

Solenoid Valve

For pneumatically operated control valves



Type 3701

Application

Servo-assisted solenoid valve for converting electrical binary signals into pneumatic binary (switching) output signals.

Attachment to control valves according to DIN IEC 534 and NAMUR recommendation, positioners (Type 4763 Electropneumatic or Type 4765 Pneumatic Positioners) and rotary (part-turn) actuators according to VDI/VDE 3845.



The solenoid valve is designed for attachment to air-operated control valves. It converts electrical binary signals received from control equipment into pneumatic output signals which, in a binary fashion, serve to open or close the final control element.

Electrical input: Designed for electrical binary signals up to 24 V DC, 220 V AC or 22 mA common in control engineering. Low power consumption of approximately 0.1 W.

Pneumatic output: Maximum 6 bar. Optionally available with one or two 3/2-way valves. Therefore suitable for controlling all single or double-acting linear or rotary-type actuators.

Depending on how the internal turnboard (also called interface plate by manufacturers) is oriented, either the output signal pressure or the supply air can be switched in the line (Fig. 2).

Versions (Fig. 1)

Type 3701- .. · Solenoid valve for pneumatic output signal pressures from 0 to 6 bar (0 to 90 psi). Supply air: 1.4 to 6 bar (20 to 90 psi)

Versions for non-hazardous areas

Type 3701-0. · Electrical input (nominal signal level): DC voltage of 6 V, 12 V or 24 V; load-independent DC current of 22 mA

Type 3701-2. · Electrical input (nominal signal level): AC voltage of 50 Hz; 220 V, 110 V, 48 V or 24 V

Versions for hazardous areas

Type 3701-3. · With CSA and FM certifications
Electrical input (nominal signal level): DC voltage of 6 V, 7.5 V, 12 V or 24 V; load-independent DC current of 22 mA

Type 3701-4. · Input electric circuit having Type of Protection EEx ia IIC T6

Electrical input (nominal signal level): DC voltage of 6 V, 7.5 V, 12 V or 24 V; load-independent DC current of 22 mA

See "Summary of the approved explosion protection certifications" on the second to last page of this technical description.

Type-tested versions

Available in Degree of Protection IP 65. The 3/2-way valve for controlling pneumatically operated shut-off devices with fail-safe action has been type-tested by the German Technical Inspectorate TÜV (Technischer Überwachungsverein) and is in line with the following standards: DIN EN 161 (DIN 3394 T1), DIN EN 264 (DIN 32 725) and DIN 32 730.



Fig. 1 · Type 3701-01 Solenoid Valve

Other versions (see "Technical data" on the second to last page of this technical description).

Type 3701-03, Type 3701-21 and Type 3701-24

Register numbers available on request

NOTE:

Additional solenoid valves are available for field or mounting channel assembly.

Details can be found in SAMSOMATIC Data Sheet T 962 E and T 963 E.

Principle of operation (Figs. 2 and 3)

The servo-assisted valve essentially consists of an electropneumatic (E/P) converter (1) and one or two 3/2-way valves controlled by compressed air. An internal turnboard (interface plate) is used to choose whether the output signal pressure (a pressure from 0 to 6 bar) or the supply air (1.4 to 6 bar) is to be switched in the line or blocked. The following versions are available depending on the number of valves and the how the internal board is oriented (Fig. 2):

- **Switching function 1:** With a 3/2-way valve
Neutral position: Output exhausted ($p_A = 0$ bar)
- **Switching function 2:** With a 3/2-way valve
Neutral position: Output switched in the line ($p_A =$ output pressure)
- **Switching function 3:** With two 3/2-way valves
Neutral position: Outputs exhausted ($p_{A1} = p_{A2} = 0$ bar)
- **Switching function 4:** With two 3/2-way valves
Neutral position: Output signal pressure switched in the line once ($p_{A1} =$ output pressure), one output exhausted ($p_{A2} = 0$ bar)

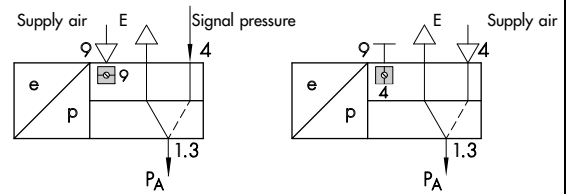
Switching functions 1, 2 and 3 are suitable for single-acting actuators, switching function 4 for double-acting actuators.

Fig. 3.1 schematically illustrates the operating principle of the solenoid valve having switching function 1. If a signal corresponding to the binary signal "0" (off) is applied to the input of the relay coil (1.1), the nozzle (1.4) is opened, and the cascade pressure p_K decreases. This causes the following actions to occur: The switching diaphragm (2.1) of the 3/2-way valve is relieved of pressure; the control piston (2.2) closes the lower valve seat; and the output signal pressure p_{st} is blocked. The output pressure p_A is reduced to 0 (resting position).

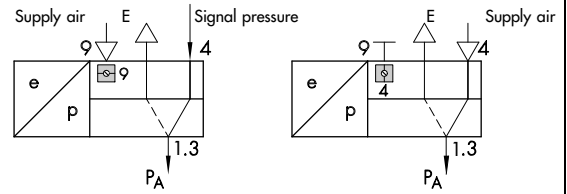
If a voltage or current signal corresponding to binary signal "1" (on) is applied to the input, the coil (1.1) is energized, and the flapper plate (1.2) closes the nozzle (1.4). The cascade pressure p_K increases and switches over the 3/2-way valve (2). The output pressure p_A corresponds to the pressure supplied to air connection 4; e.g., output signal pressure p_{st} .

For solenoid valves having switching function 2 (Fig. 3.2), a reverse-acting 3/2-way valve (3) is employed. When the binary signal is "0", the pressure existing at air connection 4 is switched in the line. When the binary signal is "1", p_A is without pressure.

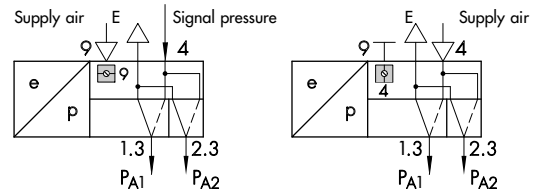
Switching function 1



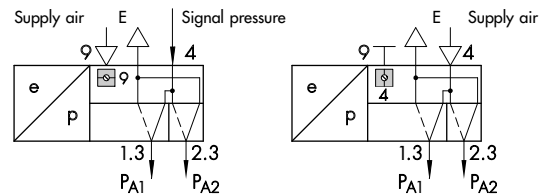
Switching function 2



Switching function 3



Switching function 4



Internal turnboard position 9 - Signal pressure is switched
Internal turnboard position 4 - Supply air is switched

Fig. 2 · Switching functions

Legend to Fig. 2

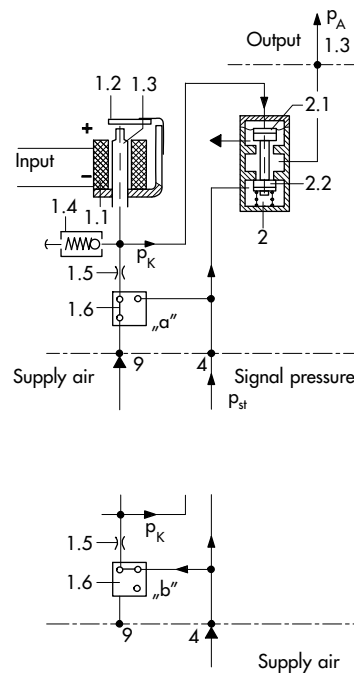
p_A Output pressure to actuator E Ventilation (exhaust)

Legend to Fig. 3

1	Electropneumatic converter	1.3	Air connection for p_{A1}
1.1	Relay with coil	2.3	Air connection for p_{A2}
1.2	Flapper plate	4	Air connection for pressure to be switched in the line
1.4	Nozzle	9	Air connection for supply if the output signal pressure p_{st} is switched
1.5	Pressure limiter		
1.6	Restriction		
1.7	Internal turnboard		
2	3/2-way valve		
2.1	Switching diaphragm		
2.2	Control piston (plunger)		
3	3/2-way valve (reverse acting)		

The terminal markings 1.3, 2.3, 4 and 9 are visible on the solenoid valve.

3.1 Switching function 1



3.2 Switching function

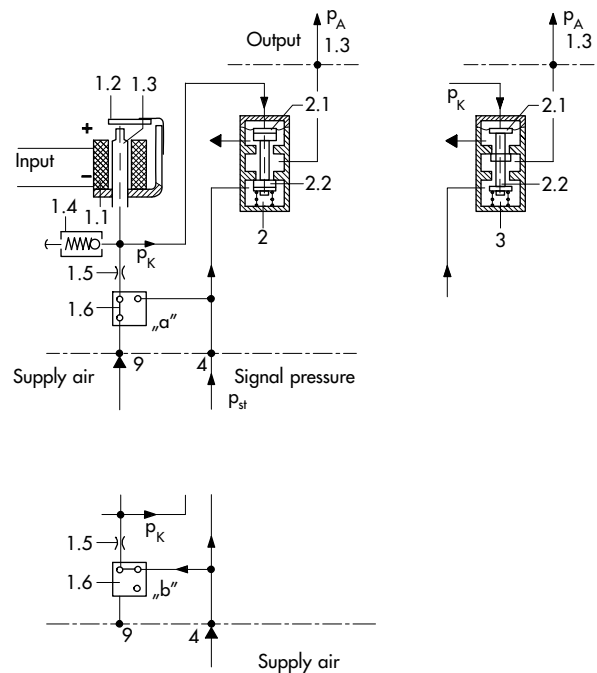


Fig. 3 · Functional diagram with a 3/2-way valve

Table 1 · Technical data

Electrical input signal	Binary DC voltage, AC voltage or DC current signal							
Type of protection	Not intrinsically safe							
Solenoid valve, Type	3701-01	3701-02	3701-03 ³⁾	3701-04	3701-213)	3701-22	3701-23	3701-24 ³⁾
Nominal voltage (nom. current)	6 V~	12 V~	24 V~	22 mA~	220 V~	110 V~	48 V~	24 V~
Signal "0" (off) ⁴⁾	< 2 V	< 4 V	< 6.5 V	< 8 mA~	0 ... 70 V~	0 ... 35 V~	0 ... 16 V~	0 ... 8V~
Signal "1" (on) ⁵⁾	> 5.6 V	> 11.9 V	> 18.6 V	> 18.2 mA/ 3.6 V	187...242 V~	108...140 V~	40 ... 53 V~	20 ... 27 V~
Maximum permissible signal	27 V	28 V	32 V	15 V	242 V~	140 V~	53 V~	27 V~
Input resistance R _i at 20 °C (approx.)	420 Ω	1800 Ω	4000 Ω	160 Ω	19 kΩ	11 kΩ	7 kΩ	4.6 kΩ
Type of protection	Intrinsically safe ¹⁾							
Solenoid valve, Type	3701-41	3701-42	3701-43	3701-44	–	–	3701-47	–
Nominal voltage (nom. current)	6 V~	12 V~	24 V~	22 mA~	–	–	7.5 V~	–
Signal "0" (off) ⁴⁾	< 2 V	< 4 V	< 6.5 V	< 8 mA	–	–	< 2.5 V	–
Signal "1" (on) ⁵⁾	> 5.6 V	> 11.9 V	> 18.6 V	>18.2 mA/ 4.12 V	–	–	> 7.0 V	–
	10.7 mA	5.3 mA	3.75 mA	3.6 V	–	–	2.0 mA	–
Input resistance R _i at 20 °C (approx.)	420 Ω	1800 Ω	4000 Ω	160 Ω	–	–	2860 Ω	–
Maximum values	For connection to intrinsically safe electric circuits							
U ₀	27 V	28 V	32 V/28 V	15 V	–	–	32 V/28 V	–
I _K	125 mA	115 mA	90/115 mA	200 mA	–	–	90/115 mA	–
P	0.4 W	0.4 W	0.25 W	0.4 W	–	–	0.35 W	–
Supply air	Minimum 1.4 bar (20 psi), maximum 6 bar (90 psi)							
Pneumatic output	Binary acting signal pressure (switching function according to Fig. 3) Maximum 6 bar or 90 psi							
Output signal pressure p _{st}	Maximum 0 to 6 bar or 0 to 90 psi							
Air consumed in the steady state	At supply air 1.4 to 6 bar (20 to 90 psi) Signal "0": < 90 l _n /h · Signal "1": < 20 l _n /h							
Air output capacity per output	At supply air 1.4 bar: > 8 m _n ³ /h ≙ K _{vs} = 0.25							
Service life	> 10 ⁷ switching cycles							
Perm. ambient temperature	–20 ... +80 °C ^{1) 6)}							
Influence of the ambient temperature at limit value	Approximately 0.4 %/°C (inapplicable for 22 mA versions)							
Degree of protection	IP 54 (IP 65 on request)							
Approximate weight in kg	0.45							

¹⁾ Versions with input current circuit in Type of Protection "Intrinsically Safe EEx ia II C"

²⁾ Maximum values corresponding to the PTB Certificate of Conformity Ex-94.C.4002 (CSA-/FM maximum values available on request)

³⁾ Also available in type-tested version (degree of protection IP 65)

⁴⁾ DC voltage signal at 20 °C

⁵⁾ DC voltage signal at 80 °C

⁶⁾ Extended temperature ranges available on request

Summary of the approved explosion protection certifications

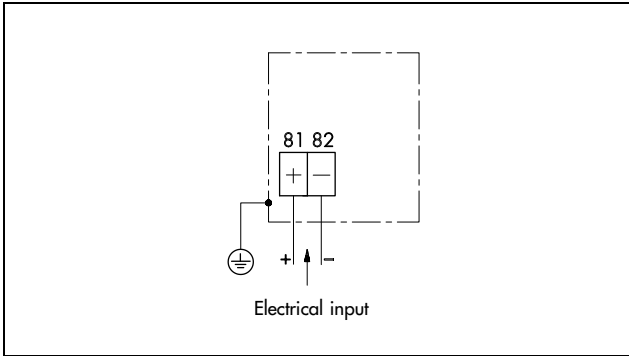
Certificate type	Certificate number	Date	Comments
Certificate of Conformity	PTB no. Ex-89.C.2189	24.01.1990	EEx ia II C T6
First addendum		17.1.1992	Higher Ex-i parameters
Second addendum		22.11.1993	–45 °C ambient temperature
CSA certification	LR 54227-3	25.10.1988	Class I, Groups A, B, C, D
FM certification	J.I.102A0.AX	06.06.1990	Class I, II, III, Div. 1 Groups A, B, C, D, E, F, G
SEV certification	93.1 00906.08	03.09.1993	EEx ia II C T4 - T6

The Certificates of Conformity are contained in the "Mounting and operating instructions" and are available on request.

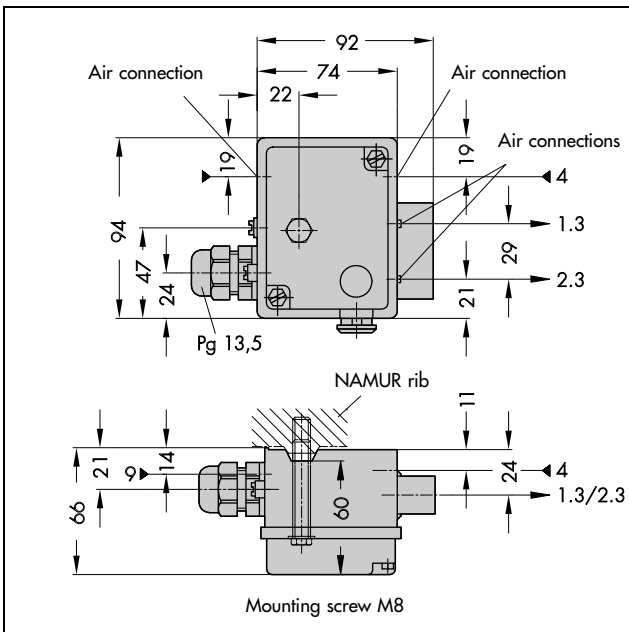
Materials (WN = Material Number according to DIN)

Case	Die-cast aluminum, plastic coated
Switching diaphragm	ECO (epichlorhydrine rubber)
Control piston	CuZn 40 Pb2, WN 2.0402 with NBR sealing rings

Electrical connections



Dimensions in mm



Air connections: Tapped hole with NPT 1/4 or G 1/4 threads

Assignment of the air connections:

- 1.3 Output
- 2.3 Additional output for switching function 3 and 4
- 4 External output signal pressure (with internal turnboard positioned for supply air)
- 9 Supply air (with internal turnboard blocked)

DIN IEC 534 and NAMUR attachment

For control valves of Series 240, nominal sizes DN 15 to DN 80, equipped with positioners or limit switches (proximity switches): Attachment of the solenoid valve only with additional base mounting element (product order number: 1400-5905)

Attachment with adapter plate

Details on this rear connection available on request

Nomenclature for ordering

Type designation	3701-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Non-Ex, DC current signal	0					
Non-Ex, AC current signal	2					
CSA/FM DC current signal	3					
EEx ia II C	4					
DC signal						
6 V						1
12 V						2
24 V						3
22 mA						4
6 V Zener	(only for	(3)				5
22 mA Zener	CSA/FM)	(3)				6
7.5 V						7
AC current signal						
220 V, 50 Hz		(2)				1
110 V, 50 Hz		(2)				2
48 V, 50 Hz		(2)				3
24 V, 50 Hz		(2)				4
Attachment to control valves according to:						
DIN IEC 534/ NAMUR						
NPT						1
NPT ¹⁾						7 (1)
G						2
G ¹⁾						8 (1)
Rotary (part-turn) actuator						
NPT						3
G						4
Type 4763 to 4765 Positioners						
>>						5 (1)
<<						6 (2)
Switching function (see second page)						
1						1
2						2
3						3
4						4
Electrical connections						
Pg 13.5 black						0
Pg 13.5 blue						1
Connector HAN 7 D, angle-type (not CSA/FM)						3

¹⁾ In combination with the Type 241 Globe Valve, type-tested according to DIN 32 730.

Specifications subject to change without notice.

