SAFETY MANUAL

# SH 3968 EN

**Translation of original instructions**

# Type 3968 Solenoid Valve Island

SIL/PL Capability

TÜVRheinland CERTIFIED

www.tuv.com ID 0600000000

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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 3968 contains information relevant for the use of the Type 3968 Solenoid Valve Island (consisting of the Type 3964 Solenoid Pilot Valve and the Type 3756 Booster 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.

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**NOTICE**

***Risk of malfunction due to incorrect mounting, connection or start-up of the solenoid pilot valve.***

➔ *Refer to the Mounting and Operating Instructions EB 3964 and EB 3756 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 3964 and EB 3756.*

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**Further documentation**

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

Type 3964 Solenoid Pilot Valve

- T 3964: Data Sheet
- EB 3964: Mounting and operating instructions

Type 3756 Booster Valve

- T 3756: Data sheet
- EB 3756: Mounting and operating instructions

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**Note**

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

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Contents

# 1 Scope

## 1.1 General

The Type 3968 Solenoid Valve Island (consisting of the Type 3964 Solenoid Pilot Valve and the Type 3756 Booster Valve) is used to control pneumatic actuators.

## 1.2 Use in safety-instrumented systems

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

On observing the requirements of IEC 61511 and the required hardware fault tolerance, the solenoid valve island is suitable for use in safety-instrumented systems up to SIL 2 (HFT = 0). On observing the minimum required fault tolerance of HFT = 1, the solenoid valve island can be used in a redundant version also up to SIL 3.

The solenoid valve island is regarded as a type A device according to IEC 61508-2 in view of its safety functions.

## 1.3 Versions and ordering data

Not all versions of the Type 3968 Solenoid Valve Island are suitable for use in safety-instrumented systems. Solenoid valve islands suitable for safety-instrumented systems are marked '**SIL**' in the following article code. The last digit of the article code for these versions is '**1**' (e.g. 3968-xxxxxxxxxxxxxxx**1**):

| **Solenoid valve island** | **Type 3968-** | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type of protection (solenoid pilot valve) | | | | | | | | | | | | | | | | | | |
| Without explosion protection (pneumatic) | 0 | 0 | | | | | | | | | | | | | | | | |
| II 2G Ex ia IIC T6 (ATEX) | 1 | 1 | | | | | | | | | | | | | | | | |
| Ex ia (CSA/FM) | 1 | 3 | | | | | | | | | | | | | | | | |
| II 2G Ex d IIC T6 (ATEX) | 2 | 1 | | | | | | | | | | | | | | | | |
| II G Ex nA II T6 (ATEX) | 8 | 1 | | | | | | | | | | | | | | | | |
| Special version | 9 | 9 | | | | | | | | | | | | | | | | |
| Design | | | | | | | | | | | | | | | | | | |
| Electric | | | **SIL** | 1 | | | | | | | | | | | | | | |
| Pneumatic | | | | 2 | | | | | | | | | | | | | | |
| Special version | | | | 9 | | | | | | | | | | | | | | |

| Solenoid valve island | Type 3968- x x x x x x x x x x x x x x x x x x |
|---|---|
| Solenoid pilot valve [1] | |
| M5 connection (pneumatic) | 0 0 |
| Type 3964 Solenoid Pilot Valve, without cable socket | 0 1 |
| Type 3964 Solenoid Pilot Valve, with cable socket | 0 2 |
| Type 3962-0 Solenoid Pilot Valve, without cable socket | 1 0 |
| Type 3962-0 Solenoid Pilot Valve, with cable socket | 1 1 |
| Type 3962-9 Solenoid Pilot Valve, M20x1.5 | 1 2 |
| Type 3962-9 Solenoid Pilot Valve, M20x1.5 to NPT | 1 3 |
| Special version | 9 9 |
| Nominal signal | |
| Without (pneumatic) | 0 0 |
| 6 V DC | 1 0 |
| 12 V DC | 2 0 |
| 24 V DC | 3 0 |
| 24 V AC | 8 0 |
| Switching function | |
| 2/2-way function [2] | 0 |
| 3/2-way function [2] | **SIL** 1 |
| 2/2-way, freely connectable [2] | **SIL** 2 |
| *5/2-way function* | *5* |
| Number of switching functions | |
| 1 switching function | 0 1 |
| 2 switching functions | 0 2 |
| 3 switching functions | 0 3 |
| 4 switching functions | 0 4 |
| 5 switching functions | 0 5 |
| 6 switching functions | 0 6 |
| 7 switching functions | 0 7 |
| 8 switching functions | 0 8 |
| 9 switching functions | 0 9 |
| 10 switching functions | 1 0 |
| 11 switching functions | 1 1 |
| 12 switching functions | 1 2 |
| 13 switching functions | 1 3 |
| 14 switching functions | 1 4 |

| **Solenoid valve island** | **Type 3968-** x x x x x x x x x x x x x x x x x x |
|---|---|
| Reserve booster valve | |
| Without (pneumatic) | 0 |
| 1 reserve booster valve with dummy plate | 1 |
| 2 reserve booster valves with dummy plate | 2 |
| 3 reserve booster valves with dummy plate | 3 |
| 4 reserve booster valves with dummy plate | 4 |
| 5 reserve booster valves with dummy plate | 5 |
| 6 reserve booster valves with dummy plate | 6 |
| 7 reserve booster valves with dummy plate | 7 |
| Pneumatic connection | |
| G thread | 1 |
| NPT thread | 2 |
| Connection block | |
| Without | 0 0 |
| Connection block without pressure reducer | 1 0 |
| Connection block with pressure reducer | 2 0 |
| Degree of protection | |
| IP 54 | 0 |
| IP 20 | 2 |
| Permissible ambient temperature | |
| –25 to +80 °C | 0 |
| –45 to +80 °C | 1 |
| –10 to +40 °C | 2 |
| –45 to +40 °C | 3 |
| Safety function | |
| Without | 0 |
| SIL | **SIL** 1 |

1) Solenoid pilot valves must be ordered separately.
2) A reserve switching function is included when uneven numbers are specified.

# 2 Attachment

The solenoid valve island is mounted between the actuator and the device actuating it. It is suitable for attachment using threaded connections.

# 3 Technical data

**Table 1:** *General data*

| Type 3964 | | -X1 | -X2 | -X3 | -X8 |
|---|---|---|---|---|---|
| Design | | Solenoid with flapper/nozzle assembly, diaphragm switching element with return spring as booster (optional) | | | |
| Degree of protection | | IP 20/IP 54 (without/with mounted cable socket) | | | |
| Material | Enclosure | Polyamide PA6-3-T, black, polyoxymethylene, green (booster) | | | |
| | Adapter plate | Black anodized aluminum | | | |
| | Screws | Stainless steel 1.4571 | | | |
| | Springs | Stainless steel 1.4310 | | | |
| | Seals | Silicone rubber, Perbunan | | | |
| | Diaphragms | Chloroprene rubber 57 Cr 868 (booster, at –25 to +60 °C), silicone rubber (booster, at –40 to +60 °C) | | | |
| Ambient temperature | | See Electrical data and Pneumatic data | | | |
| Mounting orientation | | Any desired position | | | |
| Approx. weight | | 50 g, 100 g (with CNOMO adapter plate), 150 g (with CNOMO adapter plate and booster) | | | |

**Table 2:** *Pneumatic data*

| Type 3964 | | -X1 | -X2 | -X3 | -X8 |
|---|---|---|---|---|---|
| Supply | Medium | Instrument air, free from corrosive substances | | | |
| | Pressure | 1.4 to 2.0 bar, 3.0 to 3.6 bar, 3.0 to 8.0 bar | | | |
| Output signal | Without booster | ≥1.2 bar at 1.4 bar pilot supply, ≥1.8 bar at 2.0 bar pilot supply, ≥2.5 bar at 3.6 bar pilot supply | | | |
| | With booster | Same pressure as pilot supply | | | |
| Air consumption | | ≤60 l/h at 1.4 bar pilot supply in neutral position ≤15 l/h at 1.4 bar pilot supply in operating position | | | |
| $K_{VS}$ [1] | | 0.01 (without booster), 0.02 (with booster) | | | |
| Ambient temperature [2] | | –45 to +80 °C, –25 to +60 °C (booster with diaphragm made of chloroprene rubber 57 Cr 868), –45 to +60 °C (booster with diaphragm made of silicone rubber) | | | |
| Connection | | Connection for direct mounting, optionally with CNOMO adapter plate or connecting plate | | | |

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) The maximum permissible ambient temperature of the solenoid pilot valve depends on type of protection and temperature class.

**Table 3:** *Electric data*

| **Type 3964** | | **-X1** | **-X2** | **-X3** | **-X8** |
|---|---|---|---|---|---|
| Nominal signal | $U_N$ | 6 V DC<br>max. 27 V [1] | 12 V DC<br>max. 25 V [1] | 24 V DC<br>max. 32 V [1] | 24 V AC<br>max. 36 V [1] |
| | $f_N$ | – | | | 48 to 62 Hz |
| Switching point | | | | | |
| ON | $U_{80\,°C}$ | ≥4.8 V | ≥9.6 V | ≥18.0 V | 19 to 36 V |
| | $I_{20\,°C}$ | ≥ 1.41 mA | ≥ 1.52 mA | ≥1.57 mA | ≥ 1.9 mA |
| | $P_{20\,°C}$ | ≥5.47 mW | ≥13.05 mW | ≥26.71 mW | ≥0.04 VA |
| OFF | $U_{-25\,°C}$ | ≤1.0 V | ≤2.4 V | ≤4.7 V | ≤4.5 V |
| Impedance | $R_{20\,°C}$ | 2.6 kΩ | 5.5 kΩ | 10.7 kΩ | Approx. 10 kΩ |
| Effect of temperature | | 0.4 %/°C | 0.2 %/°C | 0.1 %/°C | 0.1 %/°C |
| **Type of protection Ex ia IIC [2] for use in hazardous areas (Zone 1)** | | | | | – |
| **Type 3964** | | **-11** | **-12** | **-13** | |
| Maximum values when connected to a certified intrinsically safe circuit | | | | | |
| Output voltage | $U_i$ | Pairs of values $U_i$/$I_i$ apply to 6, 12, 24 V DC nominal signals:<br>25 V/150 mA, 27 V/125 mA, 28 V/115 mA,<br>30 V/100 mA, 32 V/85 mA | | | |
| Output current | $I_i$ | | | | |
| Outer capacitance | $C_i$ | ≈0 | | | |
| Outer inductivity | $L_i$ | ≈0 | | | |
| Ambient temperature in temperature class | T6 | –20 to +60 °C | | | |
| | T5 | –20 to +70 °C | | | |
| | T4 | –20 to +80 °C | | | |
| **Type of protection Ex nA II [3] for use in hazardous areas (Zone 2)** | | | | | – |
| **Type 3964** | | **-81** | **-82** | **-83** | |
| Ambient temperature in temperature class | T6 | –45 to +60 °C | | | |
| | T5 | –45 to +70 °C | | | |
| | T4 | –45 to +80 °C | | | |
| Switching time | | ≤15 ms | | | |
| Effect of temperature | | 0.4 %/°C | 0.2 %/°C | 0.12 %/°C | 0.15 %/°C |
| Connection | | Connector type C according to EN 175301-803, distance between contacts 8 mm [4] or industrial standard type C, distance between contacts 9.4 mm [5] | | | |

1) Maximum permissible value at 100 % duty cycle. The maximum permissible value $U_i$ applies to explosion-protected versions.
2) II 2 G Ex ia IIC T6 (Zone 1) according to EC Type Examination Certificate PTB 98 ATEX 2047
3) II 3 G Ex nA II T6 (Zone 2) according to Statement of Conformity PTB 06 ATEX 2193 X
Note: a manufacturer's declaration of use in explosive atmospheres (Zone 22) is available on request.
4) The cable socket with seal (option) is included in the scope of delivery.
5) The cable socket with seal is not included in the scope of delivery.

**Table 4:** *Booster valves*

| | |
|---|---|
| Design | Diaphragm switching elements with return spring |
| Switching function | Double 2/2-way function, double 3/2-way function or 5/2-way function |
| Material | Enclosure: TROGAMID® TG 35, glass-fiber reinforced, black<br>Connecting plates: AlMgPbSi, powder coated, RAL 1019<br>Diaphragms: chloroprene rubber (–25 to +80 °C) or silicone rubber (–45 to +80 °C)<br>Screws: zinc-plated steel and chromate coating<br>Springs: stainless steel 1.4310<br>Seals: PERBUNAN® |
| Actuation | Pneumatic with M5 connecting plate,<br>electric over CNOMO interface with Type 3962 or Type 3964 Solenoid Pilot Valves |
| $K_{VS}$ [1)] | 0.16 |
| Pilot supply pressure | 1.4 to 1.6 bar |
| Operating pressure | 1.4 to 6.0 bar |
| Output pressure | Same pressure as pilot supply |
| Pneumatic connection | CNOMO interface (solenoid pilot valves),<br>M5 connecting plate (pneumatic actuation),<br>G ¼ or ¼ NPT (supply and exhaust),<br>G ⅛ or ⅛ NPT (outputs) |
| Approx. weight | 0.6 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.

**Table 5:** *Connection block*

| | |
|---|---|
| Design | Optionally with or without pressure reducer |
| Material | Enclosure: aluminum, powder coated, gray beige RAL 1019<br>Pressure reducer: polyamide, glass-fiber reinforced, green<br>Screws: zinc-plated steel and chromate coating |
| Pilot supply pressure | 1.4 to 6.0 bar, briefly 8.0 bar |
| Output pressure | 1.4 to 1.6 bar |
| Air capacity | Sufficient for max. 14 switching functions |
| Pneumatic connection | G ¼ or ¼ NPT (supply and exhaust),<br>M5 (optional for test diode) |
| Approx. weight | 0.1 kg |

# 4 Safety-related functions

The solenoid valve island is actuated by a binary voltage signal at the solenoid pilot valve and by a pneumatic signal at the booster valve. Fail-safe action is triggered when no voltage signal or pneumatic signal is applied to the solenoid valve island. As a result, the solenoid valve island vents to the atmosphere and the actuator is vented as well.

## 4.1 Fail-safe action

Fail-safe action is triggered by the voltage signal or the pneumatic supply. The solenoid pilot valve changes to the neutral position as soon as there is no voltage signal. The solenoid pilot valve and booster valve change to the neutral position upon air supply failure. This causes the pneumatic actuator to be vented and the control valve to move to its 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).

## 4.2 Protection against unauthorized changes to the configuration

A change to the configuration cannot affect the safety function nor cause it to be deactivated.

# 5 Mounting, connection and start-up

Refer to Mounting and Operating Instructions ▶ EB 3964 and ▶ EB 3756 on how to mount the solenoid valve island, perform the electric and pneumatic connections as well as start up the device.
Only use the specified original mounting parts and accessories.

# 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 island.*

## 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 island is suitable for the prevailing ambient temperature.

| Versions (solenoid pilot valve) | Temperature range |
|---|---|
| Type 3964 (standard) | –45 to +80 °C |
| Type 3964 with booster diaphragm made of chloroprene rubber | –25 to +60 °C |
| **The maximum permissible ambient temperature of the solenoid pilot valve depends on type of protection and temperature class.** | |

| Versions (solenoid valve island) | Temperature range |
|---|---|
| Type 3968-xxxxxxxxxxxxxxx0x | –25 to +80 °C |
| Type 3968-xxxxxxxxxxxxxxx1x | –45 to +80 °C |
| Type 3968-xxxxxxxxxxxxxxx2x | –10 to +40 °C |
| Type 3968-xxxxxxxxxxxxxxx3x | –45 to +40 °C |

➔ The temperature limits are observed.

## 6.2 Mechanical and pneumatic installation

➔ The solenoid valve island is mounted properly as described in the Mounting and Operating Instructions ▶ EB 3964 and ▶ EB 3756 and connected to the air supply.

➔ The maximum supply pressure does not exceed 3.6 bar at the solenoid pilot valve and 10 bar at the booster valve.

➔ The pneumatic air supply 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 supply air hoses have a minimum cross section of 4x1 mm (inside diameter x wall thickness).
Select the cross section and length of the line to ensure that the supply pressure at the solenoid pilot valve on supplying air does not fall below the minimum limit of 1.4 bar.

➔ The minimum inside diameter of the supply air line is observed.
Select the cross section and length of the line to ensure that the supply pressure (see section 3) at the device on supplying air does not fall below the minimum limit.

➔ The booster valve is mounted as prescribed (preferably with the vent holes facing downwards or alternatively, in the horizontal mounting position).

## 6.3 Electrical installation

➔ The Type 3964 Solenoid Pilot Valve is connected properly to the electric power supply as described in the Mounting and Operating Instructions ▶ EB 3964.

➔ 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 (periodic)

**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 checklist.**

**⚠ 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 island 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.

**Note**

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

➔ Connect the air supply.

➔ Apply the nominal voltage $U_N$ specified in Table 3 to the solenoid pilot valve.

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

➔ De-energize the solenoid pilot valve.

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

**Tip**

*You can connect a pressure gauge to check whether 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 island described in the Mounting and Operating Instructions ▶ EB 3964 and ▶ EB 3756.

**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


**No.: 968/V 1160.02/21**

| | | | |
|---|---|---|---|
| **Product tested** | Electromagnetic control, solenoid, booster valves and electrical position feedback | **Certificate holder** | SAMSON AG<br>Weismüllerstr. 3<br>60314 Frankfurt / Main<br>Germany |
| **Type designation** | 3963, 3967, 3964, 3756, 3701, 3968,<br>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)<br><br>The test items are suitable for use in a safety instrumented system up to SIL 2 (low demand mode).<br>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

Köln, 2021-09-13 — Certification Body Safety & Security for Automation & Grid — Dipl.-Ing. (FH) Wolf Rückwart

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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] | $\lambda_{DU}$ | 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] | $\lambda_{DU}$ | 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] | $\lambda_{DU}$ | 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] | $\lambda_{DU}$ | 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 $\beta_{1oo2}$ = 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**

TÜVRheinland®
Precisely Right.

## 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<br>(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

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## Manufacturing locations

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

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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 |



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**SH 3968 EN**

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