The mounting and operating instructions for all supplied devices are included in the delivery. The latest versions of the documents are available on our website at www.samson.de > Product documentation. You can enter the document number or type number in the [Find:] field to look for a document.

**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 8384-3 contains information relevant for the use of the Type 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 the Mounting and Operating Instructions EB 8384-3 on how to mount the positioner, perform the electric and pneumatic connections as well as start up the positioner. Observe the warnings and safety instructions written in the Mounting and Operating Instructions EB 8384-3.

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.

Type 3730-3 Positioner with HART® communication

- T 8384-3: Data sheet
- EB 8384-3*: Mounting and operating instructions
- KH 8384-3*: Configuration instructions for HART® communication
- KA 8384-2/3*: Quick guide

EXPERTplus diagnostics (Type 3730-3 Positioner in firmware version 1.50 and higher)

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

EXPERT+ diagnostics (Type 3730-3 Positioner up to firmware version 1.49)

- T 8388: Data sheet
- EB 8388: Operating instructions

💬 Note
In addition to the positioner documentation, observe the documentation for the pneumatic actuator, valve, and other valve accessories.
Contents

1. Scope ........................................................................................................... 5
2. Technical data (excerpt from EB 8384-3) ............................................. 6
3. Safety-related functions ............................................................................ 8
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7. Repairs ..................................................................................................... 15
# 1 Scope

**General**

The Type 3730-3 Electropneumatic 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.

**Use in safety-instrumented systems**

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

---

**Note**

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

---

**Versions and ordering data**

Apart from the low-temperature version with metal cable gland, all versions of the Type 3730-3 Positioner are suitable for use in safety-instrumented systems. However, the optional equipment affects the safety-related behavior of the positioner. These options are the inductive limit contact SJ2-SN and the solenoid valve.

The article code written on the nameplate provides details on the optional equipment of the positioner:
Technical data (excerpt from EB 8384-3)

<table>
<thead>
<tr>
<th>Type 3730-3 Positioner</th>
<th>x x x x x x x 0 x 0 0 x x</th>
</tr>
</thead>
</table>

**Option (additional equipment)**

- Without inductive limit contact 0
- With inductive limit contact SJ2-SN (NAMUR NC contact) 1
- Without solenoid valve 0
- With 24 V DC solenoid valve 4

**Attachment**

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

- Direct attachment to SAMSON Type 3277 Actuators
- Attachment to linear actuators according to IEC 60534-6 (NAMUR)
- Attachment to linear actuators according to VDI/VDE 3847
- Attachment to SAMSON Type 3510 Micro-flow Valve
- Attachment to rotary actuators according to VDI/VDE 3845, fixing levels 1 and 2

2 Technical data (excerpt from EB 8384-3)

<table>
<thead>
<tr>
<th>Type 3730-3 Positioner: also observe the technical data in the test certificates for explosion-protected versions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference variable  w</td>
</tr>
<tr>
<td>Signal range</td>
</tr>
<tr>
<td>Static destruction limit</td>
</tr>
<tr>
<td>Minimum current</td>
</tr>
<tr>
<td>Load impedance</td>
</tr>
<tr>
<td>Supply air</td>
</tr>
<tr>
<td>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</td>
</tr>
<tr>
<td>Signal pressure (output)</td>
</tr>
<tr>
<td>Hysteresis</td>
</tr>
</tbody>
</table>
**Technical data (excerpt from EB 8384-3)**

<table>
<thead>
<tr>
<th>Type 3730-3 Positioner: also observe the technical data in the test certificates for explosion-protected versions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensitivity</strong></td>
</tr>
<tr>
<td><strong>Transit time</strong></td>
</tr>
<tr>
<td><strong>Air output capacity</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Permissible ambient temperature</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Use in safety-instrumented systems (SIL)</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Safety-relevant options**

**Solenoid valve · Approval according to IEC 61508/SIL · Emergency venting function**

<table>
<thead>
<tr>
<th>Input</th>
<th>24 V DC · Electrical isolation and reverse polarity protection · Static destruction limit 40 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current consumption $I = \frac{U - 5.7 , V}{3840 , \Omega}$ (corresponding to 4.8 mA at 24 V/114 mW)</td>
<td></td>
</tr>
<tr>
<td>Signal '0' (no response)</td>
<td>&lt;12 V (emergency shutdown at 0 V)</td>
</tr>
<tr>
<td>Signal '1' (response)</td>
<td>&gt;19 V</td>
</tr>
<tr>
<td>Service life</td>
<td>$&gt;5 \times 10^6$ switching cycles</td>
</tr>
<tr>
<td>$K_V$ coefficient</td>
<td>0.15</td>
</tr>
</tbody>
</table>

**Use in safety-instrumented systems acc. to IEC 61508/SIL**

| Same as positioner pneumatics |

**Inductive limit contact by Pepperl+Fuchs · Function: safety-related end position monitoring**

<table>
<thead>
<tr>
<th>For connection to switching amplifier according to EN 60947-5-6. Can be used in combination with a software limit contact.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SJ2-SN proximity switch</td>
</tr>
</tbody>
</table>
3 Safety-related functions

1. **Emergency venting over the i/p converter** (Fig. 1 path ————)

   In automatic operation, the PD controller (3) compares the actual value to the DC control signal from 4 to 20 mA coming from the microcontroller. In case of a system deviation, the activation of the i/p converter is changed so that the actuator (1) is either vented or filled with air. Fail-safe action is triggered when no signal (0 mA) is applied to terminals 11/12 and, as a result, to the i/p converter.

2. **Emergency venting over the optional solenoid valve** (Fig. 1 path ————)

   The solenoid valve (12) is energized by a 24 V DC voltage signal. Fail-safe action is triggered when no signal (0 mA) is applied to terminals 81/82. This causes the solenoid valve (12) to vent the output of the i/p converter to the atmosphere. The actuator is vented as well.

3. **Safety-related end position monitoring over the optional inductive limit contact** (Fig. 1 path ————)

   The inductive limit contact SJ2-SN (NAMUR NC contact) indicates the adjusted end position in a safety-instrumented system at terminals 41/42. See EB 8384-3 for adjusting the limit contacts.

**Fail-safe action**

Fail-safe action is triggered by the i/p converter or solenoid valve and upon supply air failure. The positioner 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).

When the air supply fails and the optional solenoid valve is de-energized, all positioner functions, except open/closed loop control, remain active (including diagnostics, HART® communication as well as position and status feedback).

---

**Note**

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

**Protection against unauthorized changes to the configuration**

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

Fig. 1: Functional diagram of the positioner

1. Control valve
2. Travel sensor
3. PD controller
4. A/D converter
5. Microcontroller
6. i/p converter
7. Air capacity booster
8. Pressure regulator
9. Flow regulator
10. Volume restriction
11*. Inductive limit contact
12*. Solenoid valve
13* Analog position transmitter
14. Software limit contact, alarm 1/2
15. Fault alarm output, alarm 3
16. Display
17*. Actuation of solenoid valve
18*. Electrical insulation
19. D/A converter
20. Communication interface
21. HART® connection
22. Binary input BE*

* Options
4 Mounting, connection, and start-up

Refer to Mounting and Operating Instructions EB 8384-3 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.

Fig. 2: Electrical connection
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 after the necessary conditions in the plant have been fulfilled. The same applies to the mounted positioner.

**Selection**

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

  **Tip**
  
  The minimum OPEN and CLOSE transit times can be read in Codes 40 and 41 after the positioner has been initialized.

- The positioner is suitable for the prevailing ambient temperature.

<table>
<thead>
<tr>
<th>Versions</th>
<th>Temperature range</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>−20 to +80 °C</td>
</tr>
<tr>
<td>With metal cable gland</td>
<td>−45 to +80 °C</td>
</tr>
</tbody>
</table>

The limits in the test certificates additionally apply to explosion-protected versions.

- The temperature limits are observed.

**Mechanical and pneumatic installation**

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

  **Tip**
  
  Error codes 50 to 58 indicate incorrect attachment. For safety-instrumented systems, we recommend assigning the 'Maintenance alarm' status to these errors to quickly recognize them when they occur (indicated by \(\text{I}\) on the display).

- The maximum supply pressure does not exceed 7 bar.
- The pneumatic air supply meets the instrument air specifications.
Required conditions

<table>
<thead>
<tr>
<th>Particle size and quantity</th>
<th>Oil content</th>
<th>Pressure dew point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 4</td>
<td>Class 3</td>
<td>Class 3</td>
</tr>
<tr>
<td>≤ 5 µm and 1000/m³</td>
<td>≤ 1 mg/m³</td>
<td>−20 °C or at least 10 K below the lowest ambient temperature to be expected</td>
</tr>
</tbody>
</table>

**Tip**

*We recommend installing a supply pressure regulator/filter upstream of the positioner. For example, the SAMSON Type 4708 Supply Pressure Regulator with 5 µm filter cartridge can be used.*

- The supply air line has a minimum inside diameter of 4 mm. Select the cross section and length of the line to ensure that the supply pressure at the positioner on filling the actuator with air does not fall below the minimum limit.
- The positioner is mounted as prescribed.
- The vent opening at the back of the positioner remains open when the positioner is installed on site.

**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.

**Operation**

- When the optional inductive limit contact is used, Code 38 is set to YES.
- The inductive limit contact 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 (PFDavg).

Function testing

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

ℹ️ Note

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

Emergency venting by applying a 0 mA signal to terminals 11/12 (control signal):

1. Apply supply air within the permissible range (max. 7 bar) to the positioner which allows the valve to move to the maximum travel/angle of rotation.
2. Apply an electric input signal ≥3.6 mA to the positioner (terminals 11/12).
3. Switch the positioner to automatic mode (if it has not already been done).
4. Apply 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/opening angle.

☀️ Tip

The travel in automatic mode can be read at the positioner in Code 0.

5. Set the electric input signal to 0 mA or disconnect it.

This must cause the valve to move to its fail-safe position (terminals 11/12).
6. Check whether the actuator is fully vented within the demanded time.

---

**Tip**

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

---

**Emergency venting by applying a 0 V signal to terminals 81/82 (solenoid valve):**

1. Apply supply air within the permissible range (max. 7 bar) to the positioner which allows the valve to move to the maximum travel/angle of rotation.
2. Apply an electric input signal $\geq 3.6$ mA to the positioner (terminals 11/12).
3. Supply the solenoid valve with a voltage $> 19$ V DC (terminals 81/82).
4. Apply 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/opening angle.

---

**Tip**

The travel in automatic mode can be read at the positioner in Code 0.

---

5. Set the voltage to 0 V DC (terminals 81/82).
6. Check whether the actuator is fully vented within the demanded time.

---

**Tip**

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

---

**Safety-related end position monitoring**

1. Apply supply air within the permissible range (max. 7 bar) to the positioner which allows the valve to move to the maximum travel/angle of rotation.
2. Apply an electric input signal $\geq 3.6$ mA to the positioner (terminals 11/12).
3. Switch the positioner to automatic mode (if it has not already been done).
4. Apply 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/opening angle.
5. Apply 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 exists at terminals 41/42 when the valve has reached the end position.
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 elastomer, 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  Repairs

Only perform the work on the positioner described in EB 8384-3.

**NOTICE**

Fail-safe action impaired due to incorrect repair.
Service and repair work must only be performed by trained staff.
Herstellererklärung

Für folgende Produkte

Stellungsregler
Typ 3730-0XXXXXXXXXXXX00...
Typ 3730-1XXXXXXXXXXXX00...
Typ 3730-2XXXXXXXXXXXX00...
Typ 3730-3XXXXXXXXXXXX00...
Typ 3730-4XXXXXXXXXXXX00...
Typ 3730-5XXXXXXXXXXXX00...

Hiermit wird bestätigt, dass das Steuerventil in den o. g. Stellungsreglern gemäß IEC 61508 für den Einsatz in sicherheitsgerichteten Kreisen geeignet ist.

Die Stellungsregler haben eine HFT von 0 und können nach IEC 61511 bis SIL 2 (einzelnes Gerät, HFT = 0) und SIL 3 (redundante Verschaltung, HFT = 1) eingesetzt werden. Die Geräte sind nach Typ A eingestuft.

Die Konformität des Entwicklungsprozesses, der durchgeführten FMEDA und der Aussagen dieser Herstellererklärung sind von der TÜV Rheinland Industrie Service durch das Zertifikat V60 2012 C8 vom Dezember 2012 zertifiziert.

Safety-related assumptions

When the i/p converter and/or the optional solenoid valve are used, the single-acting positioner discharges its pneumatic output to the atmosphere, causing the mounted actuator to be vented.

Sicherheitstechnische Kenndaten

\[
\begin{array}{|c|c|}
\hline
\text{Parameter} & \text{Wert} \\
\hline
\lambda_{\text{safe, undetected}} & 9 \text{ FIT} \\
\lambda_{\text{safe, detected}} & 0 \text{ FIT} \\
\lambda_{\text{dangerous, undetected}} & 1 \text{ FIT} \\
\lambda_{\text{dangerous, detected}} & 0 \text{ FIT} \\
\text{PFD}_{\text{avg}} \text{ bei jährlicher Prüfung} & 4.2 \cdot 10^{-6} \\
\text{HFT} & 0 \\
\text{Gerätetyp} & \text{A} \\
\text{SFF (Safe Failure Fraction)} & 90 \% \\
\text{MTBF}_{\text{erwartet}} & 11940 \text{ Jahre} \\
\text{MTBF}_{\text{dangerous, undetected}} & 119530 \text{ Jahre} \\
\hline
\end{array}
\]

1 FIT = 1 Ausfall pro 10^6 Stunden

Safety-related data

\[
\begin{array}{|c|c|}
\hline
\text{Parameter} & \text{Wert} \\
\hline
\lambda_{\text{safe, undetected}} & 9 \text{ FIT} \\
\lambda_{\text{safe, detected}} & 0 \text{ FIT} \\
\lambda_{\text{dangerous, undetected}} & 1 \text{ FIT} \\
\lambda_{\text{dangerous, detected}} & 0 \text{ FIT} \\
\text{PFD}_{\text{avg}} \text{ with annual test} & 4.2 \cdot 10^{-6} \\
\text{HFT} & 0 \\
\text{Device type} & \text{A} \\
\text{Safe failure fraction (SFF)} & 90 \% \\
\text{MTBF}_{\text{total}} & 11940 \text{ years} \\
\text{MTBF}_{\text{dangerous, undetected}} & 119530 \text{ years} \\
\hline
\end{array}
\]

1 FIT = 1 failure per 10^6 hours
Nutzbare Gebrauchsdauer

Nach IEC 61508-2 Abschnitt 7.4.9.5 können acht bis zwölf Jahre angenommen oder ein Wert benutzt werden, der sich durch Betriebsbewährung des Anwenders ergibt.

Bestimmungsgemäße Verwendung

– Bedienungsanleitung
– Sicherheitsanleitung + TV-SK 9838
– Anforderung an Instrumentenluft-Qualität

Das sicherheitsermöglichte Entlüften kann wie folgt ausgelöst werden:

– Der elektrische Eingang des Stellungsreglers wird energielos gesetzt.
  o Typen 3730-0/-1/-2/-3: 0 mA an den Klemmen 11/12
  o Typen 3730-4/-5: Spannungspegel 0 V an den Klemmen: IEC 1158-2

– Der elektrische Eingang des optionalen Magnetventils wird energielos gesetzt.
  o Typen 3730-2/-3/-4/-5: Spannungspegel 0 V DC an den Klemmen: 81/82

Hinweis!


Voraussetzungen


Useful lifetime

According to IEC 61508-2, section 7.4.9.5, a useful lifetime of eight to twelve years can be assumed. Other values can be used based on the user’s previous experience (prior use/proven-in-use).

Intended use

– Operating instructions
– Safety manual + TV-SK 9838
– Quality requirements for instrument air

Emergency venting can be triggered as follows:

– The electrical input of the positioner is de-energized.
  o Types 3730-0/-1/-2/-3: 0 mA at terminals 11/12
  o Types 3730-4/-5: 0 V voltage level at terminals "IEC 1158-2"

– The electrical input of the optional solenoid valve is de-energized.
  o Types 3730-2/-3/-4/-5: 0 V DC voltage level at terminals 81/82

Note!

The Types 3730-2/-3/-4/-5 Positioners come with extensive diagnostic functions. They assess the condition of the positioner as well as of the control valve it is mounted on. The safety-related data can be improved by using the diagnostics. Diagnostics also serve to reveal undetected systematic failures (refer to VDI 2180, sheet 5).

Requirements

Short mean time to repair compared to the average rate of demand. Normal exposure to industrial environment and fluids is assumed. The user is responsible for ensuring that the device is used as intended.