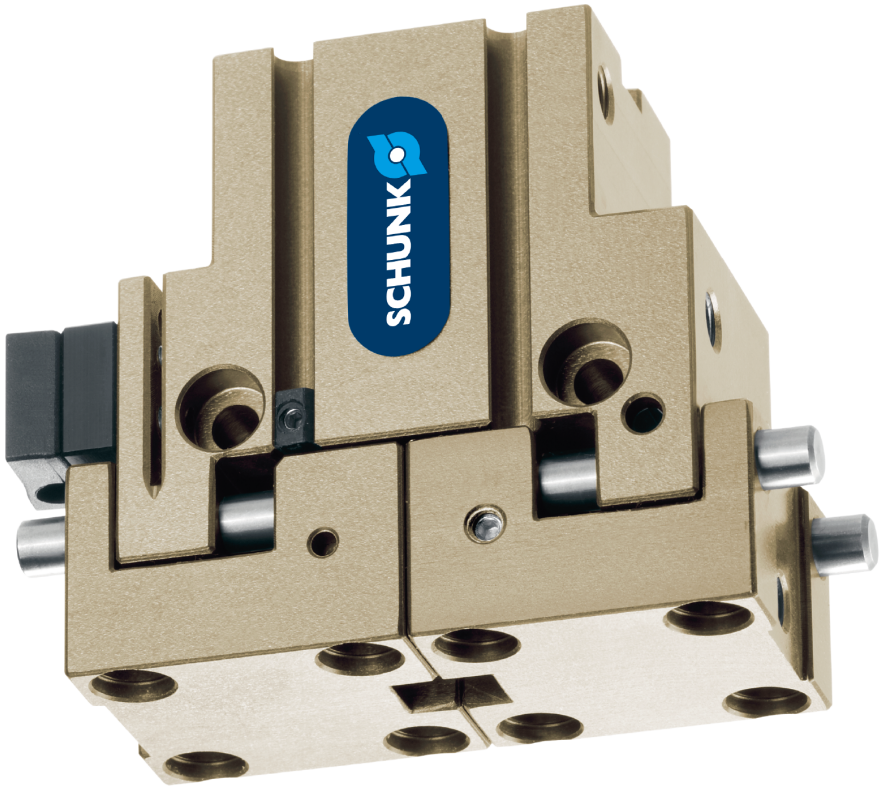
Assembly and Operating Manual

PGM 29 - 140

2-Finger Parallel Gripper



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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Table of contents

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 *
- Assembly and operating manuals of the accessories *

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

- 2-Finger Parallel Gripper PGM in the version ordered
- Assembly and Operating Manual
- Accessory pack

1.3.1 Accessories pack

Content of the accessory pack:

- 6 x Centering sleeves for mounting

ID.-No. of the accessory pack

Accessory pack for	ID number
PGM 29	5516094
PGM 38	5516095
PGM 50	5516096
PGM 60	5516097
PGM 82	5516098
PGM 96	5516099
PGM 120	5516100
PGM 140	5516101

1.4 Accessories

A wide range of accessories are available for this product

For information regarding which accessory articles can be used with the corresponding product variants, see catalog data sheet.

2 Basic safety notes

2.1 Intended use

The product is designed exclusively for gripping and temporarily holding workpieces or objects.

- The product may only be used within the scope of its technical data, Technical data [▶ 10].
- When implementing and operating components in safety-related parts of the control systems, the basic safety principles in accordance with DIN EN ISO 13849-2 apply. The proven safety principles in accordance with DIN EN ISO 13849-2 also apply to categories 1, 2, 3 and 4.
- 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 Not intended use

It is not intended use if the product is used, for example, as a pressing tool, stamping tool, lifting gear, guide for tools, cutting tool, clamping device or a drilling tool.

- Any utilization that exceeds or differs from the appropriate use is regarded as misuse.

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. See also Environmental and operating conditions [▶ 6].

- Make sure that the product and the top jaws are a sufficient size for the application.
- Ensure that maintenance and lubrication intervals are observed, Maintenance [▶ 23].

2.4 Product safety

Dangers arise from the product, if:

- the product is not used in accordance with its intended purpose.
- the product is not installed or maintained properly.
- the safety and installation notes are not observed.

Avoid any manner of working that may interfere with the function and operational safety of the product.

Wear protective equipment.

NOTE

More information is contained in the relevant chapters.

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.

The following personal qualifications are necessary for the various activities related to the product:

Trained electrician	Due to their technical training, knowledge and experience, trained electricians are able to work on electrical systems, recognize and avoid possible dangers and know the relevant standards and regulations.
Qualified personnel	Due to its technical training, knowledge and experience, qualified personnel is able to perform the delegated tasks, recognize and avoid possible dangers and knows the relevant standards and regulations.
Instructed person	Instructed persons were instructed by the operator about the delegated tasks and possible dangers due to improper behaviour.
Service personnel of the manufacturer	Due to its technical training, knowledge and experience, service personnel of the manufacturer is able to perform the delegated tasks and to recognize and avoid possible dangers.

2.6 Using personal protective equipment

When using this product, observe the relevant industrial safety regulations and use the personal protective equipment (PPE) required!

- Use protective gloves, safety shoes and safety goggles..
- Observe safe distances.

2.7 Notes on particular risks

Generally valid:

- Remove the energy supplies before installation, modification, maintenance, or adjustment work.
- Make sure that no residual energy remains in the system.
- Do not move parts by hand when the energy supply is connected.
- Do not reach into the open mechanism or the movement area of the module.
- Perform maintenance, modifications, and additions outside of the danger zone.
- For all work, secure the unit against accidental operation.
- Take a precautionary approach by maintenance and disassembly.
- Only specially trained staff should disassemble the module.

⚠ CAUTION

Possible risk of injury due to electrostatic energy!

Components or assembly groups may become electrostatically charged. When touched, the electrostatic discharge can trigger a startle response, which can result in injuries.

- The operator must ensure that all components and assembly groups are included in the local equipotential bonding in line with the applicable regulations.

NOTE

- The equipotential bonding must be installed by a specialist electrician in line with the applicable regulations, paying particular attention to the actual conditions in the working environment.
- The effectiveness of the equipotential bonding must be verified by a specialist electrician through regular safety measurements.

⚠ WARNING

Risk of injury from objects falling and being ejected!

Falling and ejected objects during operation can lead to serious injury or death.

- Take appropriate protective measures to secure the danger zone.

3 Technical data

Size	29	38	50	60	82	96	120	140
Weight [kg]	0.025	0.050	0.105	0.210	0.60	0.84	1.26	2.55
Max. permissible finger length [mm]	15	25	40	50	65	80	110	140
Max. permitted weight per top jaw [kg]	0.010	0.017	0.035	0.070	0.17	0.28	0.58	1.0
Min. ambient temperature [°C]	- 10							
Max. ambient temperature [°C]	+ 90							
Stroke per jaw [mm]	2	3	4	5	10	12	12	15
Closing force [N]	30	47	75	190	320	540	760	1180
Opening force [N]	40	63	95	210	350	580	810	1250
IP rating	30							
Noise emission [dB(A)]	≤ 70							
Pressure medium	Compressed air, compressed air quality according to ISO 8573-1:7 4 4							
Min. pressure [bar]	2							
Max. pressure [bar]	8							
Nominal working pressure [bar]	6							

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

4 Assembly

4.1 Mechanical connection

Evenness of the mounting surface

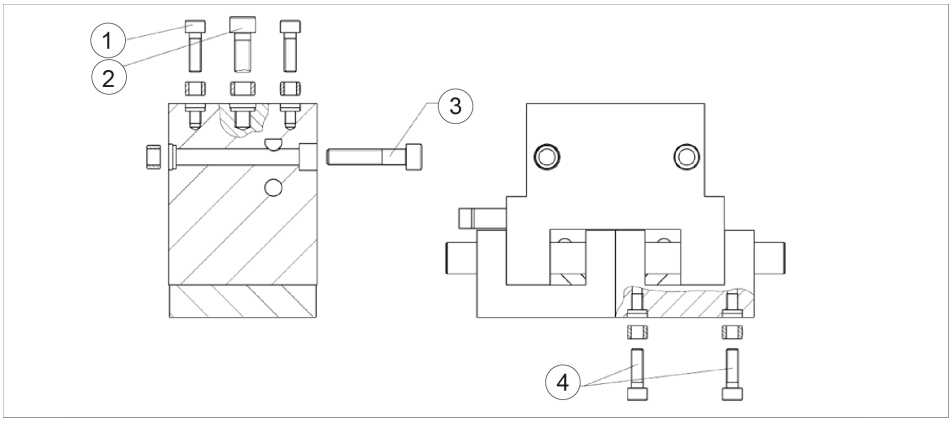
The values apply to the whole mounting surface to which the product is mounted.

Requirements for evenness of the mounting surface (Dimensions in mm)

Edge length	Permissible unevenness
< 100	< 0.02
> 100	< 0.05

Mounting

The module can be mounted from the side and rear.



Assembly options

Mounting material (provided by customer)

Item	Mounting	29	38	50	60	82	96	120	140
1	Rear module	M3 4.5 deep	-	-	-	-	-	-	M6 10 deep
2	Rear module	M2.5 4.5 deep	M3 7 deep	M4 10 deep			M6 10 deep	M6 11 deep	M8 12 deep
3	Module on the side	-	M2.5	M4			M6		M8
4	Top jaws	M3 4 deep	M3 7.5 deep	M4 8 deep		M4 10 deep	M6 10 deep	M4 11 deep	M4 12 deep

NOTE

- The centering sleeves needed for centering are supplied in the accessory pack.
- For mounting from the rear or side fix the module on the proposed fixing bores with centering sleeves.
- Mount the module using the mounting bores.
- Mount the top jaws using the mounting bores.

4.2 Air connection

NOTICE

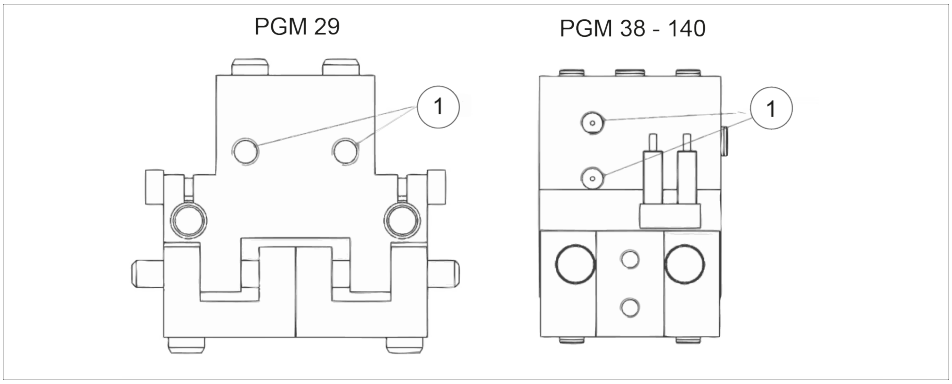
Damage to the gripper is possible!

If the maximum permissible finger weight or the permissible mass moment of inertia of the fingers is exceeded, the gripper can be damaged.

- A jaw movement always has to be without jerks and bounce.
- You must therefore implement sufficient reduction and/or damping.
- Observe the diagrams and information in the catalog data sheet.

NOTE

- Observe the requirements for the compressed air supply, Technical data [▶ 10].
- In case of compressed air loss (cutting off the energy line), the components lose their dynamic effects and do not remain in a secure position. However, the use of a SDV-P pressure maintenance valve is recommended in this case in order to maintain the dynamic effect for some time. Product variants are also offered with mechanical gripping force via springs, which also ensure a minimum clamping force in the event of a pressure drop.



Luftanschlüsse

Thread diameter of the air connections

Item	Connection	26	38	50	60	82	96	120	140
1	Hose connection (A = AUF, B = ZU)	M3	M5				G 1/8"		

- Open only the air connections that are needed.
- Close unused main air connections using the screw plugs from the enclosed pack.
- For a hose-free direction connection, use the O-rings from the enclosed pack.

4.3 Mounting the sensor

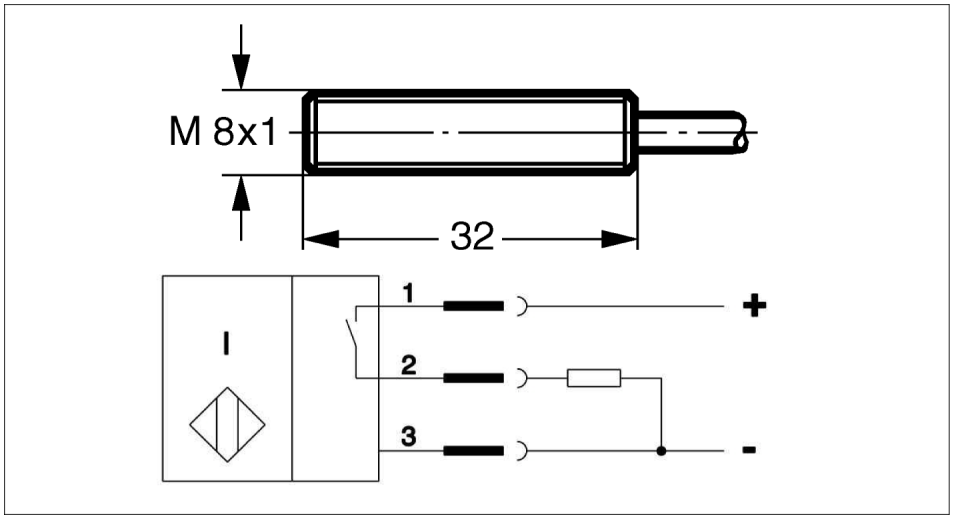
NOTE

Observe the assembly and operating manual of the sensor for mounting and connecting.

The product is prepared for the use of sensors.

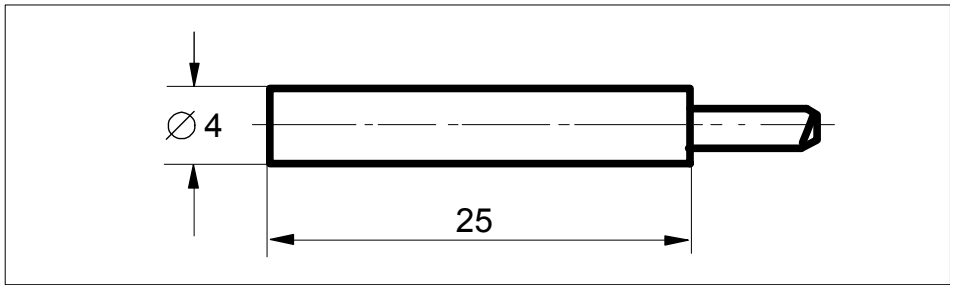
- For the exact type designations of suitable sensors, please see catalog datasheet and Link Übersicht Sensoren.
- For technical data for the suitable sensors, see assembly and operating manual and catalog datasheet.
  - The assembly and operating manual and catalog datasheet are included in the scope of delivery for the sensors and are available at schunk.com.
- Information on handling sensors is available at schunk.com or from SCHUNK contact persons.

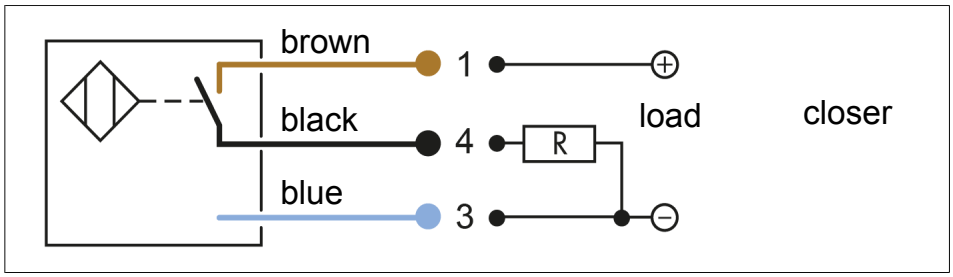
4.3.1 Proximity switch IN 40 / 80



Connection example for IN 80

1	brown	2	black	3	blue





Types that can be ordered (☞ catalog):

The inductive proximity switches used are equipped with reverse polarity protection and are short-circuit-proof.

Make sure that you handle the proximity switches properly:

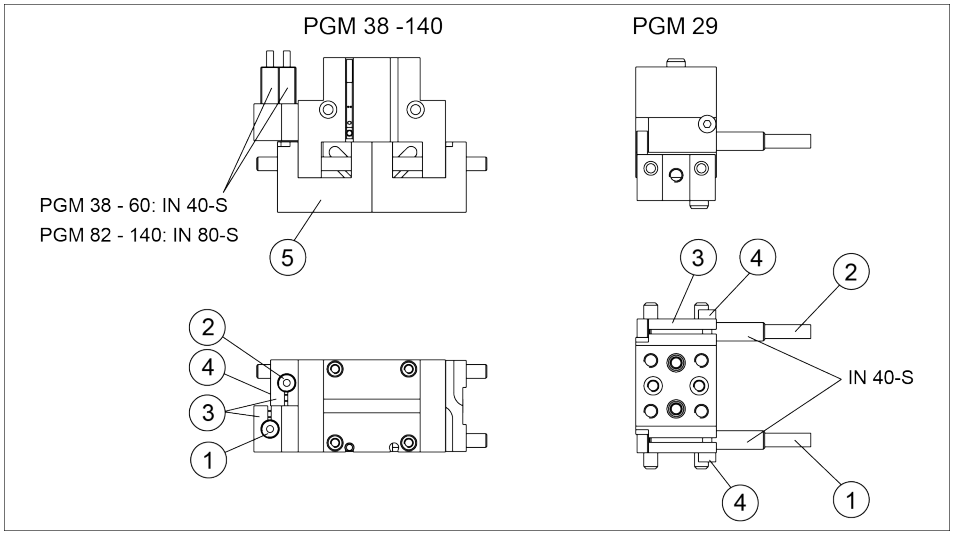
- Do not pull on the cable.
- Do not allow the sensor to dangle from the cable.
- Do not overtighten the mounting screw or mounting clip.
- Please adhere to a permitted bend radius of the cable (☞ catalog).
- Avoid contact of the proximity switches with hard objects and with chemicals, in particular nitric acid, chromic acid and sulphuric acid.

The inductive proximity switches are electronic components, which can react sensitively to high-frequency interference or electromagnetic fields.

- Check to make sure that the cable is fastened and installed correctly. Provide for sufficient clearance to sources of high-frequency interference and their supply cables.
- Parallel switching of several sensor outputs of the same type (npn, pnp) is permissible, but does not increase the permissible load current.
- Note that the leakage current of the individual sensors (approx. 2 mA) is cumulative.

Assembly of the proximity switch

The switching points of the "open" and "closed" position were set at the factory by SCHUNK.



NOTICE

The sensor may become damaged then the gripper os operated.

Observe the steps for mounting the sensor.

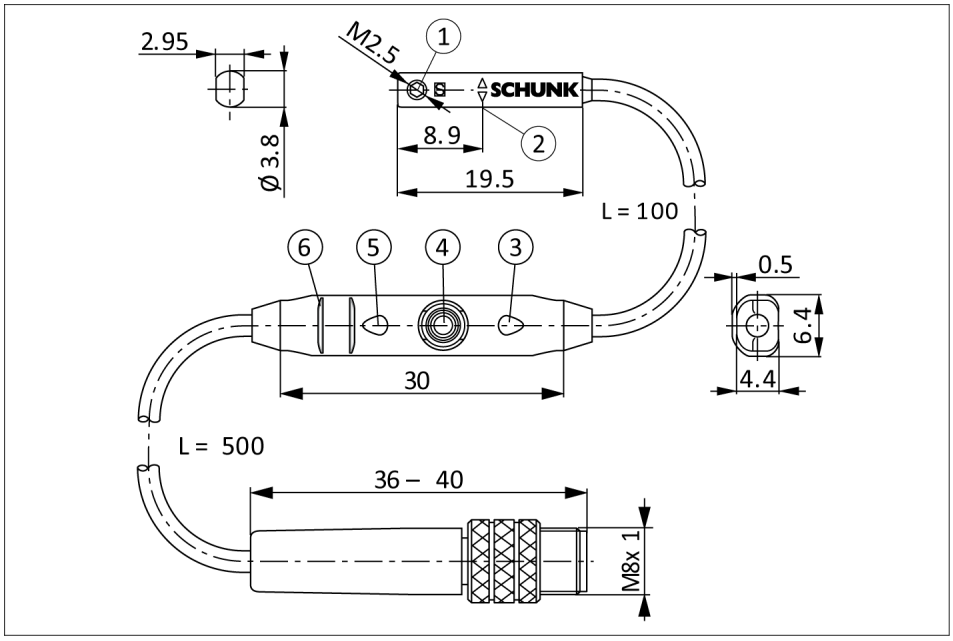
Gripper open:

- Set the gripper in position "open".
- Carefully push proximity switch 1 (1) into the bracket (3) until it touches the base jaq (5).
- Pull proximity switch 1 (1) back again by approx. 0.5mm.
- Fasten the proximity switch by tightening the screw (4). Tighten the screw (4) with max. 30Ncm.
- Test the function by closing the gripper and then opening it again.

Gripper closed:

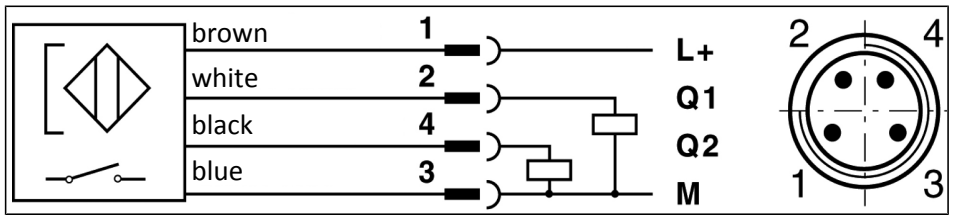
- Set the gripper in position "closed".
- Carefully push proximity switch 2 (2) into the bracket (3) until it touches the base jaw (5).
- Pull proximity switch 2 (2) back again by approx. 0.5mm.
- Fasten the proximity switch by tightening the screw (4). Tighten the screw (4) with max. 30Ncm.
- Test the function by closing the gripper and then opening it again.

4.3.2 Programmable magnetic switch (MMS-P)



Magnetic switch MMS-P 22

1	Mounting screw	4	Teach-button
2	Center sensor elements	5	LED display
3	LED display	6	Ribs for cable tires



Connection diagram PNP-4 conductor (MMS-P 22)

Types available for order (see catalog):

- MMS-P 22-S-M8-PNP
- MMSK-P 22-S-PNP
- V2-M8-4-2XM8-3

The MMSK-P 22-S-PNP features a cable with open strands so that it can be connected via terminal contacts.
The V2-M8-4-2XM8-3 distributor is used to convert the 4-pin connector plug of the MMS-P 22-S-M8-PNP sensor to two standard M8 plugs with 3 pins each.

Mounting of the sensor

NOTICE

Sensor can be damaged during assembly.

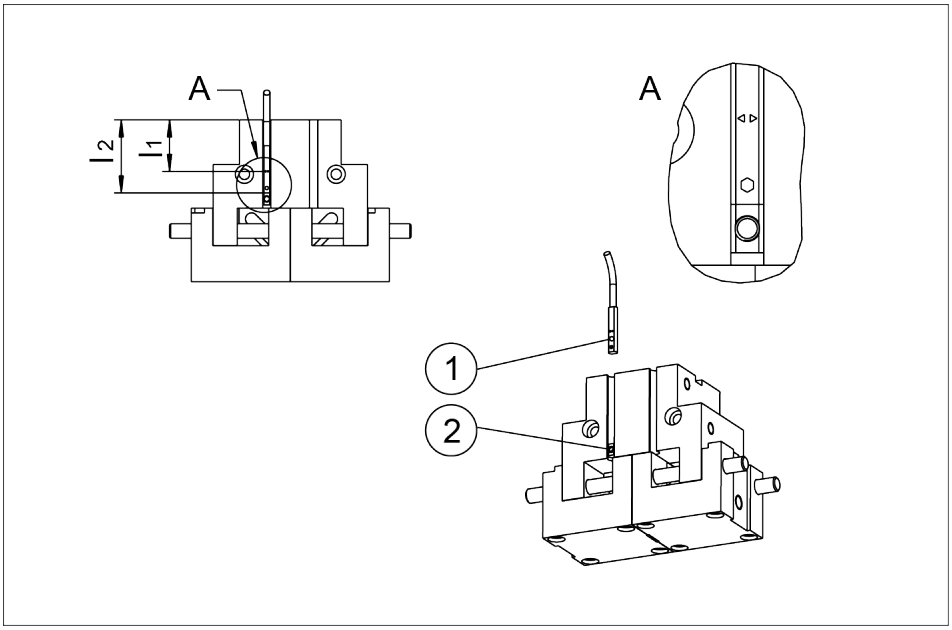
- Do not exceed the maximum tightening torque of 10 Ncm for the set screws!

NOTE

Ferromagnetic material changes the switching positions of the sensor (e.g. Adapter plate made of ordinary steel).

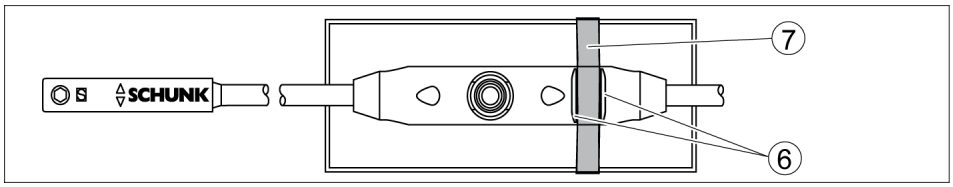
For ferromagnetic adapter plates:

- The module must be first mounted on the adapter plate.
- Then, the position of the magnetic switchs has to be set.

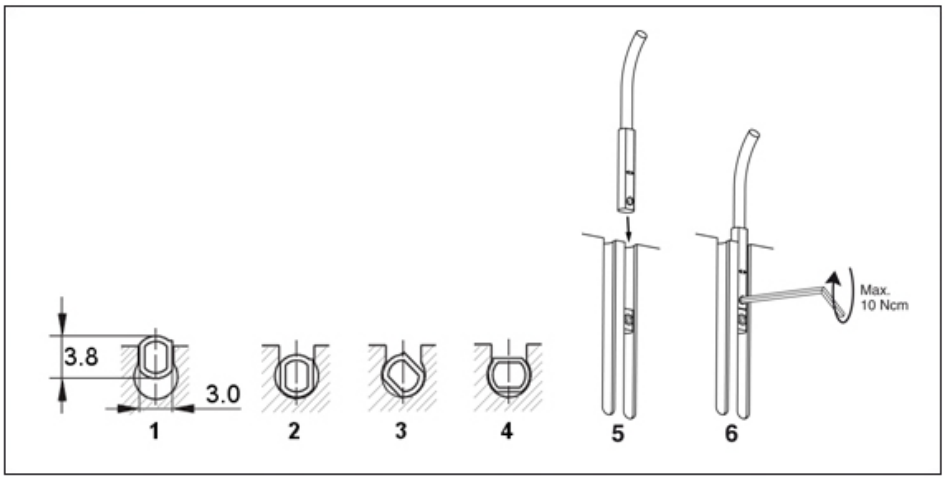


- Slide or turn in the magnetic switch (1) into the groove until it bears against the stop (2) (if available).
- If there is no terminal stop, then slide the magnetic switch according to dimension l2 (bottom edge of gripper up to front side of sensor) or according to dimension l1 (bottom edge of gripper up to double arrow on sensor) and then clamp with the mounting screw.

Type	Maß l_1	Maß l_2
PGM 60	23.9	32.8
PGM 82	21.3	30.2
PGM 96	27.4	36.3
PGM 120	26.9	35.8
PGM 140	34.2	43.1



- To relieve the cable, the electronics have to be fixed in place using cable ties (7).
  There are ribs (6) in place on the electronics for mounting purposes.



- Turn in the sensor (1 - 4).
  OR
  Push the sensor axially into the slot until it contacts the stop (5).
- Fix the sensor with an Allen wrench (6).
- Keep the Teach-Button (4) pressed for 2 seconds.
  - ✓ After 2 seconds flashing LED 1 (3).
- Move the gripper into position 1 (e.g. "0 - position").
- Press the Teach-Button (4) briefly.
  - ✓ LED 1 (3) lights up and LED 2 (5) is flashing.
- Move the gripper manually into position 2 (e.g. "-2mm").
  - ✓ LED 1 (3) should turn out as soon as the switching point 1 is left.
- Press the Teach-Button (4) briefly.
  - ✓ LED 2 (5) lights up.

✓ The switching points are set.

Adjusting the hysteresis

The hysteresis to both switching points will be adjusted automatically corresponding to the characteristics of the magnetic field.
The user can set the switching and trigging points of each position a little bit closer than for the automatic mode. The trigging point is closer to the switching point. At the same time the susceptibility to trouble and damage increases. In the mode of the lowest hysteresis, an error signal (such as jitter or untimely switch off) can be avoided, if the sensor is protected against all types of disturbances (i.e. by shielding). Frequent types of disturbances are change in temperature and electro-magnetic influences.
Within the closest fine-teach mode, SCHUNK cannot guarantee EMC-compatibility any more.
The hysteresis adjustment is used for the manual adjustment of the switching points (if necessary).
In case that the hysteresis automatically determined by the sensor should be too high or too low after “the adjustment of the switching points”, you may correct the value as follows.
The sensor avoids a too small hysteresis during hysteresis adjustment.

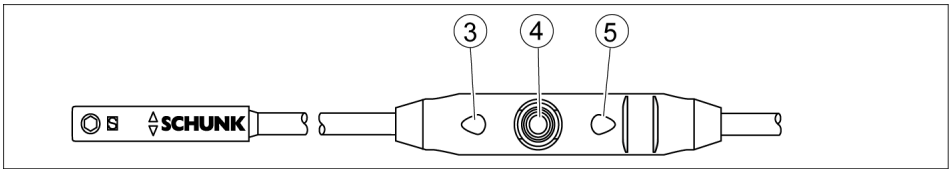
Sensors MMS 22, MMS-P 22, MMS 22-PI1 and MMS 22-PI2

The smallest detectable difference in stroke is defined in the following table:

The smallest detectable difference in stroke based on the nominal stroke

For grippers with X mm nominal stroke per jaw	Min. query range per jaw/ min. queried stroke difference per jaw
X ≤ 5 mm	30% of the nominal stroke per jaw
X > 5 mm to X ≤ 10 mm	20% of the nominal stroke per jaw
X > 10 mm	10% of the nominal stroke per jaw

Example: Product with 7 mm nominal stroke per jaw
7 mm * 20% = 1.4 mm



- ➢ Press the Teach-button (4) for 5 seconds.
  - ✓ LED 1 (3) will flash up after 2 seconds.
  - ✓ LED 1 will stop after 5 seconds.
- ➢ Release the Teach-button.
- ➢ Put the gripper to position "switch-off point of switching point 1".
- ➢ Press the Teach-Button (4) briefly. LED 1 (3) will light up twice.
- ➢ Put the gripper to position "switch-off point of switching point 2".
- ➢ Press the Teach-Button (4) briefly.
  - ✓ LED 1 (3) will light up twice.
- ✓ The mounting of the sensor MMS-P is completed.

5 Troubleshooting

5.1 Product is not moving

Possible cause	Corrective action
Base jaws jam in housing, e.g. mounting surface is not sufficiently even.	Check the evenness of the mounting surface. Mechanical connection [▶ 11]
	Loosen the mounting screws of the product and actuate the product again.
Pressure drops below minimum.	Check air supply. Air connection [▶ 12]
Compressed air lines switched.	Check compressed air lines. Air connection [▶ 12]
Proximity switch defective or set incorrect.	Readjust or change sensor.
Unused air connections open.	Close unused air connections.
Flow control valve closed.	Open the flow control valve.
Component part defective.	Replace component or send it to SCHUNK for repair.

5.2 The module does not travel through the entire stroke?

Possible cause	Corrective action
Dirt deposits between basic jaws and guidance.	Disassemble and clean the product.
Pressure drops below minimum.	Check air supply. Air connection [▶ 12]
Mounting surface is not sufficiently flat.	Check the evenness of the mounting surface. Mechanical connection [▶ 11]
Components have come loose e.g. due to overloading.	Completely replace the module

5.3 Product opens or closes abruptly

Possible cause	Corrective action
Too little grease in the mechanical guiding areas.	Clean and lubricate product. Maintenance [▶ 23]
Compressed air lines blocked.	Check compressed air lines of damage.
Mounting surface is not sufficiently flat.	Check the evenness of the mounting surface.
One-way flow control valve is missing or adjustet incorrectly.	Install and adjust one-way flow control valve.
Loading too large.	Check permissible weight and length of the gripper fingers.

5.4 Gripping force is dropping

Possible cause	Corrective action
Compressed air can escape.	Check seals, if necessary, disassemble the product and replace seals.
Too much grease in the mechanical movement space.	Clean and lubricate product. Maintenance [▶ 23]
Pressure drops below minimum.	Check air supply. Link Pneumatischer Anschluss
Component part defective.	Replace component or send it to SCHUNK for repair.

5.5 Product does not achieve the opening and closing times

Possible cause	Corrective action
Compressed air lines are not installed optimally.	If present: Open the flow control couplings on the product to the maximum that the movement of the jaws occurs without bouncing and hitting.
	Check compressed air lines.
	Inner diameters of compressed air lines are of sufficient size in relation to compressed air consumption.
	Keep compressed air lines between the product and directional control valve as short as possible.
	Flow rate of valve is sufficiently large relative to the compressed air consumption.
	NOTICE! The throttle check valve must not be removed, even if the product has not reached the opening and closing times.
	If, despite optimum air connections, the opening and closing times specified in the catalogue are not achieved, SCHUNK recommends the use of quick-air-vent-valves directly at the product.
Loading too large.	Check permissible weight and length of the gripper fingers.

6 Maintenance

6.1 Notes

Original spare parts

Use only original spare parts of SCHUNK when replacing spare and wear parts.

Exchange of housing and base jaws

The base jaws and the guidance in the housing are matched. To exchange these parts, send the product with a repair order to SCHUNK or order the housing with the base jaws as a set.

6.2 Maintenance and lubrication intervals

NOTICE

Material damage due to hardening lubricants!

Lubricants harden more quickly at temperatures above 60°C, leading to possible product damage.

- Reduce the lubricant intervals accordingly.

Size	29 - 140
Interval [Mio. cycles]	2

6.3 Lubricants/Lubrication points (basic lubrication)

SCHUNK recommends the lubricants listed.

During maintenance, treat all greased areas with lubricant. Thinly apply lubricant with a lint-free cloth.

Lubricant point	Lubricant
Metallic sliding surfaces	microGLEIT GP 360
All seals	Renolit HLT 2

6.4 Servicing the module

Maintenance

- Clean all parts thoroughly and check for damage and wear.
- Treat all greased areas with lubricant.
  Lubricants/Lubrication points (basic lubrication) [▶ 23]
- Oil or grease bare external steel parts.

7 Translation of original declaration of incorporation

in terms of the Directive 2006/42/EG, Annex II, Part 1.B of the European Parliament and of the Council on machinery.

Manufacturer/ Distributor	SCHUNK GmbH & Co. KG Spann- und Greiftechnik Bahnhofstr. 106 – 134 D-74348 Lauffen/Neckar

We hereby declare that on the date of the declaration the following partly completed machine complied with all basic safety and health regulations found in the directive 2006/42/EC of the European Parliament and of the Council on machinery. The declaration is rendered invalid if modifications are made to the product.

Product designation:	2-Finger Parallel Gripper / PGM 29 - 140 / pneumatic
ID number	0302680 ... 0302687

The partly completed machine may not be put into operation until conformity of the machine into which the partly completed machine is to be installed with the provisions of the Machinery Directive (2006/42/EC) is confirmed.

Applied harmonized standards, especially:

EN ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction

The manufacturer agrees to forward on demand the relevant technical documentation for the partly completed machinery in electronic form to national authorities.

The relevant technical documentation according to Annex VII, Part B, belonging to the partly completed machinery, has been created.

Person authorized to compile the technical documentation:
Robert Leuthner, Address: see manufacturer's address

Signature: see original declaration

Lauffen/Neckar, January 2019

p.p. Ralf Winkler,
Manager for development
of gripping system components

8 Annex to Declaration of Incorporation

according 2006/42/EG, Annex II, No. 1 B

1.Description of the essential health and safety requirements pursuant to 2006/42/EC, Annex I that are applicable and that have been fulfilled with:

Product designation	2-Finger Parallel Gripper
Type designation	PGM
ID number	0302680 ... 0302687

To be provided by the System Integrator for the overall machine			⇓
Fulfilled for the scope of the partly completed machine		⇓	
Not relevant	⇓		

1.1	**Essential Requirements**			
1.1.1	Definitions		X	
1.1.2	Principles of safety integration		X	
1.1.3	Materials and products		X	
1.1.4	Lighting		X	
1.1.5	Design of machinery to facilitate its handling		X	
1.1.6	Ergonomics		X	
1.1.7	Operating positions			X
1.1.8	Seating			X

1.2	**Control Systems**			
1.2.1	Safety and reliability of control systems		X	
1.2.2	Control devices		X	
1.2.3	Starting		X	
1.2.4	Stopping		X	
1.2.4.1	Normal stop		X	
1.2.4.2	Operational stop		X	
1.2.4.3	Emergency stop		X	
1.2.4.4	Assembly of machinery		X	
1.2.5	Selection of control or operating modes		X	
1.2.6	Failure of the power supply			X

1.3	**Protection against mechanical hazards**			
1.3.1	Risk of loss of stability			X
1.3.2	Risk of break-up during operation			X
1.3.3	Risks due to falling or ejected objects			X
1.3.4	Risks due to surfaces, edges or angles		X	

1.3	Protection against mechanical hazards			
1.3.5	Risks related to combined machinery			X
1.3.6	Risks related to variations in operating conditions			X
1.3.7	Risks related to moving parts		X	
1.3.8	Choice of protection against risks arising from moving parts			X
1.3.8.1	Moving transmission parts		X	
1.3.8.2	Moving parts involved in the process			X
1.3.9	Risks of uncontrolled movements			X

1.4	Required characteristics of guards and protective devices			
1.4.1	General requirements			X
1.4.2	Special requirements for guards			X
1.4.2.1	Fixed guards			X
1.4.2.2	Interlocking movable guards			X
1.4.2.3	Adjustable guards restricting access			X
1.4.3	Special requirements for protective devices			X

1.5	Risks due to other hazards			
1.5.1	Electricity supply		X	
1.5.2	Static electricity		X	
1.5.3	Energy supply other than electricity		X	
1.5.4	Errors of fitting		X	
1.5.5	Extreme temperatures			X
1.5.6	Fire			X
1.5.7	Explosion			X
1.5.8	Noise			X
1.5.9	Vibrations			X
1.5.10	Radiation	X		
1.5.11	External radiation	X		
1.5.12	Laser radiation	X		
1.5.13	Emissions of hazardous materials and substances			X
1.5.14	Risk of being trapped in a machine	X		
1.5.15	Risk of slipping, tripping or falling	X		
1.5.16	Lightning			X

1.6	Maintenance			
1.6.1	Machinery maintenance		X	
1.6.2	Access to operating positions and servicing points		X	
1.6.3	Isolation of energy sources		X	
1.6.4	Operator intervention		X	
1.6.5	Cleaning of internal parts		X	

1.7	**Information**			
1.7.1	Information and warnings on the machinery		X	
1.7.1.1	Information and information devices		X	
1.7.1.2	Warning devices		X	
1.7.2	Warning of residual risks		X	
1.7.3	Marking of machinery	X		
1.7.4	Instructions	X		
1.7.4.1	General principles for the drafting of instructions	X		
1.7.4.2	Contents of the instructions	X		
1.7.4.3	Sales literature	X		

	The classification from Annex 1 is to be supplemented from here forward.			
2	Supplementary essential health and safety requirements for certain categories of machinery			X
2.1	Foodstuffs machinery and machinery for cosmetics or pharmaceutical products			X
2.2	Portable hand-held and/or guided machinery			X
2.2.1	Portable fixing and other impact machinery			X
2.3	Machinery for working wood and material with similar physical characteristics			X
3	Supplementary essential health and safety requirements to offset hazards due to the mobility of machinery		X	
4	Supplementary essential health and safety requirements to offset hazards due to lifting operations		X	
5	Supplementary essential health and safety requirements for machinery intended for underground work			X
6	Supplementary essential health and safety requirements for machinery presenting particular hazards due to the lifting of persons		X	