



Operating instructions
Position regulator / Positioner for industrial valves

GB

MVQ301
ZZ0686
ZZ0687
ZZ0688

Contents

1	Preliminary note	4
1.1	Symbols used	4
1.2	Warnings	4
2	Safety instructions	5
3	Intended use	6
3.1	Application area	6
3.2	Restriction of the application area	6
4	Items supplied	8
5	Function	9
5.1	Position feedback	9
5.1.1	Signal range	9
5.1.2	Rotational direction	10
5.2	Switching functions	10
5.3	Control	10
5.3.1	Operating range	11
5.3.2	Deadband tolerance	11
5.3.3	Tight-closing limits	11
5.3.4	Direction of approach	11
5.3.5	Delay in readjustment	12
5.3.6	Safe state [Safe-State]	12
5.3.7	Communication interruption	13
5.3.8	Restart control	13
5.3.9	Smart mode	13
5.4	Advanced teach	13
5.5	Diagnostics	14
5.5.1	Movement times	14
5.5.2	Switching cycles counters	14
5.5.3	Counter when leaving the deadband	14
5.5.4	Counter for overshoot	15
5.5.5	Counter for solenoid valve control	15
5.5.6	Monitoring the operating range	15
5.5.7	Current angle	15
5.5.8	Totaliser for movement	15
5.5.9	Target monitoring	15
5.5.10	Operating hours counter	15
5.5.11	Switch-on operations	16
5.5.12	Internal temperature	16
5.5.13	BLOBs	16
5.6	IO-Link	16
6	Installation	17
6.1	MVQ installation	18
6.2	Installation of the solenoid valve and throttle plate	18
6.2.1	Pneumatic switching symbols of the solenoid valves supplied to DIN ISO 1219	19
6.3	General notes about compressed air	19
6.4	Specification of the compressed air purity	19
6.4.1	Application note	20
6.4.2	Approved lubricants	20
7	Electrical connection	21
8	Operating and display elements	23
8.1	Status LEDs	23
8.2	RGB LED	23
9	Parameter setting	24
9.1	Adjustable parameters and system commands	24
10	Operation	26
11	Troubleshooting	27

11.1	Errors during advanced teach	27
11.2	Other sources of fault	27
11.3	Diagnostic messages	28
11.4	BLOBS	29
11.4.1	Setup data BLOB	29
11.4.2	Statistics data BLOB	29
11.4.3	Logging course BLOB	29
12	Maintenance, repair and disposal	31

1 Preliminary note

You will find instructions, technical data, approvals and further information using the QR code on the unit / packaging or at documentation.ifm.com.

1.1 Symbols used

- ✓ Requirement
- Instructions
- ▷ Reaction, result
- [...] Designation of keys, buttons or indications
- Cross-reference
-  Important note
Non-compliance may result in malfunction or interference.
-  Information
Supplementary note

1.2 Warnings

Warnings indicate the possibility of personal injury and damage to property. This enables safe product handling. Warnings are graded as follows:



WARNING

Warning of serious personal injury

- ▷ If the warning is not observed, fatal and serious injuries are possible.



CAUTION

Warning of minor to moderate personal injury

- ▷ If the warning is not observed, minor to moderate injuries are possible.

ATTENTION

Warning of damage to property

- ▷ If the warning is not observed, damage to property is possible.

2 Safety instructions

- Read this document before setting up the product and keep it during the entire service life.
- The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
- Only use the product for its intended purpose (→ Intended use).
- Only use the product for permissible media.
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
- The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
- Installation, electrical connection, set-up, operation and maintenance of the product must be carried out by qualified personnel authorised by the machine operator.
- Protect units and cables against damage.
- The device transmits data to one or several actuators. They start and execute processes and actions. Incorrect operation may cause damage to machines, material and persons. Parts are moved with great force, particularly in the area of the actuator and the valve, which can result in crush injuries.
- Operation outside the indicated operating pressure range or use of incorrectly processed compressed air can cause permanent leaks and irreparable damage to the pneumatic components and may lead to malfunctioning.

ATTENTION

Unprotected network environment.

The device does not include IT security measures according to IEC 62443.

▷ Unauthorised read or write access to data is possible.

▷ Unauthorised manipulation of the device function is possible.

► Check and restrict access options to the device.

3 Intended use

The device continuously monitors and controls the position of a quarter-turn actuator, which typically actuates a valve such as a ball valve or butterfly valve. The valve can be used to control the flow, level or cooling, for example.



On delivery the device is not operational.

- Carry out an advanced teach after mounting and installation to ensure that the device is working properly.

3.1 Application area

Automated process valves are typically opened and closed by pneumatic actuators. The device measures the position of the actuator and compares it with a target value. Solenoid valves are actuated according to the control difference, whereby the actuator is supplied with compressed air and moves in a direction so that the control difference is as balanced as possible.

The device can be operated on single and double-acting actuators. Depending on the actuator, a suitable 3-way solenoid valve must be used. During advanced teach (→ [Advanced teach](#) □ 13), the device recognises which output pattern of the solenoid valves leads to opening, closing and holding the valve.



If the valve is to assume a certain position in the power-free state, for example in the event of a power failure or compressed air failure, appropriate actuators and solenoid valves with return springs must be used.

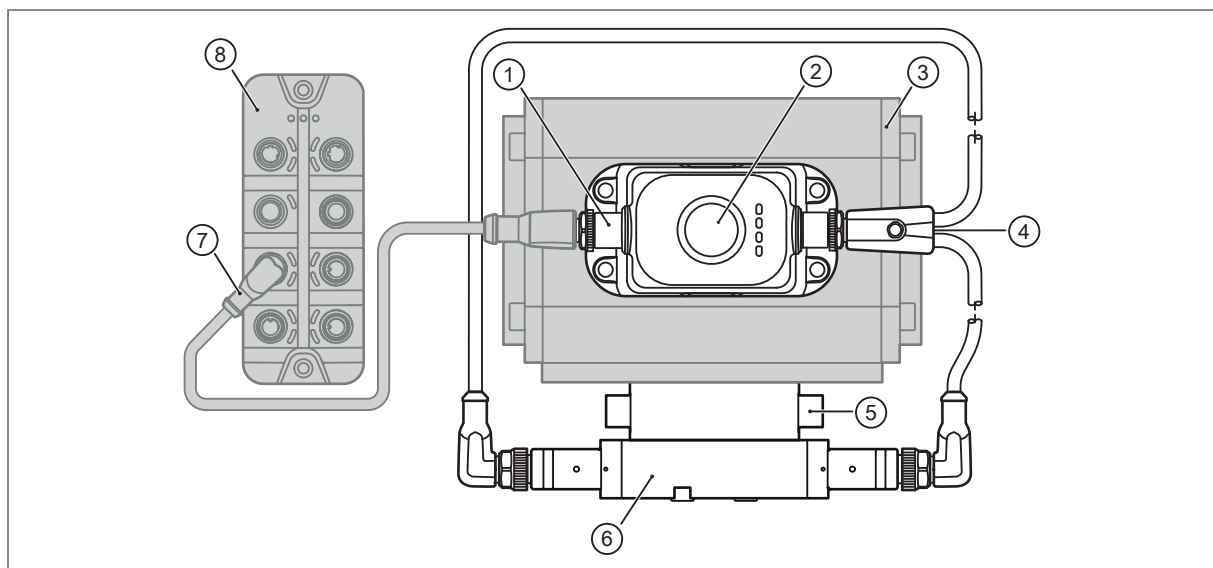


Fig. 1: Wiring of the components (greyed out components are not included)

- | | |
|-----------------------|--------------------------------|
| 1: M12 connector | 5: Throttle plate |
| 2: MVQ301 | 6: Solenoid valve |
| 3: Drive / actuator | 7: 5-wire connection cable |
| 4: Y connection cable | 8: IO-Link master port class B |

The device only has an IO-Link interface and is connected to a plant controller via an IO-Link master port class B. The continuous process data value (PDV) shows the actual course of the valve position. The status of the valve and actuator can be diagnosed via time monitoring. Maintenance work can be planned using various implemented counters.

3.2 Restriction of the application area

The device is not approved for use in potentially explosive atmospheres.



The following environmental conditions can lead to incorrect measurements:

- Alternating electromagnetic fields
- Permanent magnets
- Ferromagnetic materials
- ▶ Check the function by performing an application test.

4 Items supplied

The items supplied differ depending on the article number.

Article number	Designation
MVQ301	Sensor and control unit
	1 x puck
	Mounting material: 4 x hexagon socket screws M5 x 16, stainless steel



It is strongly recommended to use one of the following set items for the initial equipment.

▷ Otherwise, the correct function of the device cannot be guaranteed.

Article number Set item	Article number	Designation
ZZ0686	MVQ301	Sensor and control unit
	ZJF120	5/3-way solenoid valve with 2 x silencer and mounting accessories
	ZJF122	Throttle plate
	EVC508	Y connection cable (M12 connector and socket; 2 x 5 poles; 60 cm)
ZZ0687	MVQ301	Sensor and control unit
	ZJF121	3/3-way solenoid valve with 1 x silencer and mounting accessories
	ZJF123	Throttle plate
	EVC508	Y connection cable (M12 connector and socket; 2 x 5 poles; 60 cm)
ZZ0688	MVQ301	Sensor and control unit
	ZJF119	5/3-way solenoid valve with defined basic position, 2 x silencer and mounting accessories
	ZJF122	Throttle plate
	EVC508	Y connection cable (M12 connector and socket; 2 x 5 poles; 60 cm)

In addition, the following is necessary for installation and operation:

- Hexagon socket 4 mm
- IO-Link master port class B
- 5 pole connection cable with M12 connector
- Adapter plates or mounting bridges optionally



Information about available accessories at www.ifm.com

5 Function

The main function of the device is to set a certain degree of opening on a valve. The degree of opening is to be understood as any position between the taught positions [Close-State] and [Open-State]. The device compares the target value with the valve position. In the event of deviations, the device controls the solenoid valves, moving a quarter-turn actuator and the associated valve in a corresponding direction.

5.1 Position feedback

The device measures the direction of the magnetic field generated by the puck and uses this to calculate a clear angle signal.

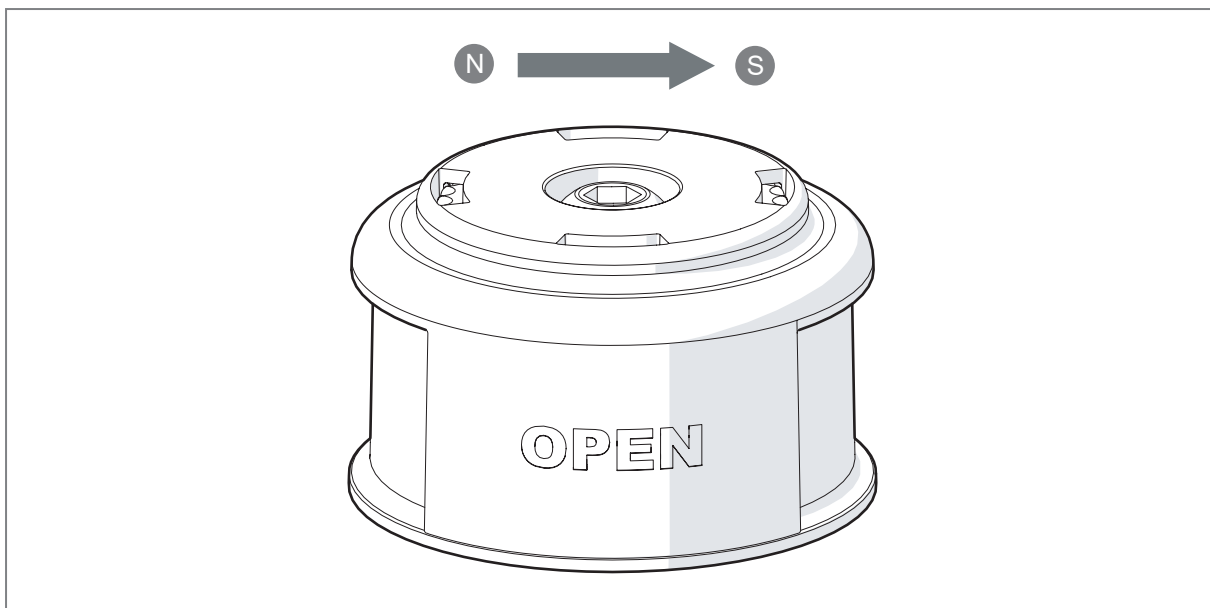


Fig. 2: Position feedback

- !** Ferromagnetic materials such as iron, permanent magnets and magnetic fields in the vicinity of the device and the puck can influence and falsify the signal.
- !** The accuracy and linearity of the signal can be affected by the following factors:
 - The distance between the puck and the device is too large.
 - The device is not mounted centrally in relation to the puck.

5.1.1 Signal range

The device provides a measured value [PDV] that corresponds to the degree of opening of the valve with a resolution of 0.1 %. 0 % corresponds to the [Close-State], 100 % corresponds to the [Open-State] determined during advanced teach.

- !** If the device displays 0 % and [Close-State] after advanced teach with the valve open, the rotational direction must be changed using the parameter [Valve rotation].

The value range is extended by 10 % beyond the determined end positions in order to take tolerances and wear into account. This is why the device outputs measured values of -10...110 %.

- !** Without advanced teach, the device outputs [No measurement data] (32764) as a substitute value.

- !** After installation work, the device and the puck may be mounted rotated by 180°. The signal is then outside the working range.

► Perform the advanced teach (→ [Advanced teach](#) 13) again.

5.1.2 Rotational direction

The [Valve rotation] parameter defines whether the connected valve opens clockwise or anti-clockwise when the device is viewed from above. The [Open-State] and [Close-State] positions are defined according to this setting during advanced teach.

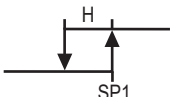
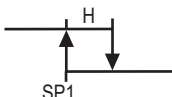
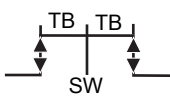
When the rotational direction is changed, all parameters relating to the [Open-State], [Close-State] and working range are automatically adjusted.



Reversing the rotational direction can lead to activation of the control if the target value is valid.

5.2 Switching functions

The device has 2 switching channels [Open-State] and [Close-State], as well as 2 status bits [In-Position-State] and [Safe-State]. The switching behaviour can be configured independently for each position feedback.

Parameter	[Open-State]	[Close-State]	[In-Position-State]
Description	[Open-State] switches when the set switch point is exceeded.	[Close-State] switches when the set switch point is not reached.	[In-Position-State] is active when the measured value is in the deadband around the target value and control is completed.
Switching characteristics			
Setting range	- SP1: 55.0...100.0 % - SP2: 32760 (= OL / not adjustable)	- SP1: 0.0...45.0 % - SP2: -32760 (= UL / not adjustable)	0.5...25 % (TB) SP1 and SP2 symmetrical around target value
Factory setting	- SP: 95.0 % - H: 1.0 % - High active	- SP: 5.0 % - H: 1.0 % - High active	TB: 2 %
hysteresis	0.4...10.0 %	0.4...10.0 %	-
Logic	- High active - Low active	- High active - Low active	High active (not adjustable)
Step increment	0.1	0.1	0.1
Unit	%	%	%
Mode	- Window - Deactivated	- Window - Deactivated	Window

Tab. 1: Switching functions

H: hysteresis
 TB: deadband
 OL: overload

SP: Switch point
 SW: preset value
 UL: underload

5.3 Control

The device continuously compares the valve position with the setpoint/target position. If the deviation between the two values is greater than the set deadband tolerance, the corresponding solenoid valves are controlled. This causes the actuator and the valve to move so that the valve position approaches the setpoint/target position again as closely as possible.

The device also monitors the control with diagnostic parameters.

5.3.1 Operating range

The operating range corresponds to the range of movement of the actuator or the valve. The limits of the operating range are determined during advanced teach.



Without advanced teach, the device has no operating range.

▷ The device cannot perform its function.



The circumference of the operating range must be at least 50° and a maximum of 300°.



If the device displays 0 % and [Close-State] after advanced teach with the valve open, the rotational direction must be changed using the parameter [Valve rotation].

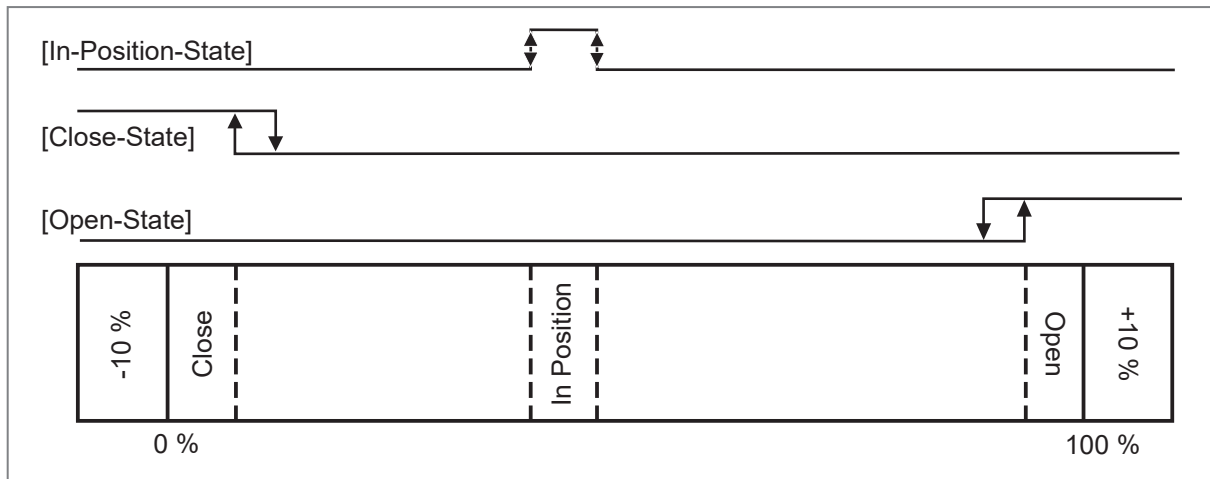


Fig. 3: Operating range

The determined limits of the operating range are extended by 10 % each to take wear, tolerances and temperature effects into account.

5.3.2 Deadband tolerance

The deadband tolerance defines the permissible deviation of the valve position from the setpoint/target position.

If the valve position deviates from the setpoint/target position by no more than the deadband tolerance during control, control is suspended until the deviation is greater again than the defined deadband tolerance.

5.3.3 Tight-closing limits

At the limits of the working range, a position control for the overall process is not effective. This is because the valve either moves in the area of the seal or because a change in the degree of opening only has a minor effect on the open cross-sectional area in the valve.

In these cases, the tight-closing limits can be set accordingly to switch off the control. There are 2 independent tight-closing limits for [Open-State] and [Close-State].

If the target value is between the tight-closing limit and the associated end position, no attempt is made to reach the target value. Instead, the valve is moved to the corresponding end position and held there.



As long as the tight-closing limits are active, the solenoid valves remain supplied with current.

5.3.4 Direction of approach

By specifying the direction of approach, the device will avoid overshoots in one direction as far as possible.

- With the setting [From open], the device tries not to fall below the target range during control → Figure 5.
- With the setting [From close], the device tries not to exceed the target range during control → Figure 4.
- With the default setting [From last position], the device controls in the direction that seems more sensible based on the current valve position.

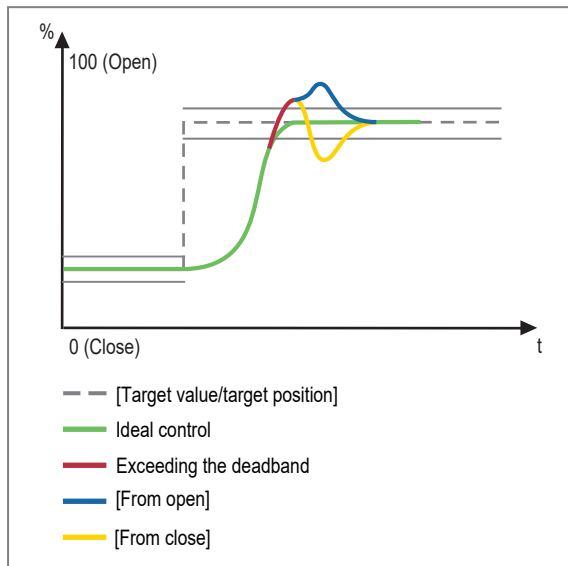


Fig. 4: Approach when the deadband is exceeded

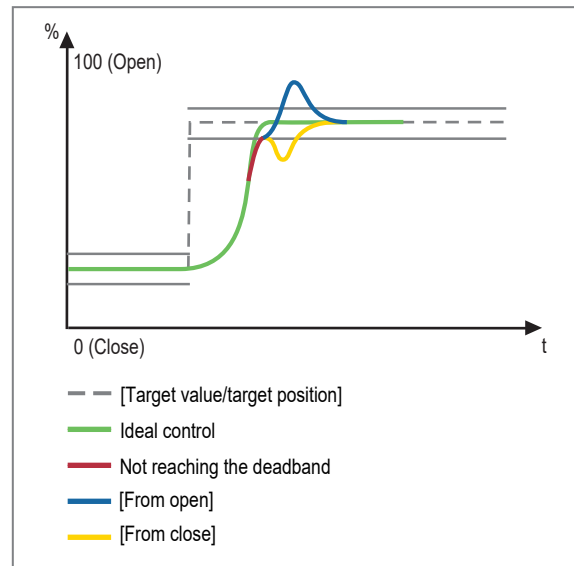


Fig. 5: Approach when the deadband is not reached

5.3.5 Delay in readjustment

A control difference triggers a readjustment of the valve position. It can be caused by faults such as pressure pulses in the pipe. The readjustment can be delayed in order to suppress such short-term faults. Ideally, the valve position returns to the deadband after the fault so that no readjustment is necessary.

5.3.6 Safe state [Safe-State]

In case of a fault, it can be an advantage to move the valve to a certain position in order to avoid disruptions in the process or hazards. Depending on the application and system architecture, it makes sense to define a valve state (Open, Close, Hold) or a specific pattern of solenoid valve control (Both SV, SV1, SV2, NoSV) as safe state.

The following errors lead to a safe state:

- Communication interruption longer than 2 s
- Invalid process data
- When controlling to a target value, the deadband is not reached within the specified time [Position control timeout] (default: 600 s)
- [Overshoot limit] exceeded (default: off)
- The output process data outputs the substitute value (32764)

The safe state is indicated as an error by the RGB LED flashing red. The position of the valve can be read on the puck or on the status LEDs.

The device leaves the safe state if:

- the specified target value changes
- the system command [Positioning Restart] is executed
- the substitute value [Restart positioning] (-32768) is sent to the output process data



If parameters for the safe state are changed while the device is in the safe state, this can lead to movements of the actuator.

5.3.7 Communication interruption

If communication between the device and the IO-Link master is interrupted, the device continues to operate normally for 2 seconds.

If the IO-Link communication is restored within these 2 seconds and valid process data is exchanged, the device continues to operate normally.

If the IO-Link communication is not restored within 2 seconds, the device controls the solenoid valves according to the parameter [Safe state configuration].



- ▶ After a communication interruption, set the process data status back to valid if this is not done automatically by the controller.

5.3.8 Restart control

The system command [Restart control] can be used to restart a previously failed control attempt and switch from the safe state back to normal operation.

5.3.9 Smart mode

Due to temperature, wear, compressed air supply, etc., the control parameters determined during advanced teach may no longer be ideal. With the [Smart mode] setting, the control parameters are optimised during operation so that the most efficient control possible is achieved without repeated advanced teach [Automatic valve setup and control tuning].

5.4 Advanced teach

During advanced teach [Setup mode], all parameters and settings required for position control are determined. 2 versions of advanced teach are available.

1. With the variant [Automatic valve setup], all necessary values (→ [Setup data BLOB](#)  29) for the advanced teach and the limits of the working range are determined.
2. With the variant [Automatic valve setup and control tuning] control parameters are optimised additionally.

Before advanced teach, parameters can be configured that are taken into account during advanced teach. This can make setup faster.



During advanced teach, the valve is moved several times at maximum speed regardless of the target value applied.

- ▶ Ensure that the movement of the valve does not damage or impair the system, the process or the product.
- ▶ If necessary, reduce the speed of the valve via the throttles.
- ▶ Select [Setup mode] and set the required adjustment version.
- ▶ Write the parameter settings to the device.
- ▶ Execute the command: [Setup Start].
- ▷ The device starts the advanced teach. The RGB LED flashes at 1 Hz and the running light at the status LEDs.
- ▷ Once the advanced teach is completed, the RGB LED flashes green 5 times.
- ▶ Read [Parameter] > [Setup result].
- ▶ If necessary, repeat the last step until the advanced teach is signalled as completed.
- ▷ [Setup result] > [Successful].

▷ [Setup mode] > [None]

In case of errors during the advanced teach:

- Read [Parameter] > [Setup result] and evaluate Error code (→ [Errors during advanced teach](#) [▢ 27](#)).
- Read [Setup data BLOB](#) (→ [▢ 29](#)) values
- Verify manually set parameters.

If [Automatic valve setup and control tuning] is aborted during control tuning, the determined parameters are still saved and the device can be used with reduced performance (increased overshoot).



No position can be determined without advanced teach. The event [Parameter missing] is active.

5.5 Diagnostics

The device offers various parameters for diagnostics. The interpretation of these measured values can vary depending on the application. The control behaviour of the valve as well as its use and wear can be derived from the movement times and counter readings. The threshold values can be used to trigger messages in order to plan appropriate maintenance and spare parts procurement.



The counter readings are saved permanently every 10 minutes. If the operating voltage is interrupted, the values since the last saving will be lost.



Counter readings have no overflow. As soon as they have reached their maximum value, they remain constant.



With the commands [All counters Reset] and [Back-to-box] all counters will be reset.

5.5.1 Movement times

The device measures the times required to open, close and position the valve. The time in which the device attempts to reach a position can be limited with the parameter [Positioning timeout]. If this time is exceeded, the event [Positioning timeout] (0x8CB5) is triggered.



By monitoring the movement times, factors such as wear, dirt or insufficient air pressure can be detected.

5.5.2 Switching cycles counters

The device has a switching cycles counter for each of the three switch points ([Open-State counter], [Close-State counter], [In-Position-State counter]). It counts the number of switching edges.



There is a separate command for each of the 3 switching cycles counters to reset the counter to 0.

5.5.3 Counter when leaving the deadband

Each time the measured value leaves the deadband without the target value having changed, a counter is incremented.

There is one counter each for exceeding the lower limit and the upper limit of the deadband. The counter reading of these two counters can indicate a leakage or insufficient holding force of the actuator. If a counter reaches the set limit, the event [Position unstable] (0x8CB4) is triggered.



There is a separate command for each of the 2 counters to reset the counter to 0.

The counter will also be reset in the event of a setpoint change that leads to activation of the control.

5.5.4 Counter for overshoot

If the valve position exceeds the deadband during the positioning process, a counter will be incremented. If the counter exceeds the set limit, the event [Positioning timeout] (0x8CB4) will be triggered.

5.5.5 Counter for solenoid valve control

There is a counter for each solenoid valve that increases when the solenoid valve is controlled. If a counter reaches the limit for controlling the solenoid valves, the event 0x8C42 will be triggered.



There is a separate command for each of the 2 counters to reset the counter to 0.

5.5.6 Monitoring the operating range

The parameter [Working range tolerance] defines how far the working range may be exceeded or not reached.

If the working range is exceeded by more than the set tolerance, the device displays a warning and triggers the following events:

- Event (0x8C10) for exceeding the tolerance.
- Event (0x8C30) for not reaching the tolerance.



Due to temperature differences or wear, the valve may move further than determined during advanced teach.

If the position in the [Open-State] and [Close-State] end positions deviates by more than the working range tolerance from the limit of the working range determined during advanced teach, the event (0x8C40) will be triggered.

5.5.7 Current angle

The parameter [Valve angle] specifies the angle of the actual valve position.

The angular range is output from -180...179.9°. This information can be used to read the position and movement of the valve independently of the working range.

5.5.8 Totaliser for movement

The angular changes of all movements are added. If the totaliser reaches the limit for the range of movement, the event (0x8C42) will be triggered.



There is a separate command to reset the totaliser to 0.

5.5.9 Target monitoring

The device recognises when no puck has been mounted and reports an error and the event (0x8CBA).

5.5.10 Operating hours counter

The operating hours since the first set-up are stored by the unit.



The maximum counter reading of 2 000 000 h will be retained when it has been reached (no overflow).

The counter cannot be reset, not even by [Back-to-box] reset.

5.5.11 Switch-on operations

The device stores the switch-on operations since the first set-up.



The maximum counter reading of 2 000 000 will be retained when it has been reached (no overflow).

The counter cannot be reset, not even by [Back-to-box] reset.

5.5.12 Internal temperature

The device outputs the internal temperature



The internal temperature may be higher than the actual temperature due to self-heating of the processor.



Due to the puck and the actuator, the device is far away from the valve. The temperature specification depends largely on the ambient temperature and not on the process temperature.

5.5.13 BLOBs

In addition to the diagnostic parameters, further diagnostic information can be read and interpreted from the BLOBs recorded by the device.

The following BLOBs are available:

- [Setup data BLOB \(→ 29\)](#)
- [Statistics data BLOB \(→ 29\)](#)
- [Logging course BLOB \(→ 29\)](#)

5.6 IO-Link

IO-Link is a communication system for connecting intelligent sensors and actuators to automation systems. IO-Link is standardised in the IEC 61131-9 standard.



General information on IO-Link at io-link.ifm



Input Output Device Description (IODD) with all parameters, process data and detailed descriptions of the device at documentation.ifm.com

IO-Link offers the following advantages:

- Interference-free transmission of all data and process values
- Parameter setting in the running process or presetting outside the application
- Parameters for identifying the connected devices in the system
- Additional parameters and diagnostic functions
- Automatic backup and restore of parameter sets in case of device replacement (data storage)
- Logging of parameter sets, process values and events
- Device description file (IODD - Input Output Device Description) for easy project planning
- Standardised electrical connection
- Remote maintenance

6 Installation



- ▶ Disconnect the power to the machine during installation.
- ▶ Ensure that the machine stands still.
- ▶ Do not start the drive during installation.
- ▶ Keep potential interfering sources (magnets, heat sources) at a distance.



Pneumatic actuators can generate very high torques and forces.

- ▷ Risk of injury / crushing.



Compressed air may be present in the chambers of the actuator even if the compressed air supply is interrupted. Rapidly escaping air can cause noise or parts to be scattered.

- ▶ Before dismantling the throttle plate or solenoid valve, ensure that no pressure is applied to all chambers of the actuator. Alternatively: Unscrew the throttle plate or solenoid valve very slowly and allow the trapped compressed air to escape.

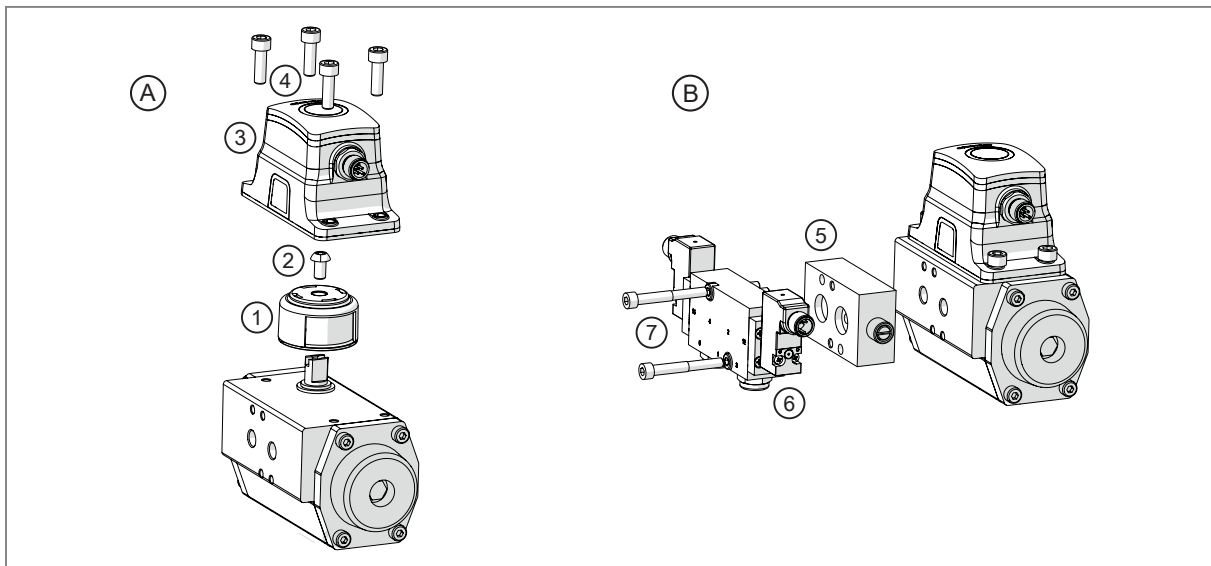


Fig. 6: Installation of the mechanical components (observe the labelled sequence)

A: Installation MVQ301

1: Puck

2: Hexagon socket screw 1 x M6 x 12

3: MVQ301

4: Hexagon socket screw 4 x M5 x 16

B: Installation of solenoid valve and throttle plate

5: Throttle plate

6: Solenoid valve

7: Cylinder screw 2 x M5 x 45

6.1 MVQ installation

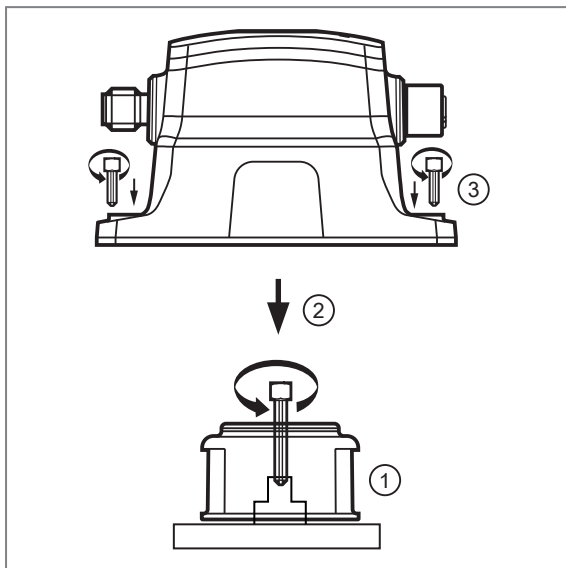


Fig. 7: MVQ installation

1. Use the two notches at the bottom of the target puck as a mounting aid for a precise positioning on the shaft. Align target puck. The puck can be rotated, the yellow area labelled "open" in the window indicates the set position. Fasten the puck to the valve head using the screw supplied, tightening torque 1.2 Nm.
2. Put the unit over the target puck.
3. Fix the unit to the actuator housing using the supplied screws, tightening torque 1.5 Nm. Use an optional mounting plate, depending on the mechanical interface.

6.2 Installation of the solenoid valve and throttle plate

- Adhere to the safety regulations and provisions for the set-up of pneumatic systems.
- Installation work is only allowed following the interruption of the compressed air supply.

Adhere to the following order of installation (deinstallation in reversed order):

1. Mechanical fixing
 2. Electrical and pneumatic connection
 3. Power on
 4. Switch on the compressed air supply
- During installation, check whether the seals pre-mounted in the solenoid valve and throttle plate are present and correctly placed on the connections 2 and 4.
 - When silencers are used make sure that they are correctly installed.



CAUTION

Hazard generated by noise

Compressed air connection only after suitable installation of all connection tubes and only with installed silencers or common exhaust allowed.

- ▷ Operation without connection tubes and with open exhaust connections can lead to a harmful noise level.



To ensure that the control functions properly, it is recommended that the throttles that regulate the exhaust air during opening and closing are set so that the maximum possible movement during opening and closing is > 3 s. Depending on the application and mass flow through the valve, a longer movement time may be required to prevent damage to the system. The movement time can be shortened by taking a larger deadband into account.

6.2.1 Pneumatic switching symbols of the solenoid valves supplied to DIN ISO 1219

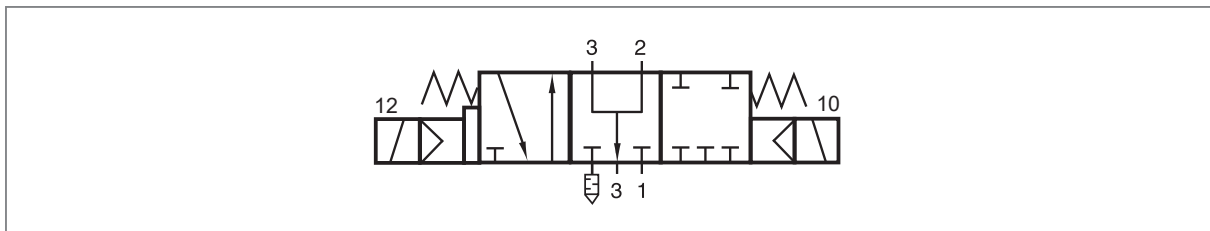


Fig. 8: ZZ0687 - 3/3-way solenoid valve

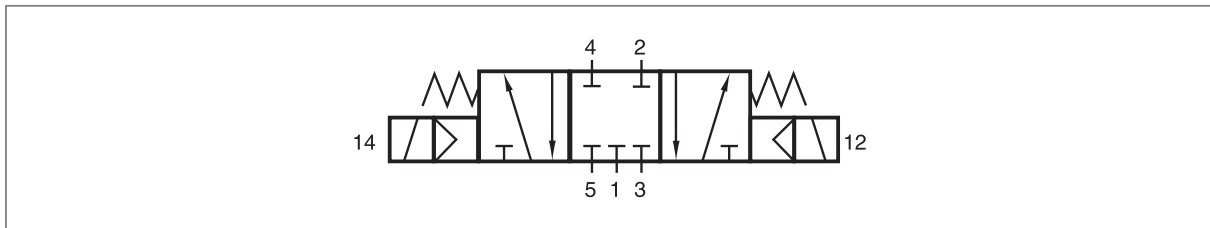


Fig. 9: ZZ0686 - 5/3-way solenoid valve

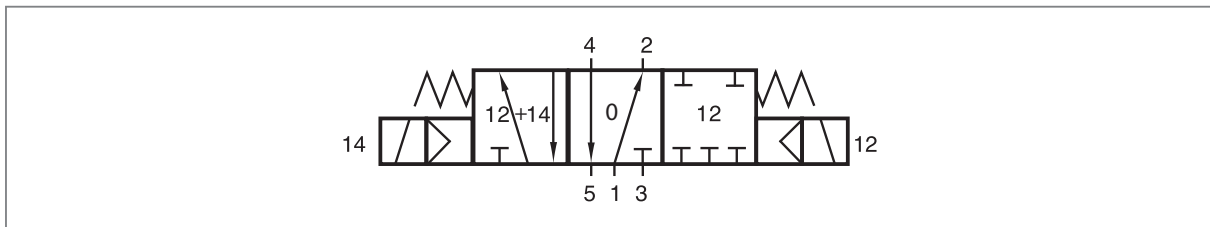


Fig. 10: ZZ0688 - 5/3-way solenoid valve with defined home position

6.3 General notes about compressed air

For all components that are operated with compressed air the purity of the compressed air determines the lifetime and the safe operation. In the supplied solenoid valve pneumatic pilot valves are used which are designed for a pressure range from 2.5 ... 10 bar. Operation outside the indicated operating pressure range or use of incorrectly processed compressed air can cause permanent leaks and irreparable damage to the pneumatic components and may lead to malfunctioning. Pressure peaks above the permissible operating pressure are to be avoided by means of approved technical measures. Not only the pressure but also the purity of the compressed air determines the lifetime of the solenoid valves and ensures safe operation. For a long life certain requirements must be met. Compressed air in perfect condition and to the greatest possible extent without any chemical contamination must be used at all times. The basis for this is ISO 8573 part 1: 2001.

6.4 Specification of the compressed air purity

According to ISO 8573-1:2001 the air purity is divided into three classes:

- The purity class of the solid particle content
- The purity class for the humidity content
- The purity class for the total oil content

The supplied solenoid valve is appropriate for lubricated or non-lubricated compressed air of the purity classes 7-4-4.

6.4.1 Application note

The indicated specification is a minimum requirement, i.e. the products may have a longer life. Higher durability is achieved by means of a lower particle concentration and humidity and if only a very small amount or no oil at all is added. The solenoid valve has an initial lubrication, therefore lubricated compressed air is not required. If lubricated air is used the initial lubrication is removed and the solenoid valve must always be used with lubricated air. Some applications such as packaging machines, food industry etc. have far higher requirements as regards the processing of compressed air.

Existing regulations have to be observed. It is recommended to filter the compressed air as close as possible in front of the solenoid valve. In this way contamination, e.g. by rust from steel pipes, can be efficiently prevented. Mixing of synthetic oils with mineral oils can lead to failure of moving parts due to adherence or clotting.

6.4.2 Approved lubricants

When using lubricated compressed air, only use class 1 oil (without additives), HLP oils to DIN 51524 part 2. The oil must not impact the materials used.

7 Electrical connection



The unit must be connected by a qualified electrician.

Observe the national and international regulations for the installation of electrical equipment.

Voltage supply according to SELV, PELV.

► Disconnect power.

► Connect the unit as follows:

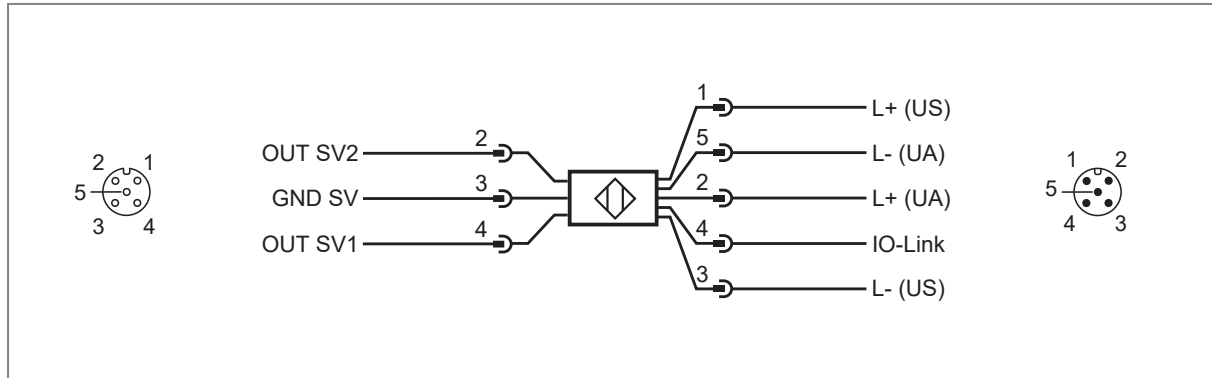


Fig. 11: Wiring

- 2: OUT SV2
- 3: GND SV = L- (UA)
- 4: OUT SV1

- 1: Sensor supply (US) L+
- 2: Actuator supply (UA) L+
- 3: Sensor supply (US) L-
- 4: IO-Link
- 5: Actuator supply (UA) L-

► Observe the notes on IO-Link wiring.

This device contains components that may be damaged or destroyed by electrostatic discharge (ESD).

► Please observe the required precautions against electrostatic discharge.

The IP rating of the overall system depends on the protection ratings of the individual devices, the connection elements used and the corresponding protective caps.

The M12 connection parts in the device comply with the ingress resistance requirements of the standard EN61076-2-101. To adhere to the protection rating, only cables certified to this standard must be used. The system architect undertakes to ensure the ingress resistance of cables they have cut to length.

- Carry out the fitting according to the indications of the cable manufacturer, a max. tightening torque of 0.8 Nm is permissible.
- During installation, place the M12 connector vertically so that the coupling nut will not damage the thread.
- Provide cables with a strain relief depending on the mounting conditions to avoid excessive strain on the installation points and the M12 connections.
- Ensure correct fit and proper assembly of the M12 connection parts. If these instructions are not complied with, the specified protection rating cannot be guaranteed.

For UL applications:

- To connect the device and the IO-Link devices, only use UL-certified cables belonging to category CYJV or PVVA with a minimum temperature of 80 °C (75 °C in case of a maximum ambient temperature of 40 °C).

By means of basic insulation according to EN 61010-1, the communication interfaces are separated from each other and from device surfaces that could be touched (secondary circuit with 30 V DC maximum, supplied from mains circuit up to 300 V overvoltage category II). They are designed for network environment 0 according to IEC TR62102.



- ▶ Only connect the device to a master port class B.



If there are differences in potential $> 36\text{ V}$ between the device and the actuator supply, the reverse polarity protection only works to a limited extent.

- ▷ The device may be permanently damaged.

ATTENTION

Lack of reverse polarity protection in the event of cross-polarity reversal between US and UA.

The supply voltages US and UA are individually protected against reverse polarity.

The supply voltages US and UA are not protected against cross-polarity.

- ▷ Damage to the device

- ▶ Ensure that the supply voltages US and UA are connected correctly.
-

8 Operating and display elements

The device has 4 status LEDs and an RGB display that are visible around the side of the device and at the top.

8.1 Status LEDs

Icon	LED name	Colour	Indication	Operating status
	PWR	Green	Statically on	On when the device is ready for operation.
	Open-State	White	Statically on	On when the valve is open (SP1 active).
	Close-State	White	Statically on	On when the valve is closed (SP2 active).
	In-Position-State	White	Statically on	On when the valve position is within the deadband and control is completed.
	Open-State Close-State In-Position-State	White	Running light (0.5 s per LED) synchronously with the RGB LED	Advanced teach
			Flash synchronously at 1 Hz	No advanced teach available.
			Double flashing	Locator

Tab. 2: Status LEDs

8.2 RGB LED

LED name	Indication	Colour
Set-up in progress	Flashes with a frequency of 1 Hz as long as the advanced teach is running.	Selectable via IO-Link: OFF, green, blue, yellow, magenta, cyan, white. Default: white
In-Position-State	On when the valve position is within the deadband and control is completed.	Selectable via IO-Link: OFF, red, green, blue, yellow, magenta, cyan, white. Default: white
Control in progress	Flashes at a frequency of 1 Hz as long as the control is active.	Selectable via IO-Link: OFF, green, blue, yellow, magenta, cyan, white. Default: OFF
Close-State	On as soon as the valve position is closed.	Selectable via IO-Link: OFF, red, green, blue, yellow, magenta, cyan, white. Default: blue
Open-State	On as soon as the valve position is open.	Selectable via IO-Link: OFF, red, green, blue, yellow, magenta, cyan, white. Default: yellow
Locator	Double flashing	Selectable via IO-Link: green, blue, yellow, magenta, cyan, white. Default: green
Error	Flashes with a frequency of 1 Hz as long as the error is present. Minimum display time 3 seconds.	Red

Tab. 3: RGB LED

9 Parameter setting

Parameters can be set before installation or during operation.



Changing parameters during operation can influence the function of the plant.

- ▶ Make sure that there will be no malfunctions or dangerous operation in your plant.

During parameter setting the device remains in the operating mode. It continues to monitor with the existing parameter until the parameter setting has been completed.



On delivery the device is not operational.

- ▶ Carry out an advanced teach after mounting and installation to ensure that the device is working properly.



An application reset [Reset application] resets all application-dependent parameters. The identification parameters of the device remain unchanged.



A [Back-to-box] reset resets the device to the factory settings. The IO-Link communication is deactivated until the device is restarted.



A new advanced teach is required after every mechanical change to the valve, the actuator or the compressed air supply → Check the function of the device.

The device parameters can be set via the IO-Link interface in the following ways, for example:

- Parameter setting via a suitable parameter setting software, e.g. ifm moneo|configure
- Parameter setting via a PLC
- Parameter setting via an IIoT application

Requirements for parameter setting via the IO-Link interface:

- ✓ The Input Output Device Description (IODD) for the device in case of parameter setting via a parameter setting software, see documentation.ifm.com
- ✓ The IO-Link interface description (PDF) for the device in case of parameter setting via a PLC or IIoT application, see documentation.ifm.com
- ✓ An IO-Link master
 - ▶ Connect the IO-Link master to the parameter setting software, the PLC or the IIoT application.
 - ▶ Connect the device to a suitable free port of the IO-Link master.
 - ▶ Set the port of the IO-Link master to the IO-Link operating mode.
 - ▷ The device changes to the IO-Link mode.
 - ▶ Change the parameter settings in the software.
 - ▶ Write the parameter settings to the device.



Support for system integration and parameter setting via IO-Link:

- Manual of the parameter setting software (e.g. moneo)
- Explanations and startup packages at ifm.com/cnt/io-link-system-integration.



- ▶ Only connect the device to a master port class B.

9.1 Adjustable parameters and system commands



A faulty configuration can result in incorrect process values and error messages.

All adjustable parameters and system commands are listed and described in the IODD description. The IODD is available as PDF and XML file for the parameter setting software at documentation.ifm.com.

The most important parameters for operating the device must be determined with an advanced teach (→ [Advanced teach](#)  13).

10 Operation

After power-on and the required parameter setting the device is in the operating mode. It carries out its measurement and evaluation functions and generates output signals according to the set parameters.

- Check whether the device operates correctly.

11 Troubleshooting

Events and BLOBs can help to narrow down an error and find the exact cause of the fault.

11.1 Errors during advanced teach

If the advanced teach is not or only partially carried out, the error codes from the [Setup result] parameter can be used to find a solution:

Error code	Cause	Recommended action
Setup issue 01	No valid signal.	► Check puck or possible signal interference (EMC).
Setup issue 02	Starting positions fluctuating.	► Check that the device and puck are correctly installed and that the compressed air supply is correct.
Setup issue 03	Movement not possible.	► Check for possible blockages, compressed air supply and power supply (IO-Link B port).
Setup issue 04	Movement too slow.	► Check the speed of the actuator and the compressed air supply.
Setup issue 05	No control to hold the position recognised.	► Check the compressed air supply (possible leakage), wiring and the type of solenoid valve.
Setup issue 06	Deviating closed positions	► Check air pressure and increase if necessary.
Setup issue 07	Deviating open positions	► Check air pressure and increase if necessary.
Setup issue 08	Operating range too small / too large.	► Check the technical data for the minimum and maximum operating range limits.
Setup issue 09	Strongly varying valve behaviour / optimisation not possible.	► Reduce the speed of the actuator or increase the deadband.
Setup issue 10	Parameter locked.	► Complete the block parameter setting before set-up.
Setup issue 11	Optimisation of the control not possible / positions could not be set in the specified time.	► Reduce the speed of the actuator or increase the deadband.

Tab. 4: Error codes from [Setup result]

11.2 Other sources of fault

Improper use of the device, accessories and power supply can lead to further faults:

Error	Cause	Recommended action
The green LED is off.	Missing voltage supply.	► Check voltage supply and wiring.
The 3 white LEDs flash synchronously at 1 Hz.	The device has no advanced teach and therefore no operating range in which a target value can be specified.	► Perform an advanced teach.
The valve does not move when an advanced teach is started.	No compressed air connected or air pressure too low.	► Increase air pressure. ► Check the installation of the throttle plate. ► Do not close the throttles completely. ► Reset the manual operation of the solenoid valve. ► Check the wiring of the solenoid valves. ► Remove the bolt from the partial stroke test.
	No B-port voltage available.	► Connect the B port voltage correctly to the device. Control via LED on the coil of the solenoid valve. Remark: with some IO-Link masters, the B port voltage must be switched on separately. ► Ensure that a 5-pole connection cable is used.

Error	Cause	Recommended action
The valve does not move after successful set-up.	The device is in the safe state. Possible causes: - IO-Link communication interrupted. - Target value not valid. - Position cannot be maintained (leakage). Positioning not possible (blockage, timeout, overshoot).	► Determine and eliminate the cause of the safe state. Write the new or changed target value to the device or execute the system command [Restart control].
The device reports an error after advanced teach.	The valve does not move.	See the error → The valve does not move when an advanced teach is started.
	The valve moves too quickly.	Set the throttles.
	The determined operating range is < 50° or > 300°.	The application is not suitable.
	The system command [Setup Start] does not start set-up. No [Inbetriebnahmemodus] was selected.	Select the required [Setup mode].

Tab. 5: Other sources of fault

11.3 Diagnostic messages

Diagnostic messages are output via events or can be read via the active events using index 545-0. Only currently pending events are output via the bits.

Diagnostic message	Bit offset / event code	Recommended action
Failure - positioning timeout - compressed air	18 / 0x8CB5	► Check compressed air, wiring and mobility of the valve. [Positioning timeout], [Overshoot threshold]
Maintenance required - position unstable	16 / 0x8CB4	► Check compressed air supply. [Out of deadband counter threshold]
Outside specification - permissible temperature exceeded	15 / 0x4210	► Eliminate heat sources.
Outside specification - permissible temperature not reached	14 / 0x4220	► Insulate device.
Maintenance required - service limit reached	13 / 0x8C42	► Perform maintenance. [Solenoid valve switching counter threshold]
Maintenance required - deposit detected	11 / 0x8C40	► Check valve and clean if necessary. [Operating range tolerance]
Function check - signal error	10 / 0x8CBA	► Check puck / magnet.
Outside specification - operating range not reached	9 / 0x8C30	► Check for wear. [Operating range tolerance]
Outside specification - operating range exceeded	8 / 0x8C10	► Check for wear. [Operating range tolerance]
Function check - no valid set-up	0 / 0x6321	► Perform set-up. [Set-up mode]
Event occurs when index 2 is set to value 242	31 / 0x8DFF	► Set index 2 to value 243.
Event occurs when index 2 is set to value 240	30 / 0x8DFE	► Set index 2 to value 241.

Tab. 6: Diagnostic messages

11.4 BLOBS

11.4.1 Setup data BLOB

The values determined during the advanced teach are provided in the setup data BLOB. The following information is included:

Values	Description
Rotation	Rotational direction
StartSVCtrl	Valve control in Close-State direction
StopSVCtrl	Valve control in Open-State direction
HaltSVCtrl	Valve control to hold the In-Position state
StartAngle [°]	Angular position - Close-State
StopAngle [°]	Angular position - Open-State
CCW time [ms]	Movement duration - anti-clockwise
CW time [ms]	Movement duration - clockwise
Deadband [%]	Deadband
ImpulseCCW [ms]	Stop pulse - anti-clockwise
ImpulseCW [ms]	Stop pulse - clockwise

Tab. 7: Setup data BLOB



Even if advanced teach is unsuccessful, data is recorded and output with this BLOB. Based on this information, it may be possible to deduce why the advanced teach was not successful.

11.4.2 Statistics data BLOB

The following parameters can be read out collectively with the Statistics data BLOB.

Values	Description
Operation hours [h]	Operating hours
Power cycles	Switch-on operations
Maximum temperature [°C]	Maximum temperature
Minimum temperature [°C]	Minimum temperature
Hit rate [%]	Success rate of the first control attempt
Open-State counter	Open-State counter
Close-State counter	Close-State counter
In-Position-State counter	In-Position-State counter
Safe-State counter	Safe-State counter
Travel distance [°]	Travel distance
SV1 activations counter	SV1 activations counter
SV2 activations counter	SV2 activations counter

Tab. 8: Statistics data BLOB

11.4.3 Logging course BLOB

The device saves movement sequences and can output them in process data.

The available BLOBS "Last course in opening direction", "Last course in closing direction" and "Last incomplete or correction course" have the same structure → see the table Logging course BLOB and are output as one row in the CSV BLOB.

Value	Description
Timestamp [ms]	Timestamp
Angle [°]	Angular position
Position [%]	Current position
SVs active	Active solenoid valves
Target position [%]	Target position

Tab. 9: Logging course BLOB

12 Maintenance, repair and disposal

The unit is maintenance-free.

- ▶ It is not possible to repair the unit.
- ▶ In case of return shipment, ensure that the unit is free from soiling, especially from dangerous and toxic substances.
- ▶ For transport only use appropriate packaging to avoid damage of the unit.
- ▶ After use, dispose of the unit in an environmentally friendly way in accordance with the applicable national regulations.