



SH 8484-3 EN

Translation of original instructions



TROVIS 3730-3 Smart Positioner with HART® communication

Edition August 2022



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 8484-3 contains information relevant for the use of the TROVIS 3730-3 Positioner 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 8484-3 for details on how to mount the device, perform the electric and pneumatic connections as well as start up.
- ➔ Observe the warnings and safety instructions written in the *Mounting and Operating Instructions* ▶ EB 8484-3.

Further documentation

The documents listed below contain descriptions of the start-up, functioning and operation of the positioner. You can download these documents from the SAMSON website. The documents marked with an asterisk (*) are supplied with the positioner either in printed or electronic form.

TROVIS 3730-3 Positioner with HART® communication

- ▶ T 8484-3: Data sheet
- ▶ EB 8484-3*: Mounting and operating instructions
- ▶ KA 8484-3*: Quick guide

Valve diagnostics EXPERTplus (TROVIS 3730-3 Positioner)

- ▶ T 8389-3: Data sheet
- ▶ EB 8389-3*: Operating instructions

i Note

In addition to the positioner documentation, observe the technical documentation for the pneumatic actuator, control valve and other valve accessories.

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1 Scope

1.1 General

The TROVIS 3730-3 Smart Positioner is a single-acting, venting positioner with HART® communication for attachment to pneumatic rotary and linear actuators with spring-return mechanism. The positioner is used to position control valves.

1.2 Use in safety-instrumented systems

i Note

For use in safety-instrumented systems, control valves must only be used in combination with a pneumatic actuator which does not have a pneumatic or electric lock-up device, travel stop or handwheel.

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

Use of the positioner 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 positioner and its safety-instrumented functions are regarded as type A according to IEC 61508-2.

i Note

The architecture and the interval between proof tests must be changed accordingly for a higher safety integrity level.

1.3 Versions and ordering data

The positioners with the following article code are suitable for use in safety-instrumented systems:

- TROVIS 3730-3-xxx0xxxxx0xx0xxxx10xxxx

The positioner can be fitted with options. The options enhance the safety-instrumented functions of the positioner. The options are the **inductive limit switches (SJ2-SN)** and **forced venting**

The article code written on the nameplate provides details on the optional equipment of the positioner:

Positioner	TROVIS 3730-3- x x x 0 x x x x x 0 x x 0 x x x x x 1 0 x x x x x			
Option B				
Forced venting	3			
Option C				
2x Inductive limit switches + Binary output (NAMUR); -50 to +85 °C	4			
Emergency shutdown				
3.8 mA		0		
Additional certification				
SIL				1

1.4 Attachment

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

Technical data (excerpt from EB 8484-3)

- Direct attachment to SAMSON Type 3277 Linear Actuators
- Attachment to linear actuators according to IEC 60534-6 (NAMUR)
- Attachment to linear actuators according to VDI/VDE 3847-1 and VDI/VDE 3847-2
- Attachment to rotary actuators according to VDI/VDE 3845

2 Technical data (excerpt from EB 8484-3)

TROVIS 3730-3 Positioner	
Technical data in test certificates additionally apply to explosion-protected devices	
Set point w	
Signal range	4 to 20 mA · Two-wire device, reverse polarity protection · Minimum span 4 mA
Static destruction limit	40 V, internal current limit approx. 40 mA
Minimum current	3.75 mA for display/operation (HART® communication and configuration) 3.90 mA for pneumatic function
Load impedance	≤9.3 V (corresponds to 465 Ω at 20 mA)
Supply	
Supply air	1.4 to 7 bar (20 to 105 psi)
Air quality acc. to ISO 8573-1	Max. particle size and density: Class 4 Oil content: Class 3 Pressure dew point: Class 3 or at least 10 K below the lowest ambient temperature to be expected
Hysteresis	≤0.3 %
Sensitivity	≤0.1 %
Transit time	Exhaust and supply adjustable separately up to 240 s by software
Air consumption, steady state	Independent of supply air, approx. 65 l _n /h
Air output capacity (when Δp = 6 bar)	
Actuator (supply)	8.5 m _n ³ /h · At Δp = 1.4 bar: 3.0 m _n ³ /h · K _{Vmax(20 °C)} = 0.09
Actuator (exhaust)	14.0 m _n ³ /h · At Δp = 1.4 bar: 4.5 m _n ³ /h · K _{Vmax(20 °C)} = 0.15
Environmental conditions and permissible temperatures	
Permissible environmental conditions according to EN 60721-3	

Storage	1K6 (relative humidity ≤95 %)
Transport	2K4
Operation	<p>-20 to +85 °C: All versions -40 to +85 °C: With metal cable glands -55 to +85 °C: Low-temperature version with metal cable glands Observe the limits in the test certificate for explosion-protected versions.</p>

Safety-relevant options

Inductive limit switches					
Version	For connection to switching amplifier according to EN 60947-5-6, SJ2-SN proximity switches, reverse polarity protection				
Measuring plate not detected	≥3 mA				
Measuring plate detected	≤1 mA				
Static destruction limit	20 V DC				
Forced venting					
Version	Galvanic isolation, reverse polarity protection				
Voltage input	0 to 24 V DC				
Input resistance	≥7 kΩ				
Signal state	<table border="0"> <tr> <td style="padding-right: 10px;">Active</td> <td>U_e < 11 V</td> </tr> <tr> <td>Not active</td> <td>U_e > 15 V</td> </tr> </table>	Active	U _e < 11 V	Not active	U _e > 15 V
Active	U _e < 11 V				
Not active	U _e > 15 V				
Static destruction limit	38 V DC/30 V AC				

Safety-related functions

Permissible ambient temperatures of SIL functions

Function	Temperature range
Emergency venting 0.0 mA	-60 to +80 °C
Emergency venting 3.8 mA	-40 to +80 °C
Emergency venting by the forced venting function	-40 to +80 °C
Safety-related end position monitoring by the inductive limit switches	-50 to +80 °C

3 Safety-related functions

The TROVIS 3730-3 Positioner is fitted with three safety-instrumented functions. They become effective independently from the microcontroller and software.

Emergency venting by an mA signal

→ See Fig. 1, path 

Fail-safe action is triggered when a signal below 3.8 mA is applied to terminals 11/12. The i/p converter (7) is de-energized and the air capacity booster (6) vents to the atmosphere over Output 38. The valve moves to the fail-safe position depending on the spring-return mechanism of the actuator.

Emergency venting by the "forced venting" option

→ See Fig. 1, path 

The positioner either vents the actuator or supplies it with air when the voltage signal at the terminals of the option module falls below 11 V. This occurs regardless of the set point. The forced venting is **not** triggered when the voltage is higher than 15 V.

Safety-related end position monitoring by the "inductive limit switches" option

→ See Fig. 1, path 

The inductive limit switches SJ2-SN (NAMUR NC contact) indicate the adjusted safety-related end position at terminals 41/42 or 51/52. See ► EB 8484-3 for adjusting the limit switches.

3.1 Fail-safe action

Fail-safe action is triggered by the i/p converter and upon supply air failure. The positioner fully discharges its pneumatic output to the atmosphere, causing the pneumatic 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). When the air supply fails and the forced venting is triggered, all positioner functions, except open/closed loop control, remain active (including diagnostics, HART® communication as well as position and status feedback).

i Note

The pneumatic output of the positioner can also be vented to the atmosphere over the software, e.g. by entering a corresponding set point. This procedure is not a safety-instrumented function.

Safety-related functions

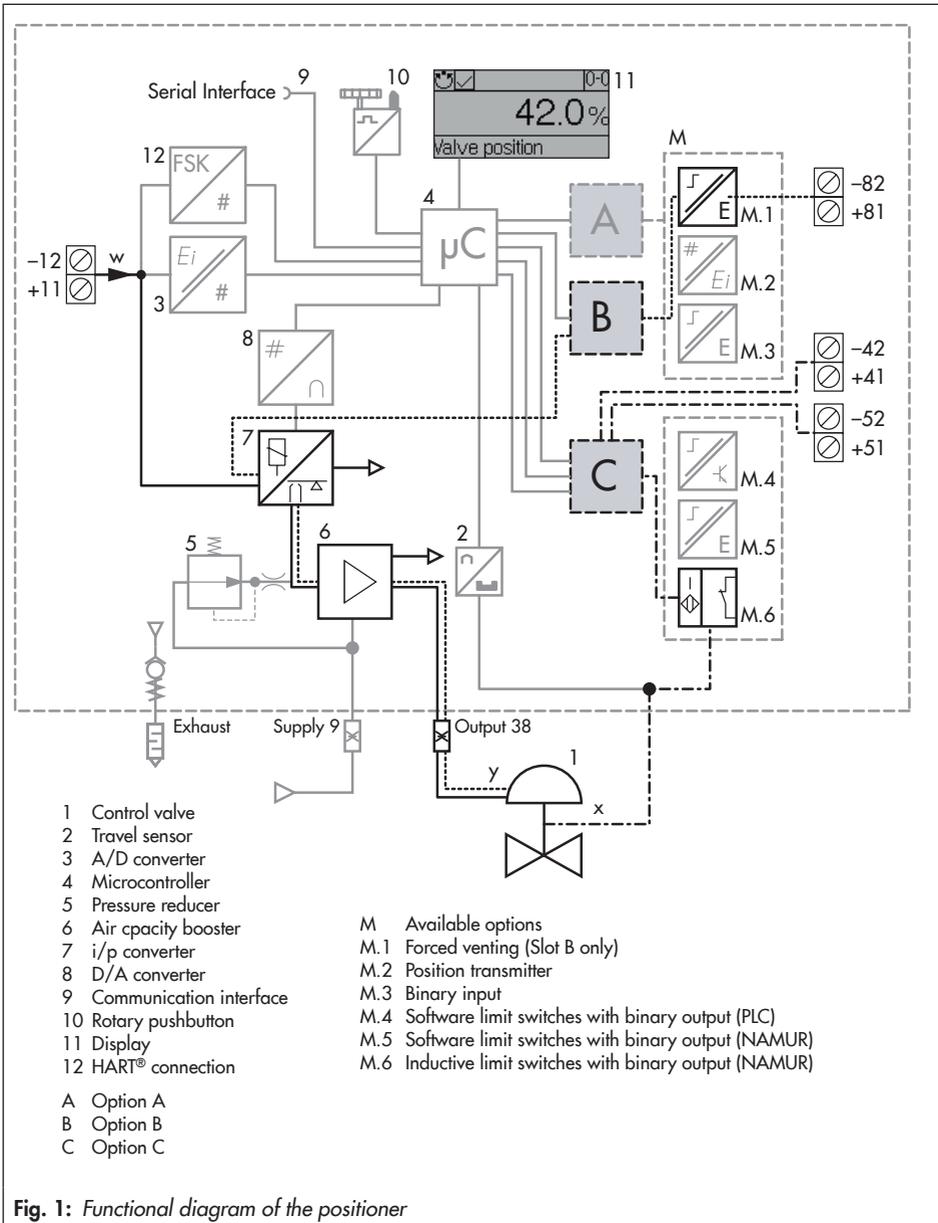


Fig. 1: Functional diagram of the positioner

3.2 Protection against unauthorized changes to the configuration

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

4 Mounting, connection and start-up

Refer to Mounting and Operating Instructions ► EB 8484-3 for details on how to mount, perform the electric and pneumatic connections as well as start up the positioner.

Only use the specified original mounting parts and accessories.

4.1 Electrical connection

→ Connect the electrical power (mA signal) as shown in Fig. 2.

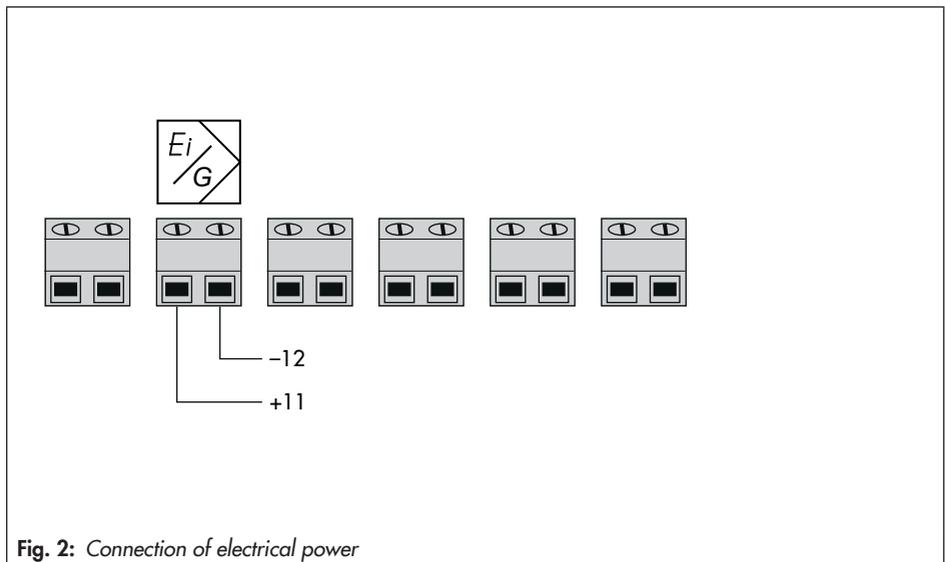
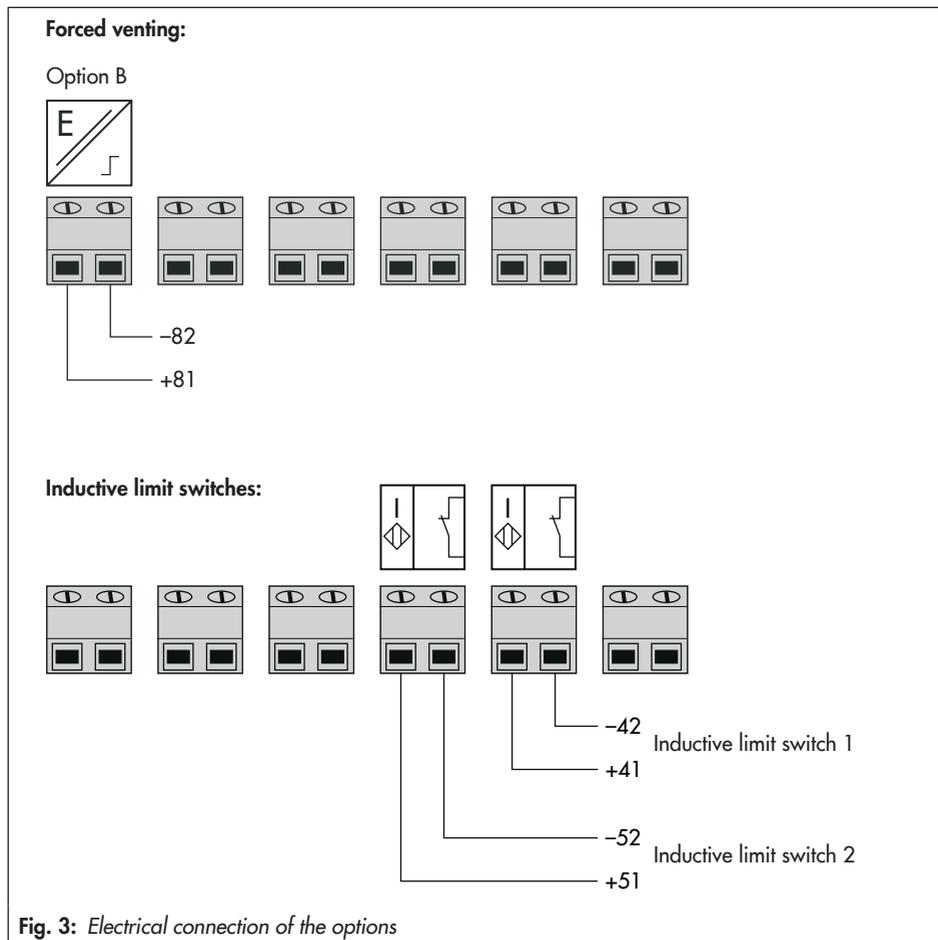


Fig. 2: Connection of electrical power

Mounting, connection and start-up

→ Connect options as shown in Fig. 3.



5 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. The same applies to the mounted positioner.

5.1 Selection

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

Tip

The minimum transit times for supply and exhaust can be read in menu items 7.27.11/7.27.12 after the positioner has been initialized.

- The positioner is suitable for the prevailing ambient temperature.
 - See Table 'Permissible ambient temperatures of SIL functions' on page 10
- The temperature limits are observed.

5.2 Mechanical and pneumatic installation

→ The positioner is mounted properly as described in the mounting and operating instructions and connected to the air supply.

Tip

The corresponding error messages indicate incorrect attachment (► EB 8484-3, 'Malfunctions' section). For safety-instrumented systems, we recommend assigning the 'Failure' status to these errors to quickly recognize them when they occur (indicated by  on the display).

→ The actuator used is single acting with a spring-return mechanism.

Required conditions

- The actuator used does not have a pneumatic or electric lock-up device, travel stop or handwheel.
- The maximum supply pressure does not exceed 7 bar.
- The actuator's bench range must be designed to ensure that a sufficient tight-closing force exists even with 0.2 bar pressure at the pneumatic outputs. The maximum pressure at the output must be taken into account on observing the safety-instrumented function of downstream pneumatic devices.
- The pneumatic air supply meets the instrument air specifications.

Particle size and quantity	Oil content	Pressure dew point
Class 4	Class 3	Class 3
$\leq 5 \mu\text{m}$ and $1000/\text{m}^3$	$\leq 1 \text{ mg}/\text{m}^3$	$-20 \text{ }^\circ\text{C}$ 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, the SAMSON Type 4708 Supply Pressure Regulator with $5 \mu\text{m}$ filter cartridge can be used.

- The positioner is mounted as prescribed.
- The vent opening at the back of the positioner remains open when the positioner is installed on site.
The maximum pressure at the output may increase due to the higher backpressure while venting to a connected chamber.

5.3 Electrical installation

- The positioner is connected to the electric power supply properly as described in the mounting and operating instructions.
- 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 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.

5.4 Operation

- The positioner is put into operation and initialized (a positioner that has not yet been initialized is in the fail-safe position) according to the mounting and operating instructions.
- The inductive limit switch is adjusted mechanically to meet the specifications.

6 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 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}).

6.1 Visual inspection to avoid systematic failure

To avoid systematic failure, inspect the positioner 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.

6.2 Function testing

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

Note

Record any faults in the positioner and inform SAMSON of them in writing.

Emergency venting by the a mA signal connected to terminals 11/12 (control signal):

1. Supply the initialized positioner with air within the permissible supply pressure range (max. 7 bar) which allows the valve to move to the maximum travel/angle of rotation.
 2. Connect an electric input signal ≥ 3.8 mA to the positioner (terminals 11/12).
 3. Switch the positioner to automatic or manual mode (if it has not already been done).
 4. Set the input signal (terminals 11/12) over a local current source or over the control system in such a way that the valve moves to 50 % of its travel/angle of rotation.
-

Tip

The travel in automatic mode can be read at the positioner in the main display.

5. Disconnect the electric input signal (terminals 11/12) or set it to < 3.8 mA. This must cause the valve to move to its fail-safe position.

6. Check whether the actuator is fully vented within the demanded time.

Emergency venting by forced venting (signal <11 V at terminals 81/82).

1. Supply the initialized positioner with air within the permissible supply pressure range (max. 7 bar) which allows the valve to move to the maximum travel/angle of rotation.
2. Connect an electric input signal ≥ 3.8 mA to the positioner (terminals 11/12).
3. Supply the forced venting option with a voltage > 15 V DC (terminals 81/82).
4. Set the input signal (terminals 11/12) over a local current source or over the control system in such a way that the valve moves to 50 % of its travel/angle of rotation.



Tip

The travel in automatic mode can be read at the positioner in the main display.

5. Set the voltage supply of the forced venting function to < 11 V DC (terminals 81/82).
6. Check whether the actuator is fully vented within the demanded time.

Safety-related end position monitoring

1. Supply the initialized positioner with air within the permissible supply pressure range (max. 7 bar) which allows the valve to move to the maximum travel/angle of rotation.
2. Connect an electric input signal ≥ 3.8 mA to the positioner (terminals 11/12).
3. Switch the positioner to automatic or manual mode (if it has not already been done).
4. Set the input signal (terminals 11/12) over a local current source or over the control system in such a way that the valve moves to 50 % of its travel/angle of rotation.
5. Set the input signal (terminals 11/12) over a local current source or over the control system in such a way that the valve moves to the end position.
6. Check whether a signal is issued at terminals 41/42 or 51/52 (depending on the upper or lower end position) when the valve has reached the end position.

7 Maintenance and repair

Only perform the work on the positioner described in ► EB 8484-3.

NOTICE

Safety-instrumented function will be impaired if repair work is performed incorrectly.

→ Only allow trained staff to perform service and repair work.

Certificate



SIL/PL
Capability

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ID 060000000

No.: 968/V 1263.00/21

Product tested	Electro Pneumatic Positioner	Certificate holder	SAMSON AG Weismüllerstr. 3 60314 Frankfurt / Main Germany
Type designation			
Codes and standards	IEC 61508 Parts 1-2 and 4-7:2010		
Intended application	The positioners 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 positioners may be used in a redundant architecture up to SIL 3. Safety functions: TROVIS 3730-1 - Safe signaling of end positions via the inductive limit switch option - Safe venting via the i/p converter TROVIS 3730-3 - Safe signaling of end positions via the inductive limit switch option - Safe venting via the i/p converter - Safe venting via the forced venting option		
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.		
	Valid until 2026-12-10		

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 1263.00/21 dated 2021-12-09. This certificate is valid only for products, which are identical with the product tested.

TÜV Rheinland Industrie Service GmbH
Bereich Automation
Funktionale Sicherheit

Köln, 2021-12-10

Certification Body Safety & Security for Automation & Grid


Dipl.-Ing. (FH) Wolf Rückwart

Holder: **SAMSON AG**
 Weismüllerstr. 3
 60314 Frankfurt am Main
 Germany

Product tested: **Electro pneumatic positioner**
TROVIS 3730-1
TROVIS 3730-3

Results of Assessment

Route of Assessment		$2_H / 1_G$
Type of Sub-system		Type A
Mode of Operation		Low Demand Mode
Hardware Fault Tolerance	HFT	0
Systematic Capability		SC 3

Safe venting by i/p-converter

Dangerous Failure Rate	λ_D	8.80 E-08 / h	88 FIT
Safe Failure Rate	λ_G	1.55 E-07 / h	155 FIT
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	3.92 E-04	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	3.93 E-05	

Safe venting via "forced venting" option

Dangerous Failure Rate	λ_D	8.80 E-08 / h	88 FIT
Safe Failure Rate	λ_G	1.55 E-07 / h	155 FIT
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	3.92 E-04	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	3.93 E-05	

Safe signaling of end position via "inductive limit switch" option

Dangerous Failure Rate	λ_D	7.10 E-08 / h	71 FIT
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	3.16 E-04	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	3.17 E-05	

Assumptions for the calculations above: DC = 0 %, $T_1 = 1$ year, MRT = 72 h, $\beta_{1oo2} = 10$ %

Origin of failure rates

The stated failure rates for low demand 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.

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.

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.

SH 8484-3 EN



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