Electrical Vacuum Generator ECBPMi

Operating instructions

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EN-US · 30.30.01.02196 · 02 · 09/21

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

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Contents

1 Important Information

1.1 Note on Using this Document

J. Schmalz GmbH is generally referred to as Schmalz in these Operating instructions.

These Operating instructions contain 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 Operating instructions describe the product at the time of delivery by Schmalz.

1.2 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

1.3 Type Plate

The type plates (1) and (2) are attached to the packaging.

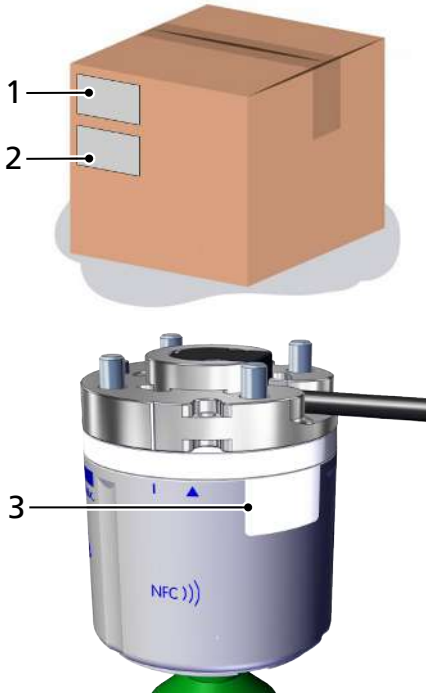
The type plate (1) contains data for the robot set:

- Name
- Part number

The type plate (2) contains data for the Mini-Cobot-Pump ECBPMi:

- Name
- Part number
- Manufacturing date
- Serial number
- QR code
- CE label
- Voltage range
- IO-Link symbol

The type plate (3) is permanently attached to for the Mini-CobotPump (which is referred to below as the ECBPMi) and must always be clearly legible. It contains the same data as the type plate (2).



Please specify all the information above when ordering replacement parts, making warranty claims or for any other inquiries.

1.4 Warnings in This Document

Warnings warn against hazards that may occur when handling the product. This document contains three levels of danger that you can recognize by the signal word.

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.

1.5 Symbol

This symbol indicates useful and important information.

✓ This symbol represents a prerequisite that must be met prior to an operational step.

▸ 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 ECBPMi is designed to generate a vacuum for gripping and transporting objects when used in conjunction with suction cups. The pump is designed to be connected to a PLC or a robot control unit.

It has been specially developed for use in collaborative robot systems.

Non-aggressive and flammable gases and dry and oil-free air (no graphite) are permitted as the media to be evacuated.

Suitable Schmalz URCap software with the current version no. V4.3.6 is a requirement for the safe operation of the ECBPMi Plus model. Schmalz URCap is not downward compatible. Validity of Schmalz URCap:

- Schmalz URCap (V4.3.6) valid for ECBPMi and ECBPMi PLUS on robot systems from UR with the control software Polyscope 5.8 or higher (used in UR e series).
- Schmalz URCap (V4.3.6) valid for ECBPMi on robot systems from UR with the control software Polyscope 3.12 or higher (used in UR CB series).

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 and commercial applications.

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.

2.3 Personnel Qualification

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

1. Only instruct qualified personnel to perform the tasks described in this manual.
2. The product may only be operated by persons who have undergone appropriate training.
3. Electrical work and installations may only be carried out by qualified electrical specialists.
4. Assembly and maintenance work may only be carried out by qualified personnel.

The following target groups are addressed in this manual:

- 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

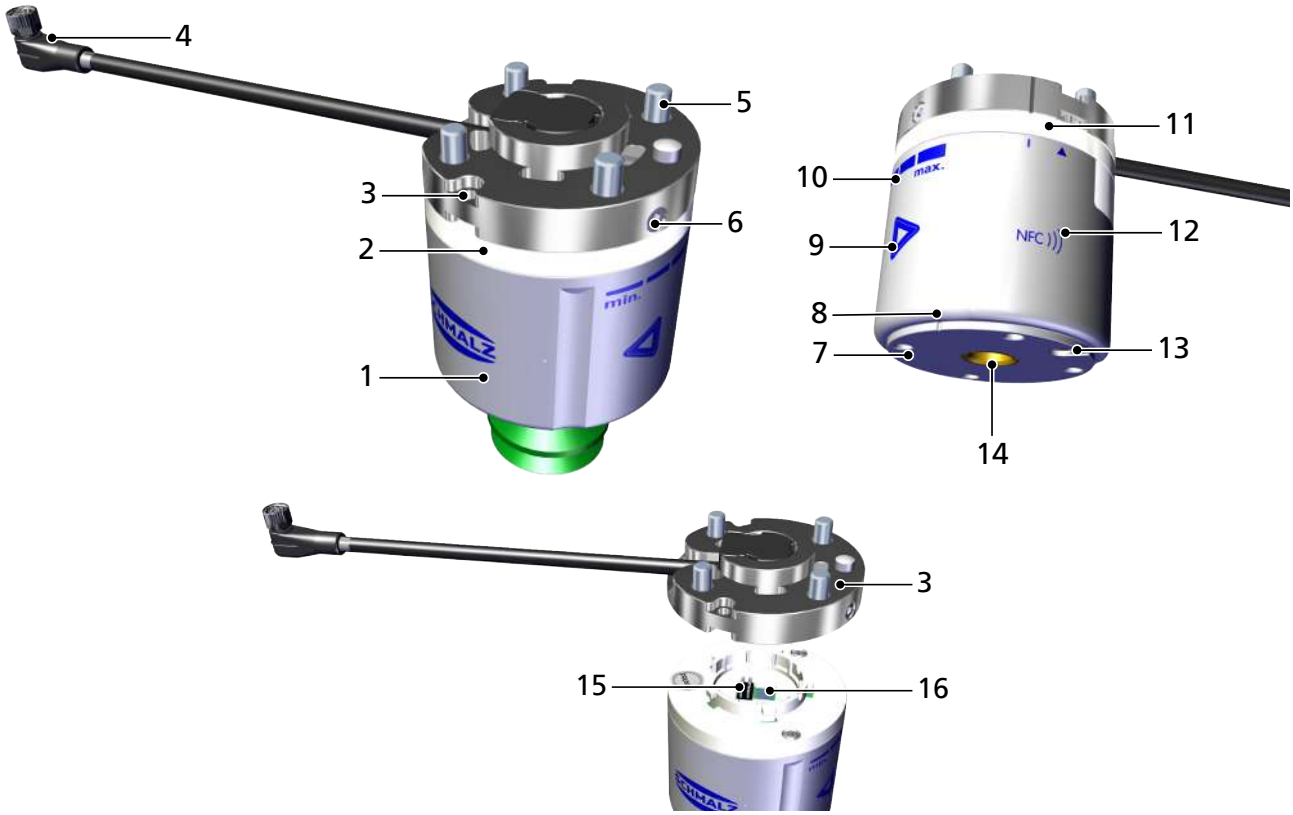
2.4 Modifications to the Product

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 Design of the ECBPMi

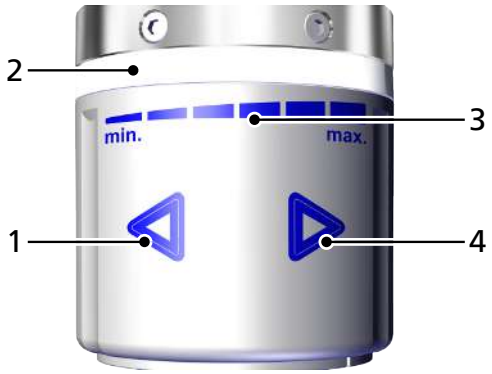


1	Housing of ECBPMi	2	LED status indicator, 360° RGB circumferential light
3	Customer-specific robot connection flange	4	Electrical connection, connection cable with robot-specific length and connection plug
5	Fastening screw for the robot, 4x M6x10	6	Fastening screw for the customer-specific robot connection flange, 2x M3x14
7	Thread insert, 4x M4 female thread	8	Marking for the alignment of the optional VEE flange [1)]
9	Touch capacitive button, 2x	10	Vacuum display field, segmented LED display in the front section
11	Bayonet fastener position indicator	12	NFC symbol
13	Ventilation opening	14	Vacuum connection with G1/4" female thread
15	Pin spring contact for the flange	16	ECBPMi PNP/NPN setting for the inputs and the output OUT2

1) When mounting the VEE flange, the side marking on the ECBPMi (8) must align with the marking on the flange.

3.2 Display and Control Elements

3.2.1 Description of the Display and Control Elements



1	“Less” touch capacitive button	2	LED illuminated ring
3	Vacuum scale, min. 100 mbar to max. 600 mbar	4	“More” touch capacitive button

The ECBPMi is operated using two touch capacitive buttons.

The buttons are used to set the limit value H2 (“Part Present”). When this limit value is exceeded, the digital output OUT2 is activated.

The LED illuminated ring conveys various status information and the vacuum level is shown in the front section when adjusting the limit value.

When the power supply is switched on, the touch capacitive buttons self-calibrate. The buttons should not be touched at this time.

3.2.2 Operation with Gloves

The sensitivity of the touch capacitive buttons is designed in such a way that the relevant button is activated only if the housing is touched during operation with the finger or hand. However, it can also be operated with a variety of thin or special gloves.

Wear gloves made from cotton or gloves with touch-sensitive surfaces with the capacitive touch feature.

Do not use thick gloves to operate the touch-sensitive buttons.

If the buttons do not respond while you are wearing gloves, please remove the gloves and try again without them.

3.2.3 LED State Indicators

The integrated LED status indicators show the current process statuses.

The ECBPMi has two LED areas for displaying the status.

The table below explains the meaning of the LEDs:

360° status indicator LEDs		ECBPMi status
	All lights are off.	No power supply The device is inactive
	Blue light remains illuminated	**Default status:** "Part Present" status: Ready, vacuum < H2 (vacuum has fallen below "Part Present" limit value), OUT2 is deactivated
	Blue light, circulating	**Freedrive:** The robot arm is free to move to a new position, output OUT3 is activated.
	Blue light, flashing	The set value has been saved.
	Green light remains illuminated	Vacuum limit value H2 is reached, vacuum > H2, output OUT2 is activated
	Yellow light, which illuminates section by section Yellow light pulsing	Initiating "Reset to factory settings" via manual operation Performing "Reset to factory settings"
	Orange light remains illuminated Orange light, flashing	Warnings have been issued The set value was not saved.
	Red light pulsing	1x supply voltage error 2x temperature error 3x pump error For more information, see *(> See ch. Displaying Errors, Page 26)*

Adjusting the color and brightness of the “Part Present” LED status display

The blue, continuously illuminated light to indicate “Part Present” status is selected in the default settings.

“Part Present” status can be adjusted in IO-Link mode in terms of color and brightness. Individual settings can be configured for “Ready” status, “Vacuum < H2” as well as the status “Vacuum limit value H2” reached, “Vacuum > H2.”

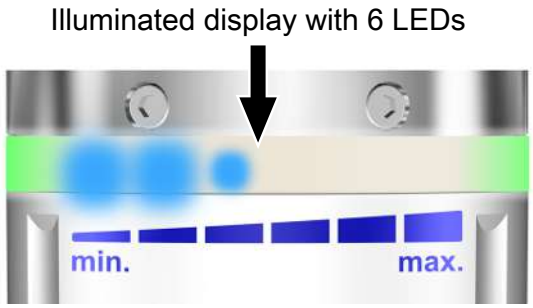
The “Color-Profile” parameter [0x0052] can then be used to define color tone (RGB) and brightness for the above-mentioned statuses using four bytes each.

The brightness setting has no influence on the color tone. I.e. when the brightness changes, the perceived brightness is changed — not the color, the color tone remains the same.

The “System Command” parameter [0x0002] can be used to reset the LED settings to the factory settings (default values) using the 0xAC command.

3.2.4 Vacuum Level Indicator

Above the printed scale on the front, six LEDs indicate the vacuum level of the vacuum limit value H2 for the “Part Present” check, in a range of 100 to 600 mbar.



The indicator for the vacuum level that is currently set is activated using one of the buttons.

The vacuum limit value can be increased or lowered either by tapping or holding down the two touch capacitive buttons.

The scale shows a range of 100 (min.) to 600 mbar (max.) (100 mbar per LED). It can be adjusted in 10 mbar increments.

The example above shows a vacuum level of 240 mbar:

- The first two LEDs light up with 100% brightness
- The third LED lights up with 40% brightness

You can save a new setting for vacuum limit value H2 by pressing both buttons for more than one second. A blue flashing light indicates that the setting was saved successfully.

If the set value is not compatible with the set profile because the H1 value is exceeded, this is also indicated by an orange flashing light.

If the buttons are not pressed for more than five seconds, the display is deactivated and the current set value is not saved. This is also indicated by the LED ring flashing orange.

4 Technical Data

4.1 Electrical Parameters

Parameter	Symbol	Limit values			Unit	Comment
		min.	typ.	max.		
Supply voltage	U_S	19.2	24	26.4	V_{DC}	PELV[1)]
Rated current from U_S	I_S	—	130	180	mA	U_S = 24.0 V
Voltage of signal output OUT2 (PNP)	U_{OH}	U_S-2	—	U_S	V_{DC}	I_{OH} < 140 mA
Voltage of signal output OUT2 (NPN)	U_{OL}	0	—	2	V_{DC}	I_{OL} < 140 mA
Voltage of signal output OUT3 (PNP)	U_{OH}	U_S-1	—	U_S	V_{DC}	I_{OH} < 5 mA
Current of signal output OUT2 (PNP)	I_{OH}	—	—	140	mA	Short-circuit-proof [2)]
Current of signal output OUT2 (NPN)	I_{OL}	—	—	-140	mA	Short-circuit-proof [2)]
Current of signal output OUT3 (only PNP)	I_{OH}	—	—	5	mA	Not protected against short circuits
Voltage of signal input IN1 / IN2 (PNP)	U_{IH}	15	—	U_A	V_{DC}	—
Voltage of signal input IN1 / IN2 (NPN)	U_{IL}	0	—	9	V_{DC}	—
Current of signal input IN1 / IN2 (PNP)	I_{IH}	—	5	—	mA	—
Current of signal input IN1 / IN2 (NPN)	I_{IL}	—	-5	—	mA	—
Reaction time of signal inputs	t_I	—	3	—	ms	—
Reaction time of signal output	t_O	—	2	3	ms	—

1) The power supply must correspond to the regulations in accordance with EN60204 (protected extra-low voltage). The signal inputs and signal outputs are all protected against reverse polarity.

2) The signal output OUT2 is protected against short circuits. However, it is not protected against overloading. Constant load currents of > 0.14 A can lead to impermissible heating and subsequent functional failure.

4.2 Mechanical Data

4.2.1 General Parameters

Parameter	Symbol	Limit values			Unit	Comment
		min.	typ.	max.		
Temperatures of working medium and environment	T_{amb}	0	—	40	° C	—
Storage temperature	T_{Sto}	-10	—	60	° C	—
Humidity	H_{rel}	10	—	90	% r.h.	Free from condensation
Degree of protection with flange	—	—	—	IP40	—	—

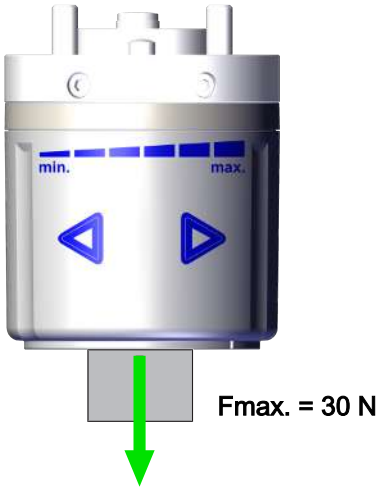
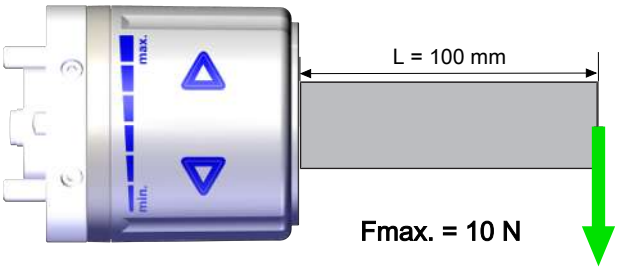
Parameter	Symbol	Limit values			Unit	Comment
Service life	—	6,000	—	—	h	At an ambient temperature of 25 °C
Permitted operating medium	—	Non-aggressive and flammable gases; dry, oil-free air (no graphite)				

4.2.2 Mechanical Performance Data

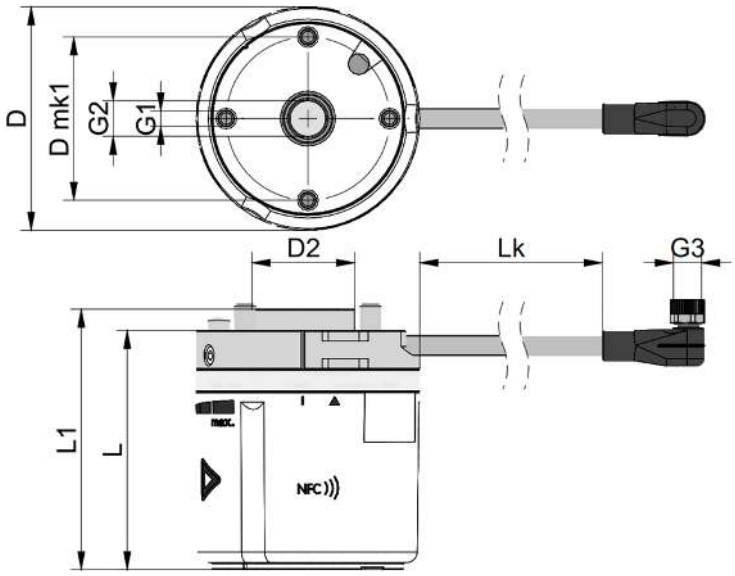
Max. vacuum	Suction rate	Sound level	Weight	Load limit Horizontal installation[1]	Load limit Vertical installation[2] (l = 100 mm)
600 mbar	0 to 1.6 l/min	57 dBA	230 g	Max. 30 N	Max. 10 N

Note on the specifications for the ECBPMi load limits

These figures apply for static loads. The maximum load limits given here apply to the ECBPMi only. For use in connection with an HRC-capable robot, observe the maximum weight limits determined by the manufacturer of the robot.

[1] horizontal installation	[2] vertical installation
	

4.2.3 Dimensions



Type	D	D2	L	L1	Dmk1	G1	G2	G3	Lk
Schmalz standard	63	31.5	67.4	73.4	46	M4 internal thread	G1/4" internal thread	M12 8-pin connector	500
UR 3/5 robot	63	31.5	67.4	73.4	46	M4 internal thread	G1/4" internal thread	M8 8-pin female connector	120.5

All dimensions given in millimeters [mm].

Other robot sets (robot flange and connection cable) available upon request.

4.2.4 Maximum Torque

Connection	Max. torque
G1 thread (4x injection bushing)	1.3 Nm
G2 thread (vacuum connection)	2.0 Nm
Attachment (2x threaded spindle M3x14)	0.6 Nm

4.2.5 Factory Settings

Parameter	Value of the factory setting
Vacuum limit value H1	600 mbar
Reset point h1	580 mbar (H1 - 20 mbar)
Vacuum limit value H2	480 mbar
Reset point h2	460 mbar (H2 - h2)
Signal type for inputs and OUT2	PNP
Signal type for OUT3	PNP

5 Description of Functions

5.1 Control Scheme

The controls of the CobotPump are defined in such a way that, if both inputs are activated at the same time, blowoff has priority over suction.

5.2 Depositing the Workpiece

The “blowoff” valve is controlled directly via the “blowoff” signal input IN2 in SIO mode. In IO-Link mode, the device changes to “Blowoff” mode via the “Drop-off” output process data bit.

In “Blowoff” operating mode, the vacuum circuit of the ECBPMi is vented to the outer atmosphere while the signal is issued. This ensures that the vacuum drops immediately and the workpiece is deposited quickly *(> See ch. Blowoff Modes [0x0045], Page 21)*.

In IO-Link mode, the set input process data bit “Signal H3 (part detached)” provides information about:

- Whether, after reaching the limit value H2 (vacuum > H2), the vacuum has dropped again during suction (vacuum < H2)
- Whether a picked-up part has been deposited.

The ventilation opening on the underside must not be covered. Otherwise, error-free blowoff will not be possible.

5.3 Interfaces

5.3.1 Basic Principles of IO-Link Communication

The product is operated in IO-Link mode to enable intelligent communication with a control unit.

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

The product’s parameters can be set remotely using IO-Link mode. In addition, the energy and process control (EPC) feature is available. The EPC is divided into 3 modules:

- Condition monitoring (CM): Condition monitoring to increase system availability.
- Energy monitoring (EM): Energy monitoring to optimize the vacuum system’s energy consumption.
- Predictive maintenance (PM): Predictive maintenance to increase the performance and quality of the gripping systems.

5.3.2 Process Data

The cyclical process data is used to control the product and receive current information reported from the component. There is a difference between the input data (Process Data In) and the output data (Process Data Out) for control:

The input data Process Data In is used to report the following information cyclically:

- Limit values H1 and H2
- The status of H3
- The product device status in the form of a status traffic light
- EPC data
- Feedback about the executed Autoset function
- Freedrive request and approval
- Feedback about the operating mode

The output data Process Data Out is used to control the product cyclically:

- EPC Select is used to define which data is sent.
- The product is controlled using the suction and blowoff commands.

- The desired operating mode is specified via control mode (continuous suction or control)
- Condition monitoring parameters can be determined automatically with CM Autoset
- Activation of predetermined parameter profiles (production profiles)
- Specification of limit value H1 in control mode
- Specification of pump capacity in continuous suction mode
- Specification of limit value H2
- Can be set to Freedrive, Warning or Error states by the robot

The exact meaning of the data and functions is described in more detail in the "Description of Functions" chapter. A detailed description of the process data can be found in the data dictionary.

The corresponding device description file (IODD) is available for integration into a higher-level control unit.

5.3.3 ISDU Parameter Data

The acyclical communication channel can be used to retrieve what are known as ISDU (Index Service Data Unit) parameters, which contain further information on the system status.

The ISDU channel can also be used to read or overwrite all the settings, e.g. the limit values, additional leakage, etc. Further information on the identity of the product, such as the part number and serial number, can be retrieved using the IO-Link. The product also provides space for saving user-specific information here, such as the installation and storage location.

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.

In order for a control unit to access the ISDU parameters, the necessary system functions must be purchased from the manufacturer of the control unit and used.

5.3.4 Near Field Communication (NFC)

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

The ECBPMi functions as a passive NFC tag that can be read or written by a read or write device which has NFC activated, such as a smartphone or tablet. Access to the ECBPMi's parameters via NFC also works when the supply voltage is not connected.

There are two options for communicating via NFC:

- Read access only can be obtained via a website viewed in a browser. For this, no additional app is needed. It requires only that NFC and the Internet connection are enabled.
- Another option for communication is the "Schmalz ControlRoom" control and service app. This permits not only read access, but also active reconfiguration of the parameters via NFC. The Schmalz ControlRoom app is available at the Google Play Store.

For the best data connection, place the reading device on the NFC symbol in the middle of the ECBPMi.

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.

5.4 Lifting the Workpiece

The ECBPMi is designed for vacuum handling of parts in combination with suction systems and collaborative robots.

The electrical pump is activated and deactivated via the “suction” signal input.

An integrated sensor measures the vacuum generated by the pump. The vacuum level is evaluated by an electronics system and, in SIO mode, issues a signal on digital output OUT2 when a preset or specified vacuum limit value H2 is exceeded. The set vacuum limit value H2 can also be indicated visually in the vacuum display and changed using the buttons.

The ECBPMi has an integrated energy-saving feature. When the machine is in “Suction” mode, it automatically controls the vacuum to keep it at the preset vacuum limit value H1 in accordance with the default settings.

5.5 Automatic Operation

Once the product is connected to the power supply, it is ready for operation and enters automatic mode. This is the normal operating mode, in which the product is operated by the system control unit.

5.6 Monitoring the System Vacuum and Displaying the Control Value [0x0040]

The ECBPMi has an integrated vacuum sensor for monitoring the current system vacuum. When you press a touch capacitive button in SIO mode, the current limit value H2 is displayed above the “vacuum display field.” Note: In IO-Link mode, the “Setpoint H2” parameter [0x0066] is displayed in profile P0.

The limit value H2 is displayed in the front section of the segmented display and can be set using the touch capacitive buttons.

For control purposes, the limit values are used to control the pump cycle speed.

Overview of the vacuum limit values:

Limit value	Description
H1	Vacuum limit value/control value
H1 - h1	Deactivation value of vacuum limit value
H2	Activation value of “Part Present” signal output
H2 - h2	Deactivation value of “Part Present” signal output

The current, minimum and maximum applied vacuum (since the supply voltage was applied) can be read from the “Vacuum value, live / Vacuum value, min / Vacuum value, max” parameters [0x0040]. The maximum and minimum values can be reset with the command 0xA9 using the “System command” parameter [0x00002].

5.7 Setting the Vacuum Limit Value H2

Display the current set vacuum limit value H2:

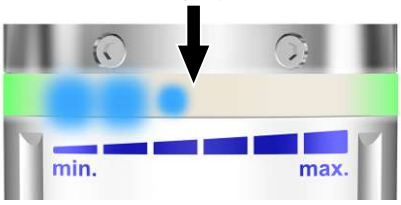
- ✓ If the status of the ECBPMi is “Part Present,” the LED ring lights up and remains blue (default setting, the color is freely adjustable) or if the status is “Warning,” the LED lights up orange.
- ▸ Press one of the two buttons for at least one second.
- ⇨ The vacuum limit value is displayed.

The vacuum limit value is used for the “Part Present” check. It can be used to check whether a sufficient vacuum has been generated. If the vacuum limit value is exceeded, the constantly illuminated blue status indicator switches to a lighter blue and the output OUT2 is activated in SIO mode. The device can continue to be operated while the vacuum limit value is being set or displayed.

Adapt the vacuum limit value H2 for monitoring the control function to the given process conditions:

- ✓ The ECBPMi is ready for operation. There must not be any errors (red lights).

Illuminated display with 6 LEDs



1. Press one of the buttons ◁ or ▷ for at least one second.
   - ⇨ The indicator LEDs (at the front = blue) are activated and roughly indicate the current vacuum limit value H2. If the device is in IO-Link mode, the value of the “Setpoint H2” parameter is displayed in the production setup profile P0.
   - ⇨ The LED ring in the rear section is not illuminated.
2. Continue to press or tap the button. The vacuum limit value is lowered (◁) or increased (▷) immediately. When you tap a button, the value is changed by ± 10 mbar per tap.
   - ⇨ The vacuum display is changed accordingly.
3. The new set value is saved by pressing the buttons ◁ and ▷ simultaneously for more than one second.

- ⇨ This is indicated by a blue flashing light in the LED status indicator.

If you wait for more than five seconds to press the buttons simultaneously after making the adjustment, the set value is not saved. This is indicated by an orange flashing light in the LED status indicator.

If the device is in IO-Link mode, the vacuum limit value is specified directly via the “Setpoint H2 demand” process data byte. If the process data byte is written as “0,” the corresponding value from the “Setpoint H2” parameter becomes valid, depending on the activated production profile set.

In IO-Link mode, the aforementioned procedure for displaying and changing the vacuum limit value is used to display or change the value in the “Setpoint H2” parameter [0x0066] in the production setup profile P0. (This only corresponds to the currently valid vacuum limit value H2 if profile P0 has been activated using process data and the “Setpoint H2” process data byte is written as 0.)

The option to change the vacuum limit value H2 using the touch capacitive buttons can be disabled *(> See ch. Device Functions, Page 24)*.

5.8 Calibrating the Vacuum Sensor [0x0002]

Since the production conditions for the integrated vacuum sensor can vary, we recommend calibrating the sensor once it is installed. To calibrate the vacuum sensor, the system’s vacuum circuit must be open to the atmosphere.

A zero offset is only possible in the range of ±3 percent of the end value of the measuring range.

If the permissible limit of ±3% is exceeded, the LED status display and various diagnostic channels display *(> See ch. Displaying Errors, Page 26)* via IO-Link.

The function for zero-point adjustment of the sensor is called from the “System Command” parameter [0x0002] using the 0xA5 command.

5.9 Suction Functions

To lift the workpiece, the ECBPMi can be operated either in continuous suction mode or in control mode.

The selection is made via “control mode” in the output data byte. In SIO mode, the “control mode” parameter [0x004E] in the production setup profile P0 determines the operating mode.

5.9.1 Sustained Suction

The ECBPMi sustains suction at the set power or motor rotation speed. The setting is made in IO-Link mode using the bit “control mode” = 1 (speed demand) in the output process data bytes.

To set the device to continuous suction in SIO mode, this setting must first be configured using the “control mode vacuum/speed” parameter [0x004E] in the “production setup profile P0.” The additional “Speed” parameter [0x0065] can then be used to specify the speed (in %) at which the pump motor should rotate (the motor only rotates from a value of around 16%).

The performance of the pump (speed of the pump motor) is set in IO-Link mode using the “setpoint for control” process data byte. Enter a value in the range from 0 to 255. If a value greater than 100 is entered, then the ECBPMi runs at full power. If the value 50 is entered, then the ECBPMi runs at half power.

If the value 0 is entered, the values set in the activated profile set are used for the motor rotation speed.

5.9.2 Control

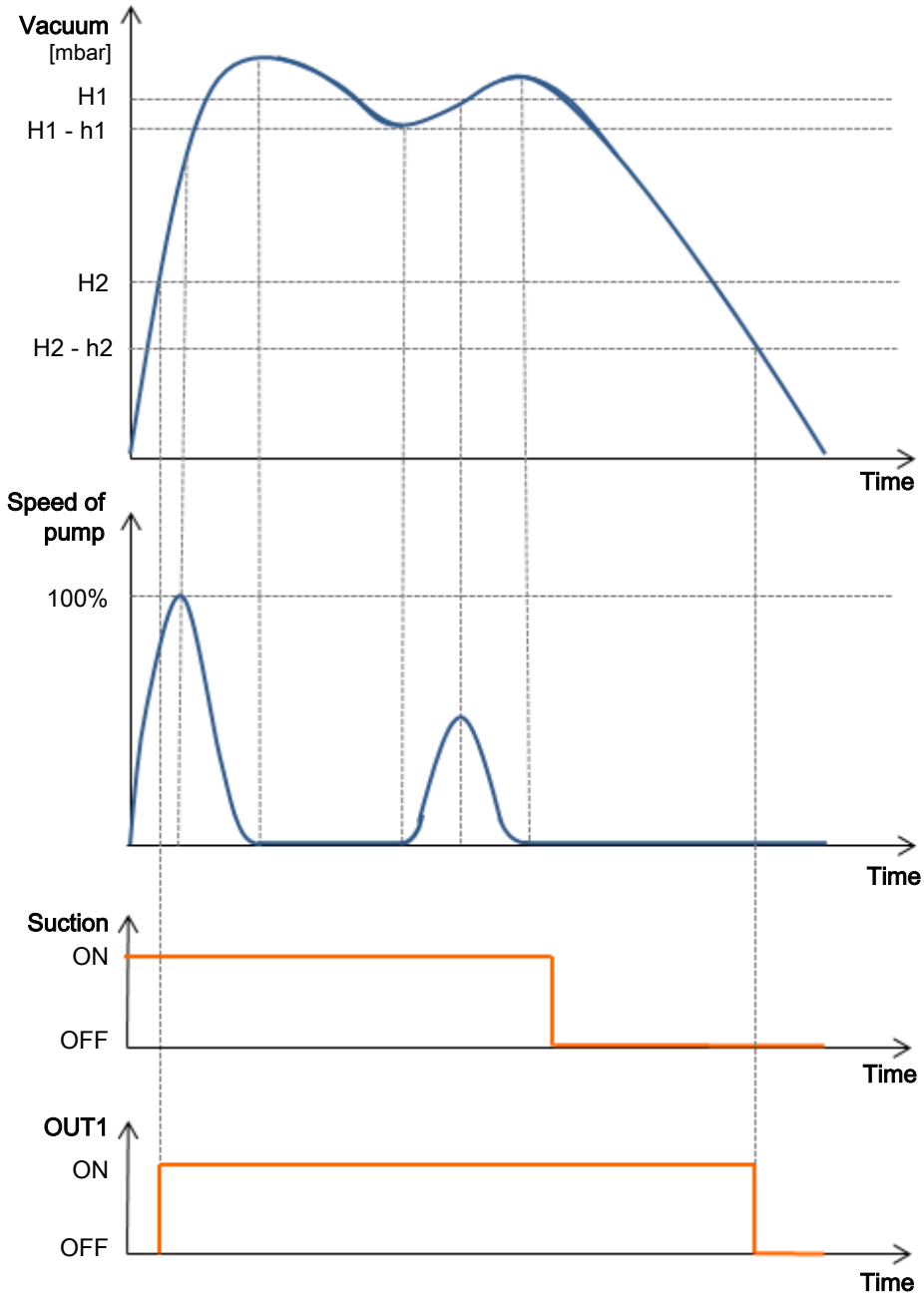
This function of the ECBPMi allows you to save energy and prevent generation of excessive vacuum levels.

H1 can be specified in IO-Link mode via output process data byte 1. In SIO mode, H1 is determined using the “Setpoint H1” parameter [0x0064] in the production setup profile P0. *(> See ch. Production Setup Profiles, Page 32)*.

The vacuum is regulated to the vacuum limit value H1.

The leakage is also measured during regulation.

The following diagram illustrates the control function.



The output OUT2 for the "Part Present" check is activated when the limit value H2 is reached in SIO mode. If the limit value H2 - h2 mbar is not reached, the output is deactivated.

5.10 Blowoff Modes [0x0045]

The following three blowoff modes are available. The function is set in the IO-Link using the "Drop-off mode" parameter [0x0045].

If you want to change the blowoff mode for SIO operation, the parameters in the production setup profile P0 must be configured accordingly beforehand via IO-Link.

5.10.1 Externally Controlled Blowoff

In SIO mode, the "Blowoff" valve is controlled directly via the "Blowoff" signal input IN_2 as standard. The ECBPMi vents to the atmosphere as long as the signal is present.

This function is activated via IO-Link with the "Externally controlled drop-off" value.

5.10.2 Internally Time-controlled Blowoff

This function is activated via IO-Link with the “Internally controlled drop-off – time-dependent (I-t)” value.

The “Blowoff” valve is automatically activated for the time period set as soon as the device leaves “Suction” mode. This function makes it possible to save an output on the controller. The duration of the blowoff time is set via the IO-Link “Duration automatic drop off” parameter [0x006A].

The “Blowoff” signal overrides the “Suction” signal, even if the specified blowoff time is very long.

“Blowoff” mode can still be activated in this mode using the “Blowoff” signal input.

5.10.3 Externally Time-controlled Blowoff

This function is activated via IO-Link with the “Externally controlled drop-off – time-dependent (E-t)” value.

The blowoff pulse is controlled externally via the “Blowoff” input IN_2. The “Blowoff” valve is activated for the specified time. A longer input signal does not increase the duration of blowoff.

The duration of the blowoff time is set via the IO-Link “Duration automatic drop off” parameter [0x006A].

5.10.4 Setting the Blowoff Time

The blowoff time can be entered for internal and external time-controlled blow-off via the IO-Link “Duration automatic drop off” parameter [0x006A].

5.11 Output and Input Signals

In SIO mode, all input and output signals are connected to the higher-level control unit (e.g. a robot) directly or via IO fieldbus boxes.

For this purpose, in addition to the power supply, two input signals and two output signals must be connected. The ECBPMi communicates with the control unit via these signals.

5.11.1 Signal Inputs

The ECBPMi only has two signal inputs IN1 and IN2 in IO mode.

The “suction ON/OFF” function is assigned to signal input IN1, while the “blowoff/vent ON/OFF” function is assigned to signal input IN2.

The signal inputs and thus SIO mode are not available in the “ECBPMi Plus” model.

5.11.2 Signal Outputs

The ECBPMi has two signal outputs.

The function of vacuum limit value H2 (Part Present) is only assigned to signal output OUT2 in SIO mode. The output is activated when the set vacuum limit value H2 is reached.

The signal output OUT3 can be used, for example, to display the manual control of a robot (e.g. freedrive).

- The output is activated when you press the buttons  and  simultaneously for more than one second.

The output is not used in the “ECBPMi Plus” model.

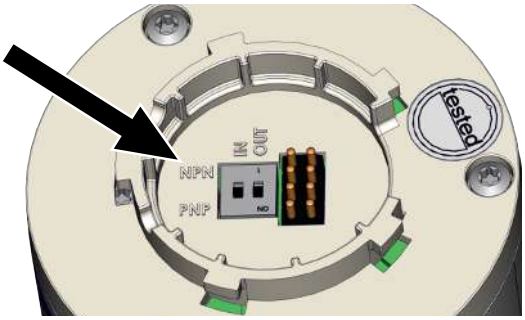
When guiding a robot arm, it has proven more effective to use both hands. In this case, one hand grasps the ECBPMi so that both buttons are pressed and the other hand assists with the movement of the robot arm.

5.11.3 Signal Type

The signal type can be switched between PNP and NPN. It is switched using the switches displayed in the figure.

- Switch 1: Switchover for inputs IN1 and IN2
- Switch 2: Switchover for output OUT2

OUT3 is fixed as a PNP output. In IO-Link mode, the signal type can be read using the "Signal type Input" parameter or "Signal type Output" parameter [0x0049].



5.12 Activating a Freedrive Request

A freedrive request is used to issue a signal to set the robot to "manual control" mode (e.g. freedrive mode when using UR robots) via the higher-level control unit. This mode must be supported by the applicable robot system and configured accordingly.

In freedrive mode, the robot arm or handling system is released and can be moved to a new position manually.

Activating a freedrive request

✓ The ECBPMi is ready for operation and remains illuminated in blue. There must not be any errors (red lights). In addition, the device must not be in the adjustment mode for the limit value.

1. Press the two buttons ◁ and ▷ simultaneously for one second (e.g. by grasping the ECBPMi with your hand to guide the robot arm).
   - ⇨ In SIO mode, the ECBPMi switches directly to freedrive mode. The output OUT3 is then set and the color of the LED status indicator switches to a blue circumferential light.
   - ⇨ You can continue to operate the device during freedrive mode. The output OUT2 is also activated and deactivated based on the vacuum limit value H2.
   - ⇨ In IO-Link operation, bit 0 is activated in input process data byte 4 (= Freedrive desired).
   - ⇨ The digital output OUT3 is not set and the freedrive request is made via the higher-level control unit.
   - ⇨ The LED status display does not change color yet.
   - ⇨ The control unit releases the robot arm or the handling system.
2. Activate bit 0 (= Enable Freedrive) using the higher-level control unit in output process data byte 3.
   - ⇨ The LED status indicator switches to a blue circumferential light.
   - ⇨ This status is then confirmed to the control unit by activating the "Freedrive activated" bit.

If freedrive mode is activated via a button other than that on the ECBPMi (e.g. on the robot itself), freedrive mode can be indicated on the LED status display of the ECBPMi without it being activated via the device.

If neither button is pressed for 0.5 seconds, the ECBPMi switches back to the status from which freedrive mode was called. The output OUT3 is deactivated in SIO mode.

The freedrive request can also be deactivated via IO-Link using the "Extended Device Access Locks" parameter [0x005A] *(> See ch. Restricting Extended Access with Extended Device Access Locks [0x005A], Page 24)*.

5.13 Switch-Off Delay [0x004B]

You can use this function to set a switch-off delay for the H2 “Part Present” signal. This can be used to mask short-term fluctuations in the vacuum level of the vacuum system. The duration of the switch-off delay is set in IO-Link via the “Output filter” parameter [0x004B]. The value can be set to 10, 50 or 200 ms. To deactivate this function, enter the value “off” (0 = Off).

The switch-off delay affects the discrete output OUT3, the process data bit in IO-Link and the status display.

If the output OUT3 is configured as a normally open contact [NO], there will be an electrical switch-off delay. On the other hand, if it is configured as a normally closed contact [NC], there will be an equivalent switch-on delay.

5.14 Device Functions

Device functions can be protected against unintentional access using the “Device Access Locks” parameter [0x000C] or “Extended Device Access Locks” parameter [0x005A].

5.14.1 Restricting Access Using Device Access Locks [0x000C]

In IO-Link mode, the “Device Access Locks” default parameter is available to prevent changes to parameter values using the operating element of the ECBPMi.

Bit	Meaning
2	Local parametrization locked (The vacuum limit value H2 cannot be changed using the touch capacitive buttons.)
3	Lock HMI (The touch capacitive buttons are deactivated)

An existing lock will be retained in SIO mode.

It can only be canceled using IO-Link, not on the ECBPMi itself.

5.14.2 Restricting Extended Access with Extended Device Access Locks [0x005A]

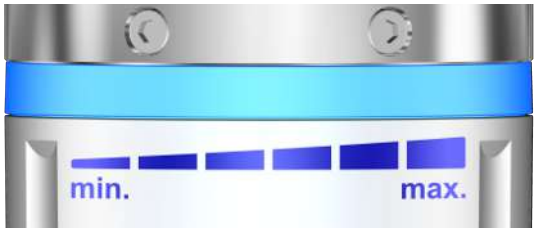
Extended device functions can be disabled via the “Extended Device Locks” parameter [0x005A].

Bit	Meaning
0	NFC write lock (Parameter changes via NFC are blocked)
1	NFC disable (NFC deactivated. The device cannot be recognized by an NFC reader.)
4	IO-Link event lock (IO-Link events are disabled in IO-Link mode)
5	Lock Freedrive desired (The device is not able to make a freedrive request when the touch capacitive buttons are pressed. The freedrive functionality is now deactivated.)

5.15 Resetting the Device to the Factory Settings

Proceed as follows to reset the ECBPMi to the factory settings. In IO-Link mode, the function is called using the “System Command” parameter [0x0002] with 0x82. This is not visually indicated by the status LEDs.

✓ The ECBPMi is in the basic state control status.

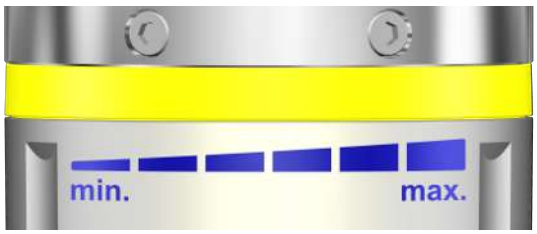


1. Press one of the buttons ◁ or ▷ for at least one second.

   ⇨ The ECBPMi first switches to the mode for adjusting the vacuum limit value.

2. Press and hold the ◁ and ▷ buttons simultaneously for more than seven seconds.

   ⇨ After one second, the ECBPMi first switches back to the basic state control status.



3. Continue to press the two buttons. After five seconds, one third of the status LEDs light up yellow; after six seconds, two thirds of the LEDs light up yellow; after seven seconds, all the LEDs flash yellow.

   ⇨ The yellow lights are activated section by section.

⇨ After they begin flashing, the ECBPMi is reset to the factory settings. It returns to the default status (constant blue light).

The function for resetting factory settings does not affect the following elements:

- The counter readings
- The zero-point adjustment of the sensor.

5.16 Counter(s)

The ECBPMi is equipped with four internal counters that cannot be cleared.

Counter 1 (Vacuum-on-counter [0x008C])	Increases with each valid pulse at the “suction” signal input, meaning that it counts the suction cycles during the ECBPMi’s service life. The time of the suction cycle can be read from the “Total Cycle time” parameter [0x0096].
Counter 2 (Power-On Total Time [0x00A8])	Measures the total running time of the ECBPMi in seconds.
Counter 3 (Pump-ON Total time [0x00A7])	Measures the total running time of the vacuum pump in seconds.
Counter 4 (Condition Monitoring counter [0x008E])	Counts the CM events that have occurred *(> See ch. Condition Monitoring Events and Status Display, Page 30)*.

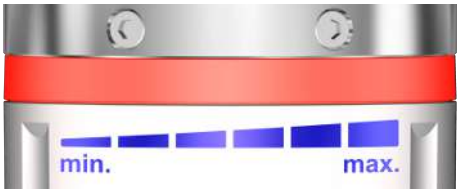
The counters can be read via IO-Link.

Counters 1 and 3 can also be read from the erasable counters “Vacuum-on counter erasable” [0x008F] and “Condition Monitoring counter erasable” [0x0091]. The counters can be cleared with the value 0xA7 using the “System Command” parameter [0x0002].

5.17 Displaying Errors and Warnings

5.17.1 Displaying Errors

If an error occurs, the ECBPMi changes to an error state. The LED ring lights up red to indicate error states.
The type of error can be identified by the repeated pulsing of the red light.



Suction cycles that are already running can be carried out to the end if an error occurs (depending on the error pattern). However, a new suction cycle cannot be started while the error is ongoing.

Warnings and errors are issued via IO-Link. They can be processed and evaluated accordingly in the higher-level control unit.

The ECBPMi monitors the following parameters:

- Supply voltage
- Internal device temperature
- Pump control
- Internal electronic fault
- Calibration error in the vacuum sensor

If the values are outside the permitted operating conditions or a pump is faulty, the ECBPMi switches to an error state.

The following table shows potential errors and the corresponding output on the LED status display or parameters in IO-Link:

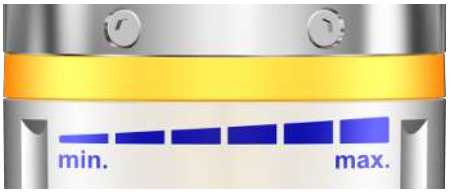
Name	Error description	LED status display	“Active Error Code” parameter [0x0082]
Electronic Error	There is an internal electronic fault	Red (3 flashes)	0x01
Sensor Voltage too low	Supply voltage < 19.2 V	Red (1 flash)	0x02
Sensor Voltage overrun	Supply voltage > 26.4 V	Red (1 flash)	0x04
Pump not working properly	Error in the pump motor control unit	Red (3 flashes)	0x08
Temperature overrun	Permissible device temperature has been exceeded	Red (2 flashes)	0x10
Error Robot	Error bit 1 of process output byte 3 was set by the robot	Red (flashing continuously)	0x20
Sensor calibration failed	The permissible zero offset was exceeded by > ±3% after calibration of the vacuum sensor	Red (3 flashes)	0x40
EEPROM Error	Internal EEPROM error	Red (3 flashes)	0x80

The number of errors (since the supply voltage was applied) can be read using the “Error Count” parameter [0x0020].

5.17.2 Display of Warnings

Condition Monitoring (CM) events are displayed as warnings via the LED ring.

If warnings occur, this is indicated by an orange light on the LED ring.



The following table shows potential warnings and the corresponding output on the LED status display or parameters in IO-Link: The exact CM description can be found under Condition Monitoring:

CM event	Description	"Condition Monitoring" parameter [0x0092]
H1 selected under H2	The "H2 not reached" process error is issued while "SUCTION = on."	0x01
Evacuation Time t1 above limit	The evacuation time exceeds the set value.	0x02
Leakage rate above limit	The measured leakage exceeds the set value.	0x04
H1 not reached in last suction cycle	Vacuum limit value H1 not reached in the last suction cycle	0x08
Free-flow vacuum > (H2-h2) but < H1	The value of the dynamic pressure measurement is larger than (H2 - h2), but smaller than H1.	0x10
Warning Robot	"Set warning robot" process output data bit was set by the higher-level control unit.	0x20
Vacuum under H2-h2 if Pump running and Vacuum over H2 prior	During suction, the vacuum fell below the value (H2 - h2) when it had previously exceeded H2. This warning is triggered by a leakage that cannot be compensated by a higher pump capacity. The error is acknowledged by issuing the "suction" command again or pressing a button. The error is acknowledged in any event (regardless of whether or not the leakage is eliminated). If the leakage is not eliminated, the LEDs initially change to blue (low brightness) and H2 is not reached.	0x40

5.17.3 Temperature Display [0x0044]

The temperature is monitored in the area of the circuit board. If the temperature exceeds an internal limit value, the ECBPMi switches off to protect against overheating. No new suction cycle can be started as long as the error state is present. The error state can only be acknowledged by setting it to an error-free state.

The error state is shown on the LED ring and/or IO-Link *(> See ch. Displaying Errors and Warnings, Page 26)*.

The current, minimum and maximum temperature (since the supply voltage was applied) can be read from the "Temperature, live / Temperature, min / Temperature, max" parameters.

The maximum and minimum values can be reset with the command 0xA7 using the "System Command" parameter [0x0002].

5.17.4 Monitoring the Supply Voltages [0x0042]

The ECBPMi has an internal voltage monitor. It requires a power supply of 24 V. If the voltage deviates outside a certain tolerance range, the ECBPMi enters an error state.

The error state is shown on the LED ring and IO-Link *(> See ch. Displaying Errors and Warnings, Page 26)*.

No new suction cycle can be started as long as the error state is present. The error state can only be acknowledged by setting it to an error-free state.

The current, minimum and maximum supply voltage (since the supply voltage was applied) can be read from the "Primary supply voltage, live / Primary supply voltage, min / Primary supply voltage, max" parameters [0x0042].

The maximum and minimum values can be reset with the command 0xA7 using the "System Command" parameter [0x0002].

Vacuum generation is switched off if the supply voltage deviates.

5.18 Energy and Process Control (EPC)

In IO-Link mode, the energy and process control (EPC) function is available. It is subdivided into three modules:

- Condition monitoring (CM): Condition monitoring to increase system availability
- Energy monitoring (EM): Energy monitoring to optimize the vacuum system's energy consumption
- Predictive maintenance (PM):
  - Predictive maintenance to increase the performance and quality of the gripping systems
  - In byte 0 of the output process data, IO-Link can be used to specify which preselected EPC values can be read using data bytes 1 + 2 of the input process data.

5.18.1 Condition Monitoring (CM) [0x0092]

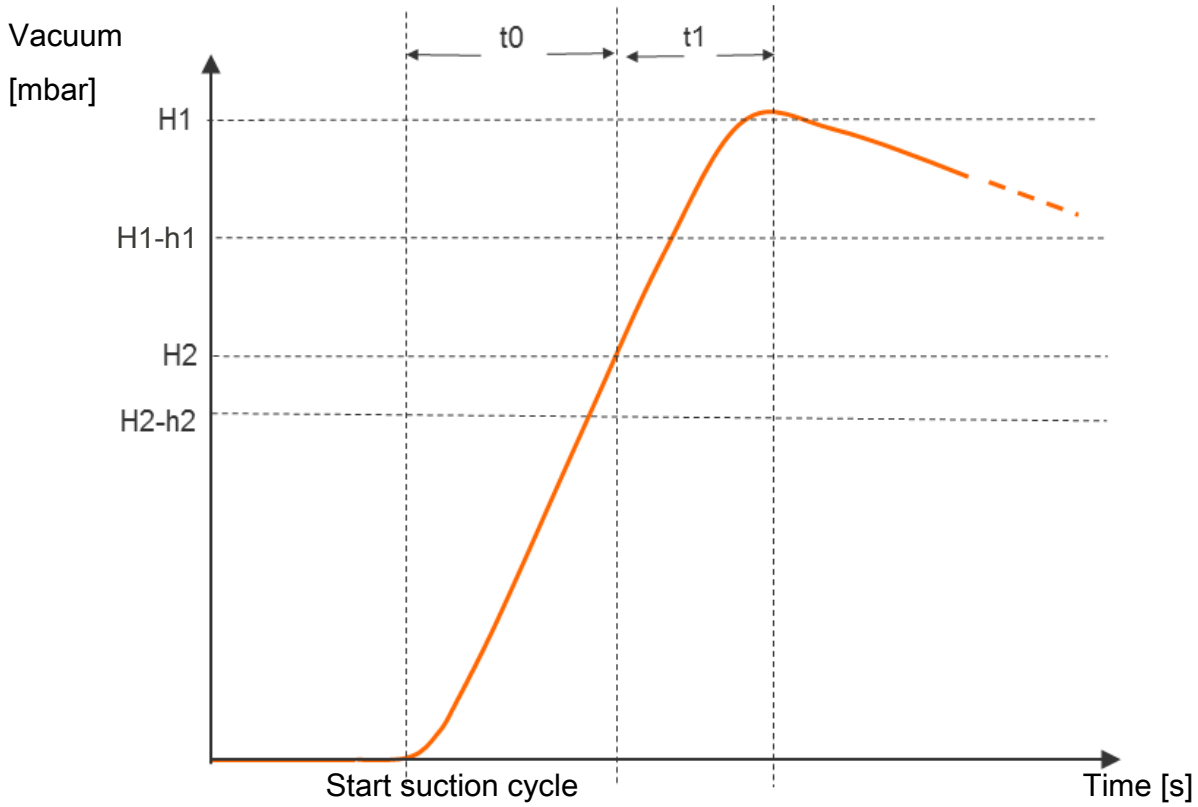
Control Threshold Monitoring

If the vacuum limit value H1 is never reached during the suction cycle, the "H1 not reached" condition monitoring warning is triggered and the system status light switches to yellow.

This warning is available at the end of the current suction phase and remains active until the next suction cycle.

Evacuation Time Monitoring

If the measured evacuation time t1 (from H2 to H1) exceeds the specified value, the "Evacuation time longer than t-1" condition monitoring warning is triggered and the system status light ("Device Status" process data) switches to yellow.



The specified value for the max. permitted evacuation time t1 can be set using the IO-Link (“Permissible evacuation time” parameter) [0x006B]. Setting the value to “0” (= off) deactivates monitoring. The maximum permitted evacuation time setting is 9.99 s.

Measuring the Evacuation Time t0 and t1

Measuring the evacuation time t0:

The time is measured (in ms) from the beginning of the suction cycle to the time when the limit value H2 is reached (“Evacuation time t0” parameter [0x0094]).

Measuring the evacuation time t1:

The interval between reaching the limit values H2 and H1 is measured (in ms) (“Evacuation time t1” parameter [0x0095]).

Leakage Monitoring and Evaluation

The leakage is measured and monitored in control mode. The measurement is performed using a calculation based on the pump control values (speed and duration) when readjusting to the setpoint H1. The calculated value can be read as a volume flow rate using the “Leakage rate” parameter [0x00A0] or alternatively using the process data (EPC-Select) in ml/min.

Evaluation of the leakage level differentiates between two statuses:

Leakage L < permitted value -L-
If the leakage L is less than the set value “Permissible leakage rate” • The condition monitoring warning is not activated • There is no effect on the system status light and the display on the LED ring
Leakage L > permitted value -L-
If the leakage L is greater than the set value “Permissible leakage rate” • The condition monitoring warning is activated • The system status light switches to yellow and a warning (orange) is displayed on the LED ring

The “Permissible leakage rate” can be set via IO-Link using the “permissible leakage rate” parameter e.g. [0x006C].

Monitor Dynamic Pressure

If possible, a dynamic pressure measurement is taken at the start of every suction cycle (vacuum during unobstructed suction). The result of this measurement is compared to the limit values set for H1 and H2.

If the dynamic pressure is greater than (H2 – h2) but less than H1, the corresponding condition monitoring warning is triggered, the system status light switches to yellow and a warning (orange) is displayed via the LED ring.

Autoset

The “CM Autoset” process data function allows the condition monitoring parameters for the maximum permitted leakage “Permissible leakage rate” and the evacuation time (t-1) to be determined automatically. The actual values from the last suction cycle are combined with an additional tolerance and stored in the parameter data of profile P0.

Feedback about the completed “CM Autoset” function is displayed via input process data byte 0 “CM-Autoset acknowledged.”

Condition Monitoring Events and Status Display

Any condition monitoring events that occur during the suction cycle cause the system status indicator light to immediately switch from green to yellow. The event that caused this switch can be seen in the “Condition monitoring” IO-Link parameter [0x0092].

The table below explains the coding of the condition monitoring warnings:

Bit	Event	Update
0	The setting for H1 was smaller than H2	Constant
1	Set limit value t_1 for evacuation time exceeded	Cyclic
2	Set limit value “Permissible leakage rate” for leakage exceeded	Cyclic
3	Vacuum limit value H1 was not reached	Cyclic
4	Dynamic pressure > (H2 - h2) and < H1	As soon as a corresponding dynamic pressure value has been determined
5	Bit 2 of process output data byte 3 was set by the robot. This indicates a warning status for the robot.	Constant
6	“H2 not reached” process error is issued while SUCTION = on.	Cyclic
7	Temperature above 50° C	Constant

Bits 1–3 and 6 describe events that can only occur once per suction cycle. They are reset at the start of every suction cycle and remain stable until it has ended.

Bit number 4, which describes dynamic overpressure, is initially deleted when the device is switched on and is updated when a dynamic pressure value is detected.

Bits 5 to 7 are regularly updated independently of the suction cycle and reflect the current values.

The values measured by the condition monitoring, namely the evacuation times t_0 and t_1 and the leakage value, are reset at the beginning of the suction and updated once they have been measured.

Bit 6: This warning is triggered by a leakage that cannot be compensated by a higher pump capacity. The error is acknowledged by issuing the “suction” command again or pressing a button.

The error is acknowledged in any event (regardless of whether or not the leakage is eliminated). If the leakage is not eliminated, the LEDs initially change to blue (low brightness) and H2 is not reached.

5.18.2 Energy Monitoring (EM) [0x009D]

In order to permit optimization of vacuum gripping systems' energy efficiency, the product provides a function for measuring and displaying the energy consumption. The electrical energy consumed by the device and by the valve coil (-n) during a suction cycle is measured and given in watt-seconds (Ws). The value can be read from the "Energy consumption per cycle" parameter [0x009D].

The measured value is reset at the beginning of the suction cycle and constantly updated during the running cycle. Thus no further changes can occur after venting has finished. For determining the electrical energy consumption, the neutral phase of the suction cycle must also be considered. Therefore the measured values can be updated only when the next suction cycle begins. During the entire cycle, they represent the results from the previous cycle.

The product is not a calibrated measuring device. However, the values may be used as a reference and for comparison measurements.

5.18.3 Predictive Maintenance (PM)

Overview of Predictive Maintenance (PM)

In order to allow early detection of wear and other impairments to the vacuum gripping system, the product provides functions for recognizing trends in the quality and performance of the system. This is accomplished using the measured values for leakage and dynamic pressure.

The measurement value for the leakage rate and the related quality assessment in percent are reset at the start of every suction cycle and constantly updated during the cycle as moving averages. The values therefore only remain stable after the end of suction and can be read from the "Quality (tightness)" parameter [0x00A2].

Measurement of Leakage [0x00A0]

The leakage is measured and monitored in control mode. The measurement is performed using a calculation based on the pump control values (speed and duration) when readjusting to the vacuum limit value H1. The calculated value can be read as a volume flow rate using the "Leakage rate" parameter [0x00A0] or alternatively using the process data (EPC-Select) in ml/min.

Measurement of Dynamic Pressure [0x00A1]

This measures the system vacuum achieved during unobstructed suction. The measurement length is approx. 1 s. Thus evaluation of a valid dynamic pressure value requires at least one second of unobstructed suction after the suction cycle has commenced. The suction point must not be occupied by a component at this time.

Measured values below 5 mbar or above the vacuum limit value H1 are not regarded as valid dynamic pressure measurements and are discarded. The result of the last valid measurement is retained.

Measured values that are below the vacuum limit value H1 but simultaneously above the vacuum limit value H2 – h2 result in a condition monitoring event.

The dynamic pressure and the percentage performance value based on it are initially unknown when the product is switched on. As soon as a dynamic pressure measurement can be performed, the dynamic pressure and the performance evaluation are updated and retain their values until the next dynamic pressure measurement. The value can be read from the "Free-flow vacuum" parameter [0x00A1].

Quality Assessment [0x00A2]

In order to evaluate the entire gripping system, the product calculates a quality rating based on the measured system leakage.

The greater the leakage in the system, the worse the quality rating of the gripping system. Conversely, low leakage results in a high quality rating.

The quality assessment can be determined by the "Quality (tightness)" parameter [0x00A2]. It indicates the quality relative to a leak-free system in %.

Performance Calculation [0x00A3]

The performance calculation helps in evaluating the system status. The performance of the gripping system can be assessed based on the measurement of the dynamic pressure.

Optimal configuration of gripping systems leads to low dynamic pressure and thus to high performance. Conversely, poorly configured systems achieve low performance.

Dynamic pressure events that exceed the vacuum limit value (H2 – h2) always result in a performance rating of zero percent. A dynamic pressure value of 0 mbar (which indicates that no valid measurement value could be obtained) also results in a performance rating of zero percent.

The value can be read from the "Performance (flow)" parameter [0x00A3].

Maximum Device Temperature that Occurred [0x00A9]

The "Maximum temperature" parameter [0x00A9] specifies the highest device temperature measured during the life cycle.

Maximum Vacuum Reached in the Last Cycle [0x00A4]

The "Maximum reached vacuum in last cycle" parameter [0x00A4] can be used to obtain the highest vacuum measured in the last cycle. In "continuous suction" mode, this can provide information about the pump capacity.

5.19 Production Setup Profiles

In IO-Link mode, the product can store up to four different production setup profiles (P0 to P3). All important parameter data for workpiece handling is stored in these profiles. The profile is selected by means of the output process data byte 0. Thus parameters can be adjusted to suit differing process conditions.

Production setup profile P0 is selected as the basic setting and in SIO mode, i.e. the settings that are valid for SIO mode are determined by profile P0.

5.20 Device Data

The product provides a range of identification data that can be used to uniquely identify a specific device.

The following parameters can be queried via IO-Link or NFC:

- Manufacturer name and web address of the manufacturer (Vendor name [0x0010] / Vendor text [0x0011])
- Supplier text (Product ID [0x0013])
- Product name and product text (Product name [0x0012] / Product text [0x0014] / Product text detailed [0x00FE])
- Serial number (Serial number [0x0015])
- Version status of the hardware and firmware (Hardware revision [0x0016] / Firmware revision [0x0017])
- Unique device ID and device properties (Unique Device ID [0x00F0])
- Article number and development status (Article number [0x00FA] / Article revision [0x00FB])
- Date of manufacture and installation (Manufacture date [0x00FC] / Installation date [0x00FD])
- Location identifier (Geolocation [0x00F6])
- System configuration (Device features [0x00F1])
- Device ID (Equipment identification [0x00F2])
- Web link for NFC app and device description file (Link to IOT-Server [0x00F8] / Weblink to IODD [0x00F7])

5.21 User-Specific Localization

The following parameters are available when saving user-specific information in every individual copy of the product:

- ID of the installation location (Equipment identification [0x00F2])
- ID of the storage location (Storage location [0x00F9])
- Equipment identification from the circuit diagram (Application specific tag [0x0018])
- Installation date (Installation Date [0x00FD])

The parameters are ASCII character strings with the maximum length given in the data dictionary. They can also be used for other purposes if necessary.

The NFC web link parameter is a special feature (link to IoT server). This parameter must include a valid web address beginning with http:// or https:// and is automatically used as a web address for NFC read access operations.

As a result, read access operations from smart phones or tablets are rerouted e.g. to an address in the company's own intranet or a local server.

5.22 Robot-specific Device Data

The following parameters are available when saving data relating to the robot tool measurement in every individual copy of the product:

- Operating point position / coordinates of the tool in x, y, z (Tool Center Point [0x0083])
- Operating point alignment of the tool in α, β, γ (Tool Center Point [0x0083])
- Center of gravity position / coordinates of the tool (Center of Gravity [0x0084])
- Gripper shape (Grippershape [0x0055])
- End effector dimensions for length, width and height (Length, Width, Height [0x0055])
- End effector weight (Weight [0x0056])

All values can be reset to the factory setting (default) using the “System Command” parameter [0x0002] with the 0xAD command.

5.23 Device Status

In IO-Link mode, further status information is available in addition to the error messages displayed in SIO mode.

More details on this can be found in the final section of the enclosed data dictionary

- Device Status (process data)
- Device Status [0x0024] and [0x0025] (parameter data)
- Extended Device Status [0x008A](type + ID)
- NFC status [0x008B]
- IO-Link events

Any condition monitoring events that occur during the suction cycle cause the system status light to immediately switch from green to yellow/orange. The specific event that caused this switch can be seen in the “Condition monitoring” IO-Link parameter [0x0092].

6 Transport and Storage

6.1 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 Installation

7.1 Installation Instructions

⚠ CAUTION

Improper installation or maintenance

Personal injury or damage to property

- Prior to installation and before maintenance work, the vacuum generator must be disconnected from the power supply and secured against unauthorized restart!

For safe installation, the following instructions must be observed:

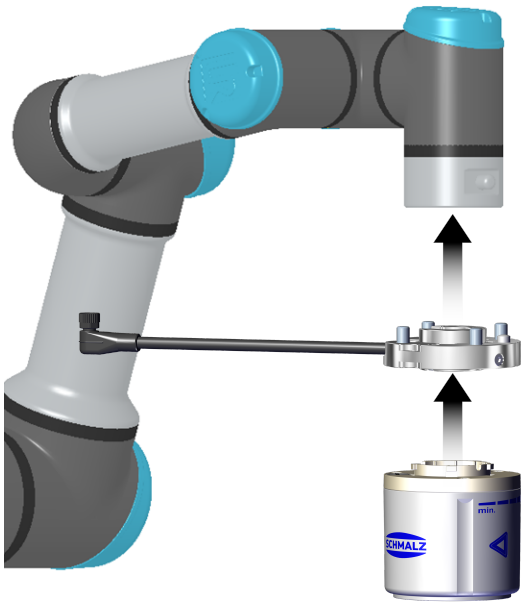
Use only the connectors, mounting holes and attachment materials that have been provided.

Firmly connect and secure pneumatic and electrical line connections to the vacuum generator.

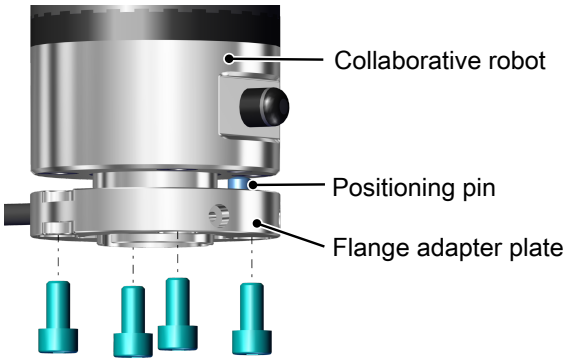
7.2 Mechanical Attachment

The ECBPMi may be installed in any position.

The ECBPMi can be adapted to a collaborative robot using a robot-specific flange adapter plate and connection cable. The markings and/or a positioning pin on the flange and a marking on the housing of the ECBPMi must be observed, because these determine the orientation of the display and the suction cup on the robot.
Flange connection: The angle of rotation of the bayonet flange is limited to 15° by stops.

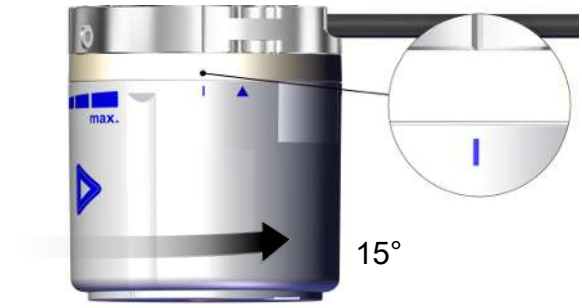


1. Position the flange adapter plate included in the delivery on the suitable collaborative robot using the positioning pin and fasten it using the four M6x12 cylinder head screws. Observe the permitted tightening torque for the thread.



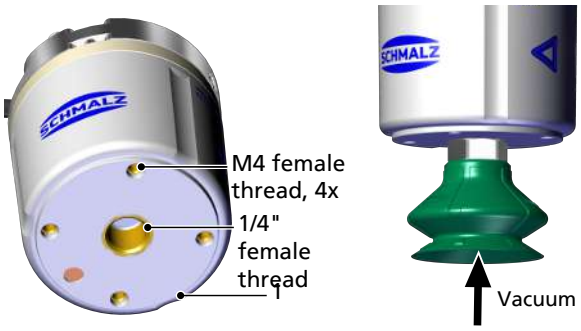
2. Tightly connect the ECBPMi to the flange adapter plate using the bayonet fastener. Position the ECBPMi so that the small triangle points toward the groove on the flange adapter plate.

3. Turn the ECBPMi clockwise by 15° (**until it stops**) (the line marking matches the groove on the adapter flange).



4. **NOTE! End position is not reached and the line on the ECBPMi does not match the groove on the flange. Screwing in the locking screws damages the light conductors.**
They are then secured against being opened unintentionally with the two screws (M3x14). Observe the max. tightening torque of 0.6 Nm.

5. To attach the vacuum suction cup, vacuum end effector or custom gripper:
» Use the bottom universal flange interface with 4x M4 internal thread with a maximum tightening torque of 1.3 Nm or
» The central ¼ inch internal thread interface with a maximum tightening torque of 2.0 Nm
.
When using the Schmalz modular system VEE, the mounted flange plate must be aligned to the marking (1).



7.3 Compatibility of the Schmalz Software for UR Robot Systems

Suitable Schmalz URCap software with the current version no. V4.3.6 is a requirement for the safe operation of the ECBPMi Plus model. Schmalz URCap is not downward compatible.

Below you will find the requirements or the description of the required software:

- Schmalz URCap (V4.3.6) valid for ECBPMi and ECBPMi PLUS on robot systems from UR with the control software Polyscope 5.8 or higher (used in UR e series).
- Schmalz URCap (V4.3.6) valid for ECBPMi on robot systems from UR with the control software Polyscope 3.12 or higher (used in UR CB series).

ECBPMi Plus is not compatible with Universal Robots CB series (Polyscope 3.x).

7.4 Description of the Electrical Connection

⚠ WARNING

Electric shock

Risk of injury

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

⚠ CAUTION

Changing output signals when the product is switched on or plug is connected

Personal injury or damage to property!

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

⚠ CAUTION

Risk of getting caught by the connection cable when the collaborative robot moves.

Injury due to limbs or hair getting caught.

- Route the connection cable as close to the robot arm as possible.
- Avoid the danger zone.

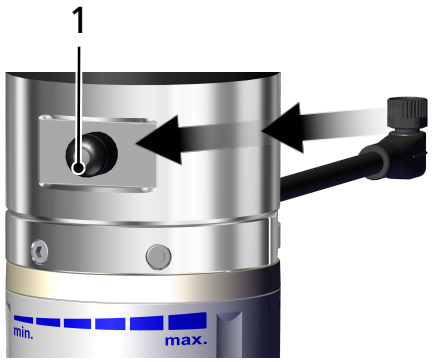
The electrical connection of the ECBPMi (the voltage supply and the transmission of input and output signals) is directly connected to the electrical interface of the robot using the adapted connection cable on the flange.

Carry out assembly or disassembly work only when the device is disconnected from the power supply. Electrical connections must be firmly connected to the ECBPMi and secured.

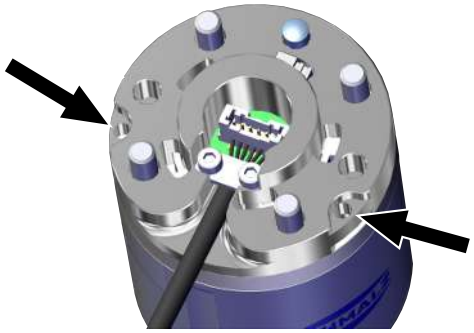
When connecting to the power supply, take note of the following:

- The maximum length of the connection cable is 20 m.
- The maximum length of the connection cable for the “ECBPMi Plus” is 10 m.

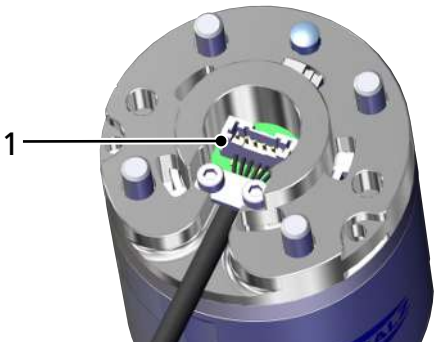
1. Connect the connection cable on the robot (1).



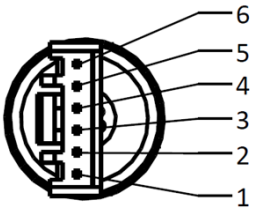
2. Optional: Use cable ties to fasten the connection cable to the drilled holes on the flange so that it is laid tightly against the robot arm.



The electrical interface to the robot is customer-specific. The PIN assignment on the flange connector (1) is always the same.



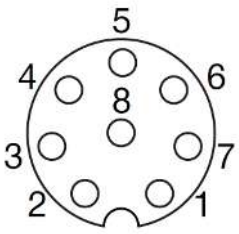
PIN assignment, 6-pin flange connector

Flange connector	PIN	Symbol	Function
	1	U	24 V supply voltage
	2	GND	Ground
	3	OUT2	Signal output for “Part Present”/IO-Link
	4	OUT3	Optional signal output (e.g. activate freedrive)
	5	IN1	“Suction” signal input
	6	IN2	“Blow off” signal input

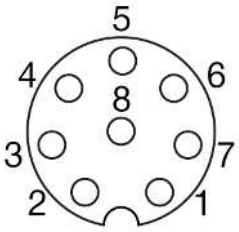
PIN assignment, flange set for Schmalz standard M12 8-pin connector

8-pin M12 connector	Pin	Symbol	Function
	1	—	—
	2	U	24 V supply voltage
	3	—	—
	4	IN1	“Suction” signal input
	5	OUT2	Signal output for “Part Present”/IO-Link
	6	IN2	“Blow off” signal input
	7	GND	Ground
	8	OUT3	Optional signal output (e.g. activate freedrive)

PIN assignment, UR M8 flange set

8-pin M8 connector	Pin	Symbol	Function
	1	—	—
	2	—	—
	3	OUT2	Signal output for “Part Present”/IO-Link
	4	OUT3	Optional signal output (e.g. activate freedrive)
	5	U	24 V supply voltage
	6	IN1	“Suction” signal input
	7	IN2	“Blow off” signal input
	8	GND	Ground

PIN assignment, UR M8 ECBPMi Plus flange set

8-pin M8 socket	Pin	Litz wire color	Function
	1	White	Communication line RS485+
	2	Brown	Communication line RS485-
	3	Green	OUT2, “part present”/IO-Link signal output
	4	Yellow	OUT3, freedrive
	5	Gray	U, +24 V supply voltage
	6	Pink	Digital IN1
	7	Blue	Digital IN2
	8	Red	GND, ground

7.5 Start of Operations

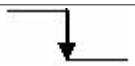
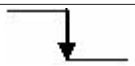
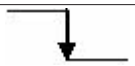
As soon as power is supplied to the ECBPMi via the higher-level control unit, it is ready for operation. If the robot is active, the ECBPMi performs an internal test run and then lights up and remains blue.

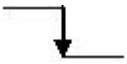
The vacuum of the ECBPMi is routed to the vacuum gripping system/suction cup via the 1/4 inch thread.

When using any grippers, ensure that the connection between the gripper and the ECBPMi is airtight.

A typical handling cycle is divided into the following three phases: pickup, blowoff and idle.

To check whether sufficient vacuum has built up, the limit value H2 is monitored by an integrated vacuum sensor during suction and output to the higher-level control unit via OUT2.

Phase	Switching step	ECBPMi		
		Signal		Status
1	1		IN1	Suction ON
	2		OUT2	Vacuum > H2
2	3		IN1	Suction OFF
	4		IN2	Blowoff ON
3	5		OUT2	Vacuum < (H2-h2)
	6		IN2	Blowoff OFF

 Signal status changes from inactive to active.  Signal status changes from active to inactive.

8 Operation

8.1 Hazard during Operation

⚠ 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).

⚠ CAUTION

A strong vacuum is produced on the suction cup and suction lines.

Hair, skin, body parts and items of clothing can be sucked in.

- Wear protective glasses and tight-fitting clothing.
- Use a hairnet if necessary.
- Do not look or reach into the suction cup openings.

8.2 Preparations

⚠ 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.

Before each activation of the CobotPump, the following measures must be taken:

1. Check the device for visible damage. Correct any faults or report them to the supervising personnel.
2. 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.
3. Ensure that the danger range of the machine or system is free of persons during automatic operation in non-HRC applications.

8.3 Operating Modes

The ECBPMi may be operated in two modes:

- SIO mode, with direct connections at inputs and outputs (SIO = standard I/O). SIO mode is not available in the “ECBPMi Plus” model
- IO-Link mode, with a communications line (IO-Link)
- RS485 operation for the “ECBPMi Plus” model

By default, the ECBPMi always runs in SIO mode, but it can be switched into and out of IO-Link mode at any time using an IO-Link master.

8.3.1 SIO Operating Mode

During operation in SIO mode, all input and output signals are connected to a control unit, either directly or using intelligent terminal boxes.

For this purpose, in addition to the power supply lines, one or two input signals and two output signals must be connected. The ECBPMi communicates with the control unit via these signals.

This enables use of the basic functions “Suction” and “Blowoff” as well as providing “Parts Present” feedback.

The individual basic functions:

ECBPMi inputs	ECBPMi outputs
Suction ON/OFF (IN_1)	H2 (Part Present) feedback (OUT2)
Blowoff ON/OFF (IN_2)	Freedrive desired

If the ECBPMi is operated in the “internally time-controlled” blowoff mode, then the “Blowoff” signal is not required. This allows operation on a single port in a configurable terminal box (using 1xDO and 1xDI). For this purpose, the parameters in production setup profile P0 must be configured accordingly beforehand via IO-Link *(> See ch. Signal Outputs, Page 22)*.

8.3.2 IO-Link Operating Mode

During operation in SIO (digital communication) mode, the power supply voltages and the communication line are connected to a control unit, either directly or using intelligent terminal boxes. The ECBPMi can be finely parameterized in IO-Link mode.

When the ECBPMi is connected via IO-Link, the following functions are enabled in addition to the basic functions:

- Selection between four production setup profiles
- Error messages and warnings
- Status display of the system
- Access to all parameters
- Condition monitoring
- Energy monitoring
- Predictive maintenance
- Robot-specific Device Data

All modifiable parameters can be read, modified and written back to the ECBPMi by the higher-level control unit.

Evaluation of the condition monitoring and energy monitoring results affords direct feedback regarding the current handling cycle as well as trend analysis.

The ECBPMi supports IO-Link version 1.1 with six bytes of input data and four bytes of output data.

The exchange of process data between the IO-Link master and the ECBPMi is cyclical. Parameter data (acyclical data) is exchanged by the user program in the control unit using communication modules.

8.3.3 Operating Mode RS-485

In the “ECBPMi Plus” model, the device communicates via a specific RS-485 protocol. Suitable software is required to use this model *(> See ch. Compatibility of the Schmalz Software for UR Robot Systems, Page 36)*, e.g. URCap. This model can only be operated on compatible Universal Robots. (ECBPMi Plus is not compatible with Universal Robots CB series).

For instructions on using this model --> see the ECBPMi Plus gripping system Quick Start Guide.

See also

Signal Outputs [› 22]

9 Maintenance

9.1 Safety

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.

Opening the ECBPMi will damage the “tested” label. This voids the warranty.

9.2 Cleaning the Device

1. Remove exterior dirt with a soft, damp cloth and soap suds (max. 60° C).
2. Ensure that the housing and control unit are not soaked with soap suds.

9.3 Cleaning the Sieve Insert

There is a sieve insert in the vacuum opening of the CobotPump. Dust, shavings and other solid materials may accumulate in this sieve over time.

- If the performance drops noticeably, clean the sieve with a paintbrush.

If it is heavily soiled, you can send the CobotPump to Schmalz for repair (subject to a fee, the soiled sieve is replaced).

9.4 Replacement of the Device with a Parameterization Server

The IO-Link protocol provides an automated process for transferring data when a device is replaced. For this Data storage mechanism, the IO-Link master mirrors all setting parameters for the device in a separate non-volatile memory. When a device is swapped for a new one of the same type, the setting parameters for the old device are automatically saved in the new device by the master.

✓ The device is operated on a master with IO-Link version 1.1 or higher.

✓ The Data storage feature in the configuration of the IO-Link port is activated.

- Ensure that the new device is restored to the factory settings **before** it is connected to the IO-Link master. If necessary, reset the device to the factory settings.

⇨ The device parameters are automatically mirrored in the master when the device is configured using an IO-Link configuration tool.

⇨ Changes to the parameters made in the user menu on the device or via NFC are mirrored in the master.

Changes to the parameters made by a PLC program using a function module are **not** automatically mirrored in the master.

- Manually mirroring data: After changing all the required parameters, execute ISDU write access to the “System Command” parameter [0x0002] using the “Force upload of parameter data into the master” command (numerical value 0x05) (> see Data Dictionary Section, page 49).

Use the Parameterization server function of the IO-Link master to ensure that no data is lost when switching the device.

10 Warranty

The CobotPump is guaranteed in accordance with our general terms of sale and delivery. The same applies to spare parts, provided that these are original parts supplied by us.

We are not liable for any damage resulting from the use of non-original spare parts or accessories.

The exclusive use of original spare parts is a prerequisite for the proper functioning of the CobotPump and for the validity of the warranty.

Wearing parts are not covered by the warranty.

NOTE

Use of non-original spare parts

Malfunctions or damage to the equipment

- Use only original and spare parts from J. Schmalz. Otherwise the warranty is void.

11 Troubleshooting

General errors

Fault	Possible cause	Solution
ECBPMi does not respond	No power supply	▸ Check electrical connection and PIN assignment.
	Signal input type does not match the signal type at the robot	▸ Set the correct signal type, PNP or NPN, using the appropriate switch
Vacuum level is not reached or vacuum is built up too slowly	Press-in screen is contaminated	▸ Clean screen or have it replaced by Schmalz if necessary
	Leakage at vacuum gripper	▸ Check vacuum gripper and replace if necessary.
Load cannot be held	Vacuum level too low	▸ Check system for leakage and correct if necessary.
	Vacuum gripper too small	▸ Choose a larger vacuum gripper.
Warning is indicated by orange light.	During the suction process, the vacuum fell below the limit value H2.	1. Check the system for leakage. 2. Check whether vacuum limit value H2 can be lowered.
Warning is indicated by red light	1x pulsing red light: Supply voltage outside the permitted range.	▸ Set the supply voltage correctly.
	2x pulsing red light: Device temperature is too high.	1. Check the ambient temperature (permitted conditions) YES => there is an internal error; contact the Schmalz service team. 2. Let the device cool down.
	3x pulsing red light: Pump error, sensor calibration error, electronic error or EEPROM error	▸ If this error occurs repeatedly, contact the Schmalz service team.
	Continuously pulsating red light: Robot error	▸ Contact the robot manufacturer

12 Spare and Wearing Parts, Accessories

Type	Part no.	Description	Part type
ECBPMi 24V-DC FK UNI	10.03.01.00500	Mini-CobotPump ECBPMi	S
ECBPMi 24V-DC FK RS-485	10.03.01.00584	Mini-CobotPump ECBPMi RS485	S
SPB1 30 ED-65 G1/4-AG	10.01.06.04530	Bellows suction cup (round)	A
SFF 20 SI-55 G1/4-AG	10.01.01.14621	Flat suction gripper (round) plus	A
SCHR 4762 M3x14 ST-8.8 VZ	20.01.02.00008	2x for fastening the ECBPMi to the flange	W
SCHR 4762 M6x12 ST-8.8 VZ	20.01.02.01002	4x for fastening the flange	W
STIFT 2338 6x10 A1	20.05.01.00081	Positioning pin	S

Legend:	W …	Wearing part
	S _	Spare part
	A _	Accessories

The accessory parts listed here are current as of the writing of the operating instructions. An up-to-date overview of all accessory parts for the ECBPMi can be found online at www.schmalz.com

13 Disposing of the Device

1. Dispose of the product properly after replacement or decommissioning.
2. Observe the country-specific guidelines and legal obligations for waste prevention and disposal.

Component	Material
Housing	PUR vacuum cast resin
Inner components	Aluminum alloy, brass, stainless steel, POM, silicone
Seals	NBR
Lubrication	Silicone-free
Screws	Galvanized steel

14 Attachment

See also

ECBPMi Data Dictionary_21.10.01.00140_00.PDF [} 49]

14.1 EC Declaration of Conformity

EC Declaration of Conformity

The manufacturer Schmalz confirms that the product for the Mini-CobotPump described in these operating instructions fulfills the following applicable EC directives:

2014/30/EU	Electromagnetic Compatibility
2011/65/EU	Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment

The following harmonized standards were applied:

EN ISO 12100	Safety of machinery — General principles for design — Risk assessment and risk reduction
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
EN IEC 63000	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Other standards and technical specifications:

EN ISO 9409-1	Manipulating industrial robots – Mechanical interfaces – Part 1: Plates
DIN ISO/ TS 15066:2017-04	Robots and robotic devices – Collaborative robots

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

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SCHMALZ

IO-Link Implementation

	IO-Link Version 1.1
Vendor ID	234 (0x00EA)
Device ID	100320
SIO-Mode	Yes
Baudrate	38.4 kBd (COM2)
Minimum cycle time	4,6 ms
Processdata input	6 byte
Processdata output	4 byte
Supported profiles	Firmware Update

Process Data

Process data In		Bits	Access	Remark
PD in byte 0	Signal H2 (part present)	0	ro	Vacuum is over H2 & not yet under H2 - h2
	Signal H1 (in control range)	1	ro	Vacuum value within setpoint area (only in setpoint mode)
	Control mode	2	ro	1 = Speed demand
	CM-Autoset acknowledged	3	ro	Acknowledge that the autoset function has been completed
	EPC-Select acknowledged	4	ro	Acknowledge that EPC values 1 and 2 have been switched according to EPC-select: 0 - EPC-Select = 00 1 - otherwise
	Signal H3 (part detached)	5	ro	The part has been detached after a suction cycle
	Device status	7..6	ro	00 - [green] Device is working optimally 01 - [yellow] Device is working but there are warnings 10 - [orange] Device is working but there are severe warnings 11 - [red] Device is not working properly
PD in byte 1	EPC value 1	7…0	ro	EPC value 1 (byte) Holds 8bit value as selected by EPC-select (see PD out byte 0)
PD in byte 2	EPC value 2, high-byte	7…0	ro	EPC value 2 (word) Holds 16bit value as selected by EPC-select (see PD out byte 0)
PD in byte 3	EPC value 2, low-byte	7…0	ro	
PD in byte 4	Freedrive desired	0	ro	Both buttons are activated, signaling to transfer in freedrive
	Freedrive activated	1	ro	Freedrive was activated on pd out 3, bit 0
	Reserved	7..2	ro	Reserved
PD in byte 5	Reserved	7…0	ro	Reserved

Process data Out		Bits	Access	Remark

IO-Link

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SCHMALZ

Process data Out		Bits	s	Remark
PD out byte 0	Vacuum	0	wo	Vacuum on/off
	Drop-off	1	wo	Activate drop-off
	control mode	2		1 = Speed demand 0 = setpoint for control
	CM-Autoset	3	wo	Perform CM-autoset function (Info:Values are beeing safed in selected profile)
	EPC-Select	5..4	wo	Select the function of EPC values 1 and 2 in PD in (content is 2 bit binary coded integer) 0: EPC value 1 = Actual power in % EPC value 2 = System vacuum (1 mbar) 1: EPC value 1 = CM-Warnings (see ISDU 146 for bit definitions) EPC value 2 = Evacuation time t1 (1 msec) 2: EPC value 1 =-Leakage of last suction cycle (1ml/min) EPC value 2 = Last measured free-flow vacuum (1 mbar) 3: EPC value 1 = Primary supply voltage (0.1 Volt) max.25,5V EPC value 2 = Energy consumption of last suction cycle (Ws)
	Profile-Set	7..6	wo	Select production profile (content is 2-bit binary coded integer) 0: Activate production setup profile P0 1: Activate production setup profile P1 2: Activate production setup profile
PD out byte 1	Vacuum demand / setpoint for control	7…0	wo	Vacuum demand in % / setpoint for control mode H1 in 10 mbar (if 0 use data from profiles)
PD out byte 2	Setpoint H2 demand	7…0	wo	Setpoint H2 in 10 mbar (if 0 use data from profiles)
PD out byte 3	Enable Freedrive	0	wo	Enable Freedrive
	Set error robot	1	wo	ECBPMi transfers in error state, LEDs red, blinking
	Set warning robot	2	wo	ECBPMi transfers in warning state,LEDs orange
	Reserved	7…3	wo	Reserved

ISDU Index (for IO-Link) dec	ISDU Index (for IO-Link) hex	Subindex (for IO-Link) dec	Parameter	Data width	Value range	Access	Default value	Remark
Identification								
Device Management								
16	0x0010	0	Vendor name	15 bytes		ro	J. Schmalz GmbH	Manufacturer designation
17	0x0011	0	Vendor text	15 bytes		ro	www.schmalz.com	Internet address
18	0x0012	0	Product name	32 bytes		ro	ECBPMi	General product name
19	0x0013	0	Product ID	32 bytes		ro	ECBPMi	General product name
20	0x0014	0	Product text	30 bytes		ro		Order-Code (partial); for complete order-code read Index 254, z.B. ECBPMi
21	0x0015	0	Serial number	9 bytes		ro		Serial number, z.B. 999000101
22	0x0016	0	Hardware revision	2 bytes		ro		Hardware revison, z.B. 00
23	0x0017	0	Firmware revision	4 bytes		ro		Firmware revision, z.B. 1.12

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240	0x00F0	0	Unique Device Identification	20 bytes		ro		10,14,1,1,3,2,2,0,30,0,0,VendorID,Device ID, Serialnumber: z.B.:0x0A0E010103020200820000 00EA 0187D7 3B8B8825
241	0x00F1	0	Device features	11 bytes		ro		z.B. 0x0A0E010103020200820000
250	0x00FA	0	Article number	14 bytes		ro		Order-Nr., z.B. 10.03.01.00500
251	0x00FB	0	Article revision	2 bytes		ro		Article revision, z.B. 00
252	0x00FC	0	Manufacture date	3 bytes		ro		Manufacture date, z.B. I19
254	0x00FE	0	Product text (detailed)	64 bytes		ro		Order-Code (complete), z.B. ECBPMi
			Device Localization					
24	0x0018	0	Application specific tag	0...32 bytes		rw	***	Device identification
242	0x00F2	0	Equipment identification: (tag 3)	64 bytes		rw	***	Installation idetification
246	0x00F6	0	Geolocation	64 bytes		rw	***	OPC-UA companion standard for auto-ID
247	0x00F7	0	Weblink to IODD	64 bytes		rw	***	User string to store web link to IODD file
248	0x00F8	0	Link to IOT-server	64 bytes	"http://"… "https://"…	rw	https://myproduct.schmalz.com/#/	Web link to NFC app (base URL for NFC tag)
249	0x00F9	0	Storage location (tag 2)	0...32 bytes		rw	***	User string to store storage location
253	0x00FD	0	Installation date	16 bytes		rw	***	User string to store date of installation
			Robot Specific Data					
83	0x0053	1	Tool center point	2 bytes	0 - 65535	rw	100	Centerpoint x-axes in mm- reset by ISDU 2 by writing 0xAD
83	0x0053	2	Tool center point	2 bytes	0 - 65535	rw	100	Centerpoint y-axes in mm- reset by ISDU 2 by writing 0xAD
83	0x0053	3	Tool center point	2 bytes	0 - 65535	rw	100	Centerpoint z-axes in mm- reset by ISDU 2 by writing 0xAD
83	0x0053	4	Tool center point	2 bytes	-6283…+6283	rw	0	Angle alpha (Unit: Millirad, signed Integer)- reset by ISDU 2 by writing 0xAD
83	0x0053	5	Tool center point	2 bytes	-6283…+6283	rw	0	Angle beta (Unit: Millirad, signed Integer)- reset by ISDU 2 by writing 0xAD
83	0x0053	6	Tool center point	2 bytes	-6283…+6283	rw	0	Angle gamma (Unit: Millirad * 1000, signed Integer)- reset by ISDU 2 by writing 0xAD
84	0x0054	1	Center of gravity	2 bytes	0 - 65535	rw	100	Center of Gravity, x-axes in mm- reset by ISDU 2 by writing 0xAD
84	0x0054	2	Center of gravity	2 bytes	0 - 65535	rw	100	Center of Gravity, y-axes in mm- reset by ISDU 2 by writing 0xAD
84	0x0054	3	Center of gravity	2 bytes	0 - 65535	rw	100	Center of Gravity, z-axes in mm- reset by ISDU 2 by writing 0xAD
85	0x0055	1	Grippershape	2 bytes	0 - 1	rw	1	0: Cuboid 1: Cylindrical - reset by ISDU 2 by writing 0xAD
85	0x0055	2	Length	2 bytes	0 - 65535	rw	100	Length of endeffector in mm- reset by ISDU 2 by writing 0xAD
85	0x0055	3	Width	2 bytes	0 - 65535	rw	100	Width of endeffector in mm- reset by ISDU 2 by writing 0xAD
85	0x0055	4	Height	2 bytes	0 - 65535	rw	100	Height of endeffector in mm- reset by ISDU 2 by writing 0xAD
86	0x0056	0	Weight	2 bytes	0 - 65535	rw	224	Weight of endeffector in g - reset by ISDU 2 by writing 0xAD
			Parameter					
			Device Settings					
			Commands					
2	0x0002	0	System command	1 byte		wo		0x05 (dec 5): Force upload of parameter data into the master 0x82 (dec 130): Reset device parameters to factory defaults 0xA5 (dec 165): Calibrate vacuum sensor 0xA7 (dec 167): Reset erasable counters 0xA8 (dec 168): Reset min/max values of supply voltage and temperature 0xA9 (dec 169): Reset vacuum min/max 0xAC (dec 172): Reset LED color 0xAD (dec 173): Reset robot-specific parameters
			Access Control					
12	0x000C	0	Device access locks	2 bytes	0, 4 , 8, 12	rw	0	Bit 0:reserved Bit 1: reserved Bit 2: Lock local parameterization Bit 3: Lock HMI

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90	0x005A	0	Extended device access locks	1 byte	0-255	rw	0	Bit 0: NFC write lock Bit 1: NFC disable Bit 2 + 3: reserved Bit 4: IO-Link event lock (suppress sending IO-link events) Bit 5: Lock freedrive desired (freedrive disabled) Bit 6-7: reserved
91	0x005B	0	NFC PIN code	2 bytes	0-999	rw	0	Pass code for writing data from NFC app
			Initial Settings					
69	0x0045	0	Drop-off mode	1 byte	0 - 2	rw	0	0 = Externally controlled drop-off (-E-) 1 = Internally controlled drop-off – time-dependent (I-t) 2 = Externally controlled drop-off – time-dependent (E-t)
73	0x0049	1	Signal type output	1 byte		ro		0 = PNP 1 = NPN Dip-Position for SIO mode
73	0x0049	2	Signal type input	1 byte		ro		0 = PNP 1 = NPN Dip-Position for SIO mode
75	0x004B	0	Output filter	1 byte	0 - 3	rw	1	0 = Off 1 = 10ms 2 = 50ms 3 = 200ms
82	0x0052	0	Color-Profile	8 byte	0x00-0xFF for colors, 0x00-0x64 for brightness	rw	0x00, 0xFF, 0x00, 0x28, 0x00, 0xFF, 0x00, 0x64	Byte 0-3: Vacuum<H2 (0 = Red, 1 = Green, 2 = Blue, 3 = Brightness 0-100%) Byte 4- 7:Vacuum >H2 (4 = Red, 5= Green, 6= Blue, 7 = Brightness 0-100%)
			Process Settings					
			Production Setup - Profile P0/ Setup for SIO Mode					
78	0x004E	0	control mode vacuum/speed	1 bytes	0-1	rw	0	0 = vacuum as controlled value 1 = motor speed as controlled value only adopted in SIO mode
100	0x0064	0	Setpoint H1	2 bytes	H1 > H2 + h2; H1 < 999	rw	600	H1 Value for Control, Unit: 1 mbar
101	0x0065	0	Speed	1 bytes	0-100	rw	100	Unit: % only adopted in SIO Mode
102	0x0066	0	Setpoint H2	2 bytes	H2 < H1 - h2; H2 > h2 + 2	rw	480	Unit: 1 mbar
103	0x0067	0	Hysteresis h2	2 bytes	h2 < H1 - H2; h2 < H2 - 2; h2 >= 10	rw	20	Unit: 1 mbar
106	0x006A	0	Duration automatic drop-off	2 bytes	100 - 9999	rw	2000	Unit: 1 ms
107	0x006B	0	Permissible evacuation time	2 bytes	0, 10 - 9999	rw	1000	Unit: 1 ms, no surveillance if 0 can be set by CM autoset
108	0x006C	0	Permissible leakage rate	2 bytes	0- 2000	rw	1000	Unit: 1 ml/min, no surveillance if 0 can be set by CM Autoset
119	0x0077	0	Profile name	1...32 bytes		rw	***	
			Production Setup - Profile P1					
182	0x00B6	0	Setpoint H1	2 bytes	H1 > H2 + h2; H1 < 999	rw	400	
184	0x00B8	0	Setpoint H2	2 bytes	H2 < H1 - h2; H2 > h2 + 2	rw	300	

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185	0x00B9	0	Hysteresis h2	2 bytes	h2 < H1 - H2; h2 < H2 - 2; h2 >= 10	rw	15	
186	0x00BA	0	Duration automatic drop-off	2 bytes	100 - 9999	rw	1500	
187	0x00BB	0	Permissible evacuation time	2 bytes	0, 10 - 9999	rw	400	
188	0x00BC	0	Permissible leakage rate	2 bytes	0- 2000	rw	1000	
199	0x00C7	0	Profile name	1...32 bytes		rw	***	
			Production Setup - Profile P2					
202	0x00CA	0	Setpoint H1	2 bytes	H1 > H2 + h2; H1 < 999	rw	600	
204	0x00CC	0	Setpoint H2	2 bytes	H2 < H1 - h2; H2 > h2 + 2	rw	500	
205	0x00CD	0	Hysteresis h2	2 bytes	h2 < H1 - H2; h2 < H2 - 2; h2 >= 10	rw	15	
206	0x00CE	0	Duration automatic drop-off	2 bytes	100 - 9999	rw	2000	
207	0x00CF	0	Permissible evacuation time	2 bytes	0, 10 - 9999	rw	600	
208	0x00D0	0	Permissible leakage rate	2 bytes	0- 2000	rw	1000	
219	0x00DB	0	Profile name	1...32 bytes		rw	***	
			Production Setup - Profile P3					
222	0x00DE	0	Setpoint H1	2 bytes	H1 > H2 + h2; H1 < 999	rw	500	
224	0x00E0	0	Setpoint H2	2 bytes	H2 < H1 - h2; H2 > h2 + 2	rw	300	
225	0x00E1	0	Hysteresis h2	2 bytes	h2 < H1 - H2; h2 < H2 - 2; h2 >= 10	rw	15	
226	0x00E2	0	Duration automatic drop-off	2 bytes	100 - 9999	rw	2000	
227	0x00E3	0	Permissible evacuation time	2 bytes	0, 10 - 9999	rw	1000	
228	0x00E4	0	Permissible leakage rate	2 bytes	0- 2000	rw	1000	
239	0x00EF	0	Profile name	1...32 bytes		rw	***	
			Observation					
			Process Data					
40	0x0028	0	Process data in copy	see PD in		ro		Copy of currently active process data input (length see above)
41	0x0029	0	Process data out copy	see PD out		ro		Copy of currently active process data output (length see above)
			Monitoring					
64	0x0040	1	Vacuum value, live	2 bytes		ro		Vacuum value as measured by the device (unit: 1 mbar)
64	0x0040	2	Vacuum value, min	2 bytes		ro		min. value of vacuum value as measured by the device - reset by ISDU 2 by writing 0xA9
64	0x0040	3	Vacuum value, max	2 bytes		ro		max. value of vacuum value as measured by the device-reset by ISDU 2 by writing 0xA9
66	0x0042	1	Primary supply voltage, live	2 bytes		ro		Primary supply voltage (US) as measured by the device (unit: 0.1 Volt)
66	0x0042	2	Primary supply voltage, min	2 bytes		ro		min. value of primary supply voltage (unit: 0.1 Volt) - reset by ISDU 2 by writing 0xA8
66	0x0042	3	Primary supply voltage, max	2 bytes		ro		max. value of primary supply voltage (unit: 0.1 Volt) - reset by ISDU 2 by writing 0xA8
68	0x0044	1	Temperature, live	2 bytes		ro		Temperature (unit 1 °C) live
68	0x0044	2	Temperature, min	2 bytes		ro		Lowest measured temperature since power-up (unit 1 °C) - reset by ISDU 2 by writing 0xA8
68	0x0044	3	Temperature, max	2 bytes		ro		Highest measured temperature since power-up (unit 1 °C) - reset by ISDU 2 by writing 0xA8

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564	0x0234	0	Communication mode	1 byte		ro		Currently active communication mode: 0x00 = SIO mode 0x10 = IO-Link Revision 1.0 (set by master) 0x11 = IO-Link Revision 1.1 (set by master)
Diagnosis								
Device Status								
32	0x0020	0	Error count	2 byte		ro		Errors since power-on or reset
36	0x0024	0	Device status	1 byte		ro		0 = Device is operating properly (GN) 1 = Maintenance required (Yellow) 2 = Out of spec (Yellow - Red) 3 = Functional check (Yellow - Red) 4 = Failure (red)
37	0x0025	0	Detailed device status	96 byte		ro		Information about currently pending events (event-list) Byte 1: 0x74 = error, 0xE4 = warning, 0xD4 = notification Byte 2..3 = ID Event Code (see below)
138	0x008A	1	Extended device status - Type	1 byte		ro		Extended device status - Type (see below) 0x10: Device operation properly 0x21 Warning lower 0x22 Warning upper 0x42 Critical condition upper 0x81 Defect lower
138	0x008A	2	Extended device status - ID	2 byte		ro		Event code of current device status (see table below)
139	0x008B	0	NFC status	1 byte		ro		Result of recent NFC activity: 0x00: Data valid, write finished successfully 0x23: Write failed: write access locked 0x30: Write failed: parameter(s) out of range 0x31: value greater then limit 0x32: value lesser then limit 0x41: Write failed: parameter set inconsistent 0xA1: Write failed: invalid authorisation 0xA2: NFC not available 0xA3: Write failed: invalid data structure 0xA5: Write pending 0xA6: NFC internal error
130	0x0082	0	Active error code	2 byte		ro		00 = No error (1x blink =sensor voltage too low/high, 2x blink = temperature, 3 x blink = electronic error, pump not working properly, sensor calibration failed or EEprom error, always blink = error robot) Bit 0 = Electronic error (IO-link connection abrupted) Bit 1 = Sensor voltage too low Bit 2 = Sensor voltage overrun Bit 3 = Pump not working properly Bit 4 = Temperatur overrun Bit 5 = Error Robot Bit 6 = Sensor calibration failed Bit 7 = reserved EEPROM
Condition Monitoring [CM]								

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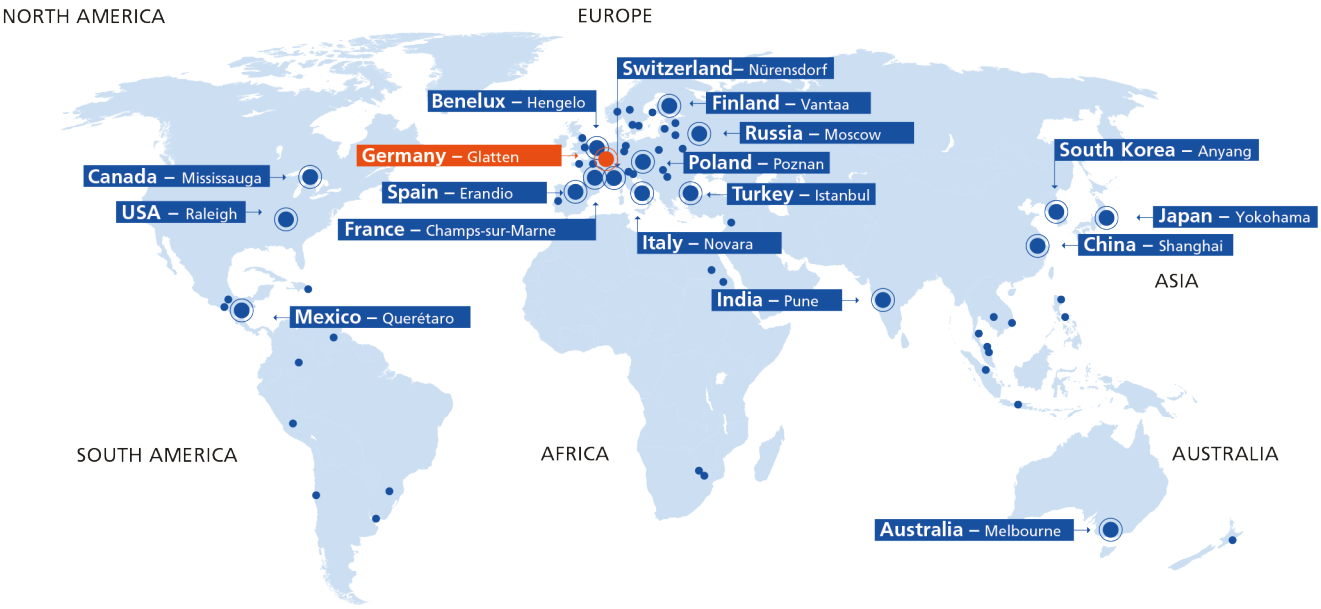
146	0x0092	0	Condition monitoring	2 byte		ro		Bit 0 = H1 selected under H2 Bit 1 = Evacuation time t1 above limit [t-1] last cycle Bit 2 = Leakage rate above limit [-L-] last cycle Bit 3 = H1 not reached in suction cycle last cycle Bit 4 = Free-flow vacuum > (H2-h2) but < H1 last cycle Bit 5 = Warning Robot Bit 6 = Vacuum under H2 - h2 if pump running and vacuum was over H2 prior bit 7= reserved
		Counters						
140	0x008C	0	Vacuum-on counter	4 bytes		ro		Total number of suction cycles (stored all 30 mins)
142	0x008E	0	Condition monitoring counter	4 bytes		ro		Total number of warnings (stored all 30 mins)
143	0x008F	0	Vacuum-on counter erasable	4 bytes		ro		Can be reset by system command "Reset erasable counters" (stored all 30 mins) by writing 0xA7
145	0x0091	0	Condition monitoring counter erasable	4 bytes		ro		Can be reset by system command "Reset erasable counters" (stored all 30 mins) by writing 0xA7
		Timing						
150	0x0096	0	Total Cycle time	4 bytes		ro		Total cycle time of last cycle (uint: 1ms)
148	0x0094	0	Evacuation time t0	2 bytes		ro		Time from start of suction to H2 (unit: 1 ms)
149	0x0095	0	Evacuation time t1	2 bytes		ro		Time from H2 to H1 (unit: 1 ms)
167	0x00A7	0	Pump-On total time	4 bytes		ro		Total time of pump-on-in min (stored all 30 min)
168	0x00A8	0	Power-On total time	4 bytes		ro		Total time of power-on in min (stored all 30 min)
		Energy Monitoring [EM]						
157	0x009D		Energy consumption per cycle	2 bytes		ro		Energy consumption of last suction cycle (unit: 1 Ws)
		Predictive Maintenance [PM]						
162	0x00A2	0	Quality (tightness)	1 byte		ro		Quality of last suction cycle (unit: 1 %)
163	0x00A3	0	Performance (flow)	1 byte		ro		Last measured performance level (unit: 1 %)
169	0x00A9	0	Maximum Temperature	2 bytes		ro		Highest measured temperature in lifecycle (unit 1 °C)
160	0x00A0	0	Leakage rate	2 bytes		ro		Leakage of last suction cycle (unit: 1 ml/min)
161	0x00A1	0	Free-flow vacuum	2 bytes		ro		Last measured free-flow vacuum (unit: 1 mbar)
164	0x00A4	0	Maximum reached vacuum in last cycle	2 bytes		ro		Maximum vacuum value of last suction cycle

Event Codes of IO-Link Events and ISDU 138 (Extended Device Status)

Event code dec	Event code hex		Event name	Event type	Extended Device Status -Type		Remark
4096	0x1000		General malfunction	Error	0x81	Defect lower	Internal error
6144	0x1800		Calibration OK	Notification	0x10	Device operation properly	Calibration offset 0 set successfully
6145	0x1801		Calibration failed	Notification	0x10	Device operation properly	Sensor calibration failed
20736	0x5100		Primary supply voltage overrun	Error	0x42	Critical Condition upper	Primary supply voltage US to low (19.2/19.0V)
20752	0x5110		Primary supply voltage overrun	Error	0x42	Critical Condition upper	Primary supply voltage US to high (26.8/26.6V)
16384	0x4000		CM: Temperature out of range	Warning	0x22	Warning upper	Temperature over 60°C
6152	0x1808		CM: Evacuation time t1 above limit	Warning	0x21	Warning lower	Evacuation time t1 above limit
6153	0x1809		CM: Leakage rate above limit	Warning	0x21	Warning lower	Leakage rate above limit
6154	0x180A		CM: H1 not reached in suction cycle	Warning	0x22	Warning upper	H1 not reached in suction cycle
6155	0x180B		CM: Free-flow vacuum > (H2-h2) but < H1	Warning	0x21	Warning lower	Free-flow vacuum > (H2-h2) but < H1
6161	0x1811		EEPROM error	Error	0x81	Defect lower	Wrong data in EEPROM or EEPROM fault
36003	0x8CA3		Factory reset triggered	Notification	0x10	Device operation properly	Factory reset was triggered
6168	0x1818		Cycle completed	Notification	0x10	Device operation properly	Cycle was completed

At your side worldwide



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