Assembly and operating manual

PA 3

Pneumatic monitoring

Superior Clamping and Gripping

SCHUNK®

Imprint

Technical changes:

We reserve the right to make alterations for the purpose of technical improvement.

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Dear Customer,

thank you for trusting our products and our family-owned company, the leading technology supplier of robots and production machines.

Our team is always available to answer any questions on this product and other solutions. Ask us questions and challenge us. We will find a solution!

Best regards,

Your SCHUNK team

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1 General

1.1 About this manual

This manual contains important information for a safe and appropriate use of the product.

This manual is an integral part of the product and must be kept accessible for the personnel at all times.

Before starting work, the personnel must have read and understood this operating manual. Prerequisite for safe working is the observance of all safety instructions in this manual.

Illustrations in this manual are provided for basic understanding and may differ from the actual product design.

In addition to these instructions, the documents listed under Applicable documents [▶ 5] are applicable.

1.1.1 Presentation of Warning Labels

To make risks clear, the following signal words and symbols are used for safety notes.

⚠ DANGER

Danger for persons!

Non-observance will inevitably cause irreversible injury or death.

⚠ WARNING

Dangers for persons!

Non-observance can lead to irreversible injury and even death.

⚠ CAUTION

Dangers for persons!

Non-observance can cause minor injuries.

NOTICE

Material damage!

Information about avoiding material damage.

1.1.2 Applicable documents

- General terms of business*
- Catalog data sheet of the purchased product *

The documents marked with an asterisk (*) can be downloaded on our homepage **schunk.com**

1.2 Warranty

If the product is used as intended, the warranty is valid for 24 months from the ex-works delivery date under the following conditions:

- Observe the specified maintenance and lubrication intervals
- Observe the ambient conditions and operating conditions

Parts touching the workpiece and wear parts are not included in the warranty.

1.3 Scope of delivery

The scope of delivery includes

- Pneumatic monitoring PA 3 in the version ordered
- Connection line 7 x 0.25 mm^2 + shield

2 Basic safety notes

2.1 Intended use

The PA3 has been designed as means of pneumatic monitoring for three positions.

For systems which cannot be monitored by means of conventional sensors.

- The product may only be used within the scope of its technical data, Technical data [▶ 8].
- The product is intended for installation in a machine/system. The applicable guidelines must be observed and complied with.
- The product is intended for industrial and industry-oriented use.
- Appropriate use of the product includes compliance with all instructions in this manual.

2.2 Inappropriate use

The product is not a safety component in accordance with the EC Machine Directive 2006/42/EC and must not be used in safety-relevant parts of machine control units.

2.3 Environmental and operating conditions

Required ambient conditions and operating conditions

Incorrect ambient and operating conditions can make the product unsafe, leading to the risk of serious injuries, considerable material damage and/or a significant reduction to the product's life span.

- Make sure that the product is used only in the context of its defined application parameters, Technical data [▶ 8].
- Make sure that the environment is free from splash water and vapors as well as from abrasion or processing dust. Exceptions are products that are designed especially for contaminated environments.

2.4 Constructional changes

Implementation of structural changes

By conversions, changes, and reworking, e.g. additional threads, holes, or safety devices can impair the functioning or safety of the product or damage it.

- Structural changes should only be made with the written approval of SCHUNK.

2.5 Personnel qualification

Inadequate qualifications of the personnel

If the personnel working with the product is not sufficiently qualified, the result may be serious injuries and significant property damage.

- All work may only be performed by qualified personnel.
- Before working with the product, the personnel must have read and understood the complete assembly and operating manual.
- Observe the national safety regulations and rules and general safety instructions.

2.6 Notes on particular risks

⚠ DANGER

Danger from electric voltage!

Touching live parts may result in death.

- Switch off the power supply before any assembly, adjustment or maintenance work and secure against being switched on again.
- Only qualified electricians may perform electrical installations.
- Check if de-energized, ground it and hot-wire.
- Cover live parts.

3 Technical data

Designation	PA 3
ID number	0301780
IP rating	67
Nominal voltage [VDC]	24
Min. voltage [V]	21.6
Max. voltage [V]	26.4
Nominal power current [A]	0.03
Max. current [A]	0.13
Weight [kg]	1.13
Hose connection [mm]	6
Min. pressure [bar]	3
Max. pressure [bar]	10
Permissible media	Compressed air
Typical switching time [s]	1
Ambient temperature [°C] Min. Max.	 0 60
Pressure medium	Compressed air, compressed air quality according to ISO 8573-1:7 4 4
Power supply [V]	24 ± 10%
Min. current input [mA] Max. current input [mA] (at RL ≥ 1 kΩ / output)	30 130
Switching outputs [Error, Open, Gripped, Closed]	4
Load resistance / output [kΩ]	≥ 1
Min. time span [ms] Max. time span [s]	10 30
Safety factor	1.1; 1.5; 2; 3
Nominal flow rate [l/min]	105
Bursting pressure sensors [bar]	2.5 * max. operating pressure

More technical data is included in the catalog data sheet.
Whichever is the latest version.

4 Introduction

There are always some automated solutions with which it is difficult or even completely impossible to monitor the condition of pneumatic actuators directly on site by means of electronic sensors. The PA3 pneumatic monitoring system is a monitoring system which has been developed for this application case and enables actuator conditions to be detected in rough industrial environments. The PA3 monitoring electronics are installed nearby the control cabinet and connected to the control unit with a shielded cable, whereas the pneumatic actuator is connected to the monitoring electronics with three pneumatic lines. The pressure conditions of the three pneumatic lines are evaluated by the monitoring electronics and represented by three electric signals (open, gripped, closed).

Application areas are, for example:

- Actuator monitoring in the interior of machining centers (influence of cooling lubricants)
- Actuator monitoring nearby strong magnetic fields
- Actuator monitoring in areas in which electronic sensors are forbidden

5 Design and mode of operation

NOTE

In order to monitor the condition of pneumatic actuators by means of pneumatic lines, the actuators must be designed as **double-acting cylinders**. This applies, for example, to the following actuators:

- Grippers
- Lifting cylinders
- Pneumatic clamping modules

The **PA3 pneumatic monitoring system cannot be used** for the following actuators:

- Pneumatic motor
- Pneumatic screwdrivers
- Further units which cannot be monitored by it due to the working principle of the PA3.

NOTE

All of the following observations only apply to grippers! Other pneumatic actuators can be treated in the same way! Changes to detail may be possible.

In order to determine the piston position of the cylinder, two small nozzle bore holes must be applied to the cylinder in addition to the A and B control connections. The nozzle bore holes are connected together with an AND valve and, in this way, form the C connection.

The PA3 pneumatic monitoring system contains three pressure sensors, which can then be used to evaluate the pressure conditions of the control lines.

In order to determine the gripper conditions reliably, it is necessary for the time to be measured in addition to the pressure. How long it takes to close and re-open the gripper is determined in this way. **The size of the gripper and the air pressure applied** are taken into account as a consequence. The measured time is used as slow-down time for the identification of the gripper condition in order to rule out any pressure surges when identifying the condition.

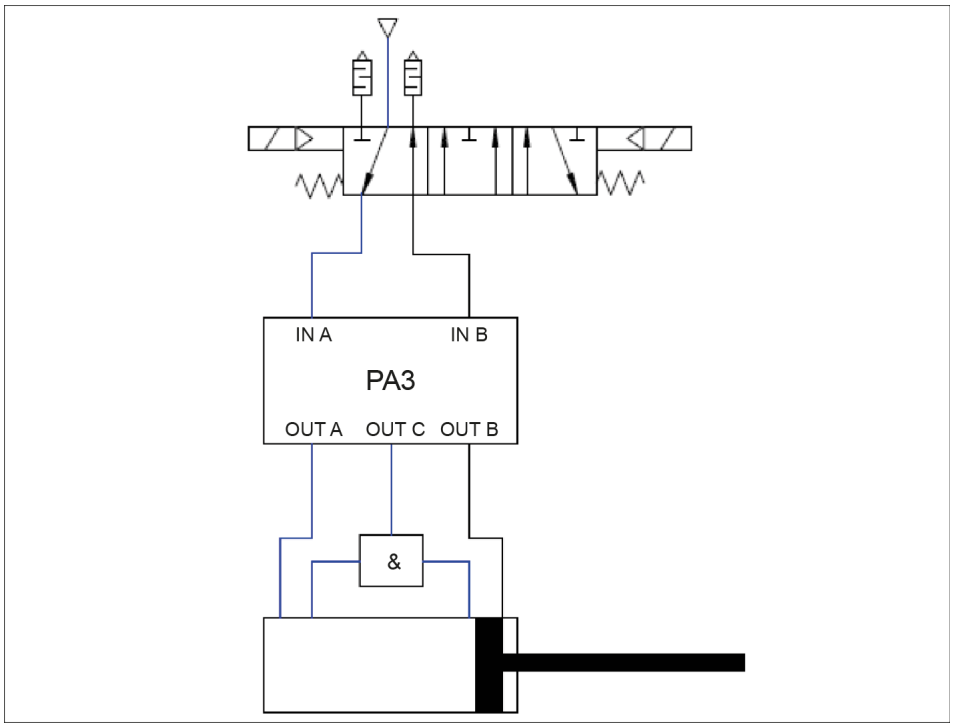
In the gripped status, the C line is ventilated by the ventilated piston chamber, which takes a certain time, depending on the hose length.

Another time factor must therefore be set in addition to the slow-down time in order to reliably determine the "gripped" status of the gripper.

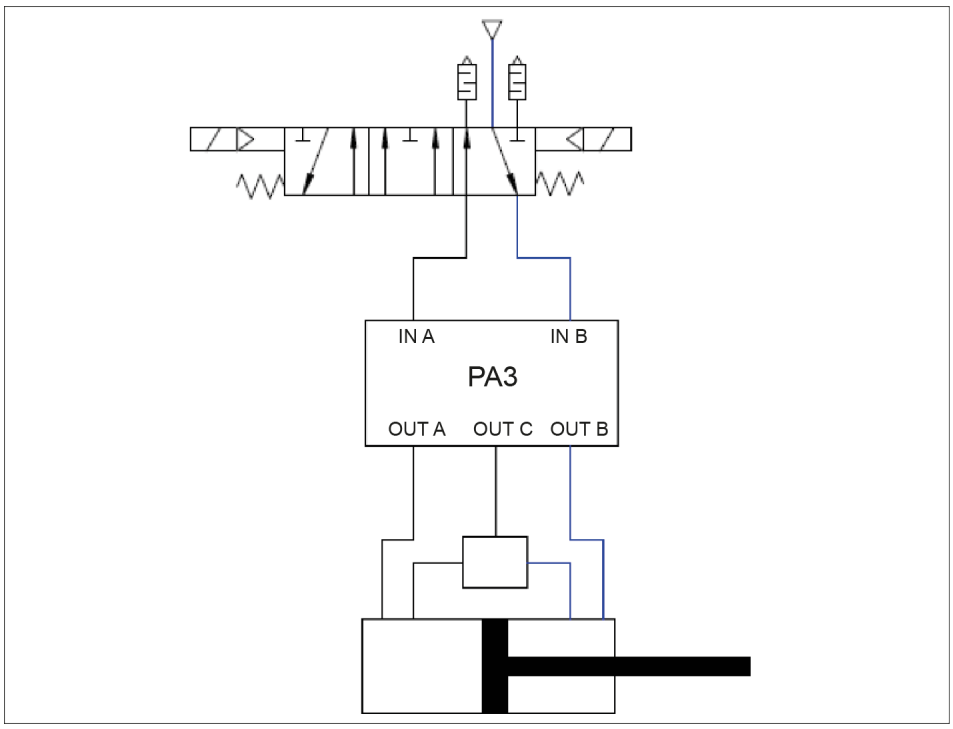
NOTE

Three incorrect interpretations are possible every 500 gripping cycles.

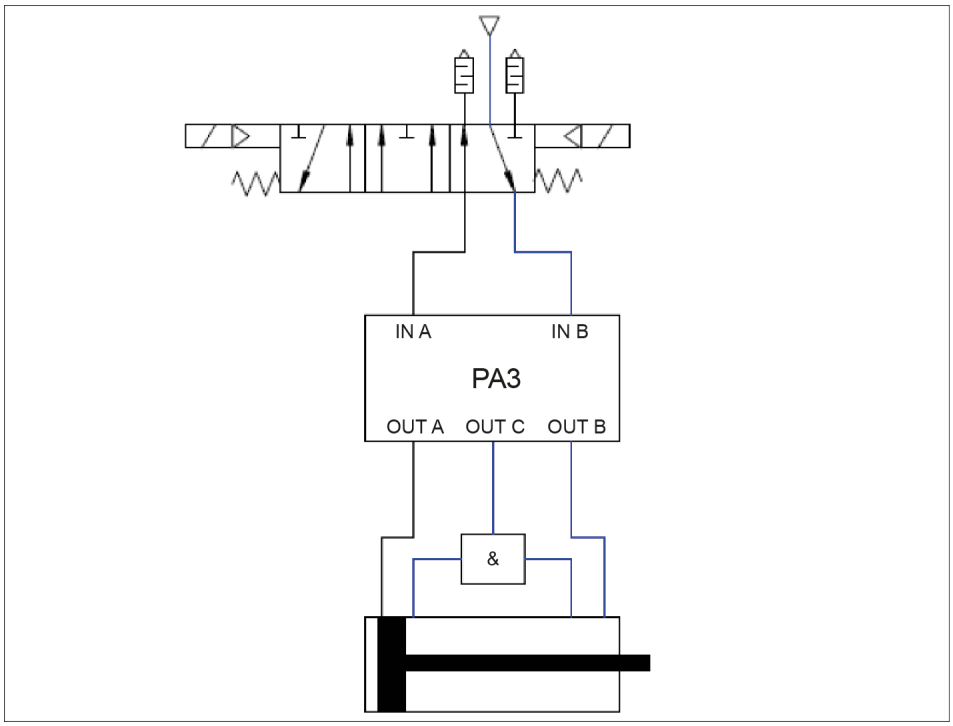
Pressure conditions in different gripper conditions:



Gripper in "open" position



Gripper in "gripped" position



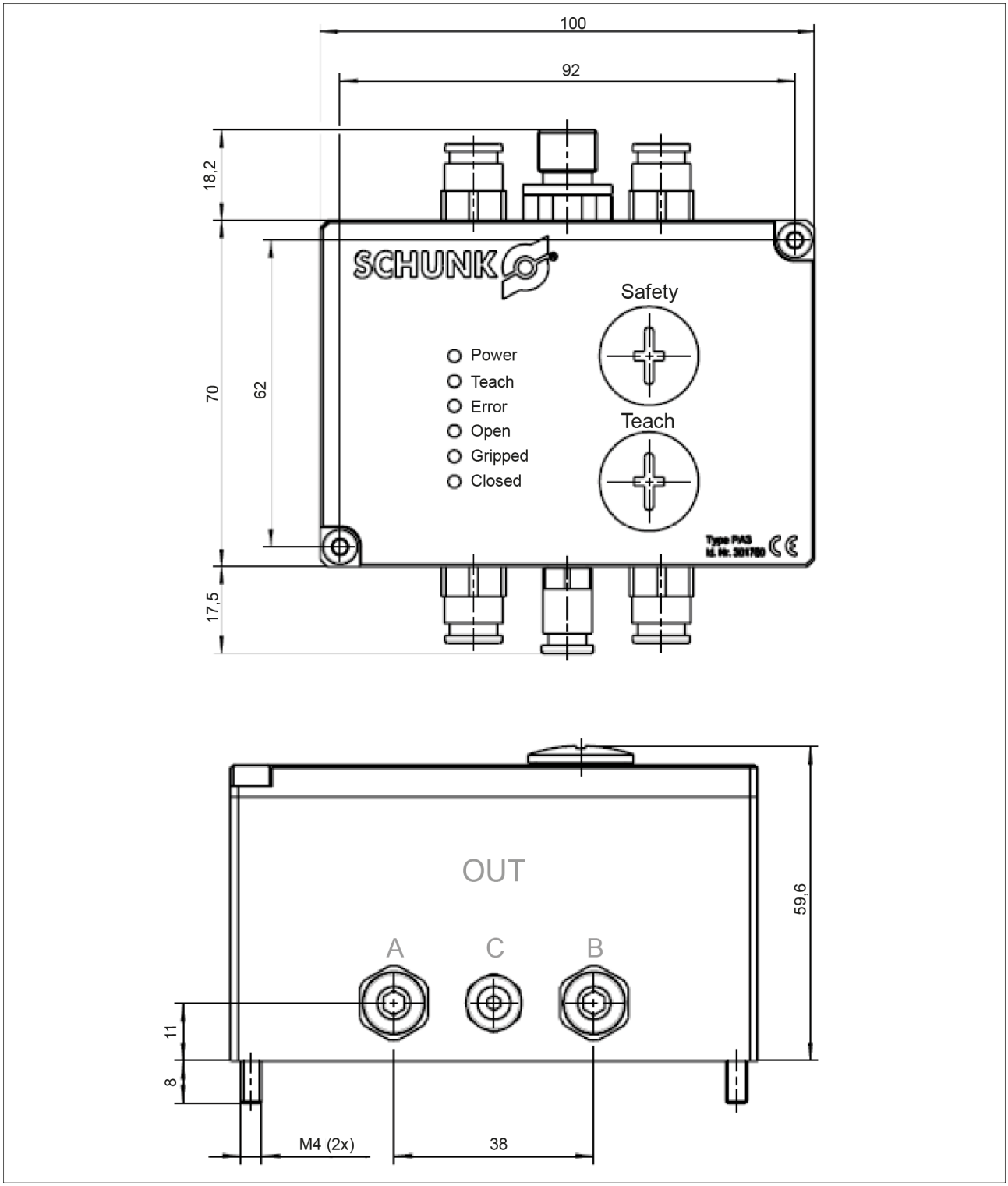
Gripper in "closed" position

6 Assembly

6.1 Mechanical connection

The PA3 pneumatic monitoring system should be installed nearby the control cabinet.

Use the following hole pattern in order to fasten the housing ideally.



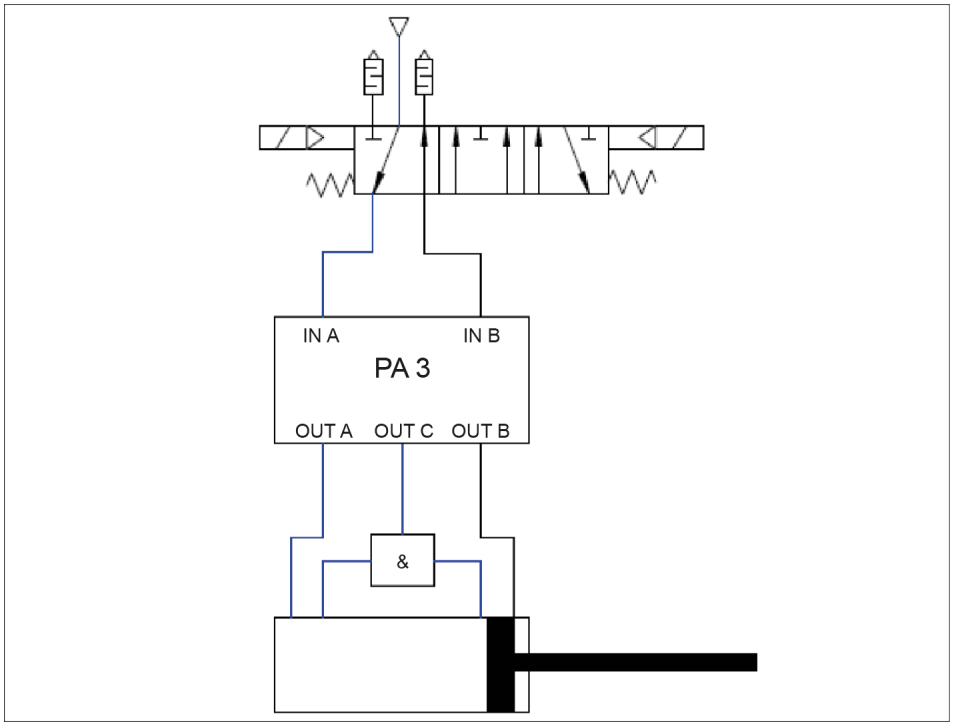
Hole pattern for housing mounting

6.2 Air connection

NOTE

In order for the electrical output signals of the PA3 pneumatic monitoring system to indicate the correct gripper condition, the gripper must be connected as follows:

- The gripper must move in "open" direction if pressure is applied to **IN A and OUT A**.
- The gripper must strive to achieve the "closed" condition if pressure is applied to **IN B and OUT B**.

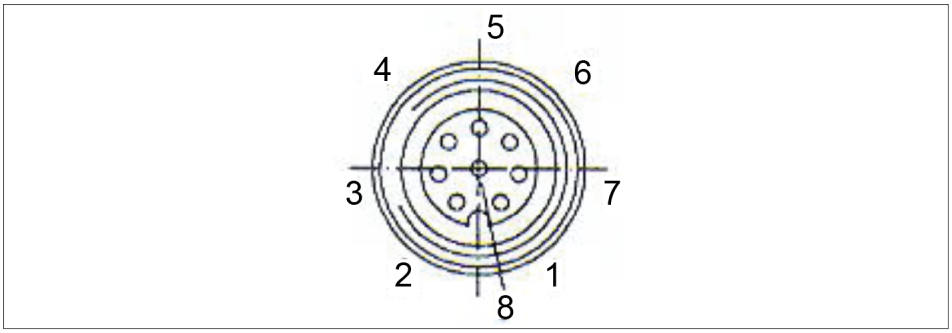


Pneumatic switching suggestion

The valves must be selected and actuated in such a manner that compressed air is always applied to a control line (either A **OR** B // "exclusive Or") **in normal mode**. This is necessary in order to evaluate the pressure flanks of the control lines.

If both control lines are ventilated, the PA3 pneumatic monitoring system indicates an error. An error is also indicated if the pressure supply **falls below 3 bar** when switching. The error LED lights up and, for safety reasons, can be reset only by switching off the supply voltage.

6.3 Electrical connection



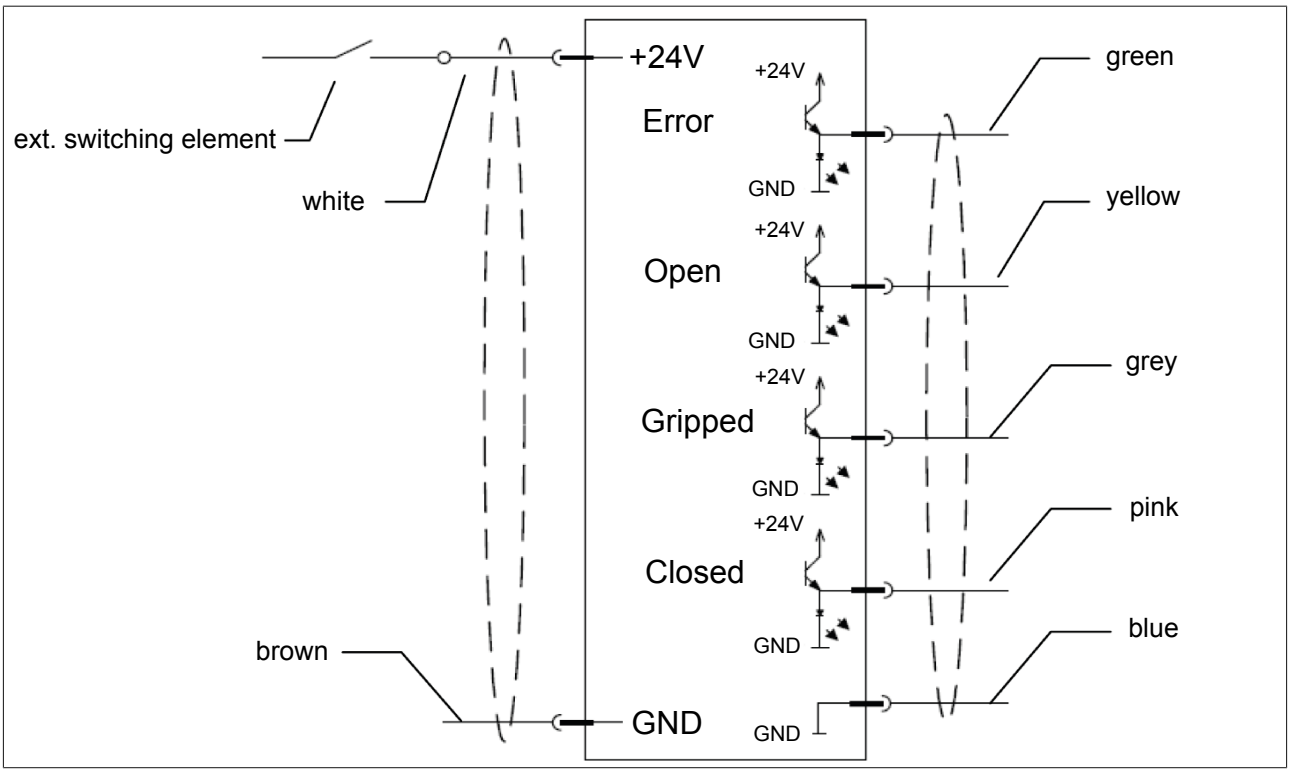
7-pin and shield

Cable assignment of the pneumatic monitoring

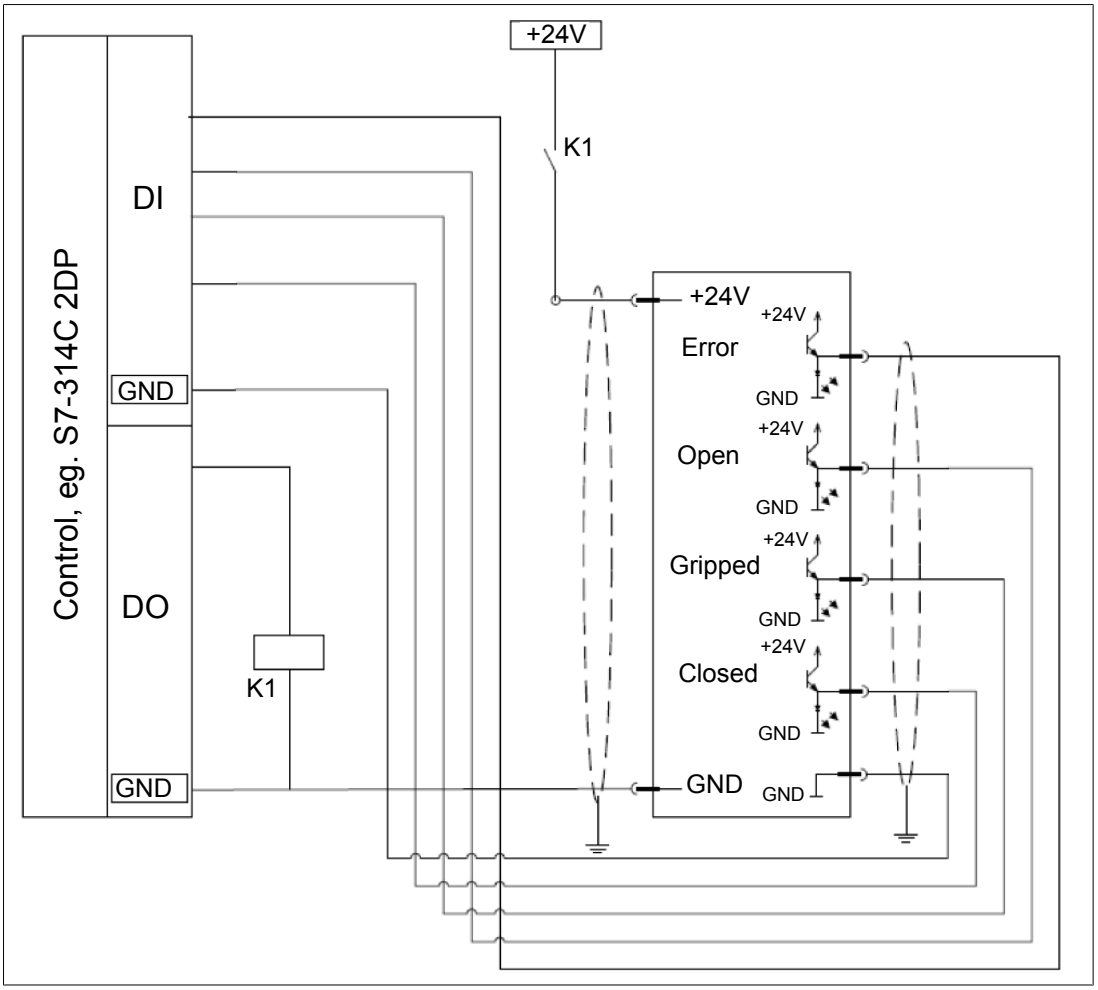
Pin no.:	Wire	Meaning
1	White	+24 V
2	Brown	0 V
3	Green	ERROR
4	Yellow	OPEN
5	Gray	GRIPPED
6	Pink	CLOSED
7	Blue	0 V
8	Shield	Shield

NOTE

If a pressure error occurs during sensor operation, it is indicated by the error LED. For safety reasons, the error LED can only be reset by switching off the power supply. For this reason, it is recommended to switch the supply voltage, for example via a relay.

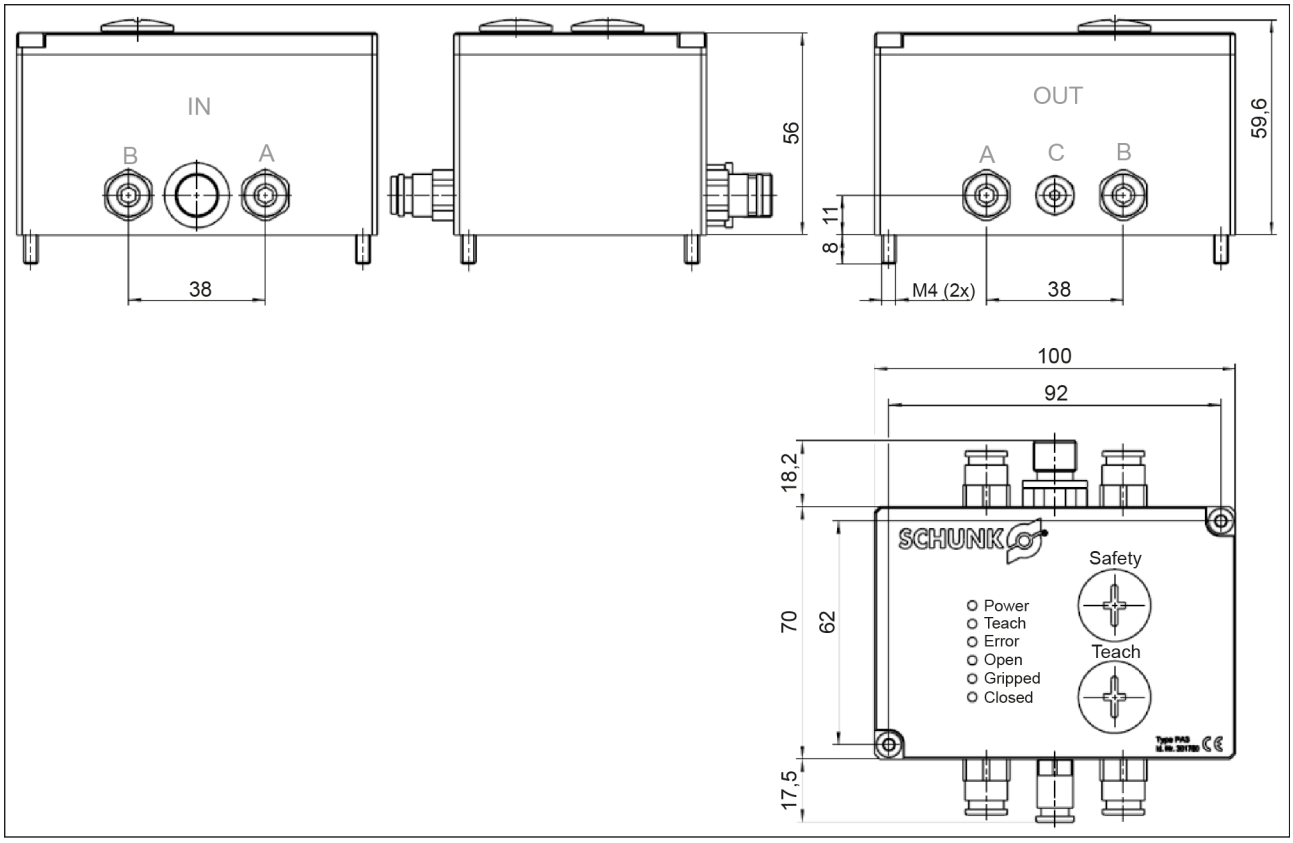


Connection overview



Suggestion for an electrical connection to a control unit

6.4 Dimensions



7 Operating modes

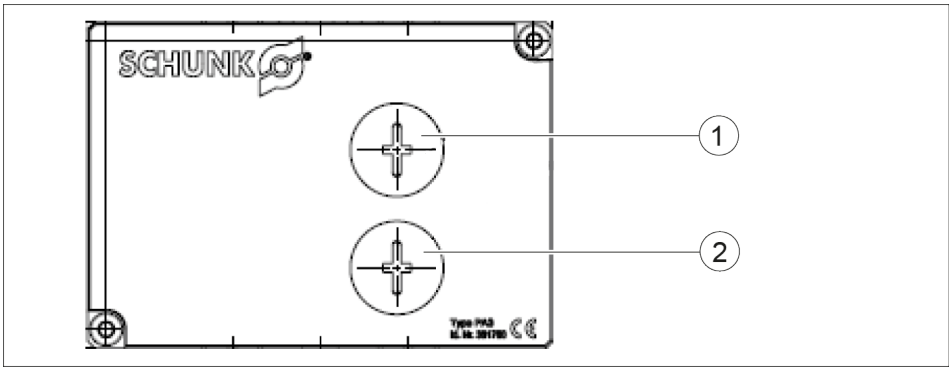
In order to take into account the size of the gripper in the evaluation, the opening and closing times are determined in teach mode, depending on the air pressure applied. In sensor mode, the actuator statuses are then indicated by the determined parameters.

7.1 Teach mode

NOTE

In order to switch the PA3 pneumatic monitoring system to teach mode:

- The operating voltage must apply.
- The gripper must be opened by the valve, i.e. pressure must be applied to the **IN A, OUT A and C** connection.
- Both cover caps must be removed from the housing cover.



- ➢ To switch to teach mode, the spring-loaded switch behind the **Teach** cover cap must be pressed with a plastic screwdriver until the **Teach LED** lights up and the **Gripped LED** starts to flash.
- ➢ Use the valve to close the gripper in order to grip the workpiece. When the workpiece is gripped, the **Gripped LED** lights up permanently and the **Closed LED** starts to flash.
- ➢ Use the valve to open the gripper. Remove the workpiece and close the gripper again. When the gripper is completely closed, the **Closed LED** lights up permanently and the **Open LED** starts to flash.
- ➢ Use the valve to open the gripper completely. The **Open LED** lights up permanently and the **Teach LED** goes out.
  - ✓ Teach mode is now finished. The unit automatically switches to sensor mode. The current gripper status is displayed.

- ➢ Grip and release the workpiece several times. Position the workpiece between the gripper fingers and open and close the gripper pneumatically. While doing so, turn the "Safety“ potentiometer **as far as possible to the right as allowed by its cycle time**.
  - ✓ The further you turn the potentiometer to the right, the longer the PA3 requires to identify the gripper condition. At the same time, however, the monitoring process becomes more resistant to external disturbance variable, such as pressure fluctuations, insufficient compressed air supply, changes in temperature or changes of the inner friction over the service life of the gripper.
- ➢ Screw the **Teach** cover cap back in again.
- ✓ The pneumatic monitoring system is now prepared for sensor operation.

7.2 Sensor mode

The PA3 pneumatic monitoring system is in sensor mode after connecting the power supply. The Run LED lights up after applying the power supply. The Teach, Error, Open, Gripped and Closed LEDs light up briefly and then go out. The current gripper status is then indicated.

The PA3 pneumatic monitoring system is now ready for operation.

The Open, Gripped and Closed LEDs go out if pressure errors occur when actuating the gripper.

The Error LED now lights up. For safety reasons, it can only go out by switching off the power supply. After connecting the power supply again, the Error LED goes out and the current gripper status is indicated again.

8 EMC test report

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Funkentstörung und elektromagnetische Verträglichkeit

Zertifiziert nach
DIN EN ISO 9001: 2000

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P R Ü F B E R I C H T

Auftraggeber	: SCHUNK GmbH & Co. KG Bahnhofstraße 106-134 D-74348 Lauffen a. N.
Messort	: NKL GmbH, D-74549 Wolpertshausen
Messdatum	: 6. September 2005
Anwesend	: Hr. Scholz
Prüfer	: R. Irion, Dipl.Ing.(FH) U. Lorenzen, Fa. NKL GmbH
Prüfgegenstand	: Pneumatische Abfrage **PA3**
Betriebsspannung	: 24 VDC
Betriebsart	: s. jeweiliges Prüf-/Messprotokoll
Prüfungen	: Störfestigkeit nach **EN 61000-6-2:2001** Störaussendung nach **EN 55011:1998 Klasse A**
Prüfergebnis	: Das Gerät erfüllt die Anforderungen der o.a. Normen ohne Modifikationen bereits im Anlieferungszustand.

Dieser Prüfbericht besteht, einschließlich dieser Seite, aus 11 Seiten, davon 10 Seiten Messprotokolle und 4 Bilder. Das Prüfergebnis bezieht sich ausschließlich auf den oben beschriebenen Prüfgegenstand. Dieser Prüfbericht darf ohne unsere schriftliche Genehmigung nur vollständig, aber nicht auszugsweise vervielfältigt werden. Die von uns verwendeten Prüfgeräte unterliegen einer regelmäßigen Kalibrierung.

Wolpertshausen, den 6. September 2005

Ralf Irion
EMV-Labor

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