Operating instructions

Matrix Area Gripper FMG

WWW.SCHMALZ.COM

EN-US · 30.30.01.04068 · 01 · 11/24

Translation of the original operating instructions

Note

The Operating instructions were originally written in German. Store in a safe place for future reference. Subject to technical changes without notice. No responsibility is taken for printing or other types of errors.

Published by

Contact

J. Schmalz GmbH

Johannes-Schmalz-Str. 1

72293 Glatten, Germany

T: +49 (0) 7443 2403-0

schmalz@schmalz.de

www.schmalz.com

Contact information for Schmalz companies and trade partners worldwide can be found at:

www.schmalz.com/salesnetwork

Contents

1 Important Information

1.1 The technical documentation is part of the product

1. For problem-free and safe operation, follow the instructions in the documents.
2. Keep the technical documentation in close proximity to the product. The documentation must be accessible to personnel at all times.
3. Pass on the technical documentation to subsequent users.

⇨ Failure to follow the instructions in these Operating instructions may result in injuries!

⇨ Schmalz is not liable for damage or malfunctions that result from failure to heed these instructions.

If you still have questions after reading the technical documentation, contact Schmalz Service at:

www.schmalz.com/services

1.2 Note on Using this Document

J. Schmalz GmbH is generally referred to as Schmalz in this document.

The document contains important notes and information about the different operating phases of the product:

- Transport, storage, start of operations and decommissioning
- Safe operation, required maintenance, rectification of any faults

The document describes the product at the time of delivery by Schmalz and is aimed at:

- Installers who are trained in handling the product and can operate and install it
- Technically trained service personnel performing the maintenance work
- Technically trained persons who work on electrical equipment

1.3 Type Plate

The type plate is permanently attached to the product and must always be clearly legible.
It contains product identification data and important technical information.

▸ For spare parts orders, warranty claims or other inquiries, have the information on the type plate to hand.

1.4 Symbols

This symbol indicates useful and important information.

✓ This symbol represents a prerequisite that must be met before an action is performed.

▸ This symbol represents an action to be performed.

⇨ This symbol represents the result of an action.

Actions that consist of more than one step are numbered:

1. First action to be performed.
2. Second action to be performed.

2 Fundamental Safety Instructions

2.1 Intended Use

The matrix area gripper (FMG) is intended for picking up and gripping different flat workpiece geometries and sizes through suction points that can be individually activated. Only the suction points that are activated are extended and supplied with a vacuum, which allows different types of workpieces to be picked up.
An FMG can be used as an end effector on robots or area gripping systems. Such an end effector can consist of several FMGs, mechanically mounted on blocks.
For applications in advanced systems, the operator is responsible for the safe integration of the product.

The device is operated using a higher-level controller that communicates with the product via IO-Link Class B (supplied by the customer).
External sources (vacuum/compressed air) can be used to supply individual suction points that grip and transport airtight workpieces with vacuum power in combination with suction cups.

The product is built in accordance with the latest standards of technology and is delivered in a safe operating condition; however, hazards may arise during use.

The product is intended for industrial use.

Intended use includes observing the technical data and the installation and operating instructions in this manual.

2.2 Non-Intended Use

Schmalz does not accept any liability for any direct or indirect losses or damages that result from using the product. This applies, in particular, to any use of the product that is not in accordance with the intended purpose and to any use that is not described or mentioned in this documentation.

In particular, the following are considered non-intended use:

- Use in potentially explosive atmospheres
- Applying suction to liquids.
- Applying suction to bulk materials (e.g. granulates)
- Transport and through-suction of potentially explosive materials
- Direct contact with perishable goods/food products
- Use in medical applications
- Suction of aggressive gases or media such as acids, acid fumes, bases, biocides, disinfectants or detergents is not permitted.
- Lifting people or animals

2.3 Personnel Qualifications

Unqualified personnel cannot recognize dangers and are therefore exposed to higher risks!

The operating company must ensure the following points:

- The personnel must be commissioned for the activities described in these instructions.
- The staff must be at least 18 years of age and physically and mentally capable.
- The product must be operated only by persons who have undergone appropriate training.
- Personnel must receive regular safety briefings (frequency as per country-specific regulations).

- Work on electrical equipment must be carried out only by qualified electrical specialists.

The following target groups are addressed in these instructions:

- Mechanical and electrical specialists who are responsible for installing, troubleshooting and maintaining the product.

The operator of the system must comply with country-specific regulations regarding the age, ability and training of the personnel.

Applicable for Germany:

A qualified employee is defined as an employee who has received technical training and has the knowledge and experience – including knowledge of applicable regulations – necessary to enable him or her to recognize possible dangers and implement the appropriate safety measures while performing tasks. Qualified employees must observe the relevant industry-specific rules and regulations.

2.4 Warnings in This Document

Warnings warn against hazards that may occur when handling the product. The signal word indicates the level of danger.

Signal word	Meaning
⚠ WARNING	Indicates a medium-risk hazard that could result in death or serious injury if not avoided.
⚠ CAUTION	Indicates a low-risk hazard that could result in minor or moderate injury if not avoided.
NOTE	Indicates a danger that leads to property damage.

2.5 Residual Risks

The system integrator must carry out a risk assessment of the entire system for all operating modes and define the danger zone precisely. In doing so, country-specific provisions and regulations must be observed.

⚠ WARNING

Electric shock from touching live components

- ▸ Make sure that the electrical components are not live before installation, maintenance and troubleshooting.

⚠ WARNING

Extraction of hazardous media, liquids or bulk material

Personal injury or damage to property!

- ▸ Do not extract harmful media such as dust, oil mists, vapors, aerosols etc.
- ▸ Do not extract aggressive gases or media such as acids, acid fumes, bases, biocides, disinfectants or detergents.
- ▸ Do not extract liquids or bulk materials, e.g. granulates.

⚠ WARNING

Change of output signals when product is switched on or plug is connected

Risk of injury to persons and damage to property due to uncontrolled movements of the higher-level machine/system!

- The electrical connection must be performed only by specialists who can evaluate the effects of signal changes on the overall system.

⚠ WARNING

Suspended load

Risk of injury!

- Do not walk, stand or work under suspended loads.

⚠ CAUTION

Falling of the product or damage to attachments

Risk of injury or damage to property

- Only mount the product on the designated support points.
- Wear safety shoes (S1) and safety glasses when handling and mounting/dismounting the product.

⚠ CAUTION

Vacuum close to the eye

Severe eye injury!

- Wear eye protection.
- Do not look into vacuum openings such as suction lines and hoses.

2.6 Modifications to the Product

Schmalz assumes no liability for consequences of modifications over which it has no control:

1. The product must be operated only in its original condition as delivered.
2. Use only original spare parts from Schmalz.
3. The product must be operated only in perfect condition.

3 Product description

3.1 Product key

For example, the matrix area gripper FMG product key (known as the system configuration) is FMG 180x60x120 30 12 20 HT1.
It is composed of the following:

Property	Example values	Variants / note
Product class	FMG	Matrix area gripper
Dimensions	180x60x120	180x60x120 (LxWxH)
Distance	30	30 60
Number of suction cups	12	12 pcs. 3 pcs.
Suction cup diameter	20	20 mm diameter 50 mm diameter
Suction cup material	HT1	HT2 HT1

3.2 General Description of Functions

The matrix area gripper (FMG) can pick up and grip different flat workpiece geometries and sizes through cylinder pistons/suction points that can be individually activated. The gripping module consists of individual suction points in a fixed grid/with fixed spacing.
It is operated through a higher-level controller. Communication takes place via IO-Link Class B.

Each suction point is activated using a corresponding valve through the supply of compressed air. Activating the suction point with compressed air extends it over a spring plunger. This opens a duct through which the external vacuum is guided to the workpiece. When the valve is switched off, the suction point is retracted by the spring return and thus deactivated.

From an operating vacuum of 400 mbar, the vacuum self-holding function that is integrated into the design takes effect when the suction points are activated (**max. effectiveness only in the preferred direction with the suction cup facing downwards.**).
Self-holding means that a gripped workpiece remains gripped when the actuator supply voltage fails.
In the absence of compressed air or if the supply voltage fails, the holding forces on the spring plungers are reduced. Due to the weight of the workpiece and the upward orientation of the suction cups, the vacuum supply may be interrupted during the handling process by the pressing in of the spring plungers, and the workpiece is released.
Important: For handling processes in which the suction cups are oriented upwards, a detailed **investigation of the process conditions** (workpiece weight, accelerations, etc.) and a risk assessment must be carried out. The permissible counterforce for one suction point with stroke must be observed in the process. Deactivated suction points remain deactivated.

Each suction point is secured against rotation, which allows a workpiece to be handled with positional accuracy even with only one suction point.

Suction points that suck in “open air” can be detected by monitoring the vacuum (optional). The vacuum can be monitored with a suitable external vacuum supply and a vacuum switch.

In the FMG variant with 12 suction points, a consistent drop in vacuum when open air is being sucked in can be detected on the ejector via filter elements. The first one to five suction points that are sucking in open air can be detected (> See ch. 3.3.2 Coverage detection for the FMG variant with 12 suction points, p. 12).

In the FMG variant with three suction points, screens are installed in the suction cups.
If a suction cup sucks in open air, a clear drop in vacuum below the self-holding limit of 400 mbar can be detected.

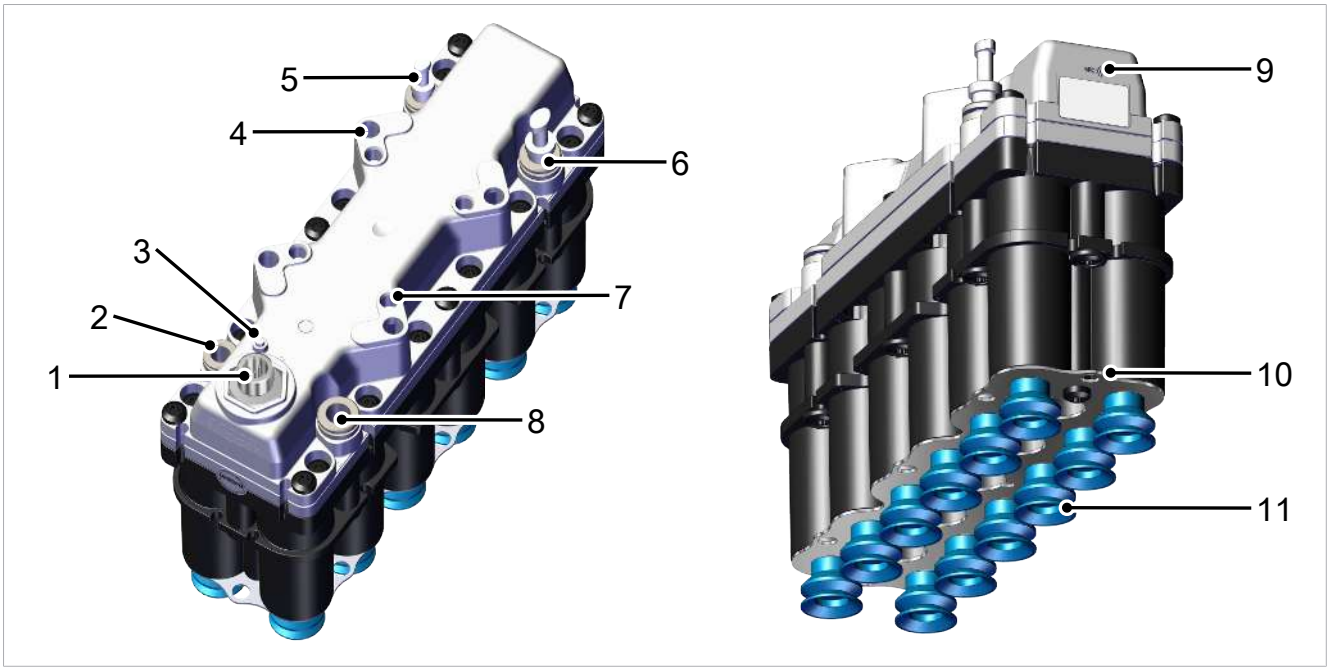
That means in the reverse situation, when a vacuum value > 400 mbar is reached, it is assumed that the workpiece is securely gripped.
Thus, a defective suction point is directly recognizable.

The contamination of filter elements or sieves has a negative effect on the detection of a drop in vacuum. Possible contamination during operation must be taken into account during monitoring. Preferably, test cycles should be integrated into operation.

If multiple FMGs are to be arranged next to each other to create an area gripping system for a larger area, it is helpful to connect each FMG to a separate vacuum generator.

3.3 Matrix area gripper FMG with 12 suction cups

3.3.1 Product structure of the FMG with 12 suction cups



1	M12 plug electrical connection for IO-Link class B	7	Pin holes for centering and replacement in the correct position
2	Compressed air connection P, 6 mm diameter	8	Vacuum connection V1, 8 mm diameter
3	Status LED	9	NFC symbol
4	Bores for attachment from above and below	10	Sensor mounting option (only for the FMG with 12 suction cups)
5	Vacuum connection V3, 6 mm diameter (plugged)	11	Suction cups, 12x
6	Vacuum connection V2, 8 mm diameter (plugged)		

3.3.2 Coverage detection for the FMG variant with 12 suction points

⚠ CAUTION

Falling objects due to a sudden drop in vacuum (e.g. a power failure)

Risk of injury from falling parts!

- Wear protective work shoes (S1).

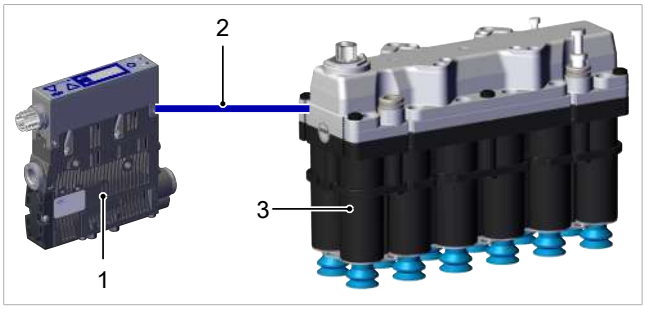
The vacuum level can be used to assess whether or how many suction points are covered or not. Among other things, the vacuum levels depend on the roughness of the gripping surface and the wear on the suction cups; however, they depend primarily on the vacuum generation and the vacuum supply line to the FMG.

The following is a schematic illustration of a **sample** configuration with 12 suction cups:

Vacuum generator (1): Compact ejector SCPSi 10

Supply lines (2):
— Vacuum hose 8/6, 2 m long,
— Compressed air supply line 6/4, and
— IO-Link connection cable class B

Gripper (3): FMG

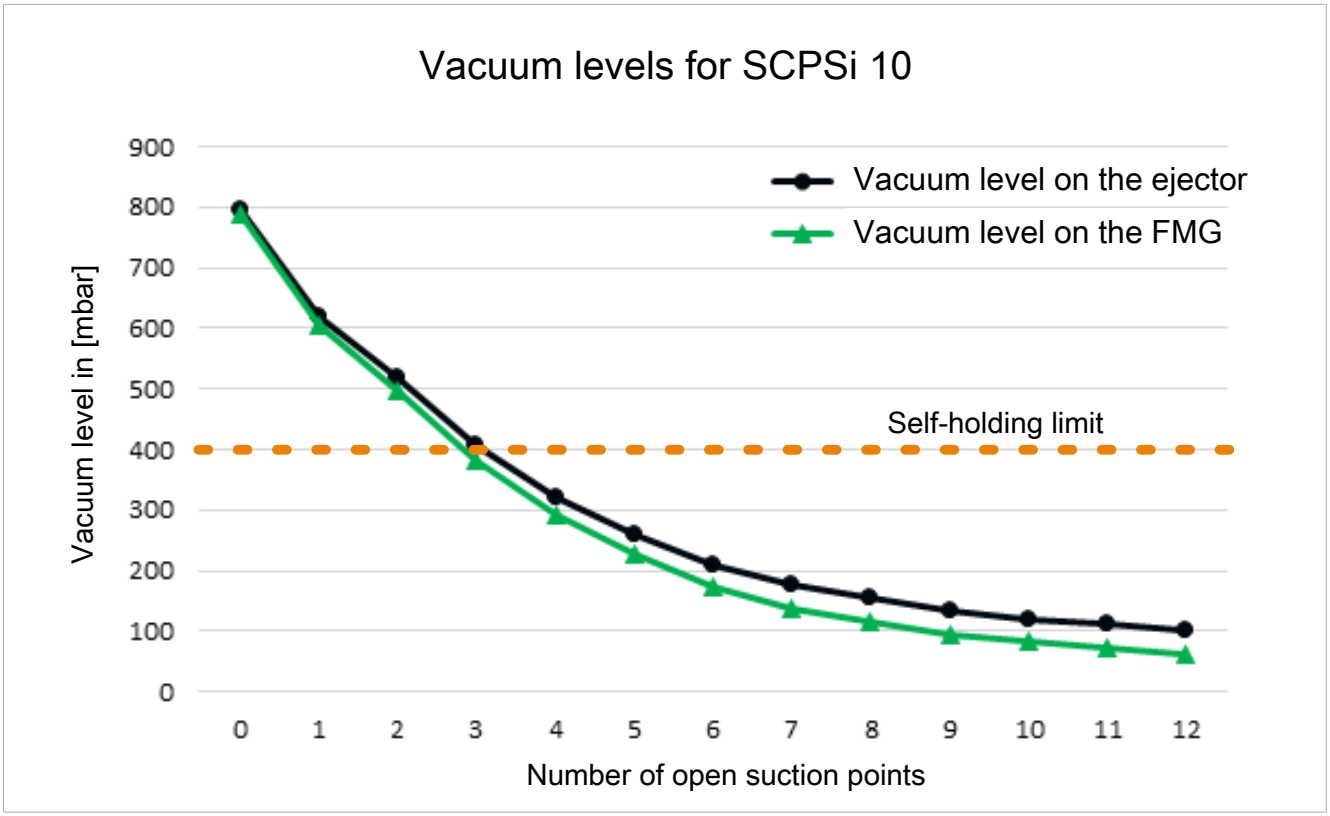


In this configuration, the vacuum levels measured at the ejector, which was operated in continuous operation without control, were determined while increasing the number of suction points that were open/sucking in open air.

Note:

This is a simplified calculation of the vacuum levels, in which the opening sequence for the suction points was measured going from valves 1 to 12. A different opening sequence can lead to different values.
During these measurements, a vacuum switch was also mounted on one of the FMG plug connections; this indicated that the values for the actual prevailing vacuum on the FMG and therefore on the suction cup are lower.
This must be taken into account when assessing the holding force and workpiece weight and must be individually determined through testing in each installed system.

The calculated values are shown in the following diagram:



In the diagram, you can see that the vacuum level decreases as the number of open suction points increases.

A minimum vacuum of 400 mbar is required for the integrated self-holding function on the FMG. In this example, a maximum number of two open suction points is therefore permissible because the vacuum level at the FMG is already below 400 mbar when three suction points are open.

If the self-holding function is not required, multiple suction points may also be uncovered, which in return reduces the vacuum levels that can be reached and therefore the holding force of the FMG and the system.

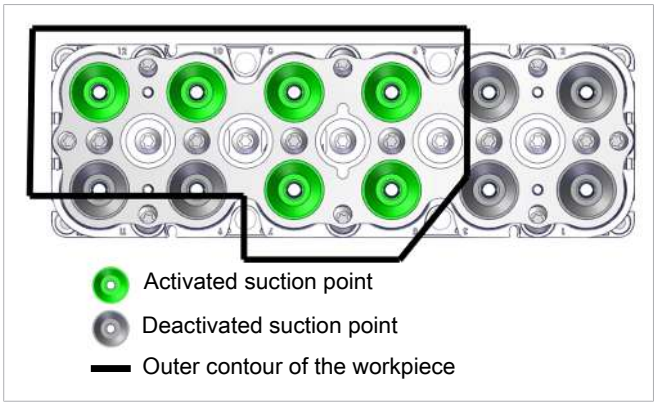
The diagram also illustrates that the vacuum levels may be more difficult to evaluate when there is a higher number of open suction points, because the delta between them is lower than, for example, the delta between no open suction point and one open suction point.

If the ejector is not operated at the maximal vacuum level (e.g. if the energy-saving function is set to -600 mbar upper switching point), or if it still has very high power reserves, this can also lead to a situation where no vacuum drop is detectable when one, two or more active suction points are not covered.

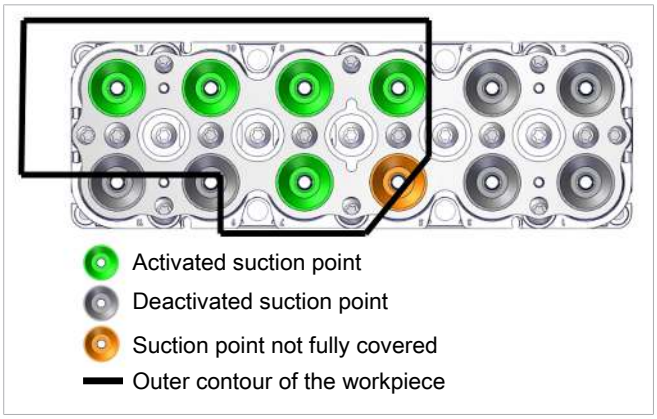
Against this background, a sample evaluation process is shown below:

1. Perform a vacuum measurement when all suction points are retracted.
   ⇨ Calculation of the maximum vacuum level that can be reached.

2. The workpiece is covered by six suction points.

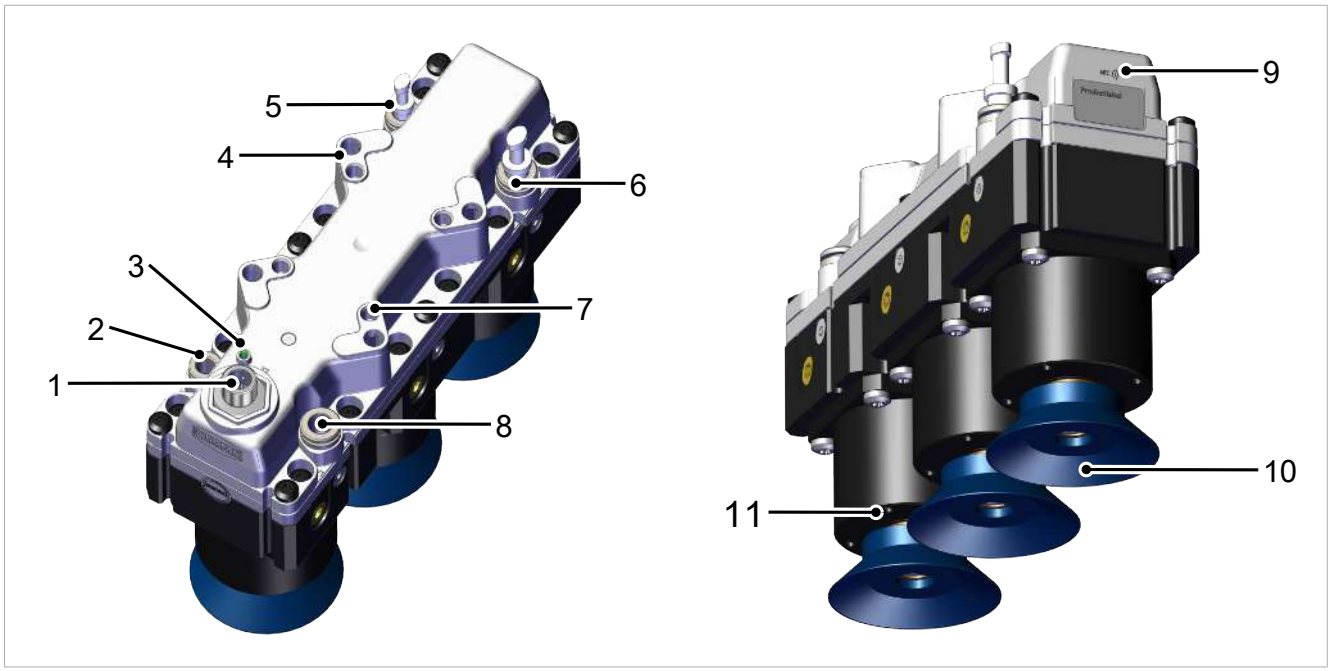


3. These six available suction points are extended at the FMG and placed on the workpiece.
4. Perform a vacuum measurement when the workpiece has been picked up by the extended suction points.
5. Comparison of the calculated vacuum level with the value determined in point 1.
   - ⇨ If this value is the same or is within range (+/-5% is accepted) of 790 mbar, it can be assumed that all the suction points are covered by the workpiece and the gripping process can be started.
     WARNING: For very thin workpieces (e.g. sheet metal with s=0.5 mm), positioning the FMG on the workpiece imprecisely may also cause the layer below to be picked up.
   - ⇨ If the vacuum levels are lower, it can be assumed that not all the intended suction points are positioned on the workpiece or that suction points are activated that are not completely covered by the workpiece. This may be the case, for example, in the position shown in the example to the side.



3.4 Matrix area gripper FMG with three suction cups

3.4.1 Product structure of the FMG with three suction cups



1	M12 plug electrical connection for IO-Link class B	7	Pin holes for centering and replacement in the correct position
2	Compressed air connection P, 6 mm diameter	8	Vacuum connection V1, 8 mm diameter
3	Status LED	9	NFC symbol
4	Bores for attachment from above and below	10	Suction cups, 3x
5	Vacuum connection V3, 6 mm diameter (plugged)	11	M4 thread (L = 4 mm) for optional sensors
6	Vacuum connection V2, 8 mm diameter (plugged)		

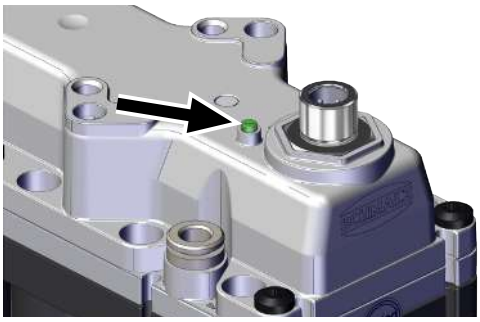
3.4.2 Coverage detection for the FMG variant with three suction points

If a suction cup of the FMG variant with three suction points sucks in the open air, a clear vacuum drop below the self-holding limit of 400 mbar can be detected.
That means in the reverse situation, when a vacuum value > 400 mbar is reached, it is assumed that the workpiece is securely gripped.

3.5 LED Status Display

The product has a light-emitting diode (LED) for status information.

The table below describes the possible states on the LED status indicators.



LED color		Behavior	Status
—	None	OFF	No sensor voltage
	Green	Continuous light	Sensor voltage present – no communication
	Green	**Flashing**	IO-Link communication okay

3.6 Workpiece detection

Workpieces can be detected using a proximity sensor. It can be mounted on the device (> See ch. 8.5 Optional: Mounting the Proximity Sensor, p. 33).

4 Control Interfaces

4.1 Basic Principles of IO-Link Communication

Abbreviations:

ISDU: Indexed service data unit, parameter data acyclically queried between the controller and the IO-Link device

IODD: IO Device Description, device description file

The component is operated via IO-Link to enable intelligent communication with a controller.

IO-Link is a communication system for connecting intelligent sensors and actuators to an automation system and is described in the standard IEC 61131-9. The standard contains both the electrical connection data as well as a digital communication protocol via which sensors and actuators exchange data with the automation system.

An IO-Link system consists of an IO-Link master and one or more IO-Link enabled sensors or actuators. The IO-Link master provides the interface to the higher level controller (PLC) and controls the communication with the connected IO-Link devices. An IO-Link master can have one or more IO-Link ports, however only one IO-Link device can be connected to each port.

IO-Link devices have parameters that can be read or written via the IO-Link protocol. Parameters can therefore be changed by the higher-level controller during operation. Since the sensor and actuator parameters are device-specific, parameter information is available for each device in the form of an IODD (IO Device Description).

The IO-Link communication takes place using cyclical process data and acyclical ISDU parameters.

IO-Link mode allows the product to be parameterized remotely via the controller of the higher-level machine (not externally).

4.2 Process Data

The device is controlled through cyclic process data.

From the perspective of the higher-level PLC, there is a difference between the

- input data (Process Data In) (data from the device) and
- output data for the control (Process Data Out (data to the device).

The output data “Process Data Out” is used to control the device cyclically (activate and deactivate the suction points and/or valves).

To integrate the device into a higher-level controller, a device description file (IODD = IO Device Description) is available. The IODD is available at www.schmalz.com.

The exact meaning of the data and functions is described in more detail in the “Description of Functions” chapter. You can find a detailed diagram of the process data in the Data Dictionary and IODD.

4.3 Retrievable Information via the ISDU Parameter

The acyclical communication channel can be used to retrieve ISDU (Index Service Data Unit) parameters, which contain information about the system status.

The ISDU channel can be used to read out or overwrite device settings. More detailed information about the identity of the device, such as the part number and serial number, can be retrieved via IO-Link. The device also provides space for saving user-specific information here, such as the installation and storage location.

You can find a detailed diagram of the parameter and process data in the Data Dictionary and IODD.

4.4 Interface NFC

The illustrations shown below may deviate from the customer's version because they serve as examples of different versions of the product.

NFC (Near Field Communication) refers to a standard for wireless data transfer between different devices over short distances.

The device functions as a passive NFC tag that can be read or written to by a reading device such as a smartphone or tablet with NFC activated. Read access to the device parameters via NFC is also possible when the supply voltage is not connected.

Web link **https://myproduct.schmalz.com/#/**

There are two ways to read data via NFC:

- Read access is available through a website viewed in a browser. This does not require an additional app. The reading device requires only that NFC and the Internet connection are enabled.
- Using the "Schmalz ControlRoom" control and service app.
  The "Schmalz ControlRoom" app is available in the Google Play Store or Apple App Store.

Process control via NFC is not possible.

For the best data connection, position the reading device at the attached NFC symbol.

The reading distance is very short for NFC applications. Determine the position of the NFC antenna in the reading device used. If parameters of the device are modified via IO-Link or NFC, then the power supply must subsequently remain stable for at least three seconds to prevent data loss.

5 Functions

5.1 Device Identification

The IO-Link protocol provides a range of identification data for compliant devices that can be used to uniquely identify a particular device. This product contains even more advanced identification parameters.

The parameters are ASCII character strings that adapt their length to the relevant content.

The following parameters can be called up:

- Manufacturer name (Vendor Name, 0x0010)
- Web address (Vendor Text, 0x0011)
- Product name and product text (Product Name, 0x0012/Product Text, 0x0014)
- Product ID (Product ID, 0x0013)
- Serial number (Serial Number, 0x0015)
- Version status of the hardware and firmware (Hardware Revision, 0x0016 and Firmware Revision, 0x0017)
- Unique ID, 0x00F0
- Article number (Article number, 0x00FA)
- Production date (Production Date, 0x00FC)

5.2 User-Specific Localization

The following parameters are available when saving user-specific information:

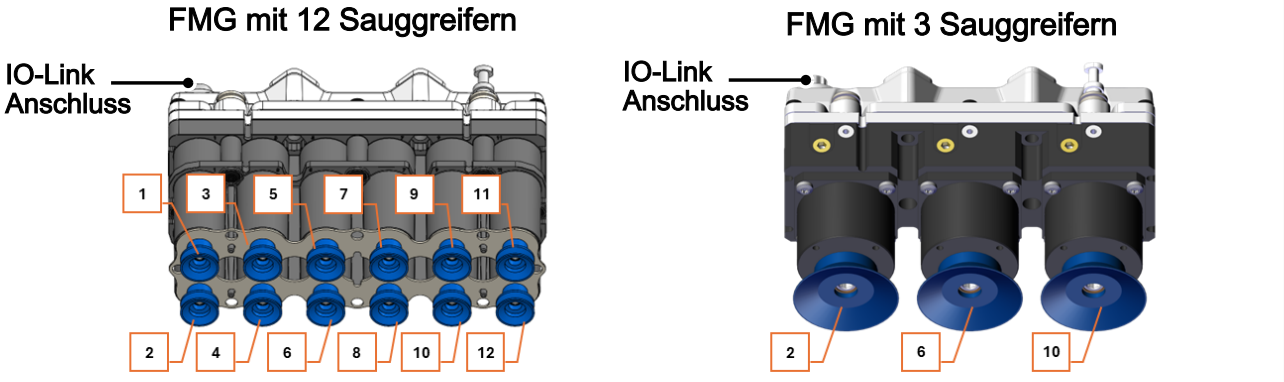
- Application-specific labeling (Application-specific tag, 0x0018)
- Function identifier (Function tag, 0x0019)
- Location (Location tag, 0x001A)
- Device identifier (Equipment identification, 0x00F2)
- Location identifier (Geolocation, 0x00F6)
- Web link to the associated IODD (IODD web link, 0x00F7)
- Identifier of the storage location (Storage location, 0x00F9)
- Installation date (Installation date, 0x00FD)

The parameters are ASCII character strings with the maximum length specified in the Data Dictionary. They can also be used for other purposes if necessary.

5.3 Controlling Valves

The device valves are individually controlled via the output data (Prozess Data Out).

The following figure shows the control position or valve coverage depending on the variants:



Process Data

Process data Out		Bits
PD out byte 0	Valve 1	0
	Valve 2	1
	Valve 3	2
	Valve 4	3
	Valve 5	4
	Valve 6	5
	Valve 7	6
	Valve 8	7
PD out byte 1	Valve 9	0
	Valve 10	1
	Valve 11	2
	Valve 12	3
	reserved	4...7

Process Data

Process data Out		Bits
PD out byte 0	reserved	0
	Valve 2	1
	reserved	2
	reserved	3
	reserved	4
	Valve 6	5
	reserved	6
	reserved	7
PD out byte 1	reserved	0
	Valve 10	1
	reserved	2
	reserved	3
	reserved	4...7

The input data (Prozess Data In) is not used with this device.

For more detailed information, see the data dictionary attached.

5.4 System Commands

System commands are predefined processes for triggering specific functions and are described below. They are controlled by writing parameter “System command” 0x0002 with a predefined value.

Offset parameter	**2 (0x0002)**
Description	System command – triggers special features of the device
Index	-
Data type	uint8
Length	1 byte
Access	Write only
Value range	0x81: Reset application 0x83: Back to box
Default value	-
Unit	-
EEPROM	No

5.4.1 Resetting the Application

Only the technology-specific application parameters are reset by this function.

System command “Reset application” 0x81 is used to reset all the parameters except the device localization parameters (see “Data Dictionary”) to their factory settings.

Any IO-Link communication is not stopped in doing so.

It is not necessary to restart the device by interrupting the supply voltage.

5.4.2 Reset to Factory Settings

The system command “Back to box” 0x83 is used to reset all the setting parameters to their factory settings.

Any IO-Link communication is stopped in doing so.

The device must be restarted by interrupting the supply voltage.

Counter readings are not affected by this function.

5.5 Counters

The gripper has a non-erasable counter (Valve operating counter, 0x008D). It counts the activation of each valve and stores it every 200 times.

The counter readings are stored every 200 "actuations" and are added to the current counter value. When the operating voltage is switched off, up to 199 steps of the counter are lost.

The sub-index matches the valve number.

6 Technical Data

6.1 General Parameters

Operating medium on the vacuum side	Neutral gases in accordance with EN 983 are approved as evacuation media.
Operating medium compressed air	Air or neutral gas, filtered to 5 µm, oiled or not oiled Class 3-3-3 compressed air quality acc. to ISO 8573-1
Operating pressure (flow pressure)	4 to 6 bar
Working temperature	0 to 50° C
Storage temperature	0 to 25° C
Permitted air humidity	10 to 90% RH (free from condensation)
Environmental conditions	Do not use outdoors and do not permanently expose to direct sunlight
Degree of protection	IP54

6.2 Matrix area gripper

Parameter		**FMG with 12 suction cups**	**FMG with three suction cups**
Workpiece temperature		Contact with hot workpieces of up to 140° C (contact duration of three seconds, recovery time of three seconds) with suction cup material HT1	
Number of suction cups		12	3
Weight		0.98 kg	0.95 kg
Spacing of suction cups		30 mm	60 mm
Plunger stroke		10 mm	
Suction cup connection nipple		Type NO16	Type SC050
Permissible counterforce for one suction point with stroke, independent of position		50 N [1]	200 N [1]
Suction force per suction cup,	FGA 20 (standard) Part no. 10.01.06.05777	4.7 N [2]	—
	SUF 50 HT1-60 Part no. 10.01.01.13996	—	95 N [2]

[1] permissible at operating pressures of at least 4 bar, specification with safety factor 2
[2] The suction force specifications consist of theoretical values at -0.6 bar vacuum on dry, flat, and even workpiece surfaces. They are specified without safety factors.

6.3 Electrical Parameters

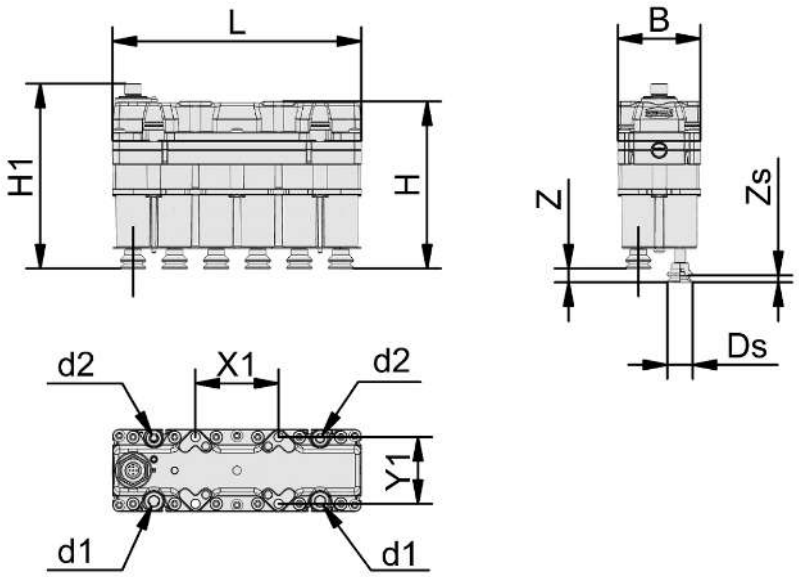
Parameter	FMG with 12 suction cups	FMG with three suction cups
Electrical connection	IO-Link Class B plug connector, M12, 5-pin	
Supply voltage for sensor [1)]	24V DC ±10% (PELV [1)])	
Supply voltage for actuator [1)]	24V DC ±10% (PELV [1)])	
Power consumption for sensor supply voltage (at 24V)	0.03 A	
Total power consumption (at 24 V)	15 W	3.75 W
Power consumption for actuator supply voltage (at 24V)	0.25 A (typ.)	0.063 A (typ.)
	0.6 A (max.) [2)]	0.15 A (max.) [2)]

[1)] The power supply must correspond to the regulations in accordance with EN60204 (protected extra-low voltage). In addition, the voltage must be electrically isolated from the sensor supply voltage while taking the basic insulation into account (in accordance with IEC 61010-1, secondary circuit with maximum 30 V DC derived from the mains circuit up to 300 V of overvoltage category II).

[2)] Max. value is before PWM (current reduction on the valve) is activated. The typ. value is when PWM is activated.

The specifications always relate to the greatest possible energy demand, i.e. when all 12 or 3 valves are active.

6.4 Dimensions



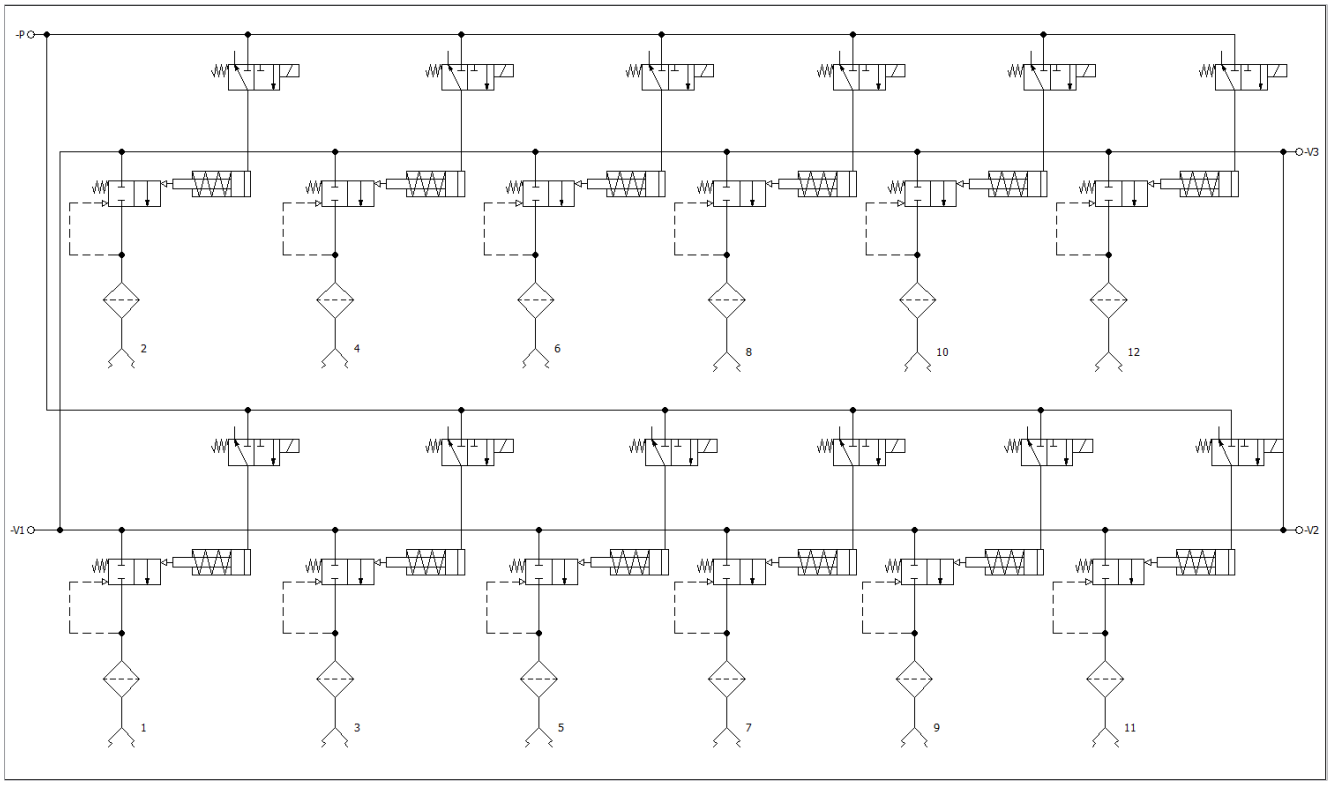
B	L	d1	d2	X1	Y1	Z
59.5	179.5	8	6	60	48	10

Variant	H	H1	D_s	Z_s
FMG 180x60x120 30 12 20-HT1	120	133	20	5
FMG 180x60x120 60 3 50-HT1	120	133	50	5

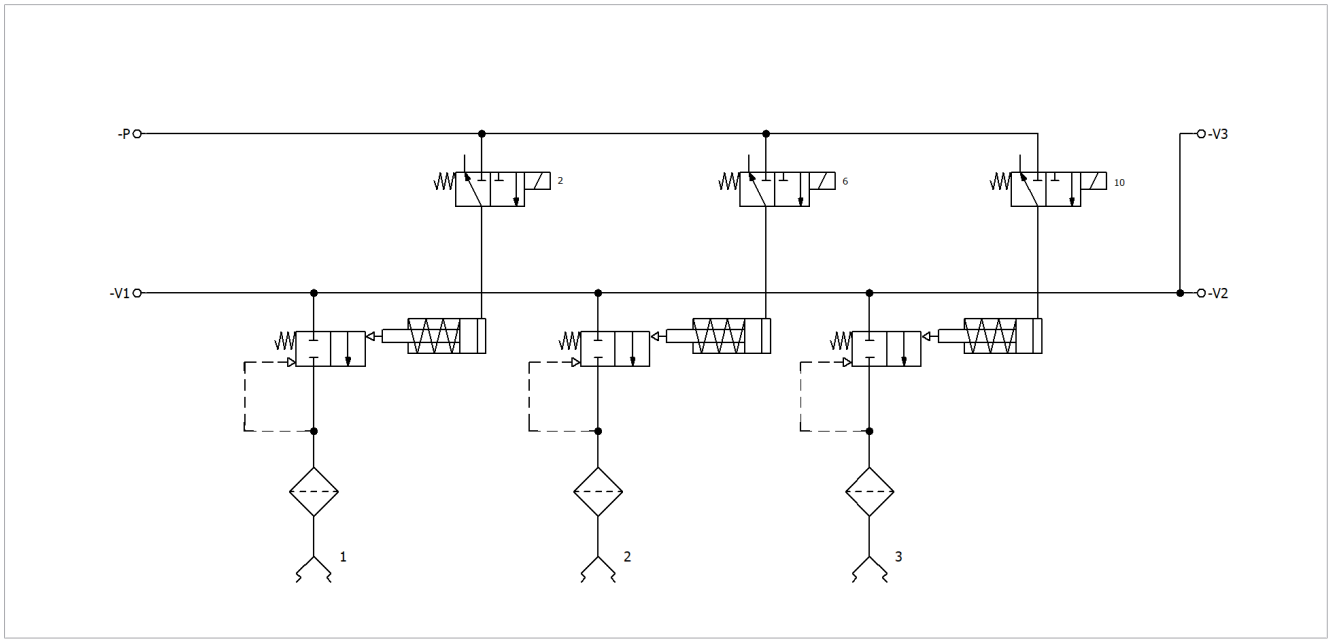
All dimensions are in the unit mm.

6.5 Pneumatic Circuit Diagram

Version of the FMG with 12 suction points



Version of the FMG with three suction points



7 Transportation and Storage

7.1 Checking the Delivery

The scope of delivery can be found in the order confirmation. The weights and dimensions are listed in the delivery notes.

1. Compare the entire delivery with the supplied delivery notes to make sure nothing is missing.
2. Damage caused by defective packaging or occurring in transit must be reported immediately to the carrier and J. Schmalz GmbH.

7.2 Storage Regulations

Observe the following storage regulations with regard to the elastomer parts:

- The storage temperature should be between 0° C and 25° C.
- Suction cups must be packaged and stored free of voltage. This applies to shipping packaging as well.
- Use the original product packaging to store the product.

8 Installation

8.1 Installation Instructions

The product must be installed and maintained only by qualified specialist electricians and mechanics.

⚠ CAUTION

Improper installation or maintenance

Personal injury or damage to property

- Prior to installation and before maintenance work, the product must be disconnected from the power supply, depressurized (vented to the atmosphere) and secured against unauthorized restart.

To ensure safe installation, observe the following instructions:

1. Check the product for visible damage. Correct any faults or report them to the supervising personnel immediately.
2. Use only the connectors, mounting holes and attachment materials that have been provided.
3. The product must be mounted only when de-energized and depressurized.
4. Firmly connect and secure pneumatic and electrical line connections to the device.
5. Ensure that only authorized persons are present in the working area of the machine or system in order to prevent any hazard from switching on the machine.

8.2 Mounting

The displayed figures are only examples. Depending on the particular design, they can differ from the product.

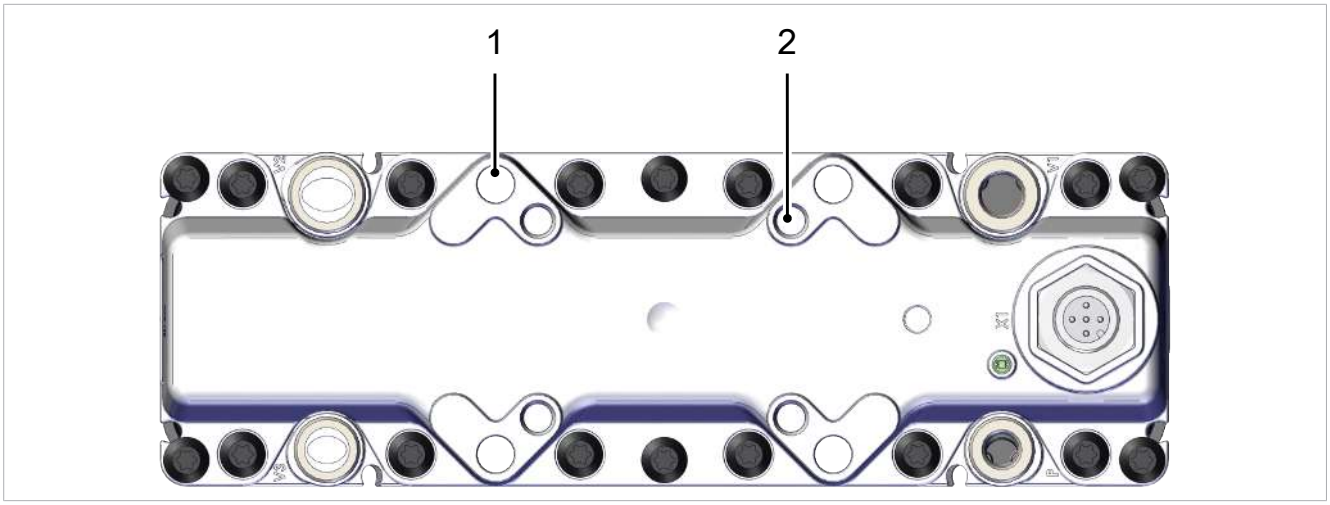
NOTE

Unscrewing the product

Risk of injury and damage to the product

- The product must not be unscrewed during mounting.
- Failure to comply shall make the warranty void.

The FMG is fastened to a handling system using screws.



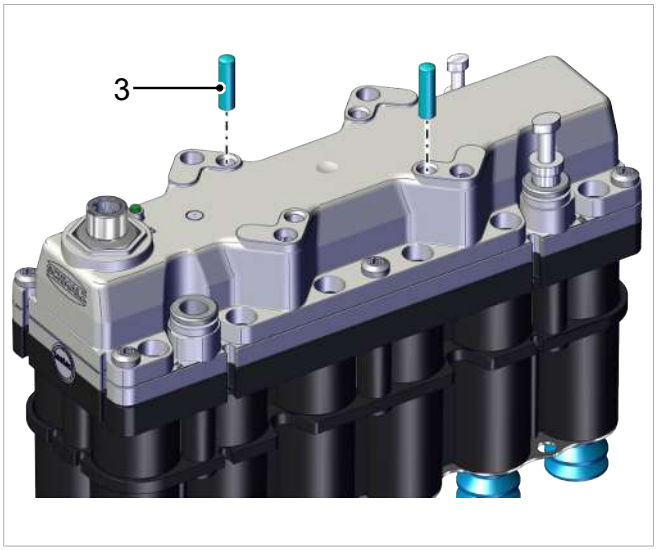
The four holes at position (2) are used to mount positioning pins with a diameter of 5 mm. The use of positioning pins increases the accuracy of the position of the FMG on the handling system (especially when replacing individual modules).

The four mounting holes at position (1) have the diameter d and can be used in the following two ways:

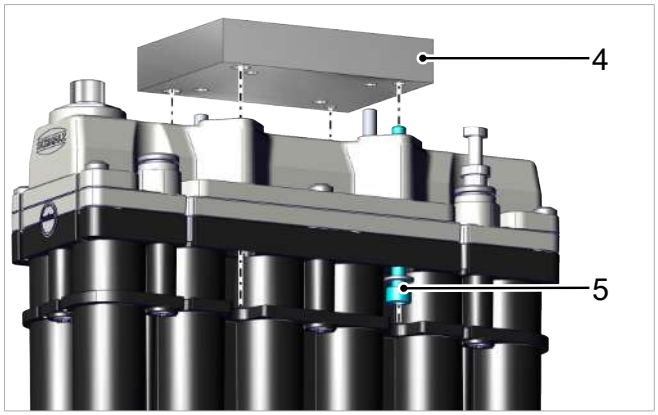
Option 1: Attachment to a threaded holder using 4 screws

- ✓ Suitable mounting material is made available by the customer:
  min. two positioning pins as per DIN 7090, 5 mm diameter
  4x machine screws, ISO 4762 – M5 x 55 – 8.8 *
  4x disks, ISO 7090-5-200HV
  * The specified screw lengths are recommended lengths to ensure a sufficient screw-in length in the illustrated connection cases. A sufficient screw-in length must always be checked and designed by the integrator.
- ✓ The appropriate bores for the positioning pins (3) have been provided in the customer-supplied holder.

1. Insert at least two positioning pins (3) into the bores (2).



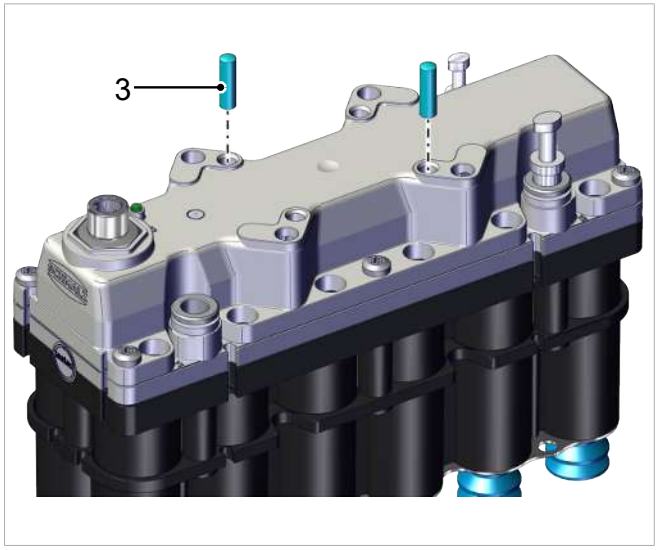
2. Mount the device on a holder (4) via the through-holes (1) with a diameter of d using **four** screws with washers (5). The length of the screws should be at least 55 mm. The tightening torque for the screws is max. 4 Nm.



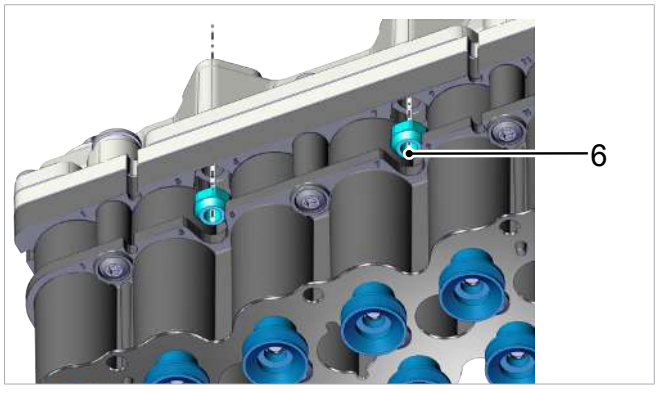
Option 2: Attachment on a holder with boreholes using 4 screws

- ✓ Suitable mounting material is made available by the customer:
  min. two positioning pins as per DIN 7090, 5 mm diameter
  4x machine screws, ISO 4762 – M6 x 60 – 8.8 *
  4x hexagonal nuts, ISO 10511 – M6 – 8
  * The specified screw lengths are recommended lengths to ensure a sufficient screw-in length in the illustrated connection cases. A sufficient screw-in length must always be checked and designed by the integrator.
- ✓ The appropriate bores for the positioning pins (3) have been provided in the customer-supplied holder.

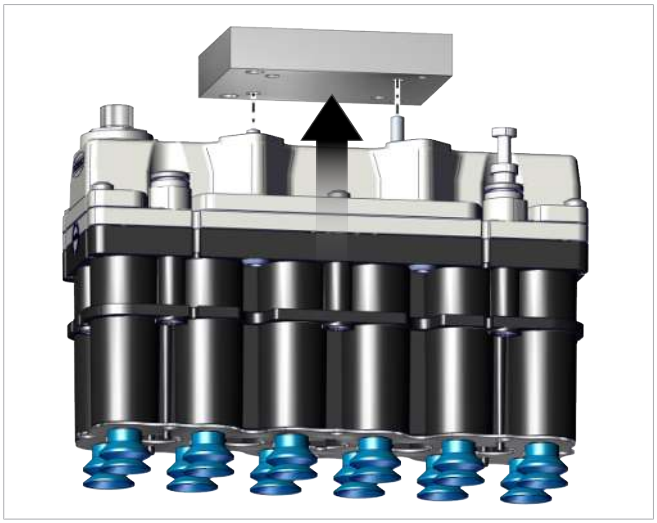
1. Insert at least two positioning pins (3) into the bores (2).



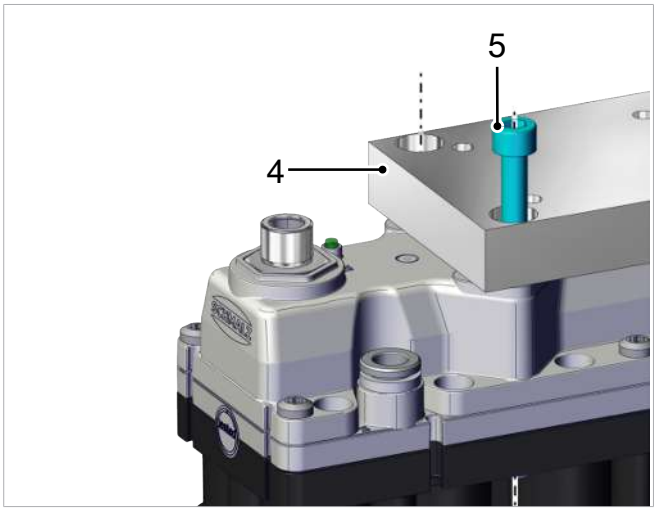
2. Push the four nuts (6) into their designated recesses in the housing in the correct position.



3. Push the device flush against the holder.



4. Mount the device on a holder (4) via the through-holes (1) with the diameter d using **four** screws (5). The tightening torque for the screws is max. 4 Nm.



8.3 Electrical Connection

8.3.1 Mounting the Connection Cable

⚠ WARNING

Electric shock

Risk of injury

- Operate the product using a power supply unit with protected extra-low voltage (PELV).

⚠ WARNING

Change of output signals when product is switched on or plug is connected

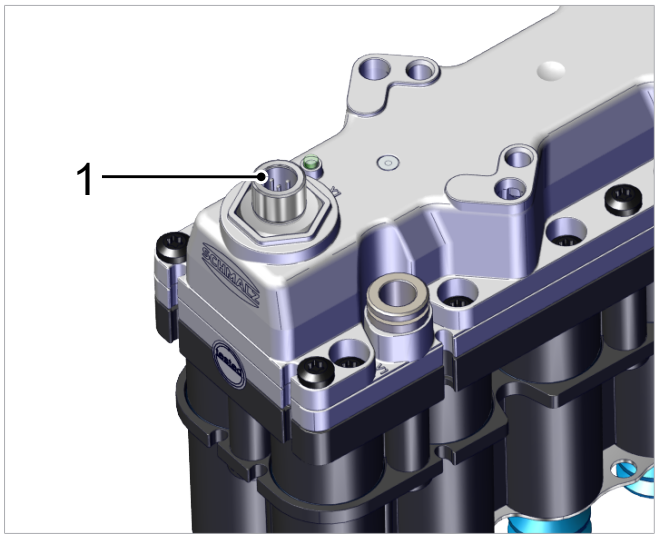
Risk of injury to persons and damage to property due to uncontrolled movements of the higher-level machine/system!

- The electrical connection must be performed only by specialists who can evaluate the effects of signal changes on the overall system.

The electrical connection is established using a 5-pin M12 connector.

The electrical connection supplies the device with power and communicates with the controller of the higher-level machine using defined outputs.

✓ Prepare an M12 5-pin connection cable with a socket (supplied by the customer).



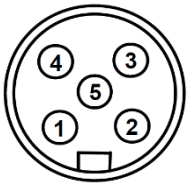
▸ Attach the connection cable to plug position (1); maximum tightening torque = hand-tight.

Observe the following connection instructions:

- The device is designed with potential separation between the sensor supply (sensors and communication) and the actuator supply (valves). It is operated with two galvanically isolated voltages.
- The maximum length of the electrical supply line is 20 meters in accordance with the IO-Link specification.

8.3.2 Pin Assignment of M12 Connector for IO-Link Class B

Electrical interface, 1x M12 – A-coded pin assignment according to IO-Link class B

M12 plug	PIN	Symbol	Wire color [1)]	Function
	1	U_s	Brown	Supply voltage for sensor
	2	U_A	White	Supply voltage for actuator
	3	GND_s	Blue	Sensor ground
	4	C/Q	Black	IO-Link
	5	GND_A	Gray	Actuator ground

[1)] When using a Schmalz connection cable

8.4 Pneumatic Connection

⚠ CAUTION

Compressed air or vacuum in direct contact with the eye

Severe eye injury!

- Wear eye protection.
- Do not look into compressed air openings.
- Do not look into vacuum openings, e.g. suction cups.

⚠ CAUTION

Noise pollution due to incorrect installation of the pressure and vacuum connections

Hearing damage!

- Correct installation.
- Wear ear protectors.

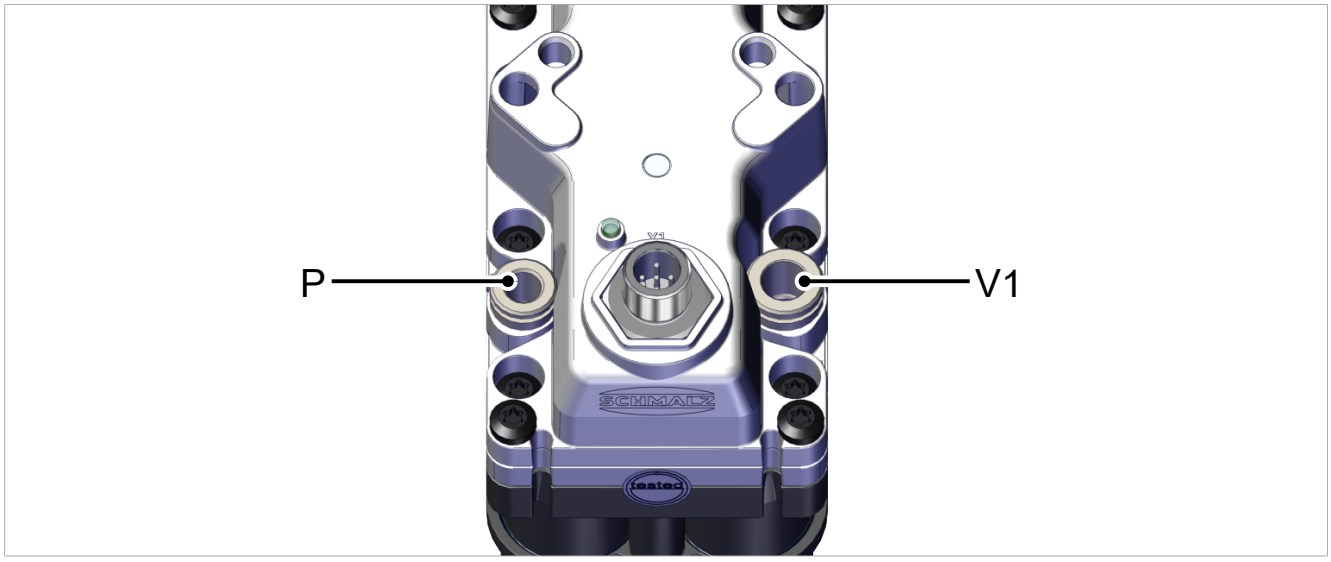
⚠ CAUTION

Uncontrolled movement (whipping) of the compressed air hose when the compressed air supply is activated

Risk of injury

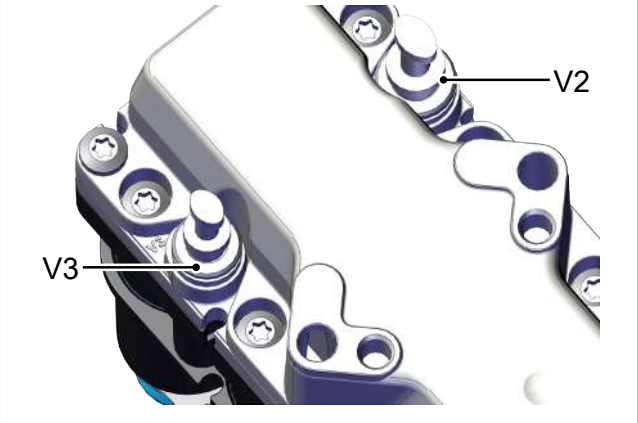
- Deactivate the compressed air supply when working on the product.
- Cut hoses as short as possible and fix in place.
- Wear eye protection.

1. Cut hoses as short as possible and fix them in place.
2. Hose lines must be laid without bends or crimps.



1. The compressed air connection (P) is used to activate the suction points and has a plug connection for hoses with an outside diameter of 6 mm (VSL 6/4 is recommended).
2. The vacuum connection (V1) supplies the vacuum to the suction cups connected to the plunger rods. The plug connection is designed for hoses with an outside diameter of 8 mm (VSL 8/6 is recommended).

Alternatively or additionally, the connections V2 and V3 can also be connected to vacuum supply lines or vacuum generators.

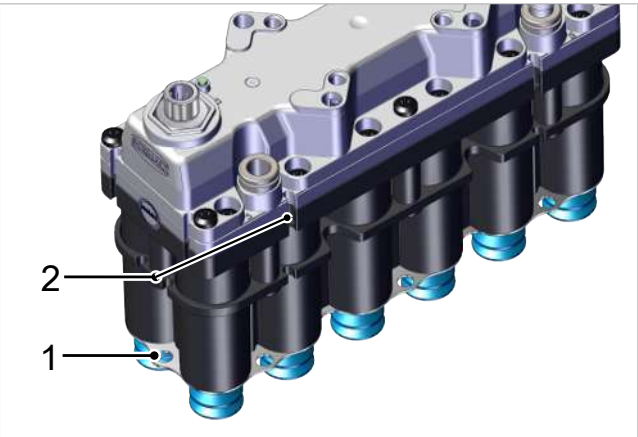


To ensure the safe operation of the gripper, the vacuum generator used should provide a suction capacity of approximately **36 liters per minute**.

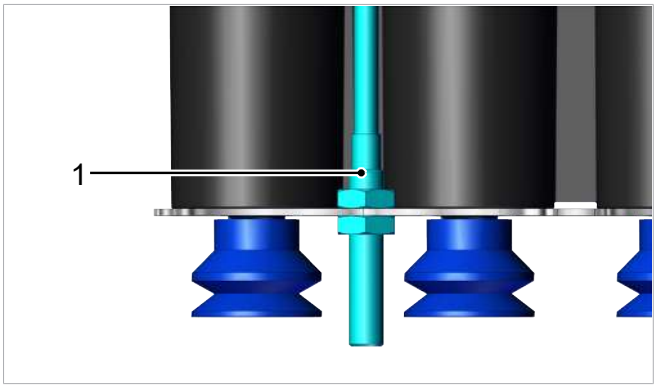
8.5 Optional: Mounting the Proximity Sensor

8.5.1 Install proximity sensor, version of the FMG with 12 suction cups

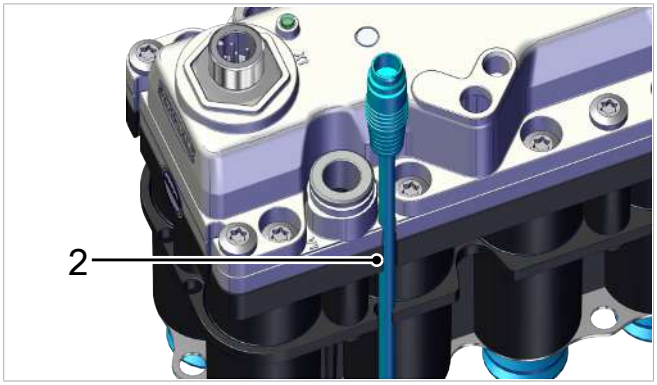
To mount the sensors, mounting holes (1) and slots (2) for the cable routing are provided on the FMG.



1. Install the sensor on the mounting hole (1) with a 5.8 mm diameter.



2. Set the distance to the workpiece according to the sensor operating instructions.



3. Guide the connection cable through the slot (2) and secure with a cable tie if necessary.

4. Connect the device and check that it is functioning.

8.5.2 Install proximity sensor, version of the FMG with three suction cups

For attaching a holder for sensors, M4 threads are incorporated around the suction cups.

If you have any questions regarding the use of the threads, please contact the Schmalz service.

9 Operation

9.1 Misuse

The device is not to be used for the following applications:

- Operation in an unsuitable environment (coarse dirt or liquids that clog the filter).
- Do not use the plunger stroke to push out workpieces.
- Do **not** extend the suction points when the vacuum is activated.
- Activate only suction points that are fully covered by the workpiece.

9.2 Before Initial Start of Operations

⚠ CAUTION

Unsuitable load

Risk of injury from falling load!

- Before handling unfamiliar loads, carry out tests to ensure safe operation.

The gripper is permitted to be put into operation only if it has been installed in the customer-supplied handling system for which it is intended.

Before the initial start of operations following installation, repair, servicing or maintenance work, you must check the following:

- All mechanical connectors are properly attached and secured.
- All bolts and nuts are tightened to specified torques according to the valid standard and secured against becoming loose.
- All components are installed.
- The safety distances have been maintained.
- The electrical cable and supply hoses are properly routed.

9.3 Transport Cycle

The valves are controlled via the higher-level controller.

1. Move the gripper to the start position.
2. Activate the required suction points.
   ⇨ The required suction points extend by 10 mm.
3. Move the gripper orthogonally to the gripping surface until it is pressed onto the workpiece.
4. Make sure that the suction cups are positioned on the pre-defined suction areas.
5. Once the suction cups are compressed by half the specified maximum suction cup stroke Z, activate the vacuum.
   ⇨ The workpiece is picked up and moves toward the gripper.
6. As soon as the workpiece is safely picked up and the working vacuum is established, the gripper can be moved.
7. Move the workpiece to the desired set-down position.
8. Before releasing the workpiece, ensure that it has been set down securely and cannot slip or tilt.

9. Deposit the workpiece on the ejector by activating the blow-off function.
10. Move the gripper to the start position.

The suction surface can be cleaned with a blow-off pulse before applying suction.

9.4 Setting Process Parameters

⚠ WARNING

Falling load – improper use of the gripper

Serious injury due to falling load!

- Conduct tests and carefully increase the load to determine the optimum settings for the process parameters required for the handling process (load, acceleration, vacuum level, and so on).

The holding force of the different grippers is limited; that is, the absorption of load forces and torques is limited. To prevent the load from shifting or even coming loose during the handling process, the operator of the respective gripper is therefore obliged to determine the optimum settings for the permitted process parameters for the handling process (load, acceleration, vacuum level, and so on) by performing testing and carefully increasing the load.

⚠ WARNING

In the absence of compressed air or failure of the supply voltage, the holding forces on the spring plungers are reduced.

Due to the weight of the workpiece and the upward orientation of the suction cups, the vacuum supply is interrupted during the handling process, and the workpiece is released.

- For handling processes in which the suction cups are oriented upwards, a detailed investigation of the process conditions (workpiece weight, accelerations, etc.) and a risk assessment must be carried out.

For the safe operation of the FMG, the following points must also be observed:

- When the compressed air supply is active, the gripper can be used within the framework of the technical data, regardless of its orientation (e.g. in robot applications).
- In the absence of compressed air or if the supply voltage fails, the holding forces on the spring plungers are reduced. Due to the weight of the workpiece and the upward orientation of the suction cups, the vacuum supply may be interrupted during the handling process by the pressing in of the spring plungers, and the workpiece is released.
  For handling processes in which the suction cups are oriented upwards, a detailed investigation of the process conditions (workpiece weight, accelerations, etc.) and a risk assessment must be carried out. The permissible counterforce for a suction point with stroke must be observed (> See ch. 6.2 Matrix area gripper, p. 22).

Schmalz assumes no liability for damages resulting from slippage or the release of the load due to the incorrect adjustment of process parameters.

10 Troubleshooting

10.1 Troubleshooting

Fault	Possible cause	Solution
Product does not respond	No power supply	▸ Check electrical connection and PIN assignment. ▸ Check whether both sensor supply and actuator supply voltage are present ▸ Check vacuum and compressed air supply.
LED not illuminated	No supply voltage present on the device	▸ Check supply voltage
The load cannot be held	Vacuum level too low	1. Check system for leakage and correct if necessary. 2. Check filter and clean if necessary 3. Replace any worn suction cup 4. Check the vacuum generator
	Vacuum gripper not fully covered	▸ Deactivate the relevant suction cups or correct their positions
Spring plungers do not extend or retract	Device is incorrectly connected	▸ Check connections and connect correctly
	Incorrect operating parameters	▸ Check the operating parameters and set them correctly
	Spring plunger damaged or worn	1. Switch off the affected suction point in the program of the higher-level control (if technically feasible in the process; otherwise, replacement is required) 2. Replace the spring plunger assembly

11 Maintenance

11.1 Cleaning the Device

⚠ CAUTION

Use of Cleaners Containing Solvents

Damage to the product (seals, insulation, coatings and other surfaces may be damaged by cleaners that contain solvents) and potentially damage to health

- Use a chemically and biologically neutral cleaning agent.
- Use cleaning agent that is rated as non-harmful to health.
- The use of the following cleaning agents is strictly prohibited:
  — Acetone
  — white spirit
  — cellulose thinner/turpentine oil (solvents)

1. For cleaning, do not use aggressive cleaning agents such as industrial alcohol, white spirit or thinners. Only use cleaning agents with pH 7–12.
2. Remove dirt on the exterior of the device with a soft cloth and soap suds at a maximum temperature of 60° C. Make sure that the product is not soaked in soapy water.
3. Ensure that no moisture gets into the electrical connection.

Cleaning the filter elements or sieves

✓ Position the device so that the blow-off air is guided into the open and ensure that there are no people in the air stream of the contaminated blow-off air.

- Remove coarse dirt on the filter elements or sieves of the suction points with one or more blow-off pulses.

11.2 Replacing a Suction Cup

Disassembly

The suction cups are attached to the nipples using an undercut.

- Remove the damaged suction cup from the nipple by hand or with a gripper.

Mounting

Make sure that suction cups with the same overall height are mounted on all covered suction points. Mixed operation of suction cups of different overall heights must be avoided.

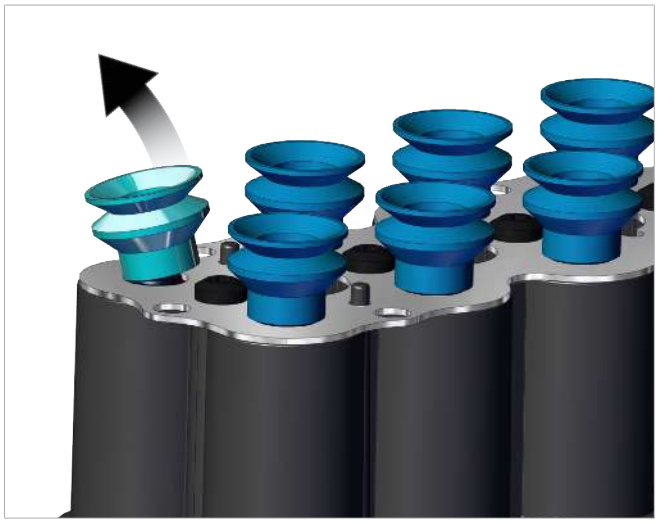
- Press the suction cup onto the exposed nipple until it is cleanly positioned over the entire circumference of the undercut. If necessary, for easy mounting, moisten the contact surfaces to the nipple with a little soapy water.

11.3 Version of the FMG with 12 suction cups: replace the filter

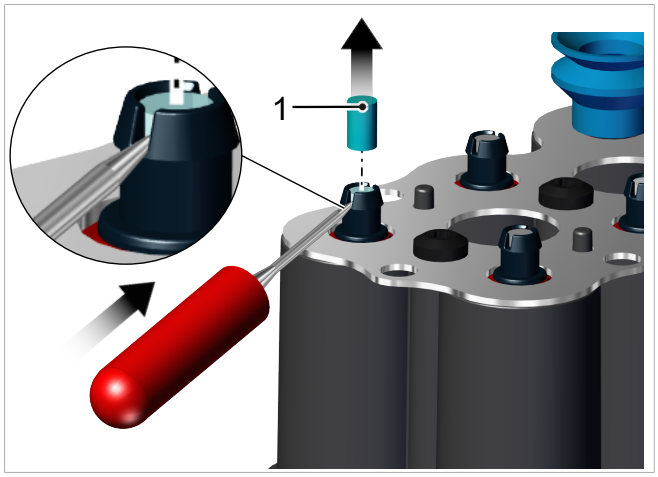
Each suction point contains a filter. This filter prevents dirt from the environment from reaching the inside of the device.
During operation, these filters can become clogged, which decreases the suction capacity. Replacement is required. When necessary, we recommend replacing all the filters.

- ✓ The device is deactivated and disconnected from the supply lines.
- ✓ The customer has provided the spare parts (> See ch. 12 Spare and Wearing Parts, p. 45).

1. Disconnect the suction cups from the nipples by hand.
   The use of tools (a gripper, for example) is not recommended because the suction cups may be damaged.



2. Lever or push the filters (1) out of the boreholes using a pointed tool.



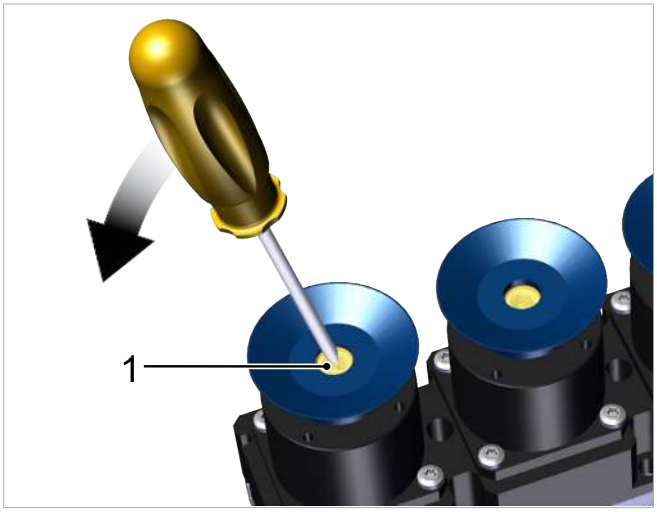
3. Push the new filter flush into the relevant hole.
4. Press the suction cups onto the exposed nipple until they are cleanly positioned over the entire circumference of the undercut.

11.4 Version of the FMG with three suction cups: replace the sieve

There is a sieve in each suction point. The sieve prevents dirt from the environment from reaching the inside of the device.
During operation, the sieves can become clogged, which decreases the suction capacity. Replacement is required. We recommend replacing all sieves, if necessary.

- ✓ The device is deactivated and disconnected from the supply lines.
- ✓ The customer has provided the spare parts (> See ch. 12 Spare and Wearing Parts, p. 45).

1. Use a sharp tool to pierce the sieves (1) and pry them out of the holes.

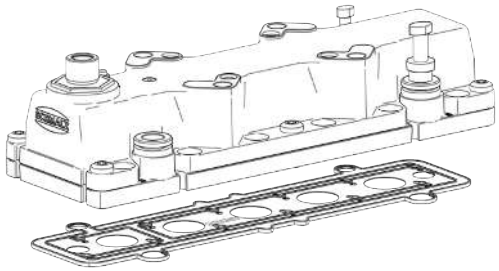
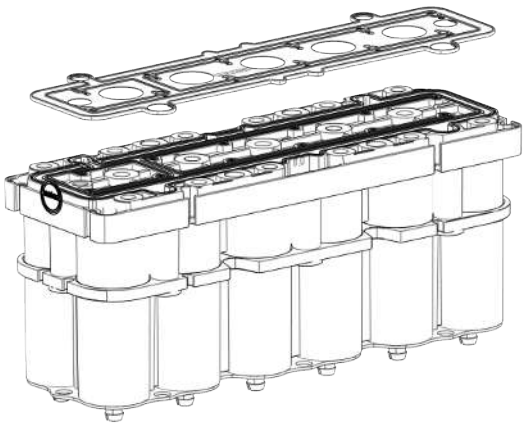


2. Push the new sieves flush into the relevant hole.

11.5 Replacing Modules

The illustrations shown below may deviate from the customer's version because they serve as examples of different versions of the product.

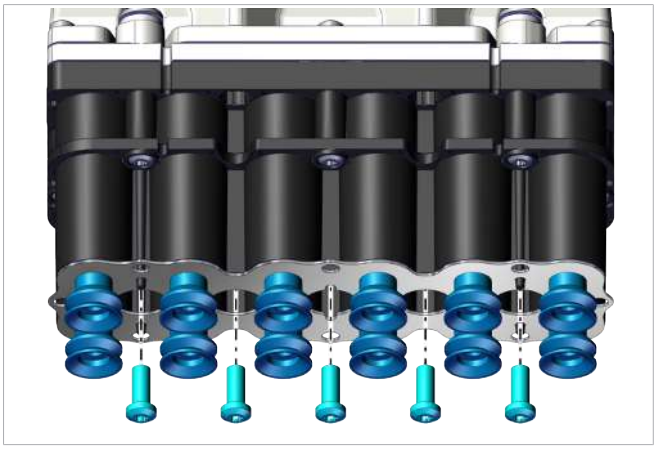
Four sets of spare parts with modules are available (> See ch. 12 Spare and Wearing Parts, p. 45):

Spare parts set	Example with 12 suction cups
Module: valve unit for the FMG with 12 suction cups Module: valve unit for the FMG with three suction cups	
Module: basic housing for the FMG with 12 suction cups Module: basic housing for the FMG with three suction cups	

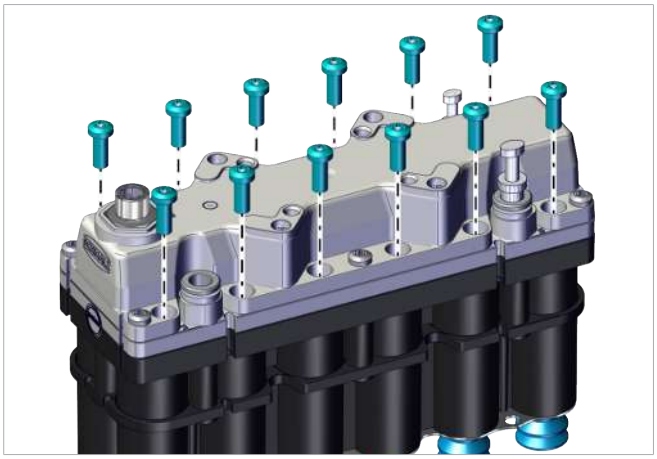
Disassembly

- ✓ The device is deactivated and disconnected from the supply lines.
- ✓ The customer has provided the spare parts set (> See ch. 12 Spare and Wearing Parts, p. 45).

1. Release and discard the bolts, which are centrally positioned from below.

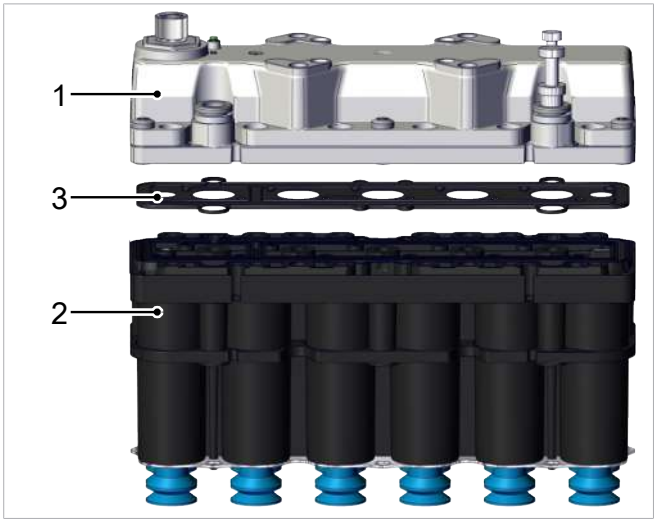


2. Release and dispose of the twelve screws positioned to the side on the top.



⇨ The fastening screws are removed and the modules can be separated.

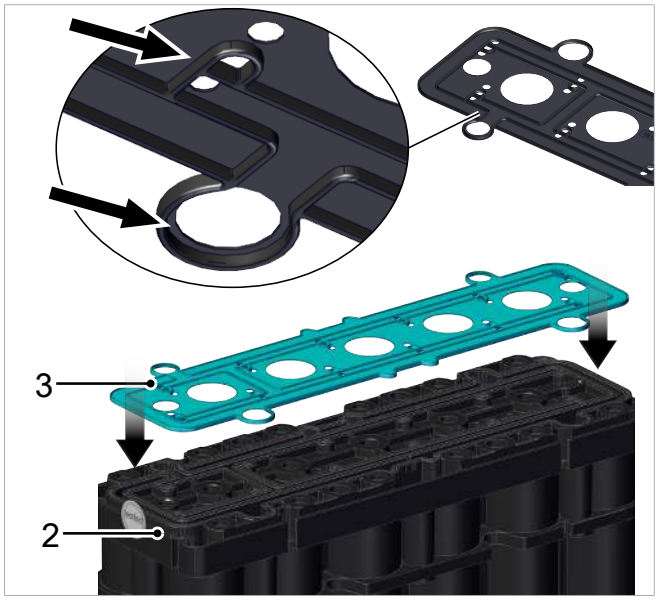
3. Separate the valve unit (1) and base housing (2) modules and dispose of the defective module. Remove and dispose of the sealing frame (3).



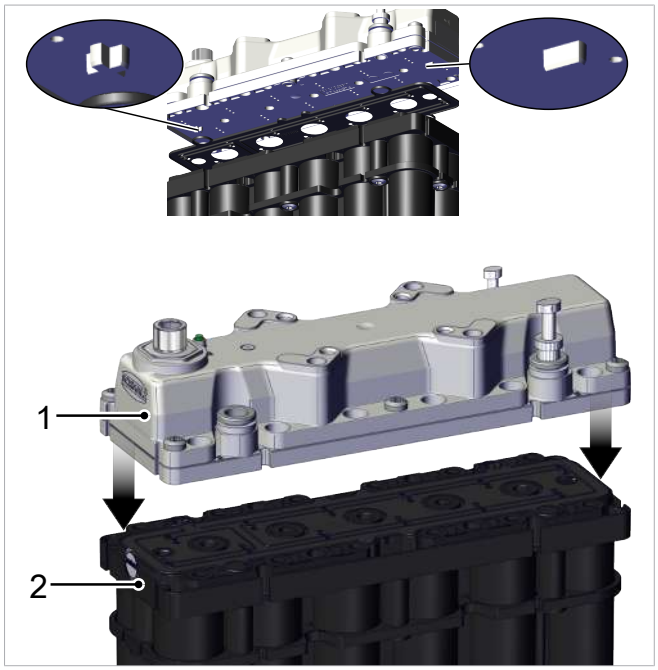
Mounting

Every time that the device is opened, the screws and sealing frame must be replaced. For this reason, these components are included in the spare part sets.

1. Correctly position the new sealing frame (3) (Poka Yoke) on the base housing (2).
   The webs of the frame seal (3) point in the direction of the base housing (2) and the bore openings are positioned on the correct side for the relevant size.

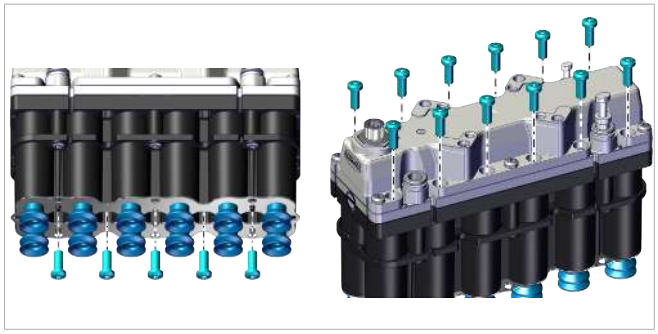


   ⇨ The frame seal is inserted or pressed into the appropriate slots in the correct position using the webs.



2. Correctly position the valve unit (1) on the base housing (2), paying attention to the Poka Yoke markings (plus and minus cams).

3. Screw in all the screws. The tightening torque is 2.5 Nm.



4. Install the device at the location of use and connect the supply lines.
5. Before starting the handling process, check to ensure the device is installed and functioning correctly.

12 Spare and Wearing Parts

Maintenance work may only be carried out by qualified personnel.

⚠ WARNING

Risk of injury due to incorrect maintenance or troubleshooting

- Check the proper functioning of the product, especially the safety features, after every maintenance or troubleshooting operation.

The following list contains the most important spare and wearing parts.

Part no.	Type	Description	Type
For the FMG with 12 suction cups			
10.12.10.00048	ERS-SET FMG 4x6	Filter set, 12 pcs.	Spare part
10.12.10.00049	ERS FMG-VENT-EINH	Spare part set	Spare part
10.12.10.00050	ERS FMG-GK	Spare part set	Spare part
10.01.06.05777	FGA 20 HT1-60 N016	Bellows suction cup (round)	Wearing part
For the FMG with three suction cups			
10.12.10.00181	ERS FMG-VENT-EINH	Spare part set	Spare part
10.12.10.00182	ERS FMG-GK	Spare part set	Spare part
10.05.03.00182	SIEVE 14x0.7 MS-A2 0.1/0.07	Round sieve	Spare part
10.01.01.13996	SUF 50 HT1-60 SC050	Flat suction gripper (round)	Wearing part

13 Accessories

Part no.	Type	Designation	Suction force	Note
10.01.06.05776	FGA 12 HT1-60 N016	Bellows suction cup (round)	1 N	only for the FMG with 12 suction cups
10.01.06.00872	FGA 25 HT1-60 N016	Bellows suction cup (round)	5.3 N	only for the FMG with 12 suction cups Overall height is different for FGA 12 and 20 [1)]

[1)] Make sure that suction cups with the same overall height are mounted on all covered suction points. Mixed operation of suction cups of different overall heights must be avoided.

14 Disposing of the Product

The components may only be prepared for disposal by qualified specialists.

- ✓ The product is out of operation.
- ▸ Disassemble the components of the product and dispose of the materials appropriately.

For proper disposal, please contact a company specializing in the disposal of technical goods and instruct the company to observe the applicable disposal and environmental regulations. Schmalz is happy to assist you in finding a suitable company.

15 Attachment

See also

FMG_Data_Dictionary_00.PDF [▶ 49]

15.1 EU Declaration of Conformity

EU Declaration of Conformity

The manufacturer Schmalz confirms that the product described in these instructions fulfills the following applicable EU directives:

2014/30/EU	Electromagnetic Compatibility
2011/65/EU	RoHS Directive

The following harmonized standards were applied:

EN ISO 12100	Safety of machinery — General principles for design — Risk assessment and risk reduction
EN 61000-6-4+A1	Electromagnetic compatibility - Part 6-4: Generic standards - Emission standard for industrial environments
EN 61000-6-2+AC	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-3+A1+AC	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments

Additional technical standards and specifications were applied:

EN 61000-4-2	Electromagnetic Compatibility (EMC) – Part 4-2: Testing and measuring procedures
EN 61000-4-3	Electromagnetic Compatibility (EMC) – Part 4-3: Testing and measuring procedures
EN 61000-4-4	Electromagnetic Compatibility (EMC) – Part 4-4: Testing and measuring procedures
EN 61000-4-6	Electromagnetic Compatibility (EMC) – Part 4-6: Testing and measuring procedures

The EU Declaration of Conformity valid at the time of product delivery is delivered with product or made available online. The standards and directives cited here reflect the status at the time of publication of the operating and assembly instructions.

IO-Link Data Dictionary

FMG Flächengreifer

13.02.2024

IO-Link

J. Schmalz GmbH
Johannes-Schmalz-Str. 1, D 72293 Glatten
Tel.: +49(0)7443/2403-0
www.schmalz.com
info@schmalz.de

SCHMALZ

IO-Link Implementation

Vendor ID	234 (0xEA)
Device ID	100150 (0x018736)
SIO-Mode	no
IO-Link Revision	1.1
IO-Link Bitrate	38.4 kBit/sec (COM2)
Minimum Cycle Time	2,2 ms
Process Data Input	0 byte
Process Data Output	2 bytes

Process Data

Process data Out		Bits	Access	Remark
PD out byte 0	Valve 1	0	wo	0 = Valve inactive 1 = Valve active
	Valve 2	1	wo	
	Valve 3	2	wo	
	Valve 4	3	wo	
	Valve 5	4	wo	
	Valve 6	5	wo	
	Valve 7	6	wo	
	Valve 8	7	wo	
PD out byte 1	Valve 9	0	wo	
	Valve 10	1	wo	
	Valve 11	2	wo	
	Valve 12	3	wo	
	reserved	4…7	wo	reserved

ISDU Parameters

ISDU Index dec	ISDU Index hex	Subindex dec	Parameter	Size	Value Range	Access	Default Value	Remark
Identification								
Device Management								
16	0x0010	0	Vendor name	0…32 bytes	-	ro	'J. Schmalz GmbH	Manufacturer designation
17	0x0011	0	Vendor text	0…32 bytes	-	ro	Innovative Vacuum Solutions	Vendor text
18	0x0012	0	Product name	0…32 bytes	-	ro	-	Product name
19	0x0013	0	Product ID	0…32 bytes	-	ro	-	Product variant name, z.B.: FMG
20	0x0014	0	Product text	0…32 bytes	-	ro	-	Order-code, z.B.: FMG
21	0x0015	0	Serial number	9 bytes	-	ro	-	Serial number, z.B.: 999000101
22	0x0016	0	Hardware revision	2 bytes	-	ro	-	Hardware revision, z.B.: 00
23	0x0017	0	Firmware revision	4 bytes	-	ro	-	Firmware revision, z.B.: 1.12
240	0x00F0	0	Unique device identification	9 bytes	-	ro	-	Unique ID, z.B.:00EA 0187D7 3B8B8825
250	0x00FA	0	Article number	14 bytes	-	ro	-	Order-number, z.B.: 10.03.01.00500
252	0x00FC	0	Production date	3 bytes	-	ro	-	Date code of production (month and year, month is letter coded, z.B.: I19
Device Localization								
24	0x0018	0	Application specific tag	1…32 bytes	-	rw	***	User string to store location or tooling information
25	0x0019	0	Function tag	1…32 bytes	-	rw	***	User string to store location or tooling information
26	0x001A	0	Location tag	1…32 bytes	-	rw	***	User string to store location or tooling information
242	0x00F2	0	Equipment identification	1…64 bytes	-	rw	***	User string to store identification name from schematic
246	0x00F6	0	Geolocation	1…64 bytes	-	rw	***	User string to store geolocation from handheld device
247	0x00F7	0	IODD web link	1…64 bytes	-	rw	***	User string to store web link to IODD file
249	0x00F9	0	Storage location	1…32 bytes	-	rw	***	User string to store storage location
253	0x00FD	0	Installation date	1…16 bytes	-	rw	***	User string to store date of installation
Device Settings								
Commands								
2	0x0002	0	System command	1 byte	5, 129, 131	wo	-	0x05 (dec 5): Force upload of parameter data into the master 0x81 (dec 129): Reset application 0x83 (dec 131): Back to box
Counter								
141	0x008D	1…12	Valve operating counter	4x12 bytes	-	ro	-	Counter for valve operating (non-erasable) Saved every 200 counts Subindex corresponds to valve number

Coding of IO-Link Events

Extended Device Status ID (= IO-Link Event Code) dec	Extended Device Status ID (= IO-Link Event Code) hex	Extended Device Status Type hex	Extended Device Status Type Meaning	IO-Link Event Type	Event name	Remark
0	0x0000	0x10	Everything OK	(no IOL event)	Everything OK	Device is working optimally

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J. Schmalz GmbH
Johannes-Schmalz-Str. 1
72293 Glatten, Germany
T: +49 (0) 7443 2403-0
schmalz@schmalz.de
WWW.SCHMALZ.COM