


Fig. 1 · Type 763 i/p Positioner

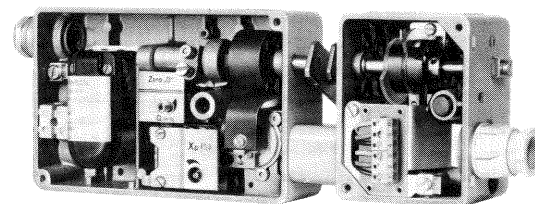


Fig. 2 · Type 763/4746-1 i/p Positioner (open) with inductive limit switch

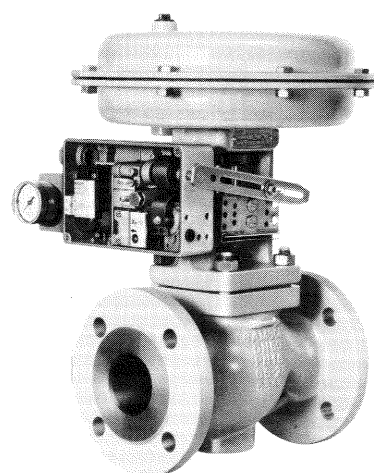


Fig. 3 · Type 3763 i/p Positioner (with gauge) attached to a Type 241-1 Pneumatic Control Valve

## Principle of operation (Fig. 4 and 5)

The electropneumatic positioner consists of an electropneumatic (i/p-)conversion unit (E) and a pneumatic positioner (P) with components also used with Type 765-2 (see Data Sheet T 8352 E). Both units operate on the force balance principle. The controlled variable  $x$  is the position of the final control element, particularly the travel of a control valve. The input  $w$  is the d.c. signal of an electric control device and the output  $y$  is the air pressure  $p_{st}$ .

The d.c. current  $i$  fed to the i/p-conversion unit (E) flows through the coil (E2) which is located in the field of a permanent magnet (E1). The force of the coil is proportional to the current  $i$ . This force is balanced in the beam (E3) by the force of the dynamic back pressure which is generated by the nozzle (E6) jet stream on the flapper (E7).

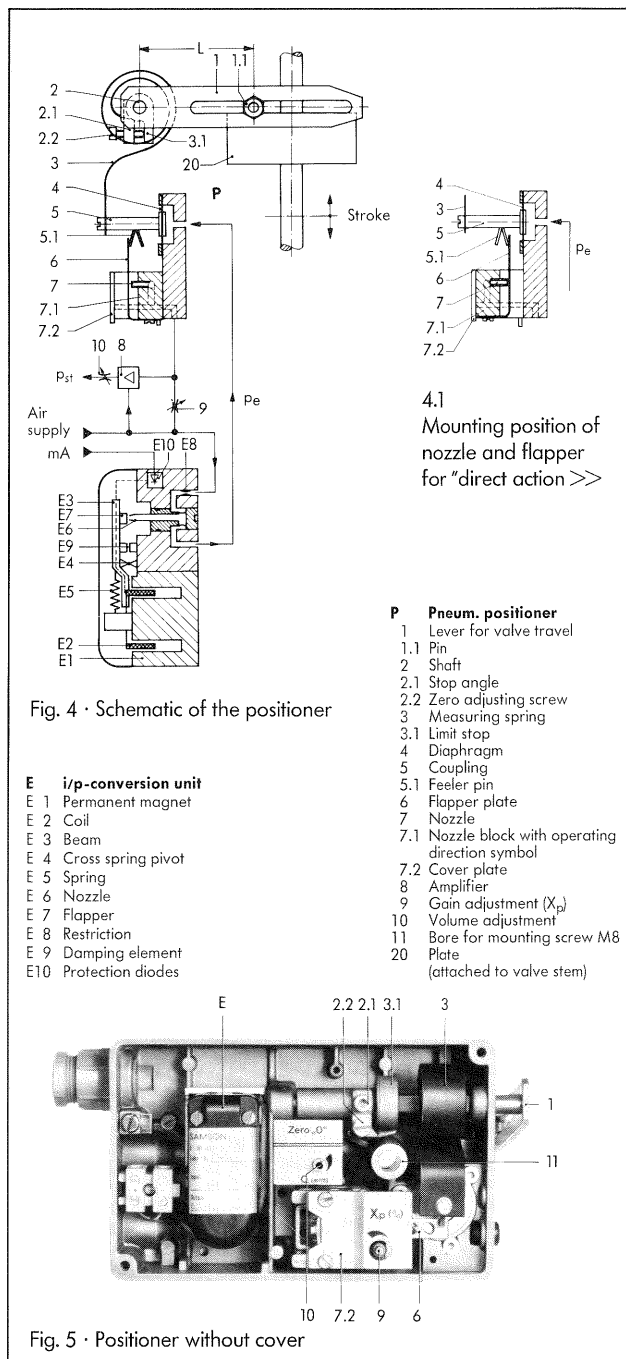
The supply air ( $p_z$ ) flows through the restriction (E8), the nozzle (E6) and hits the flapper (E7). If the input current  $i$  increases, the force of the coil increases and the flapper moves closer to the nozzle (E6). Thus the dynamic back pressure and consequently the pressure  $p_e$  fed to the positioner are increased. The pressures increase until a new balance state is reached and  $p_e$  is proportional to the current  $i$ .

The air pressure  $p_e$ , a signal in the range of 0.2 to 1 bar or 3 to 15 psi, produces a force acting on the diaphragm (4) which is balanced by the torsion load of the spring (3). If the signal  $p_e$  changes, then the feeler pin (5.1) moves. The flapper plate (6) follows this motion and influences the nozzle (7). The supply air is piped to the pneumatic amplifier (8) and flows via the  $X_p$ -throttle (9) and the nozzle (7) against the flapper plate (6). A change in either the signal input or the actuator position causes a pressure change upstream and downstream of the amplifier. The output pressure  $p_{st}$  controlled by the pneumatic amplifier flows through the adjustable volume throttle (10) to the pneumatic actuator. Adjustable needle valves (9 and 10) are used for optimization and stabilization of the position control-loop. For every position of the valve there is a corresponding torsion of the measuring spring (3). Whenever the actuator or valve stem plate (20) and the pin (1.1) move, the lever (1) and other transfer elements (2.1, 2.2, 3.1) cause the spring (3) to rotate and the spring torsion is altered.

The lever (1) and the measuring spring (3) contained within the positioner, are adaptable to the desired valve travel and the span of the input signal (see Technical Data). The relationship of valve travel and input signal can be adjusted by displacing the pin (1.1). The starting point can be adjusted with the zero adjusting screw (2.2). For normal operation, the initial value of the output pressure  $p_{st}$  is set to the corresponding value of the input pressure  $p_e$ . For different operating modes, the starting value can be shifted, i.e. with the corresponding springs to 12 mA for split-range operation, for example.

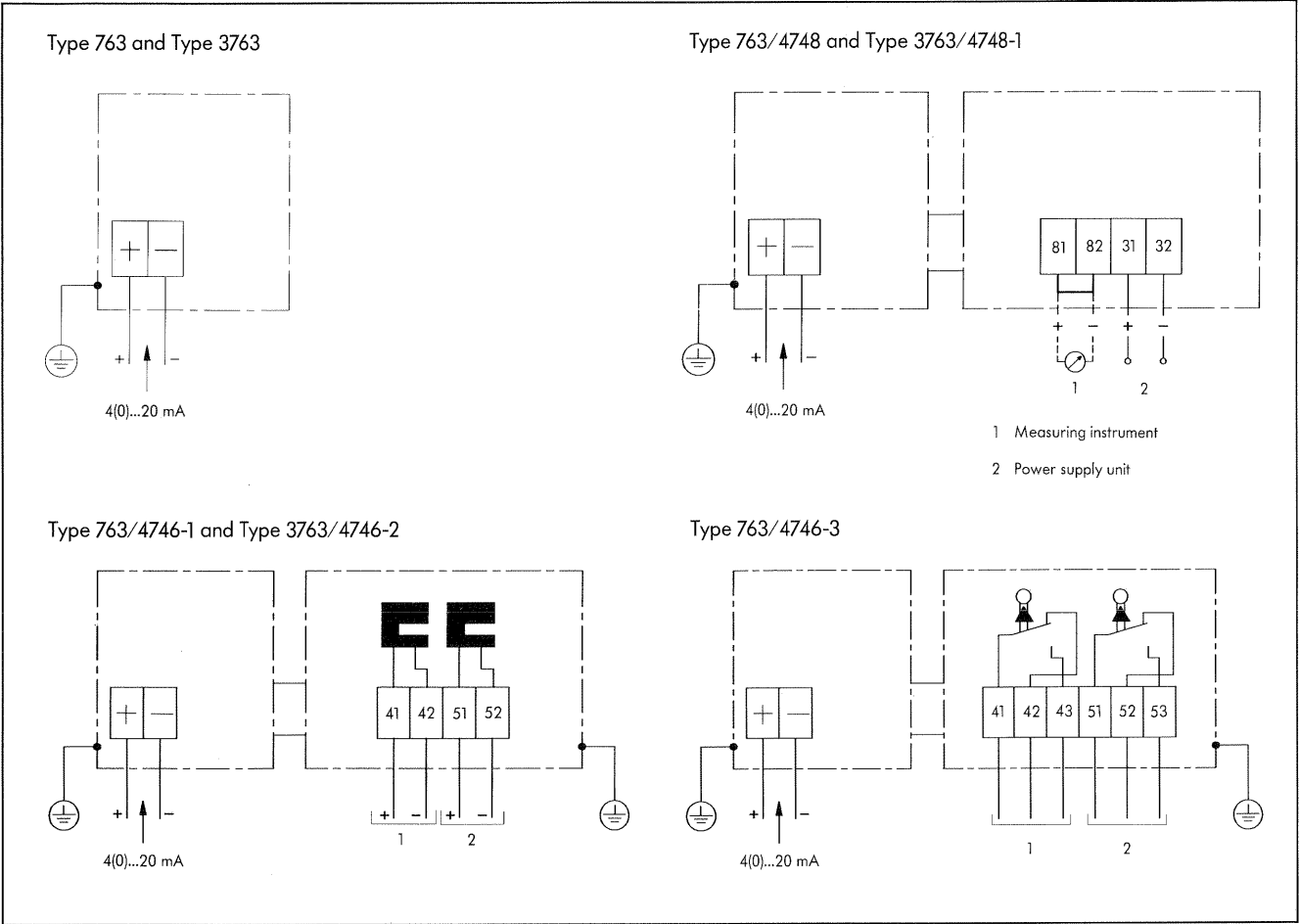
## Direction of operation

For an increase of the input ( $i$ ) the output pressure ( $p_{st}$ ) may increase (direct action  $>>$ ) or decrease (reverse action  $<<$ ). The operating direction is dependent on the mounting position of the nozzle block (7.1) and the flapper (6). In the mounting position shown in Fig. 4, the operating direction is "reverse" and the type of action is indicated by the symbol  $<<$  on the nozzle block (7.1). Fig. 4.1 shows the mounting position for direct action ( $i$  and  $p_{st}$  increasing). Accordingly, the symbol  $>>$  is visible on the nozzle block.



## Lever length L (Fig. 4) · Standard version with lever I

Measuring spring	Signal range mA	Lever	L mm		Travel mm	
			min	max	min	max
1	4...20 (0...20)	I	40		7.5	
	4...12 (0...10)			141		20
2	12...20 (10...20)	II	72		14	
				194		26
2	4...20 (0...20)	I	40		14	
	4...12 (0...10)			141		36
3	12...20 (10...20)	II	72		26	
				194		50
3	4...20 (0...20)	I	40		30	
	(no split-range)			141		75
		II	72		55	
				194		100



Type 3763 is approved according to the following explosion protection standards

Type of certificate	Certificate number	Date	Comments
Certificate of conformity	PTB-No. Ex-81/2108 X	11.08.1981	EEx ib IIC T6
1. Addendum		09.12.1981	Higher ambient temperatures
2. Addendum		29.05.1985	Version 1 to 5 mA
3. Addendum		06.12.1985	USA-cable entry
4. Addendum		30.07.1986	i/p module 6112
5. Addendum		29.04.1988	Connector
CSA Approval	LR 54227-1	31.01.1985	Class I, Groups A, B, C, D; Class II, Group G
FM Approval	J1.OMO A4.AX	12.03.1986	Class I, II, III, Div. 1, Groups A, B, C, D, E, F, G
JIS Approval Japan	40706	October 1988	3 a G5

The test certificates are enclosed in the mounting and operating instruction or are available on request.

### Positioner with limit switch (Fig. 10)

The intermediate piece (23) connects the i/p positioner and the limit switch. In this case, the valve position is picked-up by the lever (1) of the positioner. This motion is transmitted to the spring-loaded lever (G1) and the shaft of the limit switch via the coupling pin (1.2).

In the combinations with inductive and electric limit switches (Types 763/4746-1 and -3 and Type 3763/4746-2), a locking screw (22) closes the air outlet of the positioner. The excess air flows to the air outlet (21) of the limit switch via a hole in the intermediate piece. This air purge protects the electric contacts from corrosive gases.

All limit switches are equipped with two switching elements. With the inductive limit switches (Types 4746-1 and 4746-2), the shaft (G2) carries two adjustable metal tags for frictionless energizing of the incorporated inductive pick-ups. With the other limit switches, the shaft (G2) carries adjustable cam discs for actuating of the electric or pneumatic switching elements. For further details on the construction and principle of operation of the limit switches see Data Sheet T 8365 E.

### Positioner with position transmitter

The limit switch can be replaced by a Type 4748 (non intrinsically safe version) or Type 4748-1 positioner (protection type EEx ia IIC T5 or EEx ia IIC T6). For details see Data Sheet T 8363 E.

### Build-on Block with Supply Pressure Regulator (Fig. 11)

The positioners (with or without limit switch) can be equipped with a build-on pneumatic pressure regulator block. This block contains gauges for air supply pressure (max. 6 bar) and output pressure (max. 6 bar).

Optionally with an auto/manual switch (see page 6). In the "manual" position the signal from the positioner is locked and the output pressure from the pressure regulator is fed to the actuator.

The elements of the pressure regulator are largely identical to the parts of the Type 708 Pressure Regulator. The supply pressure can be adjusted with the spindle (7) to set points from 1.4 to 6 bar (20 to 90 psi). The main air supply of a pipe system flows to the positioner via the free area between seat (1.1) and plug (3). The output pressure ( $p_z$ ) produces a force on the diaphragm (4), which is balanced by the spring (6). If  $p_z$  is too high, the seat (1.1) is closed and the hole in the diaphragm plate is opened, so that the excess air flows to the air outlet. The filter unit (1.2) protects the pressure regulator and the connected equipment from dusty air, especially in start-up operation. For connection to pipelines with air containing dust, oil and condensate, the installation of a separate filter or an air cleaning station is necessary.

### Build-on Block with Pneumatic Lock-up Valve (Fig. 12)

The positioners can be also equipped with a build-on block with lock-up valve replacing the supply pressure regulator. This instrument shuts off the signal pressure tube when the air supply falls below a set value. Thus, the actuator is blocked.

The air supplied produces a force on the diaphragm (4), which is balanced by the spring (6). When the force produced on the diaphragm is higher than that of the springs, input and output are connected to each other, i.e. the signal pressure supplied by the positioner is passed on to the actuator unobstructed. When the supply air pressure falls below the set value, the spring force dominates, and the spring (6) moves the plug (3) fully into the seat (9). Thereby the pressure in the actuator is locked up.

For details and examples of application see Data Sheet T 8391 E.

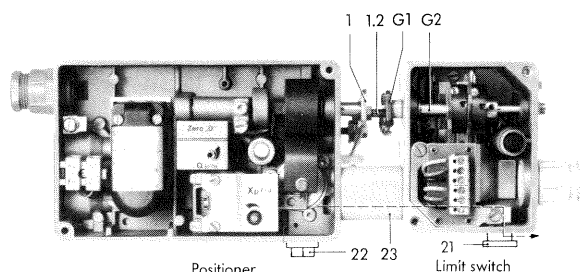


Fig. 10  
Type 763/4746-1, Positioner with limit switch (without cover).

- |                           |                       |
|---------------------------|-----------------------|
| 1 Lever of the positioner |                       |
| 1.2 Coupling pin          |                       |
| 21 Air outlet plug        |                       |
| 22 Locking screw          |                       |
| 23 Intermediate piece     |                       |
| G1 Spring loaded lever    | } of the limit switch |
| G2 Shaft                  |                       |
| ---- Excess air flow      |                       |

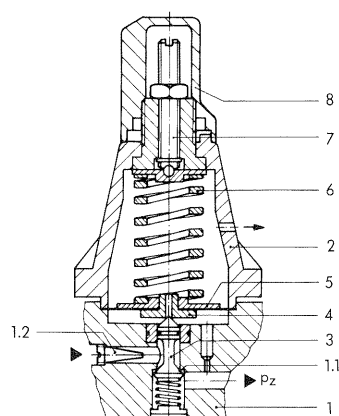


Fig. 11 · Supply pressure regulator

- |   |                   |
|---|-------------------|
| 1 Build-on-block with seat (1.1)            | 5 Diaphragm plate |
| 1.2 Filter unit (sintered brass filter 20µ) | 6 Spring          |
| 2 Cover                                     | 7 Spindle         |
| 3 Plug                                      | 8 Cap             |
| 4 Diaphragm                                 |                   |

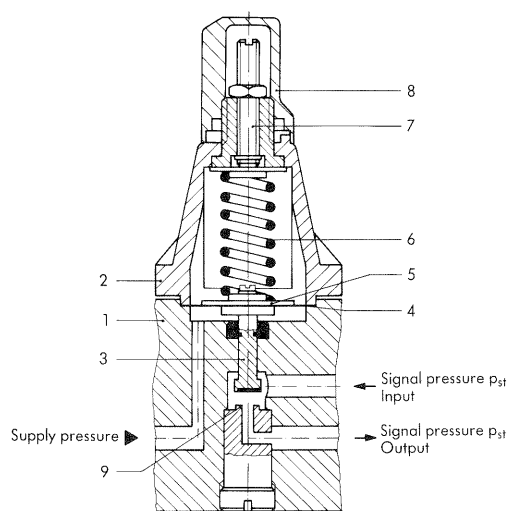


Fig. 12 · Lock-up Valve

- |                   |           |
|-------------------|-----------|
| 1 Build-on-block  | 6 Spring  |
| 2 Cover           | 7 Spindle |
| 3 Plug            | 8 Cap     |
| 4 Diaphragm       | 9 Seat    |
| 5 Diaphragm plate |           |

Positioner			1	2	3
Measuring spring			15	30	30
Controlled variable x (travel range) <sup>1)</sup> in mm	Standard version	Nominal travel	7.5...20	14...36	7.5...20
		Lever I	14...36	14...36	
	Special version	Nominal travel	20	30...50	20
		Lever II	14...26	26...50	14...26
Input signal w	Signal span <sup>1)</sup> <sup>3)</sup>	mA	16(20)	16(20)	8(10)
	Signal range <sup>3)</sup>	mA	4...20(0...20)	4...20(0...20)	4...12(0...10) to 12...20(10...20)
	R <sub>i</sub> with 20°C	approx.	Type 763: 200Ω, ±7.5% with R <sub>i</sub> <sup>4)</sup>		
Supply			Supply air from 1.4...6 bar or 20...90 psi		
Output pressure p <sub>st</sub>			max. 0...6 bar or 0...90 psi		
Characteristic			Linear Deviation from terminal based conformity <1.5%		
Hysteresis			<0.5%		
Dead band			<0.1%		
Operating direction			see Figs. 6 to 9		
Proportional band X <sub>p</sub>			0.7...6% (Gain K <sub>p</sub> : 143...17)		
			with supply air 1.4 bar		with supply air 6 bar
Steady-state air consumption			0.15 m <sub>n</sub> <sup>3</sup> /h		0.5 m <sub>n</sub> <sup>3</sup> /h
Air delivery			2.5 m <sub>n</sub> <sup>3</sup> /h		7 m <sub>n</sub> <sup>3</sup> /h
Permissible ambient temperature			-20...+80 °C <sup>3)</sup>		
Effects			Supply 0.3%/0.1 bar, Temperature 0.03%/°C		
Effects of mechanical vibrations			10...150 Hz and 1.5 g: deviation <2%, dependence on position <± 3.5%		
Degree of protection			IP 54 (IP 65 on request)		
Weight			approx. kg without gauges: 1.2; with gauges: 1.4		

1) Other travel ranges and spans on request

2) Special versions for travels up to 100 mm, see table on page 2

3) Values in brackets apply to version 0...20 mA. On option version 1...5 mA is available.

4) Coil material C<sub>u</sub>, T<sub>k</sub> = 4%/10K

#### Materials (WN = Material Number)

Housing	Die-cast aluminium, plastic-coated
External parts	Stainless steel WN 1.4571 and 1.4301
Measuring diaphragm	ECO (Epichlorhydrine rubber)

#### Attachment of positioner to actuator

(Figs. 6 to 9).

Mounting of the positioner is dependent on the operating direction of the input signal *i*, the output pressure *p<sub>st</sub>* and the type of actuator used.

Fig. 6 shows a positioner adjusted to reverse direction (<>) and a control valve with "spring opening" actuator. This arrangement is suitable for increasing input signal *i*, because the illustrated control valve opens as the pressure *p<sub>st</sub>* decreases.

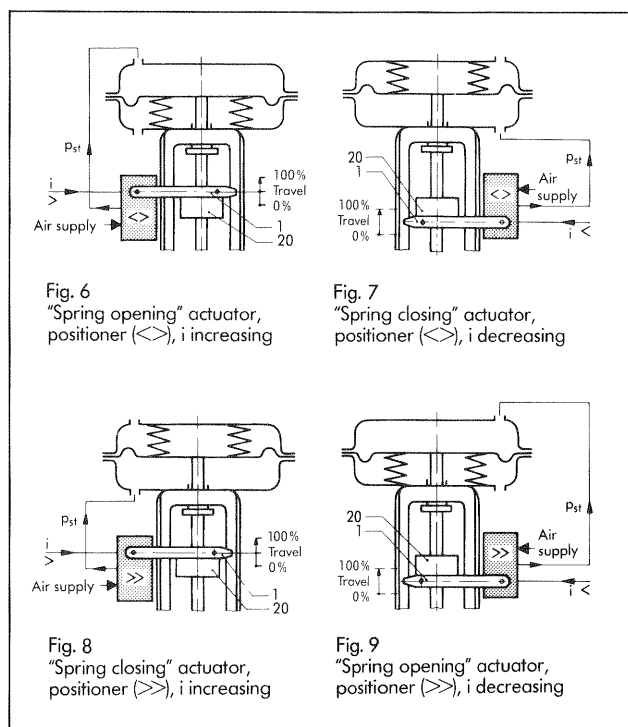
The similar positioner attachment according to Fig. 7 is provided for a "spring closing" actuator where the positioner is adjusted for "direct action" (>>) and an increasing input signal *i*.

For other modes, especially for decreasing input signal *i*, i.e. input signal *i* = 0...100 % ≙ 20...4 (20...0) mA the positioner attachment can be altered (see Figs. 7 and 9).

#### For the intrinsically-safe Type 3763 Positioner, the following technical data apply:

Input circuit	EEX ib IIC	
U <sub>O</sub>	≤ 28 mV	
I <sub>k</sub>	≤ 85 mA	≤ 100 mA
Temperature class	T4	80 °C
	T5	70 °C
	T6	60 °C      55 °C
Input impedance	200 Ω, ±7.5 % with R <sub>t</sub>	
Effective inductance	≈ 0 mH <sup>1)</sup>	

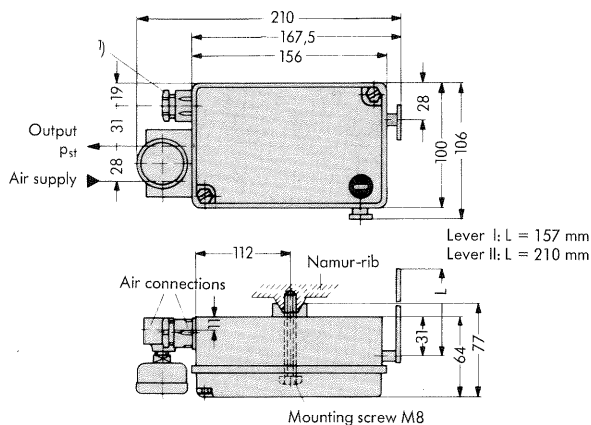
1) Coil material C<sub>u</sub>, T<sub>k</sub> = 4%/10 K



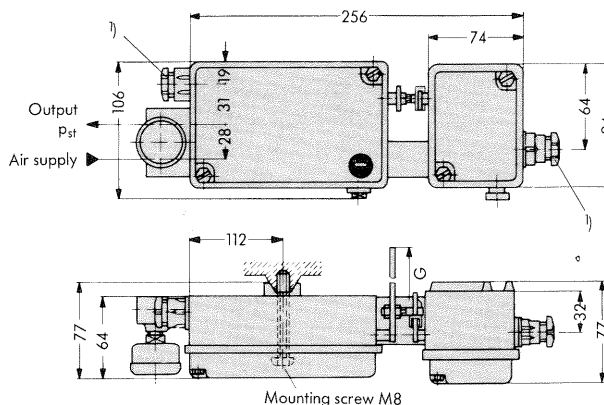
## Dimensions in mm

Air connections: Tapped hole ISO 288 G 1/4 (on request tapped hole NPT 1/4")

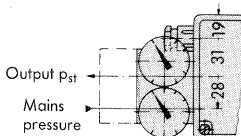
Type 763 and Type 3763



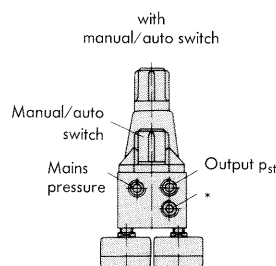
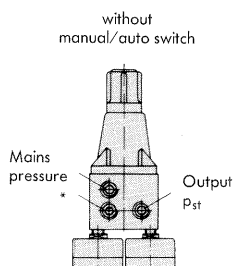
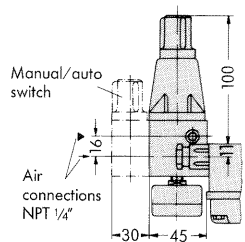
Type 763/4746-1/-3/-4, Type 3763/4746-2 and Type 3763/4746-4  
Type 763/4748 and Type 3763/4748-1



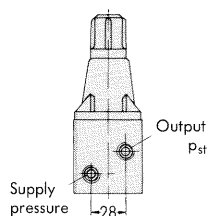
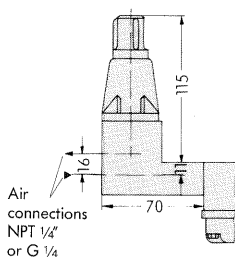
Build-on Block with Supply Pressure Regulator



1) PG 13.5 (1/2 - 14 NPT or plug HAN 7D on request)



Build-on Block with Lock-up Valve



\* The supply pressure  $p_z$  adjusted at the supply pressure regulator is connected to this tapped hole. The pressure can be used to supply external devices.

## Ordering text

i/p Positioner Type 7663 oder 3763

i/p Positioner with Limit Switch Type 763/... or 3763/...

On option with gauge

On option with lock-up valve or with supply pressure regulator

with/without manual/auto switch

Input 4...20 mA/...mA,

Lever I/II, measuring spring 1/2/3

Operating direction increasing - increasing / decreasing - increasing

Air connections NPT 1/4"/ISO 228 G 1/4

On option special version.../accessories...

Specifications subject to change without notice.



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