SAFETY MANUAL

SH 3963 EN

Translation of original instructions

Type 3963 Solenoid Valve

SIL/PL Capability

TÜVRheinland CERTIFIED

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Definition of signal words

⚠ DANGER

Hazardous situations which, if not avoided, will result in death or serious injury

⚠ WARNING

Hazardous situations which, if not avoided, could result in death or serious injury

NOTICE

Property damage message or malfunction

Note

Additional information

Tip

Recommended action

Purpose of this manual

The Safety Manual SH 3963 contains information relevant for the use of the Type 3963 Solenoid Valve in safety-instrumented systems according to IEC 61508 and IEC 61511. The safety manual is intended for planners, constructors and operators of safety-instrumented systems.

NOTICE

Risk of malfunction due to incorrect mounting, connection or start-up of the device.

➔ *Refer to Mounting and Operating Instructions EB 3963 for details on how to mount the device, perform the electric and pneumatic connections as well as start up the device.*

➔ *Observe the warnings and safety instructions written in the Mounting and Operating Instructions EB 3963.*

Further documentation

The documents listed below contain descriptions of the start-up, functioning and operation of the solenoid valve. You can download these documents from the SAMSON website.

- T 3963: Data sheet
- EB 3963: Mounting and operating instructions

Note

In addition to the solenoid valve documentation, observe the documentation for the pneumatic actuator, valve and other valve accessories.

1 Scope

1.1 General

The Type 3963 Solenoid Valve converts binary voltage signals into pneumatic control signals. It is used to control pneumatic rotary and linear actuators with spring-return mechanism.

1.2 Use in safety-instrumented systems

Observing the requirements of IEC 61508, the systematic capability of the solenoid valve for emergency venting as a component in safety-instrumented systems is given.

Use of the solenoid valve is possible on observing the requirements of IEC 61511 and the required hardware fault tolerance in safety-instrumented systems up to SIL 2 (single device/ HFT = 0) and SIL 3 (redundant configuration/HFT = 1).

The individual safety functions of the solenoid valve are to be regarded as Type A elements in accordance with IEC 61508-2.

1.3 Versions and ordering data

All versions of the solenoid valve marked with the prefix **SIL** are suitable for use in safety-instrumented systems. The article code written on the nameplate (see 6 ff.) provides details on the optional equipment of the solenoid valve.

Article code

i ***Note***

The "NAMUR interface according to VDI/VDE 3845" version in combination with K_{VS} 0.32 has an Ematal coating (Type 3963-xxxxx02xxxxxxxxx).

Solenoid valve	**Type 3963-**	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Type of protection																			
No explosion protection	0																		
ATEX [1] II 2G Ex ia IIC T6 Gb (max. 60/70/80 °C in T6/T5/T4)	1																		
CSA/FM Ex ia (max. 60/70/80 °C in T6/T5/T4)	3																		
ATEX [2] II 3G Ex nA II T6 Gc/II 3G Ex ic IIC Gc (max. 60/70/80 °C in T6/T5/T4)	8																		
Nominal signal																			
6 V DC, 5.47 mW power consumption	1																		
12 V DC, 13.05 mW power consumption	2																		
24 V DC, 26.71 mW power consumption	3																		
230 V AC, 0.46 VA power consumption (without explosion protection)	5																		
115 V AC, 0.17 VA power consumption (without explosion protection)	6																		
Manual override																			
Without manual override **SIL/TÜV**	0																		
Pushbutton underneath the enclosure cover **SIL/TÜV**	1																		
External pushbutton (accessible using a pin)	2																		
External switch (accessible using a screwdriver)	3																		
Switching function																			
3/2-way function with spring-return mechanism **SIL/TÜV** (all K_{VS} coefficients)	0																		
5/2-way function with spring-return mechanism (K_{VS} 0.16, 1.4, 2.9, 4.3; **SIL** with K_{VS} 0.16)	1																		
5/2-way function with two detent positions **TÜV** (K_{VS} 1.4/2.9)	2																		
5/3-way function with spring-centered mid-position (ports 2 and 4 closed) (K_{VS} 1.4)	3																		
5/3-way function with spring-centered mid-position (ports 2 and 4 vented) **TÜV** (K_{VS} 1.4)	5																		
6/2-way function with spring-return mechanism (K_{VS} 0.16, 4.3; **SIL** with K_{VS} 0.16)	8																		

Solenoid valve	Type 3963- x x x x x x x x x x x x x x x x x x
Restrictors	
Without restrictors **SIL/TÜV** (all K_{VS} coefficients)	0
One exhaust air restrictor (3/2-way function/NAMUR interface or mounting block/K_{VS} 0.16)	1
Two exhaust air restrictors (5/2-way function/NAMUR interface/ K_{VS} 0.16)	2
One supply air/exhaust air restrictor (3/2-way function/NAMUR interface/K_{VS} 0.16)	3
Attachment	
NAMUR interface according to VDI/VDE 3845 **SIL/TÜV** (all K_{VS} coefficients) [9]	0
Threaded connection for rail, wall or pipe mounting **SIL/TÜV** (K_{VS} 0.16, 0.32, 1.4, 4.3)	1
NAMUR rib according to IEC 60534-6-1 **SIL/TÜV** (K_{VS} 0.32)	2
Mounting block for Type 3277 Linear Actuator **SIL/TÜV** (K_{VS} 0.16, 0.32)	3
Type 3963 (flange), only as spare part (K_{VS} 0.01/0.16)	4
K_{VS} [3]	
0.16 **SIL/TÜV**	1
0,32 **SIL/TÜV** [9]	2
1.4 **TÜV**	3
4.3 **SIL/TÜV**	4
0.01 (as spare part)	5
2.9 (NAMUR interface)	6
2.0 **SIL/TÜV** (NAMUR interface)	7
Pneumatic connection	
G ¼ (K_{VS} 0.16, 0.32, 1.4, 2.0)	0
¼ NPT (K_{VS} 0.16, 0.32, 1.4, 2.0)	1
G ½ (K_{VS} 2.9, 4.3)	2
½ NPT (K_{VS} 2.9, 4.3)	3
Without (pilot valve as spare part/mounting block for Type 3277 Linear Actuator)	4
Pilot supply	
Internal pilot supply for actuators for on/off service	0
External pilot supply for actuators for throttling service	1

Solenoid valve	Type 3963- x x x x x x x x x x x x x x x x x x
Electrical connection	
Blanking plug M20x1.5	0 0
M20x1.5 cable gland, black polyamide	0 1
M20x1.5 cable gland, blue polyamide	1 1
Adapter M20x1.5 to ½ NPT (aluminum)	1 2
M20x1.5 cable gland (CEAG), black polyamide	1 3
M20x1.5 cable gland, nickel-plated brass	1 4
M20x1.5 cable gland, nickel-plated brass, blue	1 5
M20x1.5 cable gland (CEAG), blue polyamide	1 6
M20x1.5 cable gland (Jacob), blue polyamide	1 7
Device connector according to DIN EN 175301-803, black polyamide [1]	2 3
Device connector with LED according to DIN EN 175301-803, black polyamide [1]	2 5
Adapter M20x1.5 to ½ NPT (stainless steel)	2 6
Degree of protection	
IP 54 with polyethylene filter	0
IP 65 with filter check valve made of polyamide	1
IP 65 with filter check valve made of stainless steel	2
NEMA 4 with filter check valve made of polyamide	4
NEMA 4 with filter check valve made of stainless steel	5
IP 65 with labyrinth-type vent plug	6
Ambient temperature [5]	
–20 to +80 °C	0
–45 to +80 °C	2
Safety function	
Without	0
SIL [6]	1
TÜV [7]	2
Special version [8]	
Without	0 0 0
Material	
Connecting plate/booster valve enclosure made of 1.4404 on request	0 0 1

Solenoid valve		Type 3963- x x x x x x x x x x x x x x x x x x
Explosion protection		
CCC Ex	Ex ia IIC T4 ~ T6	0 0 9
EAC (GOST)	1Ex ia IIC T6...T4 Gb X	0 1 1
KCS	Ex ia IIC T6/T5/T4	0 1 3
TR CMU 1055	II 2G Ex ia IIC T6 Gb	0 1 7
TR CMU 1055	II 3G Ex ic IIC T6 Gc; II 3G Ex nA II T6 Gc	0 1 8

1) EC type examination certificate PTB 01 ATEX 2085
2) Statement of conformity PTB 01 ATEX 2086 X
3) The air flow rate when p_1 = 2.4 bar and p_2 = 1.0 bar is calculated using the following formula: $Q = K_{VS} \times 36.22$ in m^3/h.
4) The cable socket is not included in the scope of delivery.
5) The permissible ambient temperature of the solenoid valve depends on the permissible ambient temperature of the components, type of protection and temperature class.
6) SIL according to IEC 61508
7) Emergency release or locking of compressed air supply
8) Further special versions on request
9) "NAMUR interface according to VDI/VDE 3845" version in combination with K_{VS} 0.32: with Ematal coating

2 Attachment

The solenoid valve is suitable for the following types of attachment in combination with various mounting parts:

– Attachment to rotary actuators with NAMUR interface according to VDI/VDE 3845
– Attachment to linear actuators with NAMUR rib according to IEC 60534-6-1
– Direct attachment to SAMSON Type 3277 Linear Actuator using connection block
– Pipe mounting
– Panel, wall or rail mounting

3 Technical data

General data		
Design		Solenoid with flapper/nozzle assembly and booster valve
Degree of protection		IP 54 with filter
		IP 65 with filter check valve
Material	Enclosure	Polyamide PA 6-3-T-GF35, black
	Connecting plate	AlMg, powder coated, gray beige RAL 1019 or Ematal coating (depending on the version: see article code)
		1.4404 (see section 1.3 for special versions)
		Polyamide PA 6-3-T-GF35, black
	Screws	1.4571
	Springs	1.4310
	Seals	Silicone rubber, Perbunan
	Diaphragms	Chloroprene rubber 57 Cr 868 (–20 to +80 °C)
		Silicone rubber (–45 to +80 °C)
Supply air	Medium	Instrument air free from corrosive substances or nitrogen
	Pressure	1.4 to 6 bar
Air consumption		≤80 l/h at 1.4 bar supply air in neutral position
		≤10 l/h at 1.4 bar pilot supply in operating position
Switching time		≤65 ms
Service life		≥2 x 10^7 switching cycles (at –20 to +80 °C)
		≥2 x 10^6 switching cycles (at –45 to +80 °C)
Ambient temperature		Refer to Article code
Mounting orientation		Any

Electric data							
Type 3963	**-x1**	**-x2**	**-x3**	**-08**	**-07**	**-06**	**-05**
Nominal signal U_N	6 V DC	12 V DC	24 V DC	24 V AC	48 V AC	115 V AC	230 V AC
U_{max} [1]	27 V	25 V	32 V	36 V	80 V	130 V	255 V
f_N	–			48 to 62 Hz			
Switching point On $U_{+80\ °C}$	≥4.8 V	≥9.6 V	≥18 V	19 to 36 V	42 to 80 V	82 to 130 V	183 to 255 V
On $I_{+20\ °C}$	≥1.41 mA	≥1.52 mA	≥1.57 mA	≥1.9 mA	≥1.9 mA	≥2.2 mA	≥2.6 mA
On $P_{+20\ °C}$	≥5.47 mW	≥13.05 mW	≥26.71 mW	≥0.04 VA	≥0.07 VA	≥0.17 VA	≥0.46 VA
Off $U_{-25\ °C}$	≤1.0 V	≤2.4 V	≤4.7 V	≤4.5 V	≤9.0 V	≤18.0 V	≤36.0 V
Impedance $R_{+20\ °C}$	2.6 kΩ	5.5 kΩ	10.7 kΩ	Approx. 10 kΩ	Approx. 24 kΩ	Approx. 40 kΩ	Approx. 80 kΩ
Temperature influence on R	0.4 %/°C	0.2 %/°C	0.1 %/°C	0.1 %/°C	0.1 %/°C	0.05 %/°C	0.03 %/°C

Type of protection Ex ia IIC [2] for use in hazardous areas (Zone 1)			
Type 3963	**-11**	**-12**	**-13**
Nominal signal U_N	6 V DC	12 V DC	24 V DC
See EC type examination certificate PTB 01 ATEX 2085 for maximum permissible values when connected to a certified intrinsically safe circuit.			

Type of protection Ex nA II [3] for use in hazardous areas (Zone 2)			
Type 3963	**-81**	**-82**	**-83**
Nominal signal U_N	6 V DC	12 V DC	24 V DC
See statement of conformity PTB 01 ATEX 2086 X for maximum permissible values when connected to a certified intrinsically safe circuit.			

[1] Maximum permissible value at 100 % duty cycle. The maximum permissible value U_i applies to explosion-protected versions.

[2] Marking II 2G Ex ia IIC T6 Gb (gases in Zone 1)

[3] Marking II 3G Ex nA II T6 Gc/II 3G Ex ic IIC T6 Gc (gases in Zone 2)

Solenoid valve with threaded connection, K_{VS} 0.16/0.32				
Type 3963	**-xxx0x11**	**-xxx0x12**	**-xxx1x11**	**-xxx8x11**
Switching function	3/2-way function	3/2-way function	5/2-way function	6/2-way function
K_{VS} [1]	0.16	0.32	0.16	0.16
Safety function	**SIL** [2], TÜV [3]	**SIL** [2], TÜV [3]	**SIL** [2], TÜV [3]	–
Design	Diaphragm switching element, soft seated, with return spring			
Material	Enclosure:	Black polyamide		
	Connecting plate:	Aluminum, powder coated, gray beige RAL 1019 or stainless steel 1.4404		
	Springs:	Stainless steel 1.4310		
	Screws:	Stainless steel 1.4571		
	Seals:	Silicone rubber, Perbunan		
	Diaphragms:	Chloroprene rubber (–20 to +80 °C) or silicone rubber (–45 to +80 °C)		
Operating medium	Instrument air (free from corrosive substances) or nitrogen [4] Air containing oil or non-corrosive gases [5]			
Max. operating pressure	6.0 bar			
Output signal	Operating pressure			
Pneumatic connection	G ¼or ¼NPT			
Ambient temperature [6]	–20 to +80 °C (chloroprene rubber) or –45 to +80 °C (silicone rubber)			
Approx. weight	0.57 kg			

1) The air flow rate when p_1 = 2.4 bar and p_2 = 1.0 bar is calculated using the following formula: $Q = K_{VS} \times 36.22$ in m³/h.
2) SIL according to IEC 61508
3) Emergency release or locking of compressed air supply
4) With internal pilot supply
5) With external pilot supply
6) The maximum permissible ambient temperature depends on the permissible ambient temperature of the cable gland, type of protection and temperature class.

Solenoid valve with threaded connection, K_{VS} 4.3				
Type 3963	**-xxx0x14**	**-xxx0x14**	**-xxx1x14**	**-xxx8x14**
Switching function	3/2-way function	3/2-way function	5/2-way function	6/2-way function
K_{VS} [1] (direction of flow)	4.3 (3 → 5), 4.7 (5 → 3), 1.9 (4 → 3), 1.5 (3 → 4)			
Fail-safe action	**SIL** [2], TÜV [3]	**SIL** [2], TÜV [3]	–	–
Design	Poppet valve with switching diaphragm, soft seated, with return spring			
Material	Enclosure:	Black polyamide (pilot valve), aluminum, powder coated, gray beige RAL 1019, or stainless steel 1.4404 (booster valve)		
	Springs:	Stainless steel 1.4310		
	Screws:	Stainless steel 1.4571		
	Seals:	Chloroprene rubber (–20 to +80 °C) or silicone rubber (–45 to +80 °C)		
	Diaphragms:	Chloroprene rubber (–20 to +80 °C) or silicone rubber (–45 to +80 °C)		
Operating medium	Instrument air (free from corrosive substances) or nitrogen [4] Air containing oil or non-corrosive gases [5]			
Max. operating pressure (direction of flow)	10.0 bar (4 → 3, 3 → 5), 2.0 bar (as required)			
Output signal	Operating pressure			
Ambient temperature [6]	–20 to +80 °C (chloroprene rubber) or –45 to +80 °C (silicone rubber)			
Pneumatic connection	G ½or ½NPT			
Approx. weight	0.58 kg	0.58 kg	1.1 kg	1.1 kg

1) The air flow rate when p_1 = 2.4 bar and p_2 = 1.0 bar is calculated using the following formula: $Q = K_{VS} \times 36.22$ in m³/h.
2) SIL according to IEC 61508
3) Emergency release or locking of compressed air supply
4) With internal pilot supply
5) With external pilot supply
6) The maximum permissible ambient temperature depends on the permissible ambient temperature of the cable gland, type of protection and temperature class.

Solenoid valve with NAMUR interface, K_{VS} 0.16/0.32				
Type 3963	**-xxx0x01**	**-xxx0x02**	**-xxx1x01**	**-xxx8x01**
Switching function	3/2-way function	3/2-way function	5/2-way function	6/2-way function
K_{VS} [1]	0.16	0.32	0.16	0.16
Safety function	**SIL** [2], TÜV [3]	**SIL** [2], TÜV [3]	**SIL** [2], TÜV [3]	–
Design	Diaphragm switching element, soft seated, with return spring			
Material	Enclosure:	Black polyamide		
	Connecting plate:	Black polyamide, aluminum, powder coated, gray beige RAL 1019, or stainless steel 1.4404		
	Springs:	Stainless steel 1.4310		
	Screws:	Stainless steel 1.4571		
	Seals:	Silicone rubber, Perbunan		
	Diaphragms:	Chloroprene rubber (–20 to +80 °C) or silicone rubber (–45 to +80 °C)		
Operating medium	Instrument air (free from corrosive substances) or nitrogen [4] Air containing oil or non-corrosive gases [5]			
Max. operating pressure	6.0 bar			
Output signal	Operating pressure			
Pneumatic connection	G ¼ or ¼ NPT and NAMUR interface ¼" [7]			
Ambient temperature [6]	–20 to +80 °C (chloroprene rubber) or –45 to +80 °C (silicone rubber)			
Approx. weight	0.57 kg			

1) The air flow rate when p_1 = 2.4 bar and p_2 = 1.0 bar is calculated using the following formula:
$Q = K_{VS} \times 36.22$ in m³/h.
2) SIL according to IEC 61508
3) Emergency release or locking of compressed air supply
4) With internal pilot supply
5) With external pilot supply
6) The maximum permissible ambient temperature depends on the permissible ambient temperature of the cable gland, type of protection and temperature class.
7) NAMUR interface according to VDI/VDE 3845

Solenoid valve with NAMUR interface, K_{VS} 2.0		
Type 3963	**-xxx0x07**	
Switching function	3/2-way function with exhaust air feedback	
K_{VS} [1] (direction of flow)	2.0 (3 → 5), 1.1 (4 → 3)	
Fail-safe action	**SIL** [2], TÜV [3]	
Design	Poppet valve with switching diaphragm, soft seated, with return spring	
Material	Enclosure:	Black polyamide (pilot valve), aluminum, powder coated, gray beige RAL 1019, or stainless steel 1.4404 (booster valve)
	Springs:	Stainless steel 1.4310
	Screws:	Stainless steel 1.4571
	Seals:	Chloroprene rubber (–20 to +80 °C) or silicone rubber (–45 to +80 °C)
	Diaphragms:	Chloroprene rubber (–20 to +80 °C) or silicone rubber (–45 to +80 °C)
Operating medium	Instrument air (free from corrosive substances) or nitrogen [4] Air containing oil or non-corrosive gases [5]	
Max. operating pressure	10.0 bar	
Output signal	Operating pressure	
Ambient temperature [6]	–20 to +80 °C (chloroprene rubber) or –45 to +80 °C (silicone rubber)	
Pneumatic connection	Supply air:	G ¼ or ¼ NPT and NAMUR interface ¼" [7] with G ⅜
	Exhaust air:	G ½ or ½ NPT and NAMUR interface ¼" [7] with G ⅜
Approx. weight	1.38 kg	

1) The air flow rate when p_1 = 2.4 bar and p_2 = 1.0 bar is calculated using the following formula: $Q = K_{VS} \times 36.22$ in m^3/h.
2) SIL according to IEC 61508
3) Emergency release or locking of compressed air supply
4) With internal pilot supply
5) With external pilot supply
6) The maximum permissible ambient temperature depends on the permissible ambient temperature of the cable gland, type of protection and temperature class.
7) NAMUR interface according to VDI/VDE 3845

Solenoid valve with NAMUR interface, K_{VS} 4.3		
Type 3963	**-xxx0x04**	
Switching function	3/2-way function with exhaust air feedback	
K_{VS} [1] (direction of flow)	4.3 (3 → 5), 1.9 (4 → 3)	
Fail-safe action	**SIL** [2], TÜV [3]	
Design	Poppet valve with switching diaphragm, soft seated, with return spring	
Material	Enclosure:	Black polyamide (pilot valve), aluminum, powder coated, gray beige RAL 1019, or stainless steel 1.4404 (booster valve)
	Springs:	Stainless steel 1.4310
	Screws:	Stainless steel 1.4571
	Seals:	Chloroprene rubber (–20 to +80 °C) or silicone rubber (–45 to +80 °C)
	Diaphragms:	Chloroprene rubber (–20 to +80 °C) or silicone rubber (–45 to +80 °C)
Operating medium	Instrument air (free from corrosive substances) or nitrogen [4] Air containing oil or non-corrosive gases [5]	
Max. operating pressure	10.0 bar	
Output signal	Operating pressure	
Ambient temperature [6]	–20 to +80 °C (chloroprene rubber) or –45 to +80 °C (silicone rubber)	
Pneumatic connection	G ½ or ½ NPT and NAMUR interface ½" [7]	
Approx. weight	1.5 kg	

1) The air flow rate when p_1 = 2.4 bar and p_2 = 1.0 bar is calculated using the following formula: $Q = K_{VS} \times 36.22$ in m³/h.
2) SIL according to IEC 61508
3) Emergency release or locking of compressed air supply
4) With internal pilot supply
5) With external pilot supply
6) The maximum permissible ambient temperature depends on the permissible ambient temperature of the cable gland, type of protection and temperature class.
7) NAMUR interface according to VDI/VDE 3845

4 Safety-related functions

4.1 Emergency venting

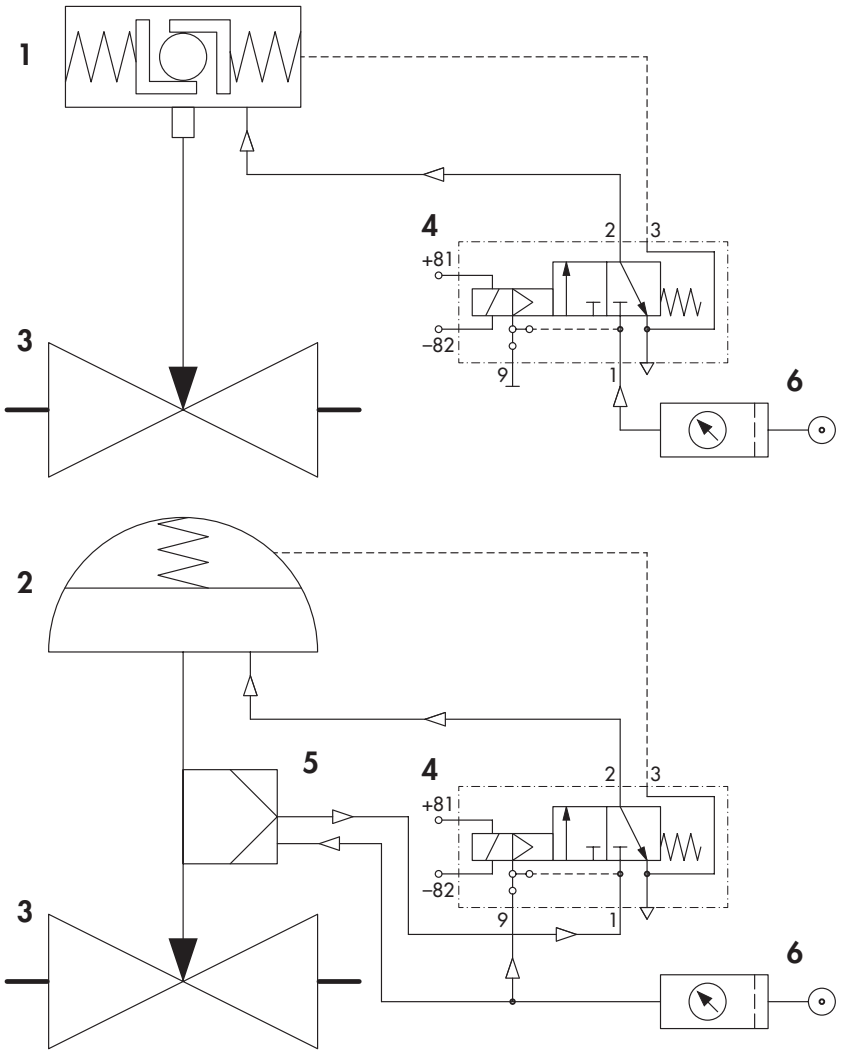
The solenoid valve is energized by a binary voltage signal. Fail-safe action is triggered when no voltage signal (0 V AC/DC) is applied to terminals +81 and –82. The solenoid valve vents to the atmosphere and the actuator is vented as well (see Fig. 1).

4.2 Fail-safe action

Fail-safe action is triggered by the solenoid valve and upon supply air failure.
The solenoid valve fully discharges its pneumatic output to the atmosphere, causing the mounted actuator to be vented. As a result, the valve moves to the fail-safe position. The fail-safe position depends on how the springs are arranged in the pneumatic actuator (air-to-close or air-to-open).

5 Mounting, connection and start-up

Refer to Mounting and Operating Instructions ▶ EB 3963 on how to mount the solenoid valve, perform the electric and pneumatic connections as well as start up the solenoid valve. Only use original mounting parts and accessories.



1 Rotary actuator
2 Linear actuator
3 Valve
4 Solenoid valve
5 Pneumatic positioner
6 Compressed air supply

Fig. 1: *Functional diagram showing emergency venting in actuators for on/off and throttling service*

6 Required conditions

⚠ WARNING

Risk of malfunction due to incorrect selection or wrong installation and operating conditions.

➔ *Only use control valves in safety-instrumented systems if the necessary conditions in the plant are fulfilled. This also applies to the mounted solenoid valve.*

6.1 Selection

➔ The required transit times of the control valve are observed.
The transit times to be implemented are determined by the process engineering requirements.

➔ The solenoid valve is suitable for the prevailing ambient temperature.

Versions	Temperature range
With diaphragm and seals made of chloroprene rubber	–20 to +80 °C
With diaphragm and seals made of silicone rubber	–45 to +80 °C
With plastic cable gland	–20 to +80 °C
With metal cable gland	–45 to +80 °C
The specifications in the test certificates additionally apply to explosion-protected versions.	

➔ The temperature limits are observed.

6.2 Mechanical and pneumatic installation

➔ The solenoid valve is mounted properly as described in the mounting and operating instructions and connected to the air supply.

➔ The maximum supply pressure does not exceed 6.0 (10.0) bar.

➔ The supply air meets the instrument air specifications.

Particle size and quantity	Oil content	Pressure dew point
Class 4	Class 3	Class 3
≤5 µm and 1000/m³	≤1 mg/m³	–20 °C or at least 10 K below the lowest ambient temperature to be expected

Tip

We recommend installing a supply pressure regulator/filter upstream of the device. For example, Type 3999-009x Service Unit or Type 3999-0096 Filter Regulator can be used.

➔ The minimum required cross section of the connecting lines is observed: 4 mm inside diameter for the external pilot supply (9) and 4 mm inside diameter for the internal pilot supply (4) for K_{VS} 0.16/0.32 and 6 mm inside diameter for the internal pilot supply (4) for K_{VS} 2.0/4.3.
See "Sizing of the connecting line" in the mounting and operating instructions ▶ EB 3963.

➔ Select the cross section and length of the line to ensure that the supply pressure at the device on supplying air does not fall below the minimum limit of 1.4 bar.

➔ The solenoid valve is mounted as prescribed.

➔ The exhaust opening at the solenoid valve remains open when the solenoid valve is installed on site.

6.3 Electrical installation

➔ The solenoid valve is mounted properly as described in the mounting and operating instructions and connected to the electric power supply.

➔ Only cables whose outside diameters are suitable for the cable glands are used.

➔ The electrical cables in Ex i circuits comply with the data that planning was based on.

➔ The cable glands and enclosure cover screws are fastened tightly to ensure that the degree of protection is met.

➔ The installation requirements for the applicable explosion protection measures are observed.

➔ The special conditions specified in the explosion protection certificates are observed.

7 Proof testing

The proof test interval and the extent of testing lie within the operator's responsibility. The operator must draw up a test plan, in which the proof tests and the interval between them are specified. We recommend summarizing the requirements of the proof test in a check-list.

⚠ WARNING

Risk of dangerous failure due to malfunction in the event of emergency (actuator is not vented or the valve does not move to the fail-safe position).

➔ *Only use devices in safety-instrumented systems that have passed the proof test according to the test plan drawn up by the operator.*

Regularly check the safety-instrumented function of the entire SIS loop. The test intervals are determined, for example on calculating each single SIS loop in a plant (PFD_{avg}).

7.1 Visual inspection to avoid systematic failure

To avoid systematic failure, inspect the solenoid valve regularly. The frequency and the scope of the inspection lie within the operator's responsibility. Take application-specific influences into account, such as:

- Dirt blocking the pneumatic connections
- Corrosion (destruction primarily of metals due to chemical and physical processes)
- Material fatigue
- Aging (damage caused to organic materials, e.g. plastics or elastomers, by exposure to light and heat)
- Chemical attack (organic materials, e.g. plastics or elastomer, which swell, leach out or decompose due to exposure to chemicals)

! *NOTICE*

Risk of malfunction due to the use of unauthorized parts.

➔ *Only use original parts to replace worn parts.*

7.2 Function testing

Regularly check the safety function according to the test plan drawn up by the operator.

Refer to the SIL proof test when large deviations occur or any other irregularities. The necessary documentation for this is provided by SAMSON.

The SIL proof test can be performed by SAMSON on request.

Note

Record any solenoid valve faults and e-mail (aftersalesservice@samsongroup.com) them to SAMSON.

➔ For the internal pilot supply, the permissible operating pressure from 1.4 to 6.0 bar must be applied to port 4.
In case of external pilot supply, air with the maximum operating pressure of 6.0 (10.0) bar or the maximum available operating pressure must be applied to port 4. On using an upstream positioner, adjust it so that the maximum output pressure is available at the positioner output.

➔ Apply the nominal voltage U_N specified on the nameplate to the solenoid valve.

➔ Check whether the valve moves to its end position on demand.

➔ De-energize the solenoid valve.

Check whether the actuator is fully vented within the demanded time (fail-safe position).

Tip

Connect a pressure gauge to check that the actuator has completely vented.

➔ Record the valve transit time and compare it to the time the valve took at start-up and during proof tests.

Proof test

A full stroke test must be performed as the proof test. The following value can be used for Proof Test Coverage to calculate PFD_{avg}:

PTC (Proof Test Coverage) = 95 % for a proof test

8 Maintenance and repair

Only perform the work on the solenoid valve described in ▶ EB 3963.

Only use the specified original mounting parts.

! NOTICE

Safety function impaired due to incorrect repair.

➔ *Only allow trained staff to perform service and repair work.*

For devices operated in the low demand mode, a useful lifetime of 11 years (plus 1.5 years storage time) is confirmed by TÜV Rheinland® from the date of manufacture while taking into account the specific conditions of use specified in the Safety Manual and the Mounting and Operating Instructions.

The results of the proof test must be assessed and the maintenance scheduled based on it. In particular, after changes (e.g. signs of aging in elastomers, changed switching times or leakage etc.), it is essential that the manufacturer performs maintenance or repair work on the device.

MTC (Maintenance Coverage) > 99 %

9 Safety-related data and certificates

The safety-related data are listed in the following certificate.

Certificate

SIL/PL Capability

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ID 0600000000

No.: 968/V 1160.02/21

Product tested	Electromagnetic control, solenoid, booster valves and electrical position feedback	**Certificate holder**	SAMSON AG Weismüllerstr. 3 60314 Frankfurt / Main Germany
Type designation	3963, 3967, 3964, 3756, 3701, 3968, 3776 (with option solenoid valve as well as safe indication of end positions)		
Codes and standards	IEC 61508 Parts 1-2 and 4-7:2010		
Intended application	Safety Function: Safe venting (and safe indication of end positions) The test items are suitable for use in a safety instrumented system up to SIL 2 (low demand mode). Under consideration of the minimum required hardware fault tolerance HFT = 1 the valves may be used in a redundant architecture up to SIL 3 according to IEC 61508 and IEC 61511-1:2016 + AMD1:2017.		
Specific requirements	The instructions of the associated Installation, Operating and Safety Manual shall be considered.		

Summary of test results see back side of this certificate.

The issue of this certificate is based upon an evaluation in accordance with the Certification Program CERT FSP1 V1.0:2017 in its actual version, whose results are documented in Report No. 968/V 1160.02/21 dated 2021-09-08. This certificate is valid only for products, which are identical with the product tested.

TÜV Rheinland Industrie Service GmbH
Bereich Automation
Funktionale Sicherheit
Certification Body Safety & Security for Automation & Grid

Köln, 2021-09-13

Dipl.-Ing. (FH) Wolf Rückwart

TÜV Rheinland Industrie Service GmbH, Am Grauen Stein, 51105 Köln / Germany
Tel.: +49 221 806-1790, Fax: +49 221 806-1539, E-Mail: industrie-service@de.tuv.com

www.fs-products.com
www.tuv.com

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Holder: **SAMSON AG**
Weismüllerstraße 3
60314 Frankfurt am Main
Germany

Product tested: **Electromagnetic control, solenoid and booster valves of the types**
3963, 3967, 3964, 3756, 3701, 3968 [4],
3776 (with option "solenoid valve" as well as "safe indication of end positions")

Results of Assessment

Route of Assessment		2_H / 1_S
Type of Sub-system		Type A
Mode of Operation		Low Demand Mode

Safe venting - Type 3701, 3963, 3967, 3776 (with option solenoid valve)

Hardware Fault Tolerance	HFT	0	
Lambda Dangerous Undetected [1]	λ_{DU}	8.02 E-08 / h	80 FIT
Average Probability of Failure on Demand [2]	**$PFD_{avg}(T_1)$**	**3.51 E-04**	

Safe indication of end positions - Type 3776 (only with inductive proximity switches)

Hardware Fault Tolerance	HFT	0	
Lambda Dangerous Undetected [1]	λ_{DU}	7.35 E-08 / h	74 FIT
Average Probability of Failure on Demand [2]	**$PFD_{avg}(T_1)$**	**3.22 E-04**	

Safe venting - Type 3756

Hardware Fault Tolerance	HFT	0 (1 as variant, see report)	
Lambda Dangerous Undetected [1]	λ_{DU}	8.38 E-08 / h	84 FIT
Average Probability of Failure on Demand [2]	**$PFD_{avg}(T_1)$**	**3.67 E-04**	
Average Probability of Failure on Demand 1oo2 [3]	**$PFD_{avg}(T_1)$**	**3.69 E-05**	

Safe venting - Type 3964 pilot valve

Hardware Fault Tolerance	HFT	0	
Lambda Dangerous Undetected [1]	λ_{DU}	5.12 E-09 / h	5 FIT
Average Probability of Failure on Demand [2]	**$PFD_{avg}(T_1)$**	**2.24 E-05**	

[1] assumed Diagnostic Coverage DC = 0 %
[2] assumed Proof Test Interval T_1 = 1 year
[3] assumed Proof Test Interval T_1 = 1 year and β_{1oo2} = 10 %
[4] The solenoid valve manifold of type 3968 is a combination of the control valves 3756 and the pilot valves 3964. The failure rates must be determined for each individual applicationfrom the given characteristic values of the single components.

Origin of values

The stated failure rates are the result of an FMEDA with tailored failure rates for the design and manufacturing process.
Furthermore the results have been verified by qualification tests and field-feedback data of the last 5 years.
Failure rates include failures that occur at a random point in time and are due to degradation mechanisms such as ageing.
The stated failure rates do not release the end-user from collecting and evaluating application-specific reliability data.

Systematic Capability

The development and manufacturing process and the functional safety management applied by the manufacturer in the relevant lifecycle phases of the product have been audited and assessed as suitable for the manufacturing of products for use in applications with a maximum Safety Integrity Level of 3 (SC 3).

Periodic Tests and Maintenance

The given values require periodic tests and maintenance as described in the Safety Manual.
The operator is responsible for the consideration of specific external conditions (e.g. ensuring of required quality of media, max. temperature, time of impact), and adequate test cycles.

TÜV Rheinland Industrie Service GmbH, Am Grauen Stein, 51105 Köln / Germany

Revision List
referred to on Certificate No.: 968/V 1160.02/21
Certified Product: Electromagnetic control, solenoid, booster valves and electrical position feedback

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Safety related modules / components

Type Designation	Description	Report–No.:	Certification Status
3963	Solenoid valve	968/V 1160.00/20	*Valid*
3967	Solenoid valve	968/V 1160.00/20	*Valid*
3964	Solenoid valve	968/V 1160.00/20	*Valid*
3756	Solenoid valve	968/V 1160.00/20	*Valid*
3701	Solenoid valve	968/V 1160.00/20	*Valid*
3968	Solenoid valve	968/V 1160.00/20	*Valid*
3776	Limit switch (with option solenoid valve as well as safe indication of end positions)	968/V 1160.00/20	*Valid*

SAMSON AG
Weismüllerstraße 3
60314 Frankfurt am Main

TÜV Rheinland Industrie Service GmbH
Automation - Functional Safety (A-FS)
Am Grauen Stein
51105 Köln / Germany

Revision List
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Manufacturing locations

Type Designation	Description	Report–No.:	Certification Status
SAMSON AG	Weismüllerstraße 3 60314 Frankfurt am Main	968/V 1160.00/20	*Valid*
SAMSON REGULATION S.A.S.	1 rue Jean Corona 69120 Vaulx-en-Velin France	968/V 1160.02/21	*Valid*

Safety Manual

Document No.	Description	Report–No.:	Certification Status
SH_3963.pdf	Safety manual for type 3963	968/V 1160.00/20	*Valid*
SH_3967.pdf	Safety manual for type 3967	968/V 1160.00/20	*Valid*
SH_3701.pdf	Safety manual for type 3701	968/V 1160.00/20	*Valid*
e3756sde.pdf	Safety manual for type 3756	968/V 1160.00/20	*Valid*
e3964sde.pdf	Safety manual for type 3964	968/V 1160.00/20	*Valid*
e3776sde.pdf	Safety manual for type 3776	968/V 1160.00/20	*Valid*
e3968sde.pdf	Safety manual for type 3968	968/V 1160.00/20	*Valid*

The content of this Revision List has been agreed between Manufacturer and Certification Body.

Revision List
referred to on Certificate No.: 968/V 1160.02/21

Certified Product: Electromagnetic control, solenoid, booster valves and electrical position feedback

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Revision:

Date	Rev.	Description / Changes	Author
2021-09-08	1.0	Initial creation, based on Report-No.: 968/V 1160.02/21	JCz/A-FS

SAMSON AG
Weismüllerstraße 3
60314 Frankfurt am Main

TÜV Rheinland Industrie Service GmbH
Automation - Functional Safety (A-FS)
Am Grauen Stein
51105 Köln / Germany

SH 3963 EN

SAMSON AKTIENGESELLSCHAFT
Weismüllerstraße 3 · 60314 Frankfurt am Main, Germany
Phone: +49 69 4009-0 · Fax: +49 69 4009-1507
samson@samsongroup.com · www.samsongroup.com

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