SPXFLOW®

INSTRUCTION MANUAL

8681 Control Unit - D4

Control Unit for D4 series valves

FORM NO.: H342989 REVISION: GB-5

READ AND UNDERSTAND THIS MANUAL PRIOR TO OPERATING OR SERVICING THIS PRODUCT.

8681 Control Unit - D4

Contents

1. OPERATING INSTRUCTIONS

The operating instructions describe the entire life cycle of the device. Keep these instructions in a location which is easily accessible to every user, and make these instructions available to every new owner of the device.

WARNING!

The operating instructions contain important safety information!

- Carefully read these instructions.
- Observe in particular the safety instructions, intended use and operating conditions.
- Persons, who work on the device, must read and understand these instructions.

1.1. Symbols

DANGER!

Warns of an immediate danger!

- Failure to observe the warning will result in a fatal or serious injury.

WARNING!

Warns of a potentially dangerous situation!

- Failure to observe the warning may result in serious injuries or death.

CAUTION!

Warns of a possible danger!

- Failure to observe this warning may result in a moderate or minor injury.

NOTE!

Warns of damage to property!

- Failure to observe the warning may result in damage to the device or the equipment.

Important additional information, tips and recommendations

- Designates an instruction for risk prevention.

→ Designates a procedure which you must carry out.

1.2. Definition of the term: “device”

The term “device” used in this manual generally denotes the “8681 Control Unit - D4” for process valves D4 series.

2. SAFETY INSTRUCTIONS

2.1. Authorized Use

Incorrect use of the device may be dangerous to people, nearby equipment and the environment.

The 8681 Control Unit - D4 is designed for use as a control unit for pneumatically actuated process valves and / or for recording their switching states.

- Use the device for its intended purpose only! Non-intended use of the device may be dangerous to people, nearby equipment and the environment.
- Use the device according to the authorized data, operating conditions and conditions of use specified in the contract documents and operating instructions. These are described in chapter “4. Technical Data”.
- In view of the large number of application options, check and, if necessary, test prior to installation whether the device is suitable for the specific application case:
  Should you have any questions, please contact the SPX Flow Service Center.

Use the device only in conjunction with third-party devices and components recommended and authorized by the manufacturer.

- Any unauthorized reconstructions and changes to the device are prohibited for safety reasons.
- Correct transportation, correct storage and installation as well as careful operation and maintenance are essential for reliable and problem-free operation.
- For connecting the device, use line installations that do not cause any mechanical stresses.

2.2. Basic Safety Instructions

These safety instructions do not consider any contingencies or incidents which occur during installation, operation and maintenance.
The operator is responsible for observing the location-specific safety regulations, also with reference to the personnel.

DANGER!

Risk of electric shock!

- Before reaching into the system, switch off the power supply and secure it to prevent restarting!
- Observe applicable accident prevention and safety regulations for electrical equipment!

WARNING!

Danger – high pressure in the plant / at the device!

- Before loosening lines and valves, turn off the pressure and vent the lines.

WARNING!

General hazardous situations.

To prevent injuries:

- Operate the device only in perfect state and in consideration of the operating instructions.
- Observe the general rules of technology.
- Install the device according to the regulations applicable in the respective country.
- Only trained technicians may perform installation and maintenance work.
- Perform installation and maintenance with suitable tools only.
- Do not make any unauthorized internal or external changes to the device!
- Ensure that the system cannot be activated unintentionally.
- After the process is interrupted, restart in a controlled manner. Observe sequence: first connect electrical or pneumatic power supply, than charge the device with medium.

NOTE!

Electrostatic sensitive components/modules!

The device contains electronic components which react sensitively to electrostatic discharge (ESD). Contact with electrostatically charged persons or objects may be hazardous to these components. In the worst case scenario, they will be destroyed immediately or will fail after start-up.

- Observe the requirements in accordance with EN 61340-5-1 to minimize or avoid the possibility of damage caused by sudden electrostatic discharge!
- Also ensure that you do not touch electronic components when the supply voltage is on!

NOTE!

Risk of damage to property!

- Do not connect any mechanically rigid connection parts, in particular those with long lever arms, as such connections could generate torques that might damage the device.
- Do not supply the medium connections of the system with liquids or aggressive or flammable media!
- Do not subject the housing to mechanical loads (e.g. by placing objects on it or standing on it).
- Do not make any external changes to the housings of the device. Do not paint housing parts or screws.
- Only use compatible cleaning agents for cleaning the securely closed device and always rinse thoroughly with clean water.

2.3. Warranty

This document does not contain any warranty acceptance. We refer to our general terms of sale and delivery. Prerequisite for a guarantee is the correct use of the unit in compliance with the specified conditions of application.

Note! This warranty only applies to the device (8681 Control Unit - D4). No liability will be accepted for consequential damage of any kind arising from failure or malfunction of the device.

3. SYSTEM DESCRIPTION

3.1. Intended application area

The device has been designed for use as an actuator for pneumatically operated process valves D4 series and / or for recording the switching states of these.

3.2. General description

The device is used for actuating pneumatically operated process valves D4 series .

For process valve actuation, the 8681 Control Unit - D4 is equipped with up to three pilot valves.

For the recording and feedback of the process valve switching positions to a higher-level control, the device has been equipped with two contact-free position sensors which operate with up to 4 discrete, adjustable feedback signals.

The 8681 Control Unit - D4 is delivered with a connected external position sensor. The 8681 Control Unit - D4 and the process valve D4 series are interconnected via the housing containing the external position sensor.

This produces an integrated, compact and decentralized system of feedback, actuation and valve function. The following advantages over centralized solutions working with valve clusters are achieved:

- low installation expenditure
- easy start-up
- higher application-specific flexibility
- shorter switching times and less air consumption due to shorter distances between the pilot valves and the process valve. 1 or 3 solenoid valves (Type 6524) in the device serve as pilot valves.

Various pneumatic and electrical connection variants are available - described in the following chapters.

3.3. Functions / options / designs

3.3.1. Structure of the 8681 Control Unit - D4

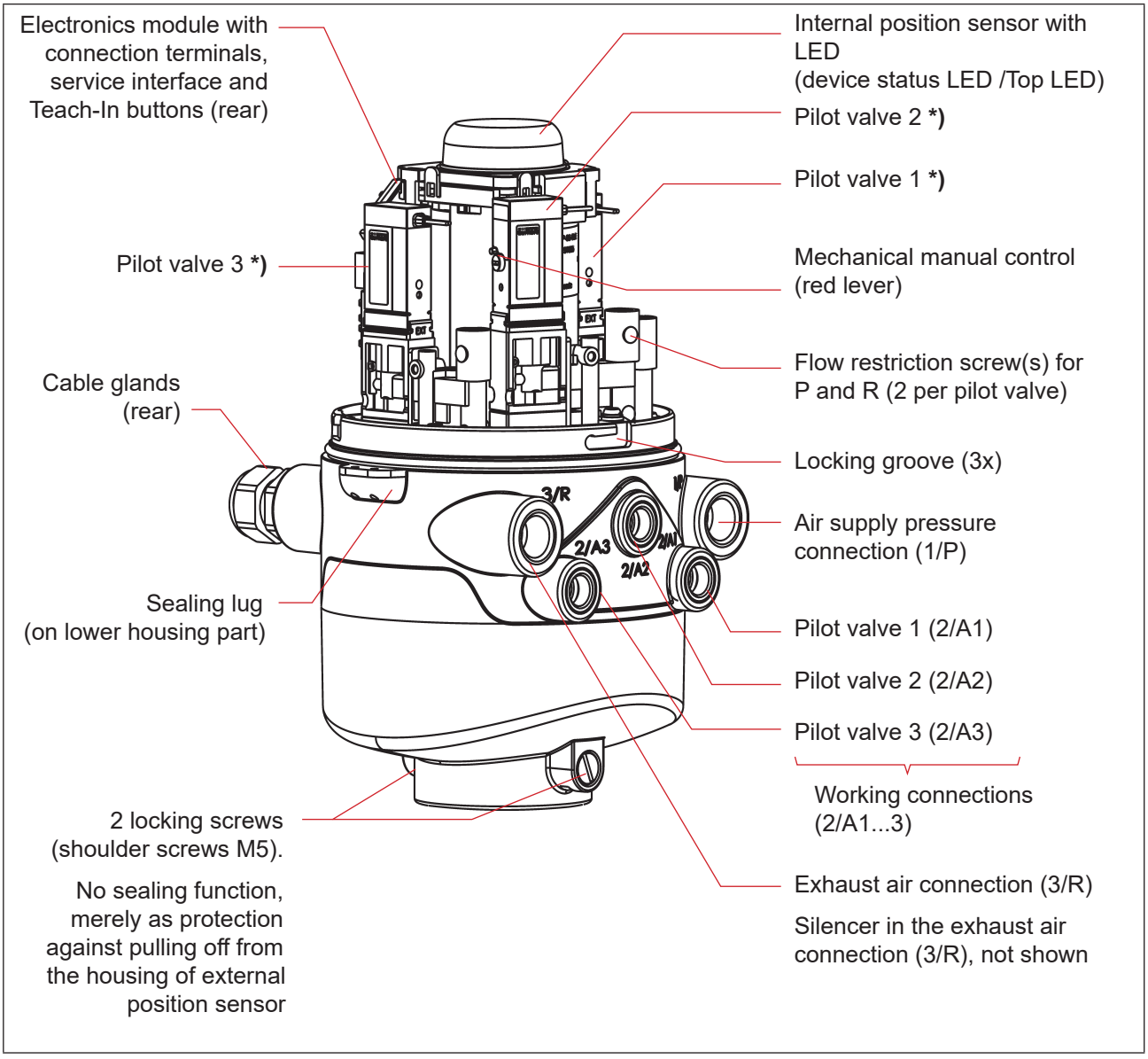


Fig. 1: General Structure of the 8681Control Unit - D4 (shown without external position sensor)

*) If a pilot valve is not present, the connection is sealed tightly with a cover plate.

3.3.2. External position sensor (housing)

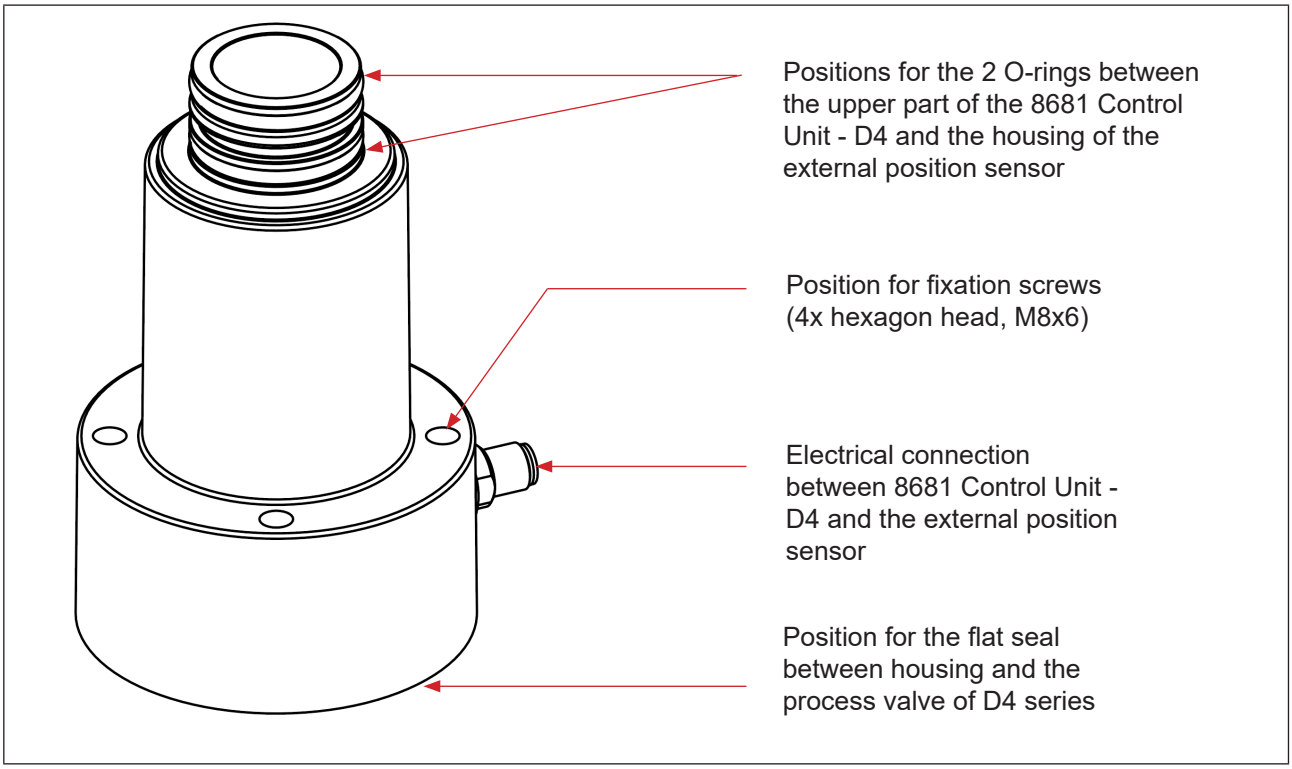


Fig. 2: External position sensor inside housing

3.3.3. Fluid diagram

Fluid diagram for the device (with restriction capability for each pilot valve Type 6524):

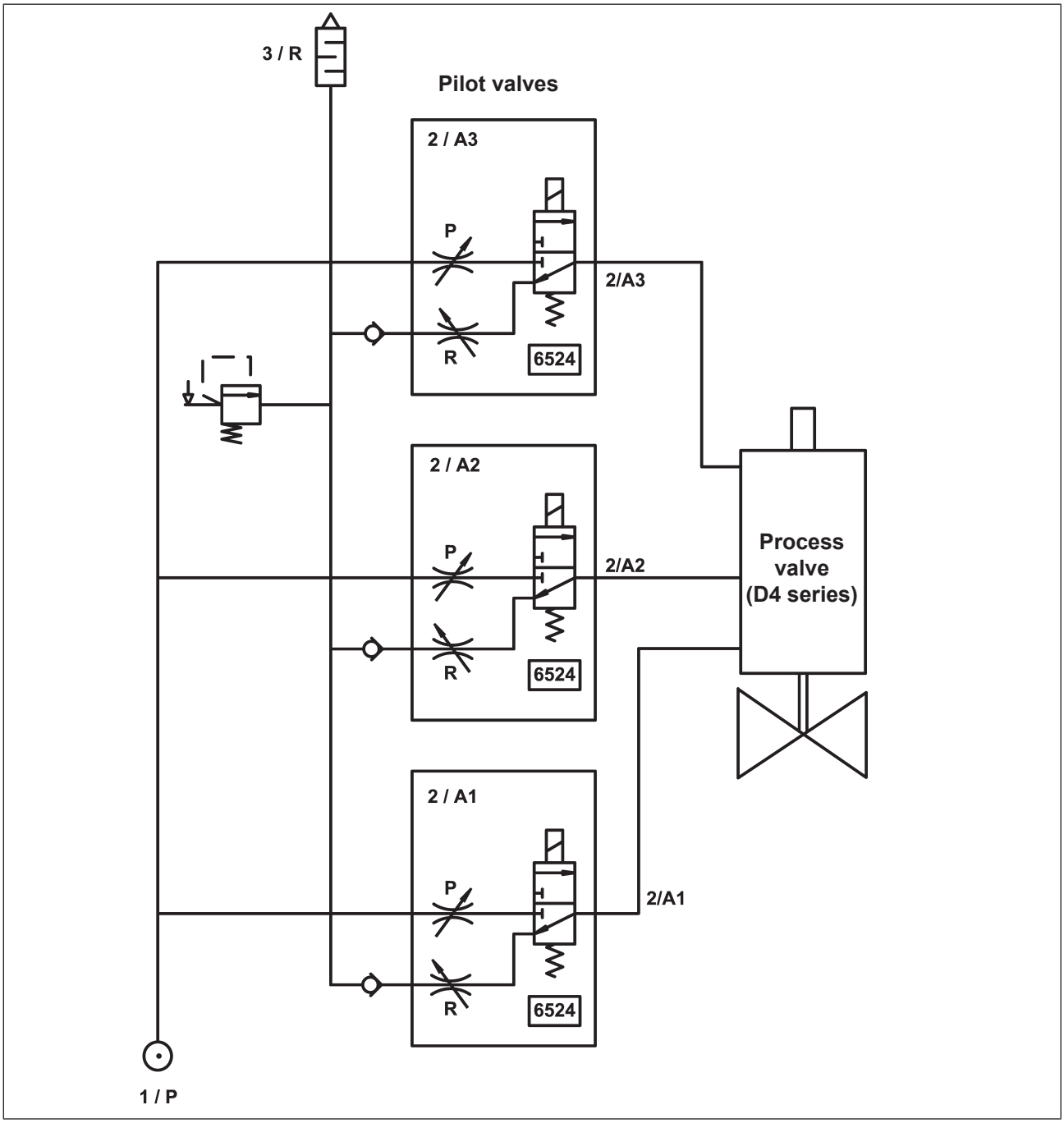


Fig. 3: Fluid diagram (variant with 3 pilot valves in the 8681 Control Unit - D4)

3.3.4. Pneumatic interfaces

- Intake & exhaust air connections (1/P, 3/R): G 1/4
  Working connections (2/A1 ... 3): G 1/8
- Integrated non-return valves in the pilot valves' exhaust air duct
- Actuation of connection 2/A1 (pilot valve V1; normally the main stroke of the process valve) using the magnetic manual control (manual override) that is externally accessible.
- A special silencer with a high flow-rate capacity to connection 3/R is already mounted.
- The interior of the housing is protected against excessive overpressure, for example due to leakages, by a pressure-relief valve with output into the joint exhaust air connection 3/R.

3.3.5. Magnetic and mechanical manual control

The 8681 Control Unit - D4 provides the following as standard:

- *Magnetic manual control (manual override):*
  easily accessible from the outside, on the basis of encoded magnetic fields for pilot valve V1 (connection 2/A1) as well as
- *Mechanical manual control:*
  on each equipped pilot valve, accessible only when the housing is open (“Fig. 6”)

The magnetic manual control has the following advantages:

- the device does not need to be opened
- simple actuation tool for opening/closing pilot valve V1 (main stroke) -
  helpful for service/maintenance work on the process valve
- LED display for the "activated (magnetic) manual control" status = service mode
  (see chapters “14. LED Colour Assignments / Display via Top LED” and “15. Service Mode / Manual Control”)

For a detailed description of the manual control, see chapter “15. Service Mode / Manual Control”.

3.3.6. Position sensors

The switching positions of the process valve are reported to the higher-level control by feedback signals from two contact-free / inductive position sensors.

The connection to the device is done by means of a simple adaptation to the process valve's shaft. Details are described in chapters “4.6. Data of position sensors” on page 22 and “12. Position Measuring System / Inductive Position Sensors” on page 83.

3.3.7. Other features

- **Central optical position/status indicator (device status LED /Top LED) for showing the process valve switching positions:** positions and status information are generally indicated by 3 signal colours of the device status LED (Top LED). For IO-Link devices, further signal colours are possible.
- **Simple adaptation of the 8681 Control Unit - D4** to the shaft of the process valve D4 series
- **Simple determination of the valve and seat state** via Autotune function of the position sensors (using three Teach buttons on the electronic module)
- The **capability of restricting the pilot valves** for the individual setting of the expansion and retraction rates of the process valve and the individual setting of the flow-rate of the working connections (see “Fig. 6: Flow restriction screws and mechanical manual control of the pilot valves” on page 21)
- **Energy efficient pilot valve actuation** by lowering the holding current during long-term operation

4. TECHNICAL DATA

4.1. Operating conditions

CAUTION!

Risk of injury from overheating of the device.

Heating above the permitted temperature range can endanger people, the device and the environment.

- Do not expose the device to any mechanical or thermal loads that will exceed the limits described in the operating instructions.

Ambient temperature: -10 ... +55 °C

Degree of protection: **Standard version:**

IP65 / IP67 according to EN 60529
(only if cables, plugs and sockets have been connected correctly, the hood has been sealed correctly and the adaptation to the process valve was done correctly)

IP69K according to IEC 40050-9
(Housing seal with connected exhaust air line instead of silencer and ideally closed cable glands confirmed through IP69K Standard testing)

4.2. Conformity with the following standards

The 8681 Control Unit - D4 conforms to the EU Directives according to the EU Declaration of Conformity.

The applied standards, which are used to demonstrate compliance with the EU Directives, are listed in the EU Declaration of Conformity and/or the EU type test certificate. These are available from the manufacturer.

The specifications on the respective type label indicate the technical data and approvals applicable to the respective device. The symbols on the type label mean:

Symbols on the type label or on the device:	
CE	Device complies with European standards according to EC Declaration of Conformity
c UL us LISTED	UL approval for USA and Canada UL 61010-1 AND CSA C22.2 NO. 61010-1 Restrictions: Application area: 0 to +55°C, Indoor use, power supply with class-2 power supply unit
	WEEE marking (separate tag) ▸ Follow national regulations regarding disposal and the environment. ▸ Collect electrical and electronic devices separately and dispose of them as special waste.

4.3. Type label (example)

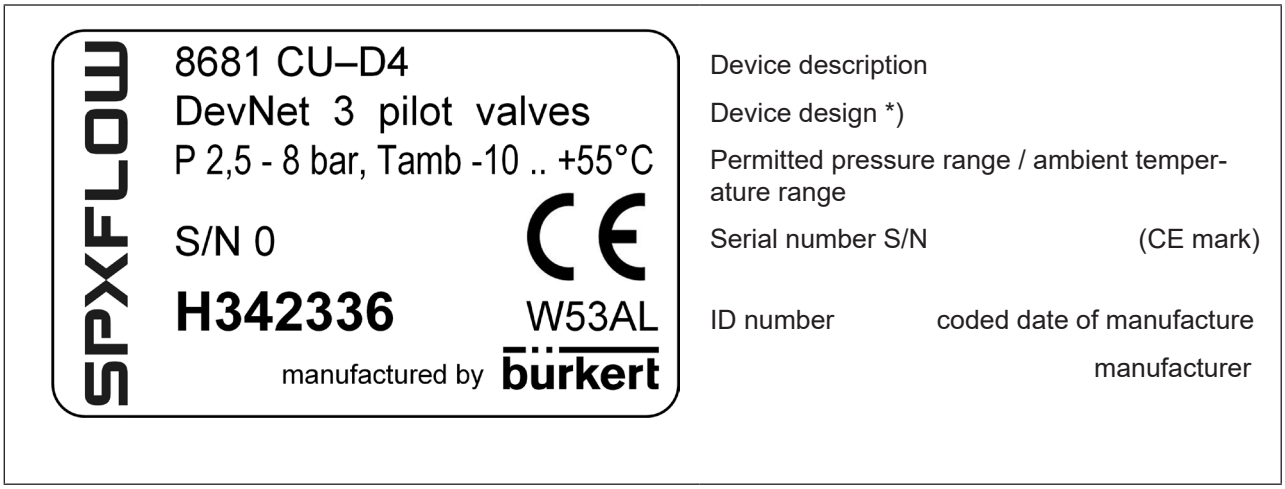


Fig. 4: Type label (example) for the 8681 Control Unit - D4

***)** Device design:
Type of communication (24 V DC, AS-i, DevNet, IO-Link);
(possibly operating voltage) and number of pilot valves

4.4. Dimensions / mechanical data

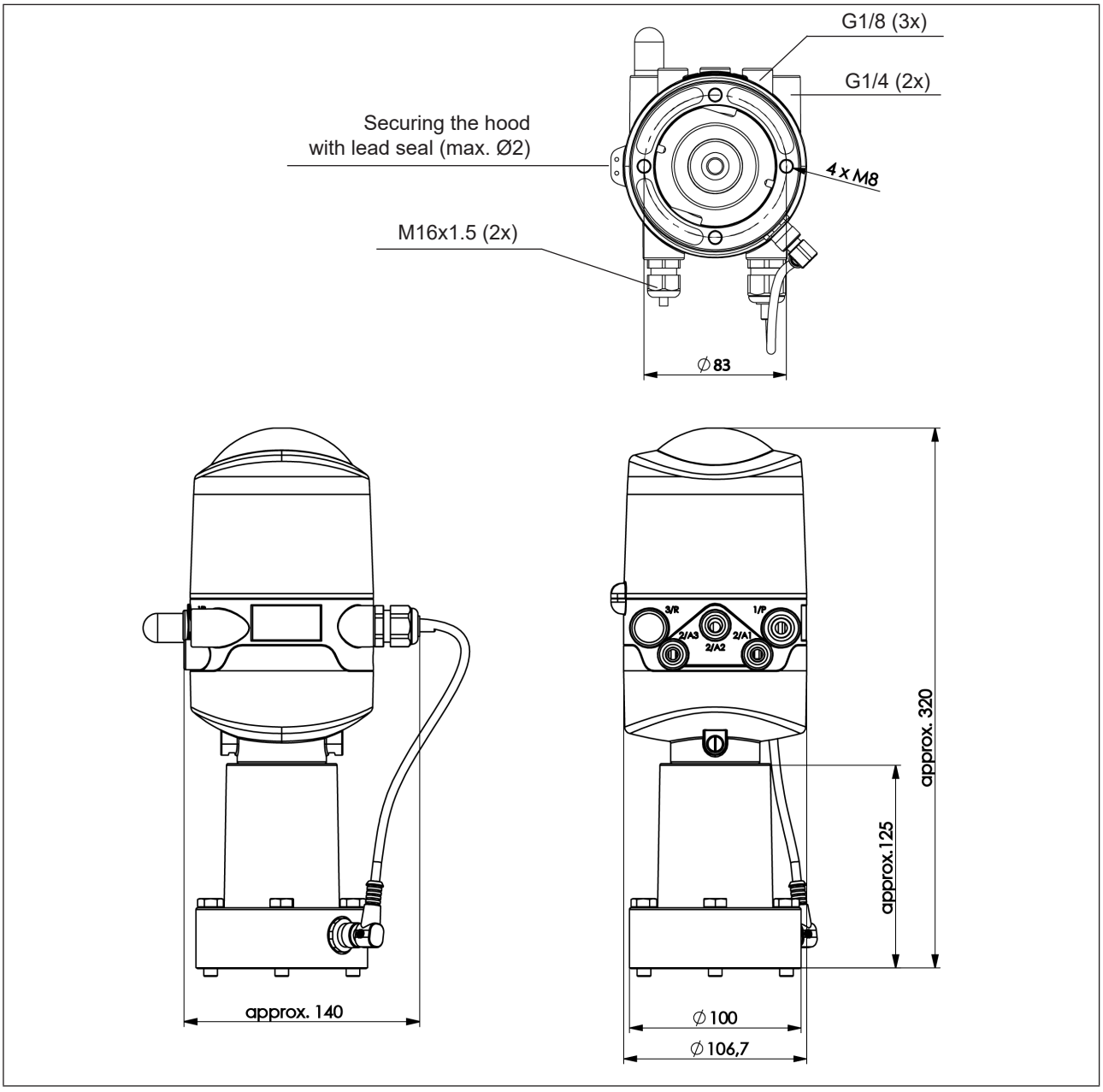


Fig. 5: Dimensional drawing (for models with 1 or 3 pilot valves)

Weight:	approx. 1 kg	
Housing material:	exterior:	PA, PC, PPO, VA
	inside:	ABS, PA, PMMA
Sealing material:	exterior:	CR, EPDM
	inside:	EPDM, FKM, NBR

4.5. Pneumatic data

Control medium:		Air, neutral gases Quality classes in accordance with ISO 8573-1 (5 µm filter recommended)
Dust content	Quality class 7:	max. particle size 40 µm, max. particle density 10 mg/m³
Water content	Quality class 3:	max. pressure dew point -20 °C or min. 10 °C below the lowest operating temperature
Oil content	Quality class X:	max. 25 mg/m³
Temperature range of compressed air:		-10 ... +50 °C = 14 ... 122 °F
Pressure range:		2.5 ... 8 bar = 36 ... 116 psi
Air rate pilot valve:		Q_{Nn} = approx. 110 l_N/min (for ventilation and deaeration, aeration) (110 l_N/min - supplied state 200 l_N/min - maximum typical flow rate) (Q_{Nn} value according to definition when pressure drops from 7 to 6 bar absolute at +20 °C)
Connections:		Intake and exhaust air connection (1/P, 3/R): G1/4 Working connections (2/A1...3): G1/8

Intake and exhaust air setting at pilot valves with flow restriction screws:

The intake and exhaust air can be set separately for each pilot valve using flow restriction screws, in order to be able to affect the expansion and retraction rates of the process valve (see figure below).

For details see chapter “7.3. Flow restriction function of the pilot valves” on page 36

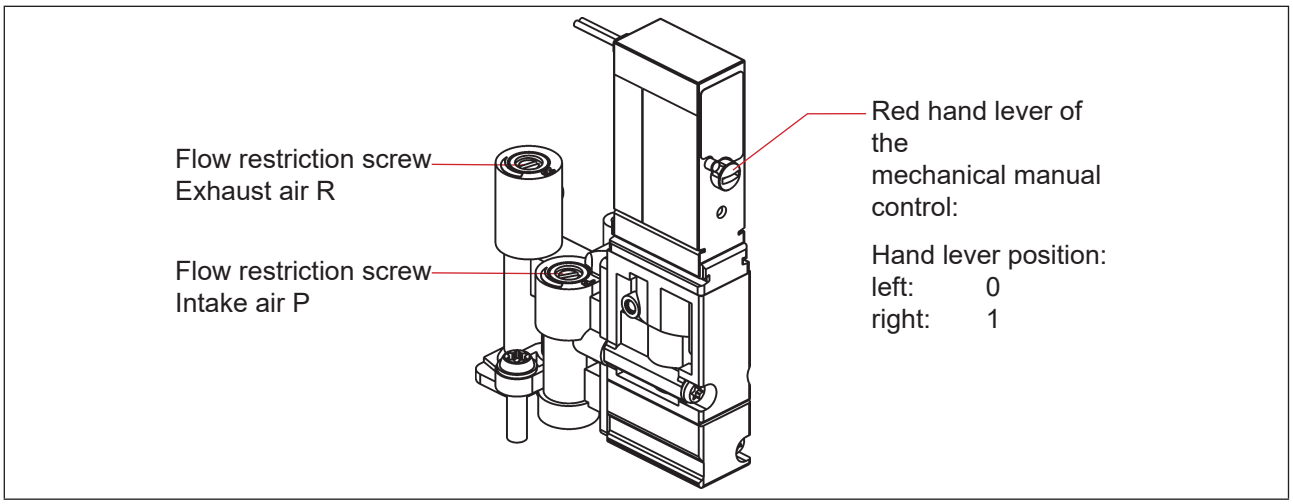


Fig. 6: Flow restriction screws and mechanical manual control of the pilot valves

4.6. Data of position sensors

The device contains two combined (but independent) analog linear inductive position sensors with 4 switching points (resulting in valve states: process valve closed, process valve open, upper seat lift, lower seat lift).

4.6.1. Internal inductive position sensor

The internal inductive position sensor of the device is used for the target positions **S3 and S4.**

Stroke range (measuring range):	0 ... 80 mm
Resolution:	≤ 0.1 mm
Total error:	± 0.5 mm - when using the delivered target and shaft extension (fault refers to the reproducibility of a taught position)
Target material:	ferromagnetic material (stainless steel 1.4021)
Shaft (extension) material **(*)**:	non-ferromagnetic material (see note **(*)** below

The “Fig. 7” shows the relationship between the device, shaft with internal and external target.

4.6.2. External inductive position sensor

The external inductive position sensor of the device is used for the target positions **S1 and S2.**

Stroke range:	0 ... 40 mm (max. usable measuring range)
Resolution:	≤ 0.1 mm
Total error:	± 0.5 mm - when using the delivered target (fault refers to the reproducibility of a taught position)
Target material:	ferromagnetic material (stainless steel 1.4021)
Shaft material **(*)**:	non-ferromagnetic material (see note **(*)** below

The “Fig. 7” shows the relationship between the device, shaft with internal and external target.

(*) *The fastening materials* for the targets and the shaft (extension) as well *as the shaft (extension) themselves* may not be made of material with very good electrical conductivity (e.g. copper, aluminum) or of ferromagnetic material.
Stainless steel without ferromagnetic properties is suitable (if necessary, check after machining).

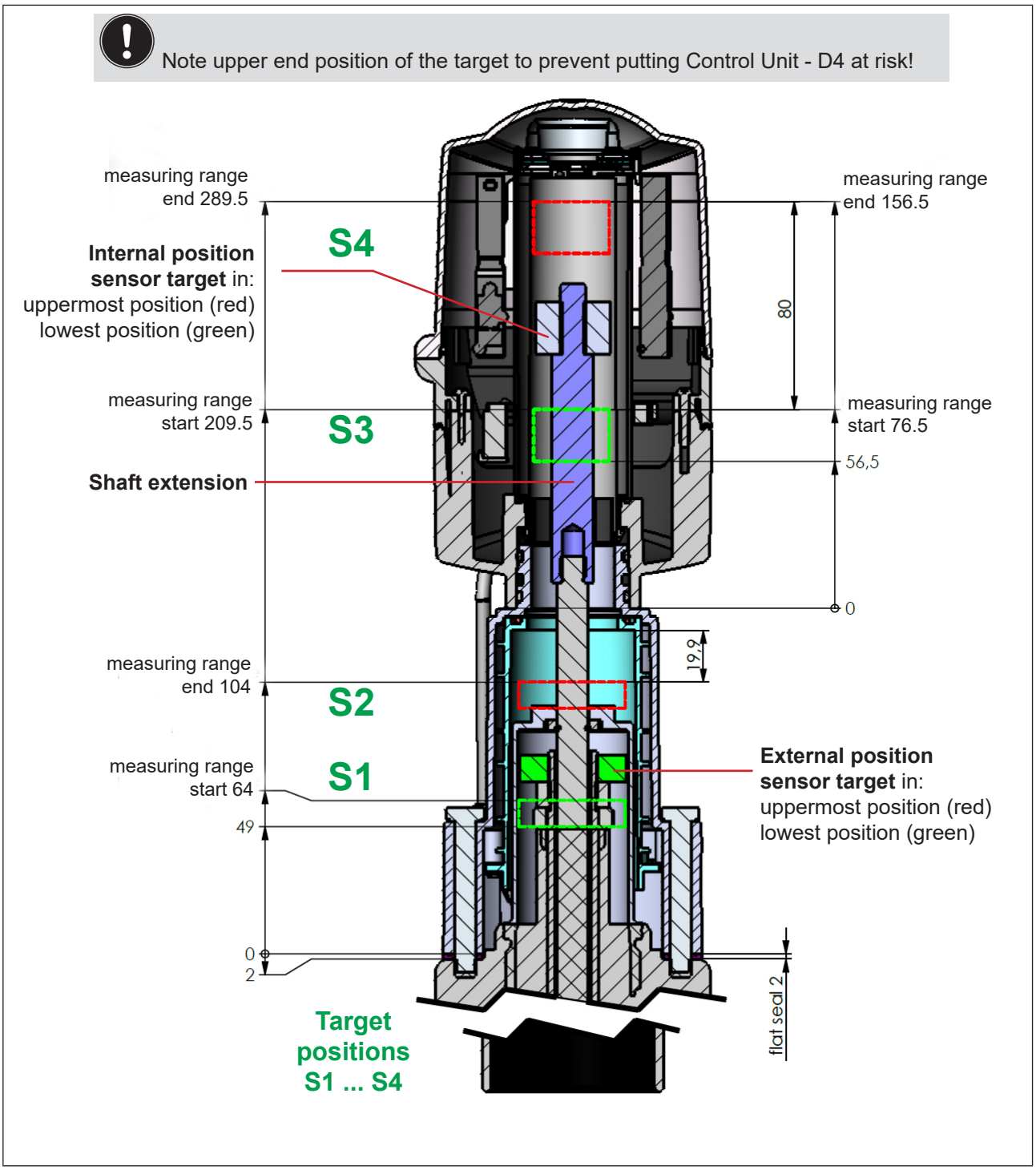


Fig. 7: Sectional view of device and shaft with both targets of internal and external position sensor

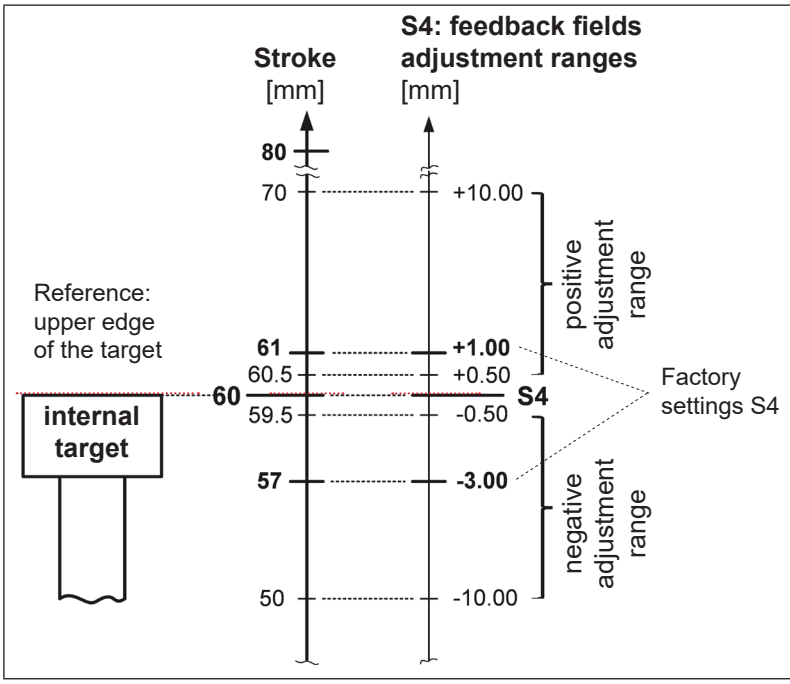
4.7. Factory settings in the firmware

The device is supplied with the firmware factory settings as listed below.

4.7.1. Feedback fields (tolerance band) of the position sensors

A feedback field or tolerance band is the area within which a valve position is reported back.

Signal of the target position		**Feedback field** (positive values)		**Feedback field** (negative values)	
		Factory setting [mm]	**Adjustment range [mm]**	**Factory setting [mm]**	**Adjustment range [mm]**
external sensor	S1	+ 1.00	+ 10.00 ... + 0.50	- 1.00	- 0.50 ... - 10.00
	S2	+ 1.00	+ 10.00 ... + 0.50	- 1.00	- 0.50 ... - 10.00
internal sensor	S3	+ 1.00	+ 10.00 ... + 0.50	- 1.00	- 0.50 ... - 10.00
	S4	+ 1.00	+ 10.00 ... + 0.50	- 3.00	- 0.50 ... - 10.00



Ensure that the target positions including their feedback fields are within the measuring range:

internal sensor: 0 to 80 mm
and
external sensor: 0 to 40 mm)

(see also “Fig. 7”).

For **changing the factory settings:** see also chapter “4.7.2”.

Fig. 8: Schematic diagram (not to scale) of the feedback fields, for example for target position S4

Important information! For process valve type **D4PMO**, the correct tolerance of the feedback fields must be checked or set.

4.7.2. Changes to the factory settings for the feedback fields

For the *designs AS-i, DeviceNet, 24 V DC*, changes to the factory settings for the ffeedback fields are possible with the PC service programme for the device.

For the *IO-Link design,* the factory settings are possible via the bus-specific communication interface - the parameters (object 0x2C03) can be found in the IODD description in the Appendix 2 (page 117).
Note the **“Important information”** regarding process valve type D4PMO (see the box above)!

4.7.3. Service / maintenance notification (maintenance request)

Factory setting for the "Service/maintenance notification" function: **not active.**

When Service/maintenance notification is activated, this is indicated by a special blinking pattern - see chapter “14.3. Blinking pattern & fault signaling” on page 95.

The Service/maintenance notification is used to observe predefined maintenance intervals which should occur either after an adjustable number of switching cycles or when a certain time has elapsed.
The PC service program is used to adjust the service/maintenance interval (number of days or switching cycles) as well as activation/deactivation of the "Service/maintenance notification" function – or *for IO-Link devices* this is possible via the bus-specific communication interface (object 0x2C04 subF – see the IODD description in the Appendix 2, starting at page 117).

Connection to the PC is via the Service interface - see “Fig. 9: Location of the service/communication interfaces on different electronic modules”. Details on the "Service" menu option are described in the "PC service program" software manual.

Feedback, indicating that a service / maintenance is required (Service/maintenance notification), occurs when a Service/maintenance notification is activated after the following counter readings:

Counter readings (service interval)	Factory setting	Adjustment range
Switching cycle counter V1	10 000	(1 ... 255) x 1000
Switching cycle counter V2	50 000	(1 ... 255) x 1000
Switching cycle counter V3	50 000	(1 ... 255) x 1000
Operating duration	365 days	1 ... 65 535 days

The resettable operating hour and switching cycle counters are reset to "0" when a Device Reset occurs.

4.7.4. Magnetic manual control function

Factory setting for magnetic manual operation: **active.**

Deactivation is possible using the PC service program, the connection to the PC is via the Service interface - see “Fig. 9”. Details are described in the "PC service program" software manual under the "SYSTEM/Start-up" menu option. *For IO-Link devices*, this is done via the bus-specific communication interface (object 0x2C04 sub1 – see the IODD description in the Appendix 2, starting at page 117).

Compare also chapter “15.1. Magnetic manual control”.

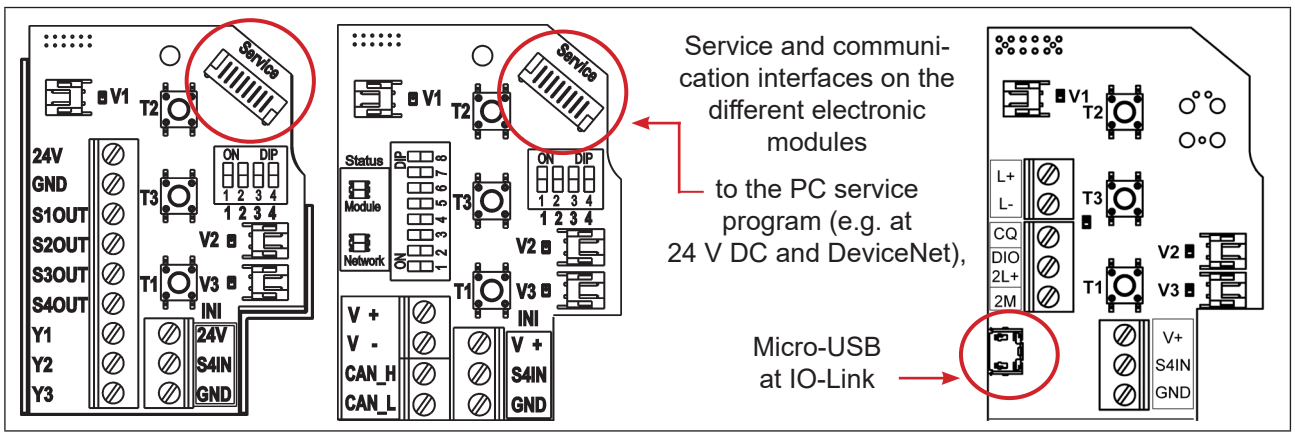


Fig. 9: Location of the service/communication interfaces on different electronic modules

4.8. Resetting the device (Device Reset)

A restricted reset of the device to factory settings can be performed:

- using the PC service program (see the software manual) or the bus-specific communication interface
- directly at the device as decribed below:

Device Reset Procedure (directly at the device):

→ Actuate simultaneously **T1 + T2 + T3** (approx. 2.5 s long) to access the "Device Reset" **mode** – for the corresponding feedback colour and blinking pattern see chapter “14. LED Colour Assignments / Display via Top LED”.
If the device is not reset 10 s after switching to the "Device Reset" mode, this mode is automatically left.

→ Actuate simultaneously **T1 + T2 + T3 again** (approx. 2.5 s long) – this will reset the device **function** for real. For the corresponding feedback colour and blinking pattern see chapter “14. LED Colour Assignments / Display via Top LED”.

Device Reset resets the following values to the factory settings:

• Target positions S1...S4	all target positions "not taught"
• Feedback fields from S1...S4	(see chapter “4.7.1” on page 24)
• Resettable switching cycle counters V1...V3	(see chapter “4.7.3” on page 25)
• Resettable operating duration	(see chapter “4.7.3” on page 25)
• Service intervals switching cycles V1...V3	(see chapter “4.7.3” on page 25)
• Service interval operating duration	(see chapter “4.7.3” on page 25)
• Service/maintenance notification (signaling of elapsed maintenance intervals)	inactive (see chapter “4.7.3” on page 25)
• Manual control function	active (see chapter “4.7.4” on page 25)
• Service display option (IO-Link only)	service indication display option: *On* (see IODD description in Appendix 2 on page 117)

Device Reset does not reset the following values (i.a.):

• all hardware configured values (i.e. set via DIP switches)	
• Switching cycle counter Total V1...V3	
• Operating duration Total	
• AS-i address	(see chapter “9.9” on page 51)
• AS-i profile	
• DeviceNet Input Assembly	(see chapter “10.11.1” on page 62)
• DeviceNet settings for (process) valve safety mode and position	(see chapter “10.13” on page 68)

5. ASSEMBLY

5.1. Safety instructions

DANGER!

Risk of injury due to electric shock!

- Before reaching into the system, switch off the power supply and secure it to prevent restarting!
- Observe applicable accident prevention and safety regulations for electrical equipment!

WARNING!

Risk of injury due to high pressure in the system!

- Before loosening lines and valves, turn off the pressure and vent the lines.

Risk of injury due to unintentional activation of the system and uncontrolled restart!

- Secure system against unintentional activation; following assembly, ensure a controlled restart.

CAUTION!

Risk of injury due to improper assembly!

- Assembly may only be carried out by trained technicians and with the appropriate tools!

5.2. Assembly 8681 Control Unit - D4 on process valve

The device is delivered with a connected external position sensor with its housing.

The device can be installed in any installation position, preferably with the hood face up.

The device should be installed such that layers of dust thicker than 5 mm cannot form; meaning that such should be ensured through correspondingly regular cleaning.

NOTE!

Risk of injury due to improper assembly!

- Do not improperly stress the device.
- Do not apply any leverage effect on the device and do not climb on it.
- When sealing the housing from the outside to the inside, make sure that the inflow of cleaning agent is considered and that the actuator space of the process valve towards the device is sealed.

Before installing the 8681 Control Unit - D4 onto a process valve D4 series, the delivered target for the external position sensor has to be screwed on the shaft of the process valve D4 series. For the assembly procedure see “5.3. Assembly sequences” and compare “Fig. 10”.

All other necessary parts for mounting on process valves D4 series are included with deliveries.

The delivered non-ferromagnetic shaft extension and both ferromagnetic targets for internal and external position sensor comply with the specifications regarding material and dimensional accuracy – see chapter “4.6. Data of position sensors” or also “Fig. 10”.

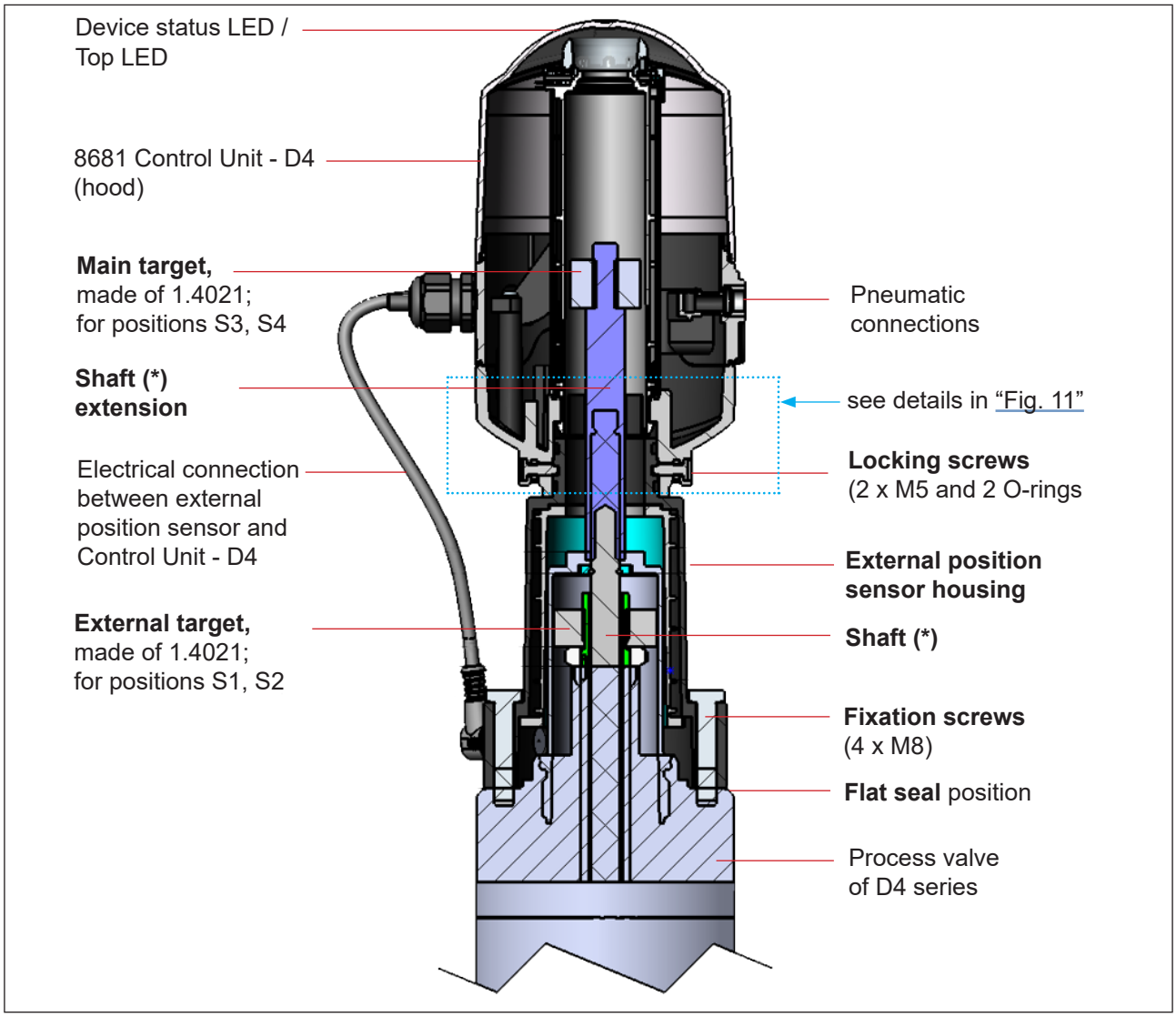


Fig. 10: Principle layout of the connection of the device and process valve D4 series

(*) *The fastening materials* for the targets and the shaft (extension) as well *as the shaft (extension) themselves* may not be made of material with very good electrical conductivity (e.g. copper, aluminum) or of ferromagnetic material. Stainless steel without ferromagnetic properties is suitable (if necessary, check after machining).

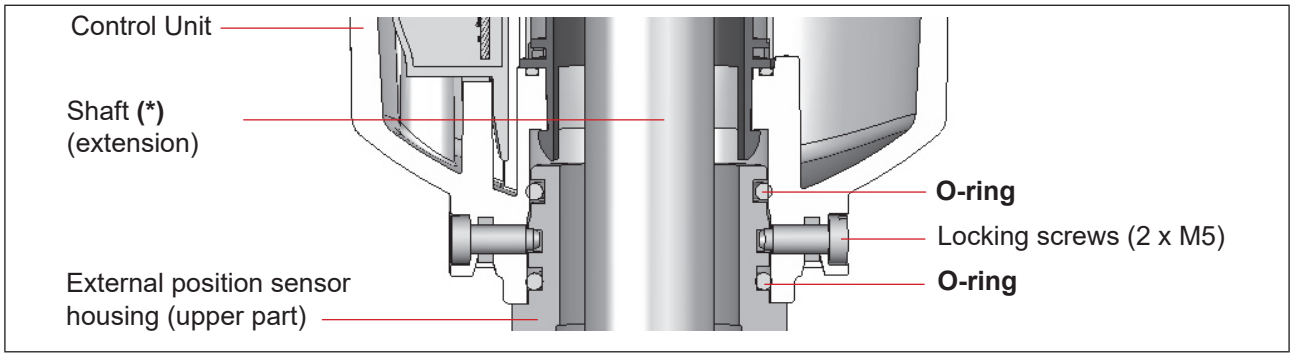


Fig. 11: Detail of the connection of 8681 Control Unit - D4 and the external position sensor housing

- To ensure the proper function of the position measuring system, the axial deviation of both position sensors must be less than ± 0.1 mm to the valve shaft when mounted!
- Use original manufacturers parts exclusively.
- Prior to assembling the device onto the process valve, lightly grease the flat seal and the O-rings with a silicone grease (see “5.7”).

For details, see also chapter “4.6. Data of position sensors”.

5.3. Assembly sequences

The delivered accessories consist of:

- 4 fixation screws M8
- shaft extension with target for internal position sensor
- target for external position sensor
- flat seal (EPDM)

Fig. 12: Delivered accessories

Procedure for mounting the external target:

→ First assemble the delivered external target on the process valve D4 series as shown in steps 1 to 6 below:

1.	2.	3.	4.	5.	6.
					
remove the black top capsule off the process valve	remove the washer		screw on the delivered target on the process valve shaft	re-assemble the washer again	re-assemble the black top capsule again

Fig. 13: Assembly sequence for mounting the external target on the process valve D4 series

Procedure for mounting the 8681 Control Unit - D4:

→ Then perform next steps 7 to 10 (see below) and sub sequently make all required connections:

7.	8.	9.	10.	
				
process valve D4 series with the mounted delivered target	assemble the delivered shaft extension with the target for the internal position sensor	put the flat seal in correct position	put the device as delivered over the target on the process valve	Fix the device on the process valve with the 4 fixation screws M8 (recommended tightening torque: max. 8 Nm)

Fig. 14: Assembly sequence for 8681 Control Unit - D4

→ For suitable position for hoses and cables, realign/rotate the upper part of the device as described in chapter “5.4. Realignment of the 8681 Control Unit - D4”

→ Connect the hoses as described in chapter “7. Pneumatic Installation” on page 35

→ Perform the electrical connections considering the necessary information given in the linked chapters of the respective device design:
“5.6. Assembly of the pneumatic and electrical connections” on page 32

→ Set the valve type - described in chapter “5.5. Selection of the process valve type (D4 series)”.

5.4. Realignment of the 8681 Control Unit - D4

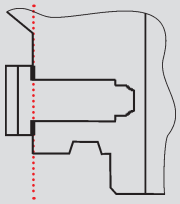
If necessary, the device can be realigned/rotated 360°, in particular if properly accessible installation of the pneumatic supply lines is not possible due to spatial conditions. This might also be required for operational aspects (accessibility of the manual control) and because of electrical connection possibilities.

The axial fastening is done by two locking screws (shoulder screws M5), which engage in the middle groove of the external position sensor housing (protection against pulling off).

Procedure:

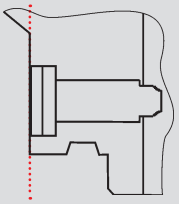
→ Loosen the locking screws (shoulder screws M5 – see "Fig. 11") slightly until the underside of the screw head is flush with the auxiliary surface of the housing.

The locking screw has been loosened sufficiently when the lower side of the screw head is flush with the auxiliary surface of the housing.



The locking screw is sufficiently tightened when the upper side of the screw head is flush with the auxiliary surface of the housing.

Tightening torque: max. 3.2 Nm

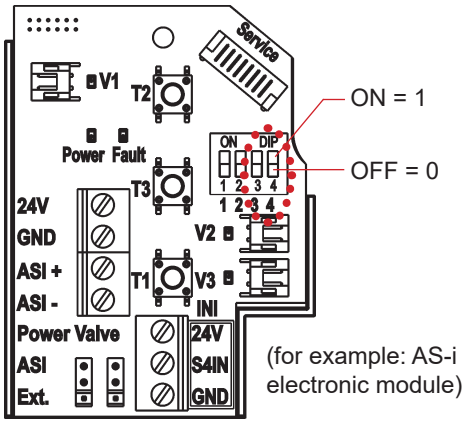
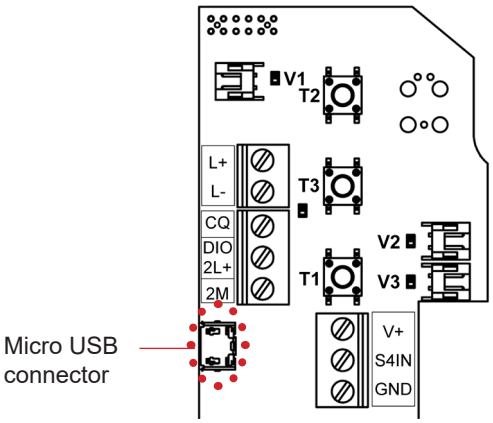


→ Rotate the device until the desired alignment has been achieved.

→ Secure it with locking screws again until the upper side of the screw head is flush with the auxiliary surface of the housing – tightening torque: max. 3.2 Nm.
The locking screws have **no sealing function.** The device is **not fixed in place** by the locking screws but is merely secured against being pulled off the external position sensor housing.

5.5. Selection of the process valve type (D4 series)

After assembling the device on a process valve of the D4 series, it is necessary to select the process valve types: The selection can be made for:

24 V and AS-i and DeviceNet devices	IO-Link devices
via the **DIP switches DIP3 + 4** of the 4-fold DIP switch	via IO-Link or via the bus-specific communication interface (**micro USB connector**)
	
Details: see „Table 1“ and „Fig. 19“, „Fig. 24“, „Fig. 27“	**Details:** see also „11.3“ and the IODD / IODD description for object 0x2C04subA

Process valve type	DIP3	DIP4	DIP1	DIP2
D4	0	0	Switches **DIP1+2** for setting the **colour combinations,** see chapter “14.1” on page 90. For **D4PMO** (setting the feedback fields) see also chapter “4.7.2” on page 24	
DA4	1 (ON)	0		
D4SL	0	1 (ON)		
D4PMO	1 (ON)	1 (ON)		

Table 1: DIP switches for the selection of process valve type and the color combinations

5.6. Assembly of the pneumatic and electrical connections

Pneumatic installation:

see chapter “7. Pneumatic Installation”

Electrical installation:

24 V DC: see chapter “8. 24 V DC - Design” on page 38,

AS interface: see chapter “9. AS Interface - Design” on page 44,

DeviceNet: see chapter “10. DeviceNet - Design” on page 54.

IO-Link: see chapter “11. IO-Link - Design” on page 72

5.7. Recommended auxiliary materials

Silicone grease for easy lubrication of the EPDM seals

6. OPENING AND CLOSING THE HOUSING

6.1. Safety instructions

DANGER!

Risk of injury due to electric shock!

- Before opening the hood and prior to reaching into the system, switch off the power supply and secure to prevent restarting!
- Observe applicable accident prevention and safety regulations for electrical equipment!

WARNING!

Risk of injury due to high pressure in the system!

- Before loosening lines and valves, turn off the pressure and vent the lines.

Risk of injury due to unintentional activation of the system and uncontrolled restart!

- Secure system against unintentional activation; following assembly, ensure a controlled restart.

CAUTION!

Risk of injury due to improper installation!

- Installation may be carried out by trained technicians only and with the appropriate tools!

6.2. Opening and closing the housing

6.2.1. Opening the housing of the device

NOTE!

Improper handling will damage the plastic hood / seal!

- Do not use excessive force (e.g. by knocks) for opening.
- Make sure that the lubricated seal contour is not soiled when the hood is placed down as this might reduce the IP protection!

Procedure:

→ Remove lead seal if the housing is secured at the sealing lug – see “Fig. 15”.

→ Open the plastic hood by turning counterclockwise (all the way, approx. 1.5 cm).
Due to the tightness of the sealing, loosen the plastic hood by carefully tilting it laterally and lift it upwards to remove it.

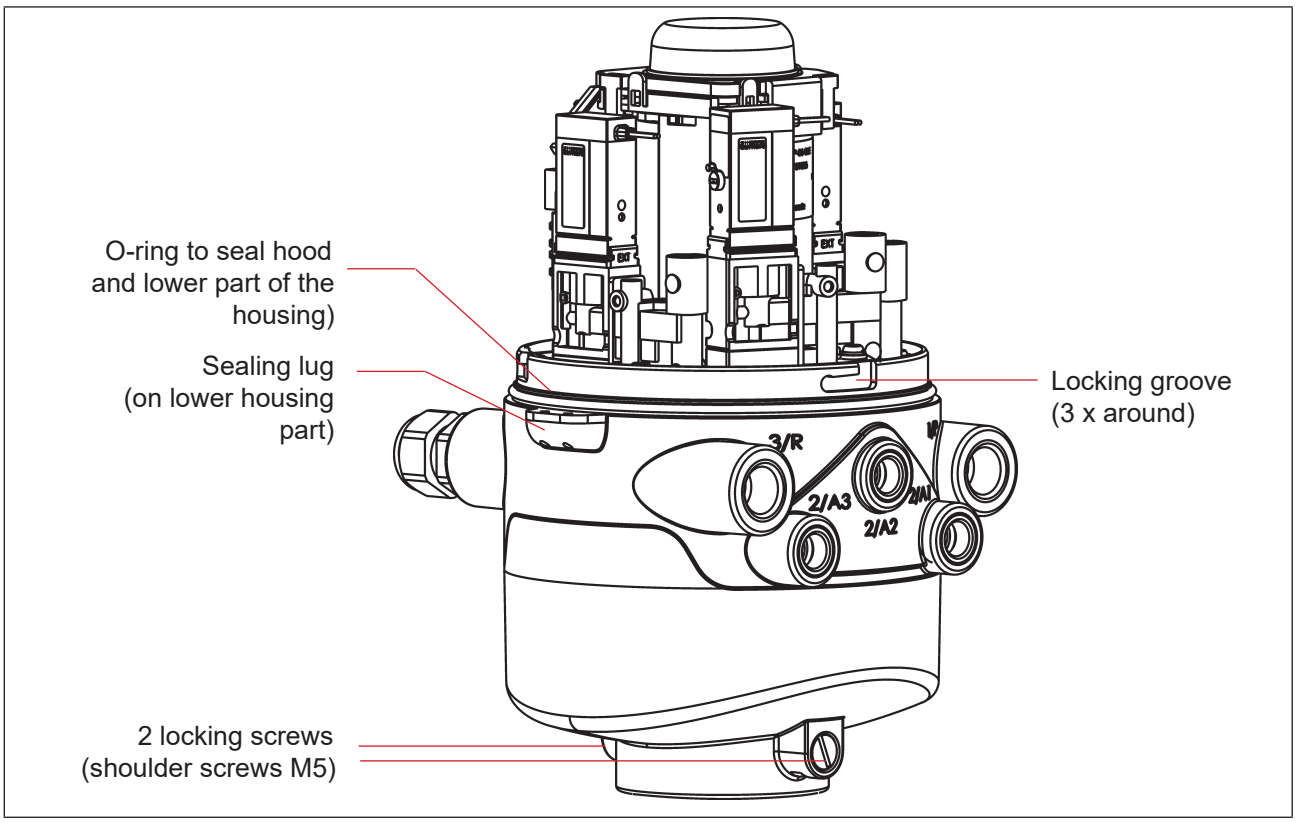


Fig. 15: Sealing and locking the housing

6.2.2. Closing the housing of the device

If necessary, clean the seal contour of the seal and of the hood and lightly lubricate it using a silicone grease.

Caution:
Do not use any petroleum-based or synthetic lubricants (except for silicone grease)!

Procedure:

→ Put the plastic hood on the lower part such that the inner "lugs" of the hood are positioned over the locking grooves and the external sealing lugs are positioned almost over each other.
Press the hood completely over the O-ring of the lower part – see also “Fig. 15”.

→ Turn the hood by approx. 1.5 cm clockwise (meaning until the sealing lugs are positioned over each other).

→ If necessary, apply a lead seal at the sealing lug to prevent opening without a tool.

7. PNEUMATIC INSTALLATION

7.1. Safety instructions

WARNING!

Risk of injury due to high pressure in the system!

- Before loosening lines and valves, turn off the pressure and vent the lines.

Risk of injury due to unintentional activation of the system and uncontrolled restart!

- Secure system against unintentional activation.
- Following installation, ensure a controlled restart.

CAUTION!

Risk of injury due to improper installation!

- Installation may be carried out by trained technicians only and with the appropriate tools!

7.2. Pneumatic connection of 8681 Control Unit - D4

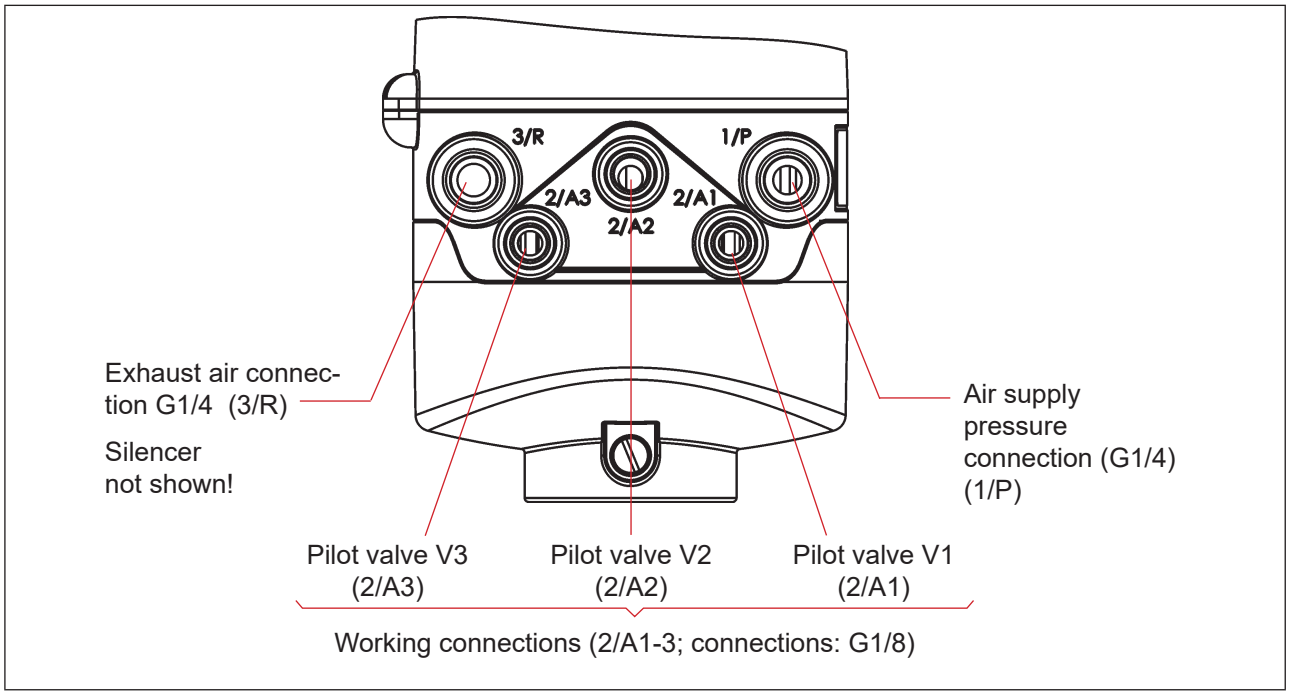


Fig. 16: Pneumatic connections

Procedure:

→ If required, realign the device (see chapter "5.4. Realignment of the 8681 Control Unit - D4").

→ A silencer has already been mounted on the exhaust air connection (**3/R** - see "Fig. 16") in the supplied state. As needed, the silencer can be replaced by an exhaust air hose (e.g. after screwing in an appro-

priate plug-in hose connectors) – see NOTE-box and recommendation box below.

→ Connect the required working connections **2/A1 to 2/A3** with the corresponding connections on the process valve (according to the number of pilot valves in the device) - compare "Fig. 16".

→ Connect the supply line to air supply pressure connection **1/P** (observe the permissible pressure range, see chapter "4.5. Pneumatic data" on page 21).

NOTE!

Details about permissible hose pipes:

- Only use approved hose pipes with ∅6 mm (or 1/4") or ∅8 mm (or 5/16") outer diameters (tolerance: +0.05/-0.1 mm).
- Only use suitable hose qualities (in particular for high ambient temperatures) that bear up under common stresses caused by the quick connector.
- Only use a suitable hose cutter when cutting hose pipes. This will safeguard against damage and impermissible deformation.
- Accordingly dimension hose length to prevent that the hose ends in the plug-in hose connectors generate any diagonally pulling stresses (curved outlet without eccentric stress).

Use of silencer or exhaust air hose?

- When using an exhaust air hose, accordingly dimension its length to ensure that a Q_{Nn} value >620 l/min is reached.

Recommendation:
Dimension the hose lengths so that the device can be removed from the process valve if required without any additional disassembly work.

7.3. Flow restriction function of the pilot valves

Set the flow restriction screws of the pilot valves only when needed and after completion of all necessary installations!

The flow restriction screws of the pilot valves (see "Fig. 17") are used for individual setting the air intake and exhaust for the working connections and so be able to affect the expansion and retraction rates of the process valve.

- Factory setting of nominal flow rate: Q_{Nn} approx. 110 l/min.
- The flow restriction screws do not serve any sealing function.
- Only tighten the flow restriction screws to the stopper, otherwise damage to device may occur.
- Only use appropriate screwdrivers (b ≤ 3 mm).

When setting the retraction and extension rates of the pneumatic actuator, ensure that there is no constant "primary pressure" during deaeration!

Keep in mind that the working conditions in the process valve area on the side of the product (flow types, pressure variations) may result in changes in the set aeration and deaeration times.

Settings of the flow-rate or the control speed with the help of the flow restriction screws:

For proper setting, it is advisable to **turn the two flow restriction screws initially** into the **minimum flow-rate position.** The process valve will then initially move slowly so that you have more time to find the optimum setting during a switching operation.
Minimizing the flow rate: turn clockwise
Maximizing the flow rate: turn counterclockwise

→ Open the housing following the instructions in chapter “6. Opening and Closing the Housing”.

→ Observing the safety guidelines, activate the respective valve location to be set (either using the system control or the manual controls).

→ Turn the flow restriction screw "P" counterclockwise to set the required flow rate and therefore the opening time for the process valve (tool: flat-blade screwdriver, width ≤ 3 mm).

→ After that deactivate the respective valve location (V1, V2 or V3).

→ Turn the flow restriction screw "R" counterclockwise to set the required flow rate and therefore the closing time for the process valve.

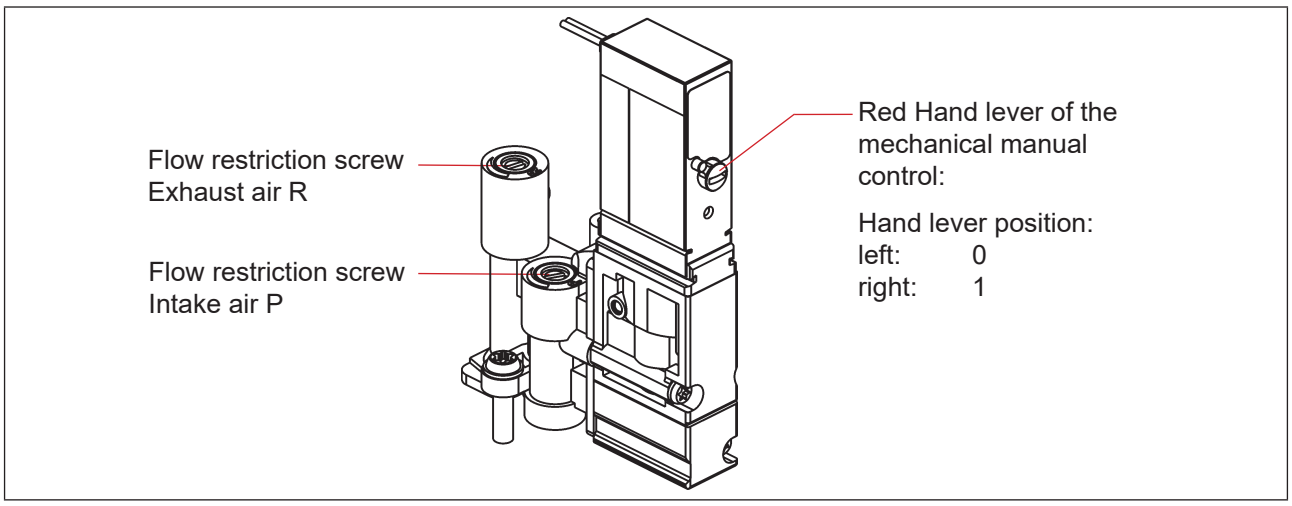


Fig. 17: Flow restriction screws and mechanical manual control of the pilot valves

NOTE!

To avoid unintentional switching of the process valve:

- Makes sure that all manual controls have been deactivated (hand lever all the way left, as pictured) after the setting work has been completed!

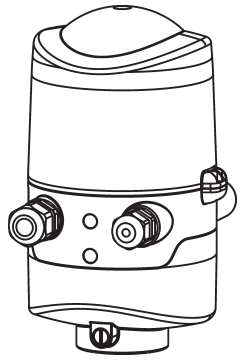
→ If no further installation work is required, close the housing following the instructions in chapter “6. Opening and Closing the Housing”.

If no system status is available during setting, readjust the system under system operation conditions if necessary.

Observe the safety guidelines during this! See chapter “2.2. Basic Safety Instructions”.

8. 24 V DC - DESIGN

8.1. Electrical connection



Connection left:	for voltage and signals (M12 plug according to IEC 61076-2-101, 12-pole, cable length ca. 80 cm)
Connection right:	for external position sensor (M12 plug according to IEC 61076-2-101, 4-pole, cable length ca. 20 cm)

Fig. 18: Connection concept 24 V DC

8.2. Electrical data

Power supply: 12 ... 28 V DC, residual ripple 10%

Connections:

For power supply and signals: 1 x M16 x 1.5 cable gland / SW22 with multi-pole connection (M12 plug according to IEC 61076-2-101, 12-pole, cable length ca. 80 cm)

For external position sensor: 1 x M16 x 1.5 cable gland/SW19 with multi-pole connection (M12 plug according to IEC 61076-2-101, 4-pole, cable length ca. 20 cm)

Power consumption (standby current): 30 mA at 24 V DC

Pilot valves:

Typ. switching capacity:	0.9 W (per pilot valve, for 200 ms after switching on)
Typ. continuous output:	0.6 W (per pilot valve, from 200 ms after switching on)
Power consumption per Pilot valve:	50 mA at 12 V DC 25 mA at 24 V DC 22 mA at 28 V DC
Operating mode:	Long-term operation (100% ED)

Central display of switching states: ca. 42 mA with a power supply of 24 V DC per illuminated display; colour switching see chapter “14. LED Colour Assignments / Display via Top LED”

Outputs/binary feedback signals: S1 out - S4 out

Design:	Normally open contact, PNP output short-circuit-proof, with self-clocking short-circuit protection
Switchable output current:	max. 100 mA per feedback signal
Output voltage - active:	≥ (operating voltage - 2 V)
Output voltage - inactive:	max. 1 V in unloaded state

Inputs valve actuation (Y1 - Y3):

Signal level - active:	U > 10 V, max. 24 V DC + 10%
Signal level - inactive:	U < 5 V
Impedance:	> 30 kOhm

8.3. Design aid

Power consumption of the electronics:								
P_{EI}	=	0.7 W	or	I_{EI}	=	30 mA	at	24 V
Power consumption of a valve during activation (200 ms):								
$P_{Valve-ON}$	=	0.9 W	or	$I_{Valve-ON}$	=	38 mA	at	24 V
Power consumption of a valve after reduction:								
P_{Valve}	=	0.6 W	or	I_{Valve}	=	25 mA	at	24 V
Power consumption of an optical position report:								
P_{LED}	=	1.0 W	or	I_{LED}	=	42 mA	at	24 V

Also, if several pilot valves of the device were to be opened simultaneously, the switch signal will be sent staggered to the valves. Only *one* 0.9 W valve will ever be recorded.

Calculation examples:

Example 1:
3 valves are activated simultaneously, one position is reported (state for 200 ms):

P_{Total} =		P_{EI}	+	1 x $P_{Valve-ON}$	+	2 x P_{Valve}	+	1 x P_{LED}
3.8 W	=	0.7 W	+	1 x 0.9 W	+	2 x 0.6 W	+	1 x 1.0 W
or								
I_{Total}	=	I_{EI}	+	1 x $I_{Valve-ON}$	+	2 x I_{Valve}	+	1 x I_{LED}
160 mA	=	30 mA	+	1 x 38 mA	+	2 x 25 mA	+	1 x 42 mA

Example 2:
3 valves have been activated simultaneously, one position is reported (persistent state):

P_{Total}	=	P_{EI}	+	3 x P_{Valve}	+	1 x P_{LED}		
3.5 W	=	0.7 W	+	3 x 0.6 W	+	1 x 1.0 W		
or								
I_{Total}	=	I_{EI}	+	3 x I_{Valve}	+	1 x I_{LED}		
147 mA	=	30 mA	+	3 x 25 mA	+	1 x 42 mA		

8.4. Safety instructions

DANGER!

Risk of injury due to electric shock!

- Before reaching into the system, switch off the power supply and secure it to prevent restarting!
- Observe applicable accident prevention and safety regulations for electrical equipment!
- When setting the position measuring system (Teach), do not contact any live components!

WARNING!

Risk of injury due to unintentional activation of the system and uncontrolled restart!

- Secure system against unintentional activation; following assembly, ensure a controlled restart.

CAUTION!

Risk of injury due to improper installation!

- Installation may be carried out by trained technicians only and with the appropriate tools!

8.5. Electrical installation

Internal cabling work is not required for devices with multi-pole connection, which makes installation and start-up on site considerably easier and quicker, reducing the risk of leaks.

→ Connect the 80 cm cable with M12 (12 pole) to the PLC.

24 V DC Electronics module, terminal strip configuration:

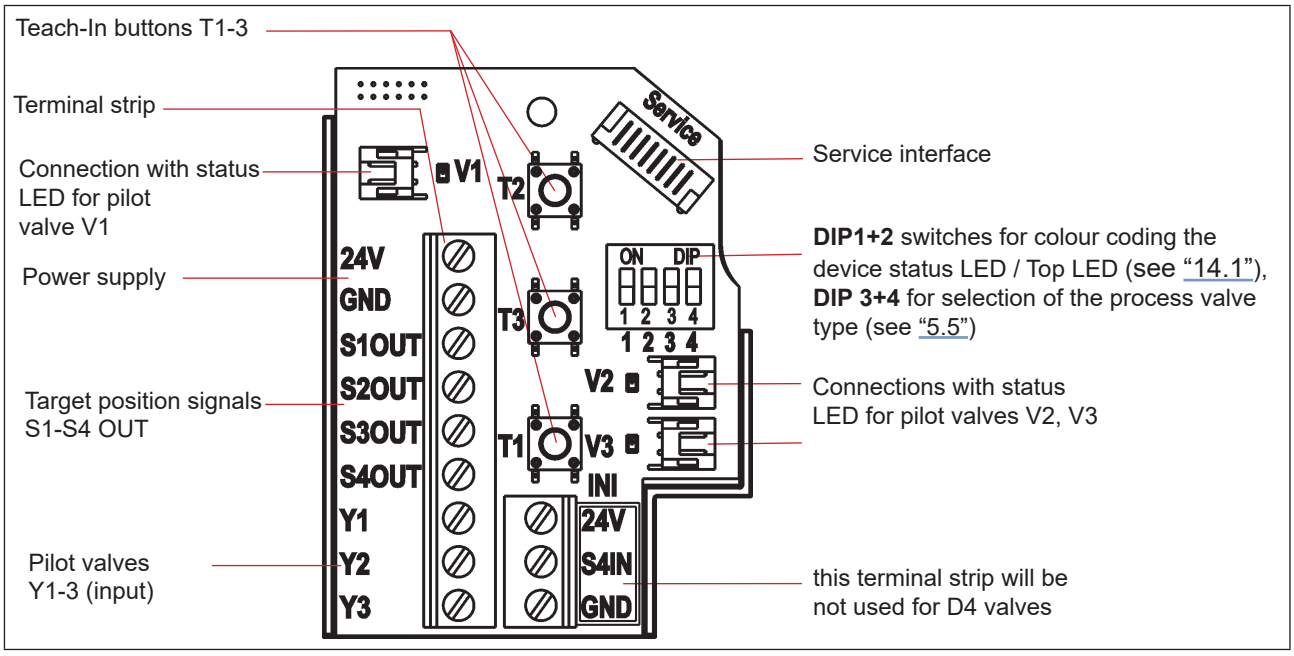


Fig. 19: 24 V DC electronic module

Input and output signals to the higher-level control (PLC):

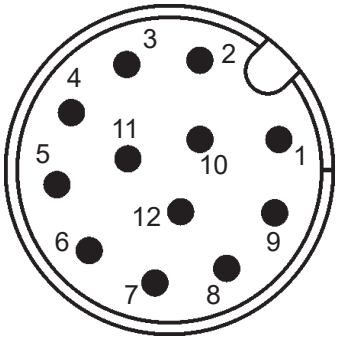
Pin	Designation on electr. module	Configuration	Connector M12, 12-pole
1	24 V	Power supply 24 V	View onto the plug pins:  The center pins (10, 11, 12) are not used
2	GND	GND	
3	S1 out	Process valve state (depending on the valve type - see tables below in “8.6”)	
4	S2 out		
5	S3 out		
6	S4 out		
7	Y1	Pilot valve V1 input	
8	Y2	Pilot valve V2 input	
9	Y3	Pilot valve V3 input	
10		Not used	
11		Not used	
12		Not used	

Table 2: Connection configuration, circular plug-in connector M12 x 1.0, male (acc. to IEC 61076-2-101)

8.6. Logic tables for the valve D4 series

The following logic tables work internally in the device, the combination of the single (target) signals S1-S4 results in the final signal for the valve state (indicated with the device status LED/Top LED).

The combination of the target signals S1-S4 for a special valve state depends on the valve type - see the following tables:

8.6.1. Logic tables for SPX D4

Output data Control Unit	**valve state**	**linear sensor 2 (teach data)** (external position sensor)		**linear sensor 1 (teach data)** (internal position sensor)	
		S1	**S2**	**S3**	**S4**
S1 out	**closed**	1	0	1	0
S2 out	**open**	0	0	0	1

Input data Control Unit	**Pilot V1** (main stroke)
Y1	1
Y2	0
Y3	0

8.6.2. Logic tables for SPX DA4

Output data Control Unit	**valve state**	**linear sensor 2 (teach data)** (external position sensor)		**linear sensor 1 (teach data)** (internal position sensor)	
		S1	**S2**	**S3**	**S4**
S1 out	**closed**	1	0	0	0
S2 out	**open**	0	0	0	1
S3 out	upper seat lift	0	1	0	0
S4 out	lower seat lift	1	0	1	0

Input data Control Unit	**Pilot V1** (main stroke)	**Pilot V2** (upper seat lift)	**Pilot V3** (lower seat lift)
Y1	1	0	0
Y2	0	1	0
Y3	0	0	1

8.6.3. Logic tables for SPX D4SL

Output data Control Unit	valve state	linear sensor 2 (teach data) (external position sensor)		linear sensor 1 (teach data) (internal position sensor)	
		S1	S2	S3	S4
S1 out	closed	1	0	1	0
S2 out	open	0	0	0	1
S3 out	upper seat lift	0	1	1	0
S4 out	lower seat lift	1	0	0	0

Input data Control Unit	Pilot V1 (main stroke)	Pilot V2 (upper seat lift)	Pilot V3 (lower seat lift)
Y1	1	0	0
Y2	0	1	0
Y3	0	0	1

8.6.4. Logic tables for SPX D4PMO

The Control Unit output data of this valve type are the sensor signals of the taught positions, not the valve state – see the following tables.

The valve state combination table has to be implemented in the PLC software.

The opposite valve shaft remains in “closed position” during seat lift - this can be monitored by observing the appropriate sensor position signal.

Logic tables for SPX D4PMO:

valve state	linear sensor 2 (teach data) (external position sensor)		linear sensor 1 (teach data) (internal position sensor)	
	S1	S2	S3	S4
closed	1	0	1	0
open	0	0	0	1
upper seat lift	0	1	1	0
lower seat lift	1	0	0	0
Output data Control Unit	**S1 out**	**S2 out**	**S3 out**	**S4 out**

Input data Control Unit	Pilot V1 (main stroke)	Pilot V2 (upper seat lift)	Pilot V3 (lower seat lift)
Y1	1	0	0
Y2	0	1	0
Y3	0	0	1

9. AS INTERFACE - DESIGN

9.1. Definition

AS interface connection:

AS interface (Actuator Sensor Interface) is a field bus system which is used primarily for networking binary sensors and actuators (slaves) with a higher-level control (master).

Connecting the Control Units - D4 to higher bus systems is possible using commercially available gateways. Contact your distribution partner in this regard.

Bus line:

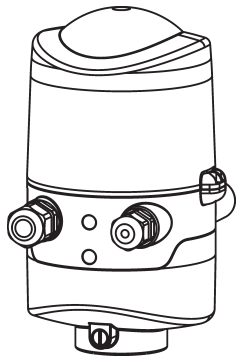
Unshielded two-wire line (AS interface line as AS interface cable harness) along which both information (data) and energy (power supply for the actuators and sensors) are transmitted.

Network topology:

Freely selectable within wide limits, i.e. star, tree and line networks are possible. Further details are described in the AS interface specification (A/B slave model complies with the version 3.0 specification).

The Control Units - D4 have been configured as AS interface version with an extended address range (A/B slaves) for 62 slaves or optionally as an AS interface version for 31 slaves. For details, see chapter “9.9. Programming data”.

9.2. Electrical connection



Connection left:	for voltage and signals (M12 plug according to IEC 61076-2-101, 4-pole, cable length ca. 80 cm)
Connection right:	for external position sensor (M12 plug according to IEC 61076-2-101, 4-pole, cable length ca. 20 cm)

Fig. 20: AS interface connection concept

9.3. Number of connectable Control Units - D4

The level of expansion that is actually possible depends on the total number of all individual operating currents for each device, which are supplied via the bus at the common AS interface bus segment (see example calculation in chapter “9.6. Design aid”).

Standard: AS interface/62 slaves:

(AS interface version with extended addressing range (A/B slave))
In AS interface versions with extended addressing range (A/B slave), 1 master can communicate with 62 slaves.

Option: AS interface/31 slaves:

(AS interface version with 31 slave addressing range)
In this case, a maximum of 31 Control Units - D4 can be connected to a bus line (address range restriction).

9.4. Maximum length of the bus line

The bus cable may be a **maximum of 100 m long.** All AS interface lines of an AS interface string must be considered for the design, i.e. even the drop lines to the individual slaves.

The M12 plug multipole connection with a cable of ca. 80 cm long has to be **calculated with 1 m length** because of the internal cabling in the device.

Example for determining the cable length:

For a multi-pole connection with ca. 80 cm cable:
When using 62 Control Units - D4, the AS interface cable harness may still be (100 m - 62 * 1 m) = 38 m long.

If the calculated line length of 100 m were to be exceeded, a commercially available AS interface repeater may be used, as needed.

Observe maximum power supply via certified AS interface power supply units ≤ 8 A!
For details see AS interface specification.

Observe the optional design **"AS Interface with External Power Supply"** to reduce the load on the AS interface bus segment! (see chapters “9.5” and “9.8”)

Use cables according to the AS interface specification.
If other cables are used, the maximum cable length will change.

9.5. Electrical data

Comments / notes:

The device was developed according to the Complete Specification (V.3.0) and the Profile S-7.A.E and S-7.F.F of the AS International Association.

Outputs (from master perspective):	1 or 3 pilot valves
Inputs (from master perspective):	4 binary feedback signals (process valve states: closed, open, upper seat lift, lower seat lift)
Watchdog:	If bus communication fails for more than 50 to 100 ms, the outputs are set to 0

Setting the **pilot valves' power supply** using jumpers on the AS interface electronic module - see "Fig. 24: AS-i electronic module":

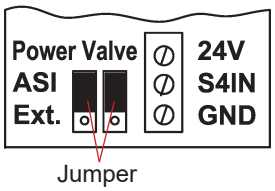
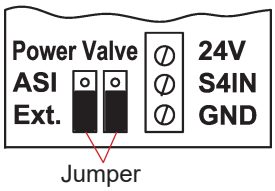
Power supply to the pilot valves via the bus:	External power supply to the pilot valves:
	

Fig. 21: Jumper setting on AS-i electronic module: Power supply to the pilot valves via the bus or externally

Connections:

Multi-pole connection:

For power supply and signals: 1 x M16 x 1.5 cable gland / SW22 with multi-pole connection (M12 plug according to IEC 61076-2-101, 4-pole, cable length ca. 80 cm)

For external position sensor: 1 x M16 x 1.5 cable gland/SW19 with multi-pole connection (M12 plug according to IEC 61076-2-101, 4-pole, cable length ca. 20 cm)

Power supply:

29.5 ... 31.6 V DC (according to specification)
21.0 ... 31.6 V DC (according to specification Power24)

Inputs (from master perspective) / binary feedback signals:
The recovery of the 4 valve positions reported back in binary format is described in chap. "12" on page 83.

Outputs (from master perspective) / pilot valves:

Typ. switching capacity:	0.9 W (per pilot valve, for 200 ms after switching on)
Typ. continuous output:	0.6 W (per pilot valve, from 200 ms after switching on)
Watchdog function:	integrated
Output reduction:	via AS interface - electronics integrated
Typ. Pull-in current (per sol. valve):	30 mA or 0.9 W/200 ms (at 30.5 V AS-i voltage)
Typ. Holding current (per sol. valve):	20 mA or 0.6 W (at 30.5 V AS-i voltage)
Operating mode:	Long-term operation (100% ED)
Valve type:	Type 6524

Central display of the switching states:

Power consumption from AS interface
at 30.5 V AS interface voltage: ca. 33 mA or 1 W per illuminated display

Number of representable colours: 2 colours for process valve switching states
1 colour for signaling a fault
For "universal colour switching" see chapter"14. LED Colour Assignments / Display via Top LED".

Power supply via AS interface bus (without external power supply):

Max. power consumption from AS-i: <160 mA
Power consumption during normal operation from the AS-i (after current reduction): <150 mA
3 valves activated, 1 position reported back by LED display

Integrated short-circuit protection

NOTE!

If all 3 pilot valves are simultaneously controlled via the AS interface, the electronics will activate the valves sequentially with a 200 ms time delay to protect the bus from overloads.

Please observe the notes on power requirement and maximum expansion stage of the AS interface network contained in chapter "9.3. Number of connectable Control Units - D4"D4s" and in the AS-i specifications, where applicable.

External power supply for pilot valves:

External power supply: 19.2 V DC to 31.6 V DC
The power supply unit must include a secure disconnect in accordance with IEC 60364-4-41. It must conform to the SELV standard. The ground potential must not have a ground connection.

Power consumption from external power supply for outputs (pilot valves) - without integrated current limiting: <110 mA at 24 V DC (for 200 ms after switching on of the 3.rd valve)

Power consumption from AS-i for inputs and display: <150 mA (incl. feedback and fault display)

Integrated short-circuit protection

Please observe the notes on power requirement and maximum expansion stage of the AS interface network contained in chapter "9.3. Number of connectable Control Units - D4"D4s" and in the AS-i specifications, where applicable.

9.6. Design aid

Design aid for power supply of the valves via the AS-i bus

Power consumption of the electronics:							
P_{EI}	=	1.0 W	or	I_{EI}	=	33 mA	at 30.5 V
Power consumption of a valve during activation (200 ms):							
$P_{Valve-ON}$	=	0.9 W	or	$I_{Valve-ON}$	=	30 mA	at 30.5 V
Power consumption of a valve after reduction:							
P_{Valve}	=	0.6 W	or	I_{Valve}	=	20 mA	at 30.5 V
Power consumption of an optical position report:							
P_{LED}	=	1.0 W	or	I_{LED}	=	33 mA	at 30.5 V

For the design of the **maximum line lengths,** observe chapter “9.3. Number of connectable Control Units - D4”D4s”.

Even if several pilot valves of the device are switched simultaneously via the bus, the switching signal is passed on to the valves in staggered order, i.e. only *one* valve is ever taken up 0.9 W.

Calculation examples:

Example 1:
3 valves are activated “simultaneously”, one position is reported (state for 200 ms):

P_{Slave}	=	P_{EI}	+	1 x $P_{Valve-ON}$	+	2 x P_{Valve}	+	1 x P_{LED}
4.1 W	=	1.0 W	+	1 x 0.9 W	+	2 x 0.6 W	+	1 x 1.0 W
or								
I_{Slave}	=	I_{EI}	+	1 x $I_{Valve-ON}$	+	2 x I_{Valve}	+	1 x I_{LED}
136 mA	=	33 mA	+	1 x 30 mA	+	2 x 20 mA	+	1 x 33 mA

Example 2:
3 valves have been activated “simultaneously”, one position is reported (persistent state):

P_{Slave}	=	P_{EI}	+	3 x P_{Valve}	+	1 x P_{LED}		
3.8 W	=	1.0 W	+	3 x 0.6 W	+	1 x 1.0 W		
or								
I_{Slave}	=	I_{EI}	+	3 x I_{Valve}	+	1 x I_{LED}		
126 mA	=	33 mA	+	3 x 20 mA	+	1 x 33 mA		

9.7. Safety instructions

DANGER!

Risk of injury due to electric shock!

- Before reaching into the system, switch off the power supply and secure it to prevent restarting!
- Observe applicable accident prevention and safety regulations for electrical equipment!
- When setting the position measuring system (Teach), do not contact any live components!

WARNING!

Risk of injury due to unintentional activation of the system and uncontrolled restart!

- Secure system against unintentional activation; following assembly, ensure a controlled restart.

CAUTION!

Risk of injury due to improper installation!

- Installation may be carried out by trained technicians only and with the appropriate tools!

9.8. Electrical installation

Internal cabling work is not required for any of the AS Interface designs with multi-pole connection, which makes installation and start-up on site considerably easier and quicker, reducing the risk of leaks.

However, you will require the correspondingly assembled cable sets with the following pin assignments (see “Fig. 22” and table below).

Likewise, the jumpers on the electronic module must be set correspondingly (see “Fig. 21” and “Fig. 24”).

Bus connection for AS interface and power supply:

AS-i bus and power supply for pilot valves via bus or external power supply (see also “Fig. 21”):

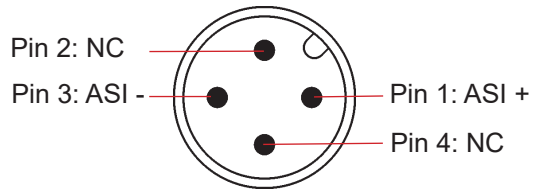
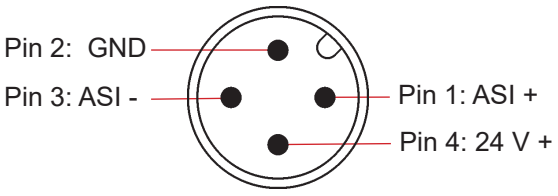
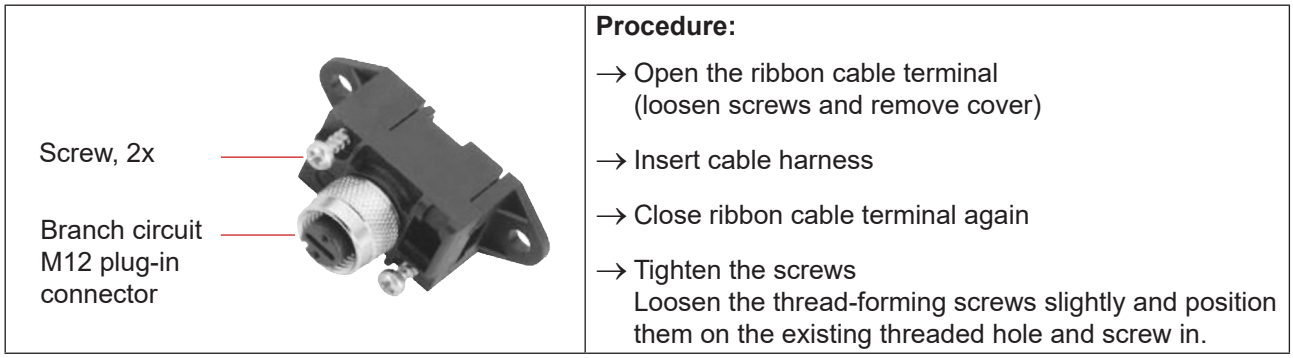
via bus	external
	
View of the M12 x 1 circular plug, 4-pole, male – from the front onto the pins	

Fig. 22: AS interface bus connection (power supply for pilot valves via bus or external power supply)

Pin	Configuration (supply via bus)	Configuration (external power supply)	Wire colour
1	AS interface - ASI+	AS interface - ASI +	brown
2	Not used	GND	white
3	AS interface - ASI –	AS interface - ASI –	blue
4	Not used	24 V +	black

The cable with multi-pole connection version is especially suited for direct and flexible connection to the AS interface cable harness using the ribbon cable terminal (M12 branch circuit, VA branch circuit) that is optionally available.

The optional ribbon cable terminal contacts the AS interface cable harness by means of penetration technology which allows installation by "clipping in" the AS interface cable harness without cutting and without removing insulation.



Procedure:

→ Open the ribbon cable terminal
(loosen screws and remove cover)

→ Insert cable harness

→ Close ribbon cable terminal again

→ Tighten the screws
Loosen the thread-forming screws slightly and position them on the existing threaded hole and screw in.

Fig. 23: Optional ribbon cable terminal for AS interface cable harness

AS interface electronic module - LED status displays:

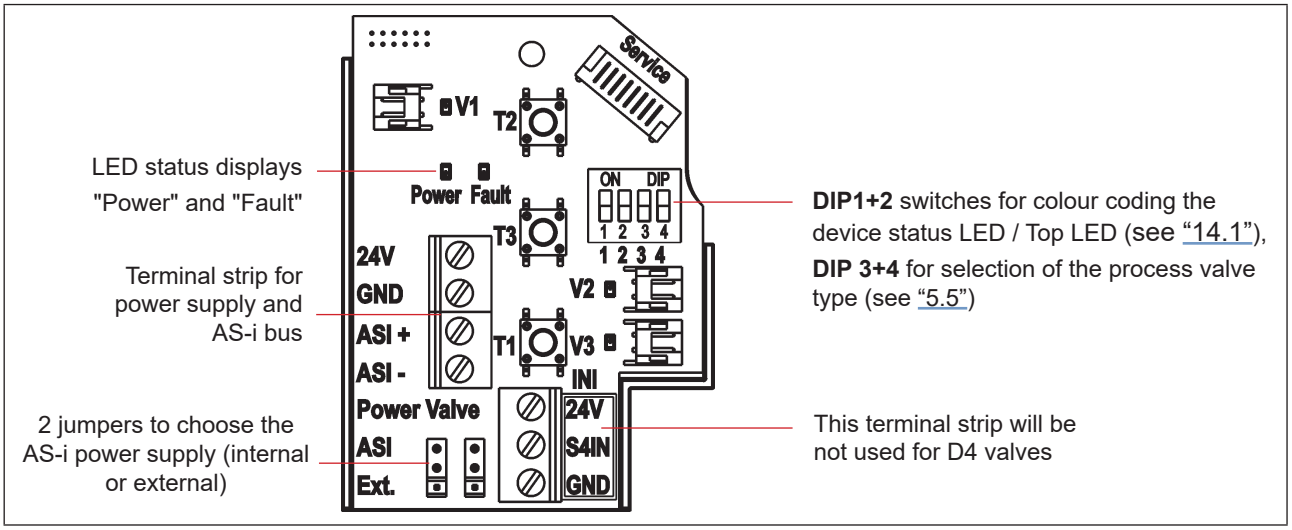


Fig. 24: AS-i electronic module

LED 1 "Power" (green)	LED 2 "Fault" (red)	signalized status
off	off	Power OFF
on	off	OK
on	on	No data traffic (expired Watchdog at slave address does not equal 0)
flashing	on	Slave address = 0
flashing	flashing	Sensor supply overload / manual actuation activated / untaught / service/ maintenance request / PC service program service mode

The central multi-colour status display (device status LED / Top LED) flashes also in the fault colour (see chapter "14.3. Blinking pattern & fault signaling"), if the status LED 2 "Fault" on the electronic module is active.

9.9. Programming data

The Control Units - D4 have been configured as AS interface version with an extended address range (A/B slaves) for 62 slaves or optionally as an AS interface version for 31 slaves.

A change between both device configurations (for 62 slaves or 31 slaves) is only possible by exchanging the electronic module (PCB).

If one device is replaced with another device having a different configuration in the AS interface field bus system (e.g. AS interface version 62 slaves (A/B-Slave) to replace a device with AS interface version 31 slaves), a configuration error will be generated at the master due to the different ID codes!

In this case (intentional replacement!), the current configuration must be re-programmed in the AS interface master. Please read the operating instructions of the used AS interface master!

AS-i address factory setting:

AS-i address = 0

The change or subsequent activation of a value (usually) requires a device restart.

	Programming data for 62 slaves AS interface - Device for A/B slave addressing (default device)	**Programming data for 31 slaves** AS interface (optional)
I/O configuration	7 hex (4 inputs / 4 outputs) see below: Bit configuration table	7 hex (4 inputs / 4 outputs) see below: Bit configuration table
ID code	A hex	F hex
Extended ID code 1	7 hex	(F hex)
Extended ID code 2	E hex	(F hex)
Profile	S-7. A.E	S-7. F.F

Table 3: Programming data for AS-i devices (62 or 31 slaves)

9.10. Logic tables for the valve D4 series

The following logic tables work internally in the device, the combination of the single (target) signals S1-S4 results in the final signal for the valve state (indicated with the device status LED/Top LED).

The combination of the target signals S1-S4 for a special valve state depends on the valve type (see tables below):

9.10.1. Logic tables for SPX D4

AS-i data INPUT data	**valve state**	**linear sensor 2 (teach data)** (external position sensor)		**linear sensor 1 (teach data)** (internal position sensor)	
		S1	**S2**	**S3**	**S4**
DI0	**closed**	1	0	1	0
DI1	**open**	0	0	0	1

AS-i data OUTPUT data	**Pilot V1** (main stroke)
DO0	1
DO1	0
DO2	0
DO3	not used

9.10.2. Logic tables for SPX DA4

AS-i data INPUT data	**valve state**	**linear sensor 2 (teach data)** (external position sensor)		**linear sensor 1 (teach data)** (internal position sensor)	
		S1	**S2**	**S3**	**S4**
DI0	**closed**	1	0	0	0
DI1	**open**	0	0	0	1
DI2	upper seat lift	0	1	0	0
DI3	lower seat lift	1	0	1	0

AS-i data OUTPUT data	**Pilot V1** (main stroke)	**Pilot V2** (upper seat lift)	**Pilot V3** (lower seat lift)
DO0	1	0	0
DO1	0	1	0
DO2	0	0	1
DO3	not used		

9.10.3. Logic tables for SPX D4SL

AS-i data INPUT data	valve state	linear sensor 2 (teach data) (external position sensor)		linear sensor 1 (teach data) (internal position sensor)	
		S1	S2	S3	S4
DI0	closed	1	0	1	0
DI1	open	0	0	0	1
DI2	upper seat lift	0	1	1	0
DI3	lower seat lift	1	0	0	0

AS-i data OUTPUT data	Pilot V1 (main stroke)	Pilot V2 (upper seat lift)	Pilot V3 (lower seat lift)
DO0	1	0	0
DO1	0	1	0
DO2	0	0	1
DO3	not used		

9.10.4. Logic tables for SPX D4PMO

The AS-i INPUT data supplied by the Control Unit for this valve type are the sensor signals of the taught positions, not the valve state – see the following tables.

The valve state combination table has to be implemented in the PLC software.

The opposite valve shaft remains in “closed position” during seat lift - this can be monitored by observing the appropriate sensor position signal.

valve state	linear sensor 2 (teach data) (external position sensor)		linear sensor 1 (teach data) (internal position sensor)	
	S1	S2	S3	S4
closed	1	0	1	0
open	0	0	0	1
upper seat lift	0	1	1	0
lower seat lift	1	0	0	0
AS-i data INPUT data	**DI0**	**DI1**	**DI2**	**DI3**

AS-i data OUTPUT data	Pilot V1 (main stroke)	Pilot V2 (upper seat lift)	Pilot V3 (lower seat lift)
DO0	1	0	0
DO1	0	1	0
DO2	0	0	1
DO3	not used		

10. DEVICENET - DESIGN

10.1. Definition

- The DeviceNet is a field bus system which is based on the CAN protocol (Controller Area Network). It enables actuators and sensors (slaves) to be networked with higher-level controllers (master).
- The device in the DeviceNet is a slave device according to the Predefined Master/Slave Connection Set stipulated in the DeviceNet specification. Polled I/O, Bit Strobed I/O and Change of State (COS) are supported as I/O connection variants.
- With DeviceNet it is necessary to differentiate between cyclical or event-driven high-priority process messages (I/O Messages) and acyclical low-priority management messages (Explicit Messages).
- The protocol process conforms to the **DeviceNet specification Release April 2010.**

10.2. DeviceNet specification

EDS file:	SPX_CU8681_D4-X.Y.eds (with X.Y = EDS revision)
Icons:	SPX_CU8681_D4-X.Y.ico
Baud rate:	125 kBit/s, 250 kBit/s, 500 kBit/s (can be adjusted using DIP switches 7, 8); factory setting: 125 kBit/s (see chapter “10.10.2. Setting the baud rate”)
Address:	0 ... 63 (via DIP switches 1 ... 6 adjustable); factory setting: 63 (see chapter “10.10.1. Setting of the DeviceNet address”)
Process data:	1 static input assembly (Input: from 8681 Control Unit - D4 to DeviceNet master/scanner) 1 static output assembly (Output: from DeviceNet master/scanner to 8681 Control Unit - D4)
Inputs:	Process valve state *or* sensor state – dependent on selected process valve type (refer to chapter “5.5” on page 32): D4, DA4, D4SL: *valve state* (closed, open, upper seat lift, lower seat lift), D4PMO: *sensor state* (S1, S2, S3, S4); Supply via DeviceNet string (11 ... 25 V DC) Switch level high signal ≥ 5 V Switch level low signal ≤ 1.5 V
Outputs:	3 pilot valves
Power consumption from the bus:	max. output 5 W, if all pilot valves are switched (3 x type 6524 with 0.6 W each)

10.2.1. Total line length and maximum line length according to DeviceNet specification

The bus line is a 4-core cable with additional shielding which must conform to the DeviceNet specification. The cable transmits both information (data) and energy (power supply for low-power actuators and sensors).

The maximum total line length (sum of trunk lines and drop lines) of a network depends on the baud rate.

When designing the network, the calculated cable length at the device must be 1 m - this takes into account the cable lengths installed outside (ca. 80 cm) and inside (ca. 20 cm) the control unit.

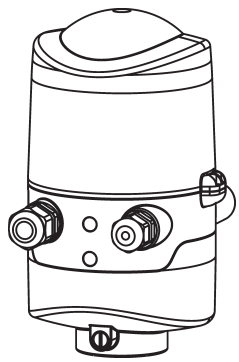
Baud rate	Maximum total line length*[1]		
	Thick Cable**	Mid Cable**	Thin Cable**
125 kBit/s	500 m	300 m	100 m for all baud rates
250 kBit/s	250 m	250 m	
500 kBit/s	100 m	100 m	

* *According to DeviceNet specification. If a different cable type is used, lower maximum values apply.*
** *For cable designation and details - see DeviceNet specification.*

10.2.2. Drop line length

Baud rate	Length of the drop lines	
	Maximum length	Maximum total length of all drop lines in the network
125 kBit/s	6 m for all baud rates	156 m
250 kBit/s		78 m
500 kBit/s		39 m

10.3. Electrical connection



Connection left: for voltage and signals

(M12 plug according to IEC 61076-2-101, 5-pole, cable length ca. 80 cm)

Connection right: for external position sensor

(M12 plug according to IEC 61076-2-101, 4-pole, cable length ca. 20 cm)

Fig. 25: Connection concept DeviceNet

10.4. Electrical data

Connections:

Multi-pole connection:	**For power supply and signals:** 1 x M16 x 1.5 cable gland / SW22 with multi-pole connection (M12 plug according to IEC 61076-2-101, 5-pole, cable length ca. 80 cm)
	For external position sensor: 1 x M16 x 1.5 cable gland/SW19 with multi-pole connection (M12 plug according to IEC 61076-2-101, 4-pole, cable length ca. 20 cm)
Power supply:	11 … 25 V DC (according to specification)
Max. power consumption:	<200 mA at 24 V DC (200 ms after switching on of the valves)

Inputs (from master perspective) / binary or analog feedback signals:
The recovery of the 3 valve positions reported back in binary format or the analog position signal is described in chapter “12” on page 83.

Outputs (from master perspective) / pilot valves:

Typ. switching capacity:	0.9 W (per pilot valve, for 200 ms after switching on)
Typ. continuous output:	0.6 W (per pilot valve, from 200 ms after switching on)
Power consumption per Pilot valve:	50 mA at 12 V DC 25 mA at 24 V DC 22 mA at 28 V DC
Operating mode:	Long-term operation (100% ED)
Valve types:	6524

Central display of the switching states:

Power consumption from DeviceNet at 24 V DC:	ca. 42 mA with a power supply of 24 V DC per illuminated display; colour switching see chapter “14. LED Colour Assignments / Display via Top LED” on page 90

10.5. Safety position if the bus fails

If the bus fails, the pilot valve is switched to a programmable safety position (default: pilot valve not energized). For configuration data see chapter “10.13.1. Configuration of the safety position of pilot valves during a bus error”.

10.6. Design aid

Power consumption of the electronics:									
P_{EI}	=	1.44 W	or	I_{EI}	=	60 mA	at	24 V	
Power consumption of a valve during activation (200 ms):									
$P_{Valve-ON}$	=	0.9 W	or	$I_{Valve-ON}$	=	38 mA	at	24 V	
Power consumption of a valve after reduction:									
P_{Valve}	=	0.6 W	or	I_{Valve}	=	25 mA	at	24 V	
Power consumption of an optical position report:									
P_{LED}	=	1.0 W	or	I_{LED}	=	42 mA	at	24 V	

Calculation examples:

Example 1: 3 valves are activated simultaneously, one position is reported (state for 200 ms):						
P_{Total}	=	P_{EI}	+	3 x $P_{Valve-ON}$	+	1 x P_{LED}
5.14 W	=	1.44 W	+	3 x 0.9 W	+	1 x 1.0 W
or						
I_{Total}	=	I_{EI}	+	3 x $I_{Valve-ON}$	+	1 x I_{LED}
216 mA	=	60 mA	+	3 x 38 mA	+	1 x 42 mA

Example 2: 3 valves have been activated simultaneously, one position is reported (persistent state):						
P_{Total}	=	P_{EI}	+	3 x P_{Valve}	+	1 x P_{LED}
4.24 W	=	1.44 W	+	3 x 0.6 W	+	1 x 1.0 W
or						
I_{Total}	=	I_{EI}	+	3 x I_{Valve}	+	1 x I_{LED}
177 mA	=	60 mA	+	3 x 25 mA	+	1 x 42 mA

10.7. Safety instructions

DANGER!

Risk of injury due to electric shock!

- Before reaching into the system, switch off the power supply and secure it to prevent restarting!
- Observe applicable accident prevention and safety regulations for electrical equipment!
- When setting the position measuring system (Teach), do not contact any live components!

WARNING!

Risk of injury due to unintentional activation of the system and uncontrolled restart!

- Secure system against unintentional activation; following assembly, ensure a controlled restart.

CAUTION!

Risk of injury due to improper installation!

- Installation may be carried out by trained technicians only and with the appropriate tools!

10.8. Electrical installation

Internal cabling work is not required for any of the DeviceNet designs (cable with multi-pole connection), which makes installation and start-up on site considerably easier and quicker, reducing the risk of leaks.

However, you will require the correspondingly assembled cable sets with the following pin assignments (see “Fig. 26” and table below).

Bus connection for DeviceNet and power supply:

Circular plug M12 x 1, 5-pole, male, cable length ca. 80 cm,
the configuration conforms to the DeviceNet specification.

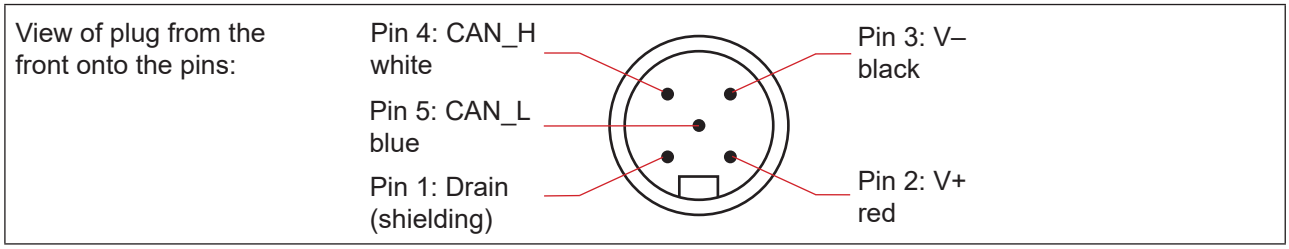


Fig. 26: Bus connection of DeviceNet with power supply

Pin	1	2	3	4	5
Signal	Shielding	V +	V –	CAN_H	CAN_L
Colour		red	black	white	blue

DeviceNet electronic module:

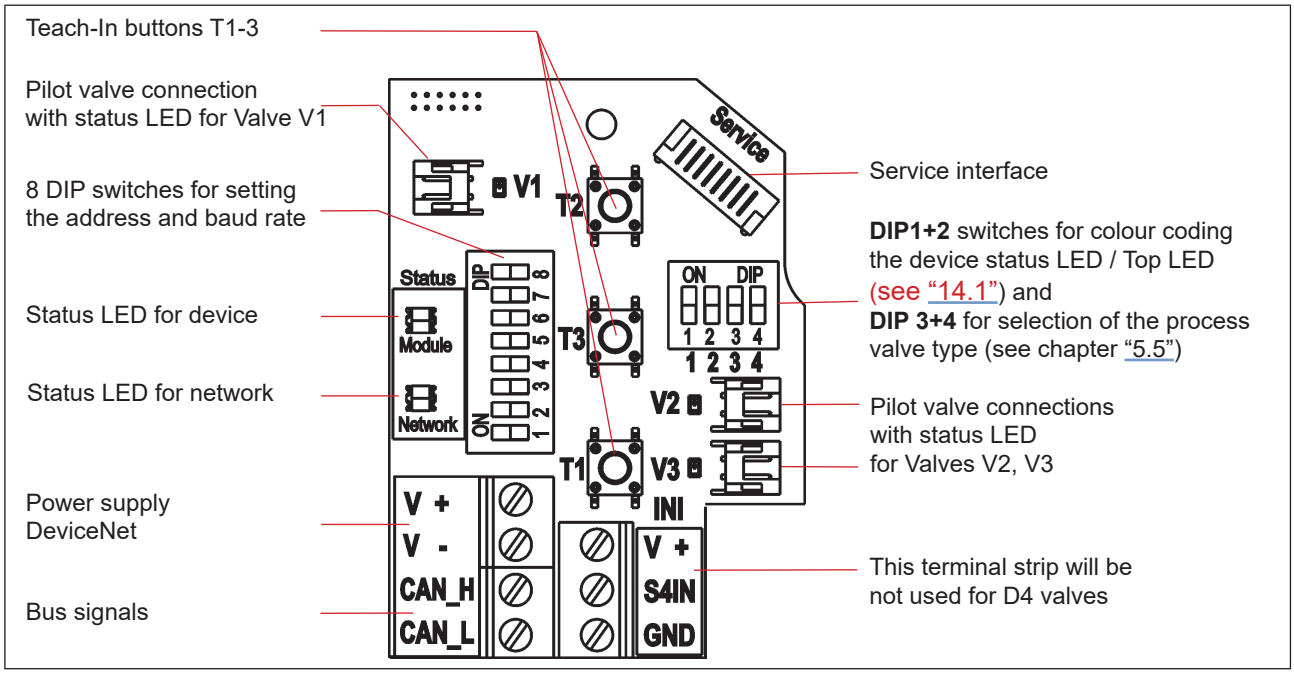


Fig. 27: DeviceNet electronic module

Terminal strip configuration:

Designation Terminal strip	Configuration
V+	Power supply DeviceNet
V -	Power supply DeviceNet
CAN_H	Bus signal CAN high
CAN_L	Bus signal CAN low

10.9. Network topology of a DeviceNet system

When installing a DeviceNet system, ensure that the terminating circuit of the data lines is correct. The circuit prevents the occurrence of interference caused by signals reflected onto the data lines.

The trunk line must be terminated at both ends with resistors of 120 Ω and 1/4 W power loss (see “Fig. 28: Network topology”).

“Fig. 28” illustrates a line with one trunk line and several drop lines. Trunk lines and drop lines consist of identical material.

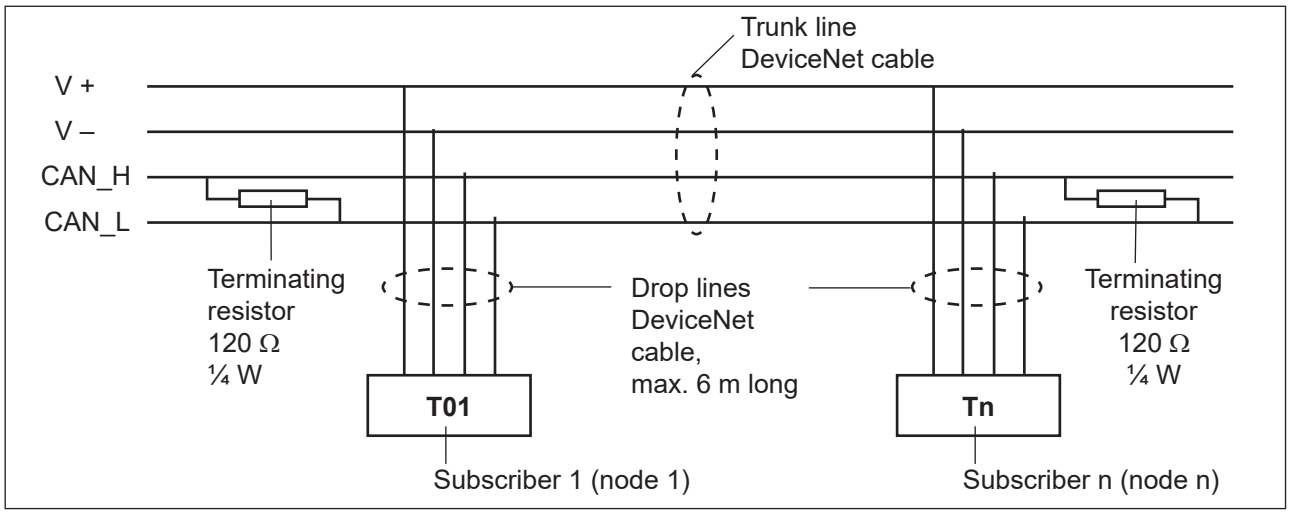


Fig. 28: Network topology

10.10. Configuration of the DeviceNet address/baud rate

8 DIP switches are available for configuration:

- DIP switches 1 to 6 for the DeviceNet address
- DIP switches 7 to 8 for the baud rate

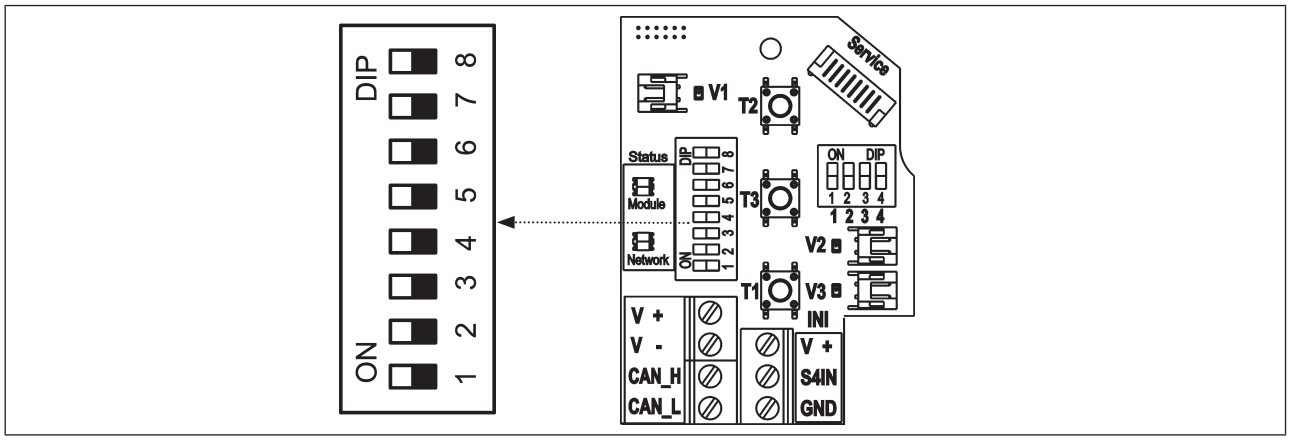


Fig. 29: Position of the DIP switches for baud rate and addressing on the electronic module

10.10.1. Setting of the DeviceNet address

MAC ID address = Medium Access Control Identifier Address

MAC ID address = [DIP 1 · 2^0 + DIP 2 · 2^1 + DIP 3 · 2^2 + DIP 4 · 2^3 + DIP 5 · 2^4 + DIP 6 · 2^5]

with DIP x = off = 0 and DIP x = on =1

Table of the settings of the DeviceNet address:

MAC ID	DIP1	DIP2	DIP3	DIP4	DIP5	DIP6
0	off	off	off	off	off	off
1	on	off	off	off	off	off
2	off	on	off	off	off	off
3	on	on	off	off	off	off
4	off	off	on	off	off	off
5	on	off	on	off	off	off
6	off	on	on	off	off	off
7	on	on	on	off	off	off
8	off	off	off	on	off	off
9	on	off	off	on	off	off
10	off	on	off	on	off	off
11	on	on	off	on	off	off
12	off	off	on	on	off	off
13	on	off	on	on	off	off
14	off	on	on	on	off	off
15	on	on	on	on	off	off
16	off	off	off	off	on	off
17	on	off	off	off	on	off
18	off	on	off	off	on	off
19	on	on	off	off	on	off
20	off	off	on	off	on	off
21	on	off	on	off	on	off
22	off	on	on	off	on	off
23	on	on	on	off	on	off
24	off	off	off	on	on	off
25	on	off	off	on	on	off
26	off	on	off	on	on	off
27	on	on	off	on	on	off
28	off	off	on	on	on	off
29	on	off	on	on	on	off
30	off	on	on	on	on	off
31	on	on	on	on	on	off

MAC ID	DIP1	DIP2	DIP3	DIP4	DIP5	DIP6
32	off	off	off	off	off	on
33	on	off	off	off	off	on
34	off	on	off	off	off	on
35	on	on	off	off	off	on
36	off	off	on	off	off	on
37	on	off	on	off	off	on
38	off	on	on	off	off	on
39	on	on	on	off	off	on
40	off	off	off	on	off	on
41	on	off	off	on	off	on
42	off	on	off	on	off	on
43	on	on	off	on	off	on
44	off	off	on	on	off	on
45	on	off	on	on	off	on
46	off	on	on	on	off	on
47	on	on	on	on	off	on
48	off	off	off	off	on	on
49	on	off	off	off	on	on
50	off	on	off	off	on	on
51	on	on	off	off	on	on
52	off	off	on	off	on	on
53	on	off	on	off	on	on
54	off	on	on	off	on	on
55	on	on	on	off	on	on
56	off	off	off	on	on	on
57	on	off	off	on	on	on
58	off	on	off	on	on	on
59	on	on	off	on	on	on
60	off	off	on	on	on	on
61	on	off	on	on	on	on
62	off	on	on	on	on	on
63	on	on	on	on	on	on

10.10.2. Setting the baud rate

Adjustment of the device to the baud rate of the network (see “Fig. 29” on page 60).

Baud rate	DIP 7	DIP 8
125 kBit/s	off	off
250 kBit/s	on	off
500 kBit/s	off	on
not permitted:	(on)	(on)

If the settings are changed by actuating the DIP switches, this change will not take effect until the device is restarted!

For a restart:

- briefly disconnect the device from the power supply and reconnect or
- switch the power supply off/on or
- transmit an appropriate reset message.

10.11. Configuration of the process data

To **transmit process data** via an I/O connection, 1 static input and 1 static output assembly are available. These assemblies contain selected attributes combined into one object so that process data can be transmitted collectively via an I/O connection.

The **process data** is selected by setting the device parameters Active Input Assembly and Active Output Assembly or - if supported by the DeviceNet-Master/Scanner - by setting Produced Connection Path and Consumed Connection Path when an I/O connection is initialized according to the DeviceNet specification.

10.11.1. Static input assembly

Name	Address of data attribute of the assembly for read access. Class, instance, attribute	Format of the data attribute Value 0: OFF, Value 1: ON
Sensor state, valve state	4, 1, 3	**Byte 0:** Bit 0 - 3: position sensor state: Bit 0: S1 Bit 1: S2 Bit 2: S3 Bit 3: S4 (Bit 0 - 3 = 0, if process valve type “D4” , “DA4” or “D4SL” selected) Bit 4 – 7: valve state: (see below)

Name	Address of data attribute of the assembly for read access. Class, instance, attribute	Format of the data attribute Value 0: OFF, Value 1: ON
Sensor state, valve state	4, 1, 3	Bit 4 – 7: valve state: Bit 4: closed Bit 5: open Bit 6: upper seat lift Bit 7: lower seat lift (Bit 4 - 7 = 0, if process valve type “D4PMO” selected) For process valve type selection refer to chapter “5.5”.

The address listed in the table above ("Static input assembly") can be used as path data for the Produced Connection Path attribute of an I/O connection.

Nevertheless, by using this address data, the attributes combined in the assemblies can also be accessed acyclically via Explicit Messages.

10.11.2. Static output assembly

Name	Address of data attribute of the assemblies for read access. Class, instance, attribute	Format of the data attribute Value 0: OFF, Value 1: ON
Pilot valves V1…3	4, 21, 3	**Byte 0:** Bit 0: Pilot valve V1 Bit 1: Pilot valve V2 Bit 2: Pilot valve V3 Bit 3…7: not used

The address listed in the table above ("Static output assembly") can be used as path data for the Produced Connection Path attribute of an I/O connection.

Nevertheless, by using this address data, the attributes combined in the assemblies can also be accessed acyclically via Explicit Messages.

10.12. Logic tables for the valve D4 series

The following logic tables work internally in the device, the combination of the single (target) signals S1-S4 results in the final signal for the valve state or sensor state for SPX D4PMO (indicated with the device status LED/Top LED).

The combination of the target signals S1-S4 for a special valve state depends on the valve type - see the following tables:

10.12.1. Logic tables for SPX D4

valve state	**linear sensor 2 (teach data)** (external position sensor)		**linear sensor 1 (teach data)** (internal position sensor)	
	S1	**S2**	**S3**	**S4**
closed	1	0	1	0
open	0	0	0	1

Static input assembly (class, instance, attribute: 4, 1, 3)			**Format of the data attribute Value 0: OFF, Value 1: ON**
Byte 0:	Bit 0	sensor state	0 (not used)
	Bit 1		0 (not used)
	Bit 2		0 (not used)
	Bit 3		0 (not used)
	Bit 4	valve state	**closed**
	Bit 5		**open**
	Bit 6		0 (not used)
	Bit 7		0 (not used)

Static output assembly (class, instance, attribute: 4, 21, 3)		**Pilot V1** (main stroke)
Byte 0:	Bit 0	1
	Bit 1	0
	Bit 2	0
	Bit 3 -7	not used

10.12.2. Logic tables for SPX DA4

valve state	linear sensor 2 (teach data) (external position sensor)		linear sensor 1 (teach data) (internal position sensor)	
	S1	S2	S3	S4
closed	1	0	0	0
open	0	0	0	1
upper seat lift	0	1	0	0
lower seat lift	1	0	1	0

Static input assembly (class, instance, attribute: 4, 1, 3)		Format of the data attribute Value 0: OFF, Value 1: ON
Byte 0:		
Bit 0	sensor state	0 (not used)
Bit 1		0 (not used)
Bit 2		0 (not used)
Bit 3		0 (not used)
Bit 4	valve state	**closed**
Bit 5		**open**
Bit 6		upper seat lift
Bit 7		lower seat lift

Static output assembly (class, instance, attribute: 4, 21, 3)	Pilot V1 (main stroke)	Pilot V2 (upper seat lift)	Pilot V3 (lower seat lift)
Byte 0:			
Bit 0	1	0	0
Bit 1	0	1	0
Bit 2	0	0	1
Bit 3 - 7	not used		

10.12.3. Logic tables for SPX D4SL

valve state	linear sensor 2 (teach data) (external position sensor)		linear sensor 1 (teach data) (internal position sensor)	
	S1	**S2**	**S3**	**S4**
closed	1	0	1	0
open	0	0	0	1
upper seat lift	0	1	1	0
lower seat lift	1	0	0	0

Static input assembly (class, instance, attribute: 4, 1, 3)		Format of the data attribute Value 0: OFF, Value 1: ON
Byte 0:		
Bit 0	sensor state	0 (not used)
Bit 1		0 (not used)
Bit 2		0 (not used)
Bit 3		0 (not used)
Bit 4	valve state	**closed**
Bit 5		**open**
Bit 6		upper seat lift
Bit 7		lower seat lift

Static output assembly (class, instance, attribute: 4, 21, 3)	Pilot V1 (main stroke)	Pilot V2 (upper seat lift)	Pilot V3 (lower seat lift)
Byte 0:			
Bit 0	1	0	0
Bit 1	0	1	0
Bit 2	0	0	1
Bit 3 - 7	not used		

10.12.4. Logic tables for SPX D4PMO

The static input assembly (class, instance, attributes 4, 1, 3) of the control unit for this valve type is the sensor signal of the taught position, not the valve state - see the following tables.

The valve state combination table must be implemented in the PLC software.

The opposite valve stem remains in “closed position” during seat lifting - this can be monitored by observing the corresponding sensor position signal.

Valve state	**linear sensor 2 (teach data)** (external position sensor)		**linear sensor 1 (teach data)** (internal position sensor)	
	S1	**S2**	**S3**	**S4**
closed	1	0	1	0
open	0	0	0	1
upper seat lift	0	1	1	0
lower seat lift	1	0	0	0

Static input assembly (class, instance, attribute: 4, 1, 3)		**Format of the data attribute Value 0: OFF, Value 1: ON**
Byte 0:		
Bit 0	sensor state	S1
Bit 1		S2
Bit 2		S3
Bit 3		S4
Bit 4	valve state	0 (not used)
Bit 5		0 (not used)
Bit 6		0 (not used)
Bit 7		0 (not used)

Static output assembly (class, instance, attribute: 4, 21, 3)	**Pilot V1** (main stroke)	**Pilot V2** (upper seat lift)	**Pilot V3** (lower seat lift)
Byte 0:			
Bit 0	1	0	0
Bit 1	0	1	0
Bit 2	0	0	1
Bit 3 - 7	not used		

10.13. Configuration of the device

10.13.1. Configuration of the safety position of pilot valves during a bus error

The *valve safety position* and the *safety mode* attributes can be used to configure the pilot valves in the event of a bus error.

The configuration data of the (behaviour of) pilot valves in case of a bus error can be accessed acyclically via Explicit Messages.

- The *Get_Attribute_Single* service stands for a **read access** of the configuration data.
- The *Set_Attribute_Single* service stands for a **write access** of the configuration data.

1 data byte for **safety mode**:
(attribute address:
class 150, instance 1, attribute 7)

Bit	Mode	Value assignment
Bit 0	Charac-teristics in event of bus error	0 Approach safety position 1 Retain last valve position
Bits 1...7	not used	0 (always)

1 data byte for **valve safety position**:
(attribute address:
class 150, instance 1, attribute 6)

Value	Pilot valve 1	Pilot valve 2	Pilot valve 3
0	OFF	OFF	OFF
1	**ON**	OFF	OFF
2	OFF	**ON**	OFF
3	OFF	OFF	**ON**

NOTE!
Maximum one pilot valve can be switched **ON** in safety position at the same time!

10.13.2. Configuration example

The example describes the principle procedure when configuring the device using the RSNetWorx software for DeviceNet (revision V.24.00).

Installation of the EDS File:

The EDS file is installed with the aid of the EDS Installation Wizard Tool associated with RSNetWorx.

During the installation procedure the icon can be assigned (if this does not occur automatically).

Offline parameterization of the device:

When a device has been inserted into the DeviceNet configuration of RSNetWorx, the device can be parameterized offline.

“Fig. 30” indicates how, for example, the process valve safety position which deviates from the factory setting can be selected.

For the D4 valves series is only one input assembly available – explained in “10.11.1. Static input assembly”.

All parameter changes implemented offline must become operative for the real device at a later date by a download process.

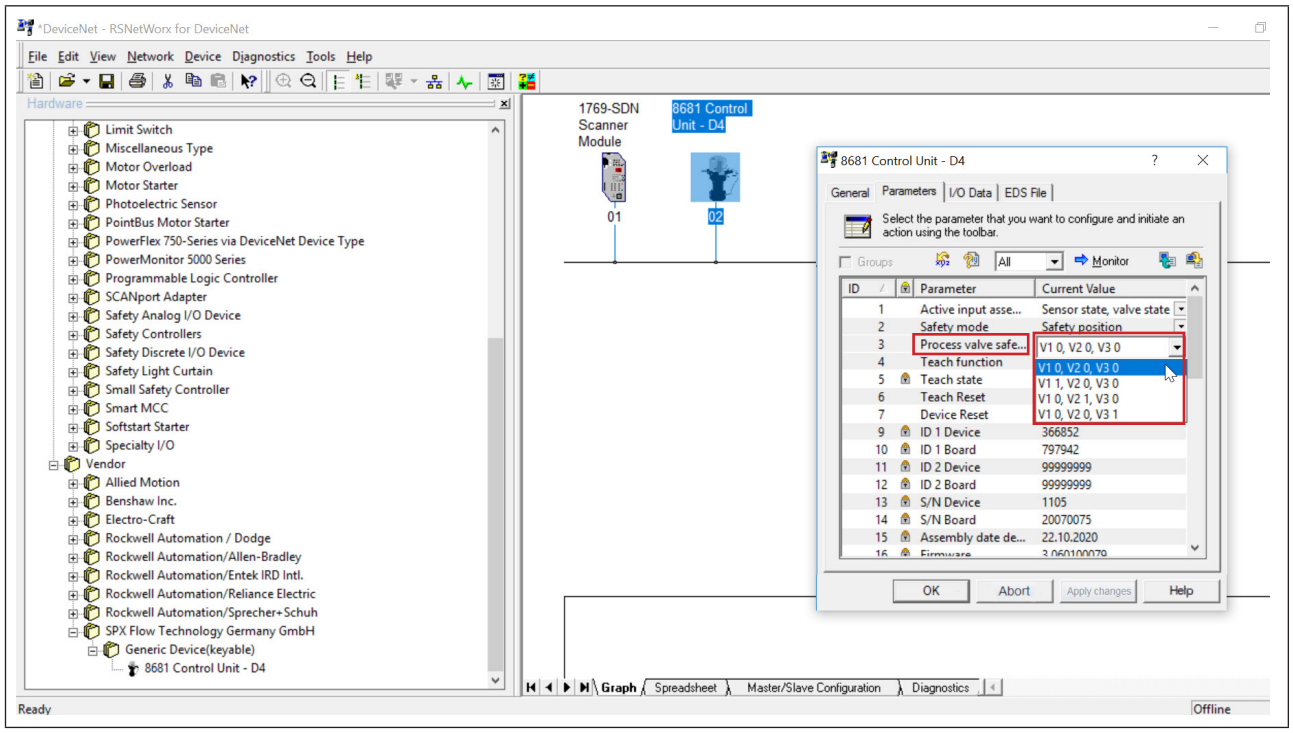


Fig. 30: Selecting, for example, the Process valve safety position (screenshot)

Online parameterization of the device:

Devices can also be parameterized online. In doing so, you can also select whether only individual parameters (single) or all parameters (all) of a group are read from the device (upload) or are loaded into the device (download).

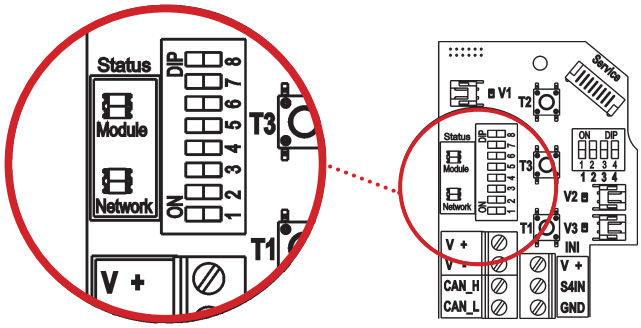
It is also possible to transfer individual parameters or all parameters of a group cyclically in monitor mode. This may be helpful particularly for start-up purposes.

10.13.3. EDS description

The DeviceNet parameters are listed in a table in the “22. Appendix 1 - EDS description for DeviceNet” on page 112

10.14. Display of the status LEDs in the event of a bus error

The bus errors are also indicated by the central multi-colour status display (device status LED / Top LED) - see chapter “14.3. Blinking pattern & fault signaling”.



The device status LED ("modules") and the bus status LED ("network") are located on the electronic module.

The errors displayed here on the electronic module are also signalled via the central multi-colour status display (device status LED / Top LED) - compare chapter “14” on page 90.

Fig. 31: Status LEDs on a DeviceNet electronic module

Function tests for both status LEDs after power has been switched on (connection of the network cable):

Status LED	Colours of the LED	Function test
"Modules"	green / red	• 250 ms ON (green) • 250 ms ON (red)
"Network"	green / red	• 250 ms ON (green) • 250 ms ON (red)

When the test is complete, the status LEDs indicate the device states which are described in the following tables (“10.14.1”, “10.14.2”).

10.14.1. Status of the device status LED "Modules"

LED	Device state	Explanation
Off	No supply	Device is not supplied with voltage
Green	Device is working	Normal operating state
Flashes red		The DIP switch setting for the baud rate or the MAC ID address has been changed and does not correspond to the value read during the last device restart. The change will not be applied until the next device restart.

10.14.2. State of bus status LED "Network"

LED	Device state	Explanation	Troubleshooting
Off	No voltage / not online	• Device is not supplied with voltage • Device has still not ended Duplicate MAC ID Test (test lasts approx. 2 s) • Device cannot end Duplicate MAC ID Test.	• Connect other devices, if the device is the only network subscriber, • replace device • check baud rate • check bus connection
Green	Online, connection to master exists	• Normal operating state with established connection to the master	
Flashes green	Online, without connection to master	• Normal operating state without established connection to the master	
Flashes red	Connection time-out	• One or more I/O connections are in Time-Out state	• New connection establishment by master to ensure that the I/O data is transmitted cyclically.
Red	Critical fault	• Another device with the same MAC ID address is in the circuit • No bus connection due to communication problems	• Check baud rate • Please check address as possible troubleshooting • If required, replace device

11. IO-LINK - DESIGN

IO-Link is a worldwide standardised IO technology (IEC 61131-9) for communicating with sensors and actuators. IO-Link is a point-to-point communication system with 3- or 5-conductor connection technology for sensors and actuators and unshielded standard sensor lines.

The 8681 Control Unit - D4 is available in this variant:

- **Port class A:** with a shared power supply (Power 1) for supply of the system as well as the actuators (solenoid valves).

The devices conform to the specifications as described in greater detail in chapter “11.4”.

11.1. Network principle / interfaces

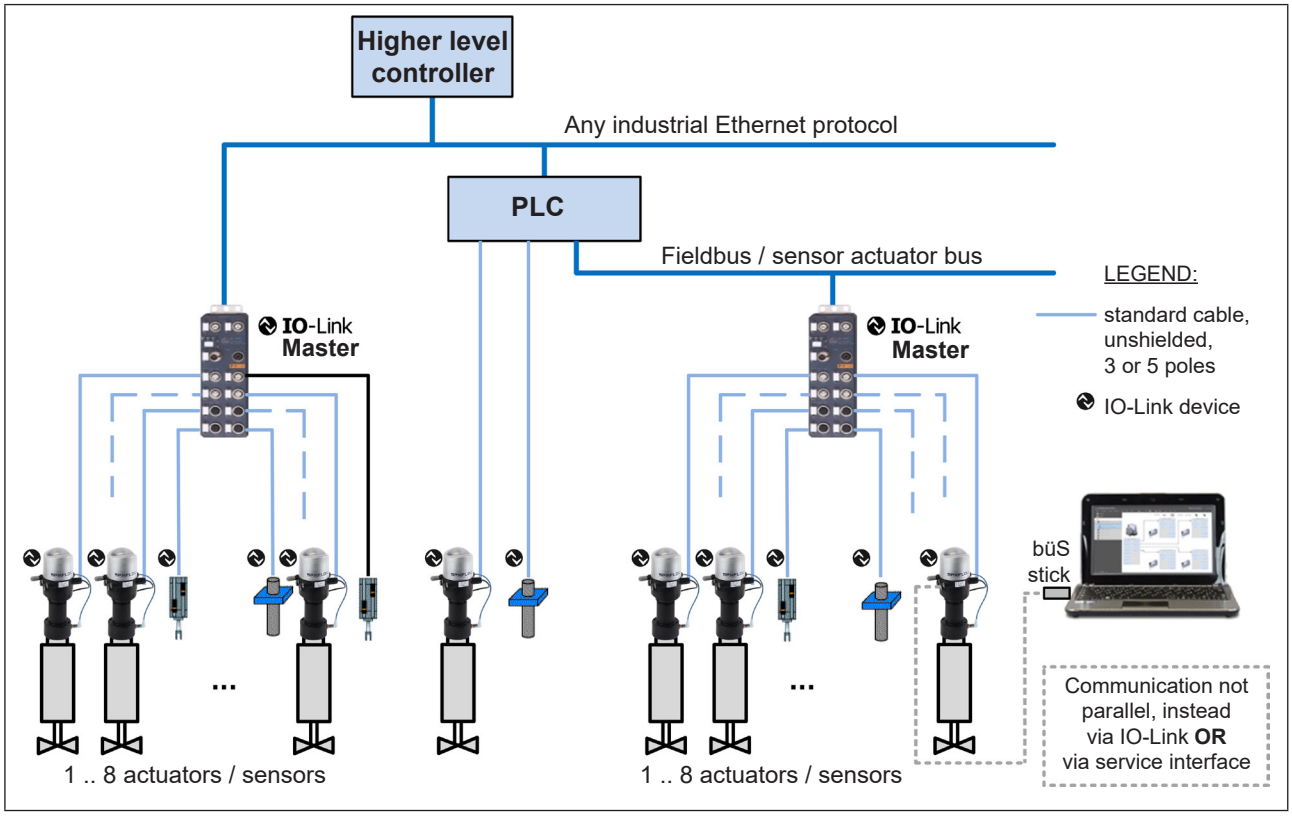


Fig. 32: Network principle of IO-Link

The **device parametrisation** is possible via IO-Link or via the Bürkert Communicator, but not simultaneously – see also chapter “11.3. IO-Link master / communication / configuration”.

The **selection of the D4 series process valve type** is described in chapter “5.5”.

11.2. Quickstart for the initial start-up

Network layout:

IO-Link devices are connected with standard commercial IO-Link masters and can easily be integrated into all commonly used fieldbus and automation systems.

The network is structured similarly to the diagram in “Fig. 32”.
3-pin or 5-pin unshielded standard cables of 20 m length between the IO-Link device and IO-Link master are sufficient for connecting IO-Link devices with IO-Link masters.

The IO-Link devices are equipped with M12 connectors (4 pole plug) at cables of 80 cm length. For details see chapter “11.5”.

Configuration:

The network will be configured by the higher-level controller/PLC. For details see chapter “11.3”.

The IODD description can be found in Appendix 2 (starting from page 117).

Software download / firmware updates:

The appropriate software files, descriptions and manuals can be downloaded from the Internet. Details can be found in chapter „11.7“.

11.3. IO-Link master / communication / configuration

IO-Link master

IO-Link masters are used as the interface between IO-Link devices and the higherlevel controller. All common IO-Link masters according to the specification (see chapter “11.4”) can be used.

The “addressing” of the IO-Link devices is defined by the connection or port on the IO-Link master – this must be noted when replacing the devices or the master.

Configuration / parametrisation / communication

After the network has been set up (see for example chapter “11.1”) and the correct software has been installed in the IO-Link devices (see IODD / IODD description) **the network has to be configured** using the higher-level controller.

For configuration/parametrisation, an IO-Link device can also be connected to the Bürkert Communicator via the service interface (micro USB connection) on the electronic module (see “Fig. 34” and also chapter “11.7.2”) in parallel to the IO-Link connection.

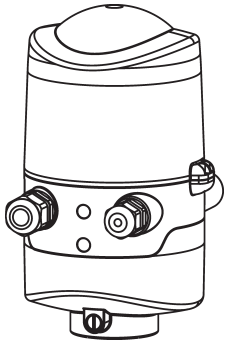
To ensure **clear communication,** IO-Link devices should be parametrised **not simultaneously** by the higher-level controller or PLC via the IO-Link master and with the Bürkert Communicator (via the micro USB connection).

11.4. Technical Data / specification

IO-Link specification:	Version 1.1.2
Port Class A:	shared power supply for the supply of the system and of the actuators (solenoid valves)
Power supplay:	Port Class A: via IO-Link connection (M12x1, 4-pole A-coded); for details see chapter „11.5.6“)
Operation mode:	IO-Link operation mode (SIO operation mode is not supported)
VendorID:	0x35C3, 13763 decimal (SPX Flow Technology Germany GmbH)
DeviceID:	see the respective IODD file Port Class A: 20 decimal
Transmission speed:	COM3 (230.4 kbit/s)
M-sequence type in Operate Mode:	TYPE_2_V
Min. cycle time:	5 ms
Data storage:	yes
Max. line length:	20 m each between IO-Link master and IO-Link device

11.5. Electrical Data

11.5.1. Electrical connection



Connection left:	for voltage and signals (M12 plug according to IEC 61076-2-101, 4-pole (Port Class A), cable length ca. 80 cm)
Connection right:	for external position sensor (M12 plug according to IEC 61076-2-101, 4-pole, cable length ca. 20 cm)

Fig. 33: Connection concept IO-Link

11.5.2. Electrical Data

Connection lines: IO-Link devices and IO-Link masters are connected by unshielded 3- or 5-conductor standard lines maximum 20 m in length with a cross-section of ≥0,34 mm²

Operating voltage: 18...30 V DC (according to specification - see chapter „11.4“)

Protection class: 3 in accordance with DIN EN 61140 (VDE 0140-1)

Current consumption for port class A (supply of the system and the actuators (solenoid valves)):

Max. current consumption: i.e. 2 solenoid valves active, 1 solenoid valves switches on (for 200 ms), 1 position feedback via LED display:
Port Class A: <151 mA at 24 V DC

Current consumption in persistent state: i.e. 3 solenoid valves active, 1 position feedback via LED display:
Port Class A: <138 mA at 24 V DC

Idle current: i.e. no solenoid valve active, no position feedback via LED display:
Port Class A: <42 mA at 24 V DC

Inputs (Control Unit –> IO-Link master/PLC) / binary or analogue feedback signals:
The recovery of the 4 valve positions reported back in binary format or the analogue position signals is described in chapter „12. Position Measuring System / Inductive Position Sensors“. The analogue target position signals (resolution: 0.1 mm) are available as cyclical value/parameter.

Outputs (IO-Link master/PLC –> Control Unit) / solenoid valves:

Typ. switching capacity:	0.9 W (per solenoid valve, for 200 ms after the power has been switched on)
Typ. continuous capacity:	0.6 W (per solenoid valve from 200 ms after the power has been switched on)
Reduction in output:	Integrated via the IO-Link electronics
Typ. inrush current:	38 mA or 0.9 W / 200 ms (per solenoid valve)
Typ. hold current:	25 mA or 0.6 W at 24 V DC (per solenoid valve)
Operation mode:	Continuous operation (100% duty cycle)
Valve types:	6524

Central display of the switching statuses:

Current consumption from IO-Link at 24 V DC: Approx 21 mA for a power supply of 24 V DC for each indicator light shown; for details see chapter „14. LED Colour Assignments / Display via Top LED“ on page 90.

11.5.3. Safety position if the bus fails

Bus errors can occur for example due to communication problems with the IO-Link master or PLC. When a bus failure occurs, the solenoid valves are switched to a programmable safety position (default: solenoid valves de-energised).

A bus failure or bus error is indicated by the central multicolour device status display (top LED).

Internal safety position

If internal errors are detected by the device, or if the power supply of the solenoid valves cannot be ensured, for example due to (massively) exceeding or falling short of the permitted power supply, the “internal safety position” of the solenoid valves is approached (i.e. all solenoid valves off) as long as the error persists.

11.5.4. Design aid

The values were determined for the design voltage of 24 V DC.

Power/current consumption for Port Class A:

Power consumption of the electronics:							
P_{el}	=	1.0 W	or	I_{el}	=	42 mA	at 24 V
Power consumption of a valve during activation (200 ms):							
$P_{valve\ ON}$	=	0.9 W	or	$I_{valve\ ON}$	=	38 mA	at 24 V
Power consumption of a valve after reduction:							
P_{valve}	=	0.6 W	or	I_{valve}	=	25 mA	at 24 V
Power consumption of an optical position feedback:							
P_{LED}	=	0.5 W	or	I_{LED}	=	21 mA	at 24 V

Calculation examples (for Port Class A):

Example 1:
3 valves are activated, one position is reported (status for 200 ms) –
the device switches automatically one valve after another to keep the current consumption low – i.e.:
max. current consumption $I_{total,\ max.}$ = current consumption of 2 valves (already activated) + 1 valve (just switching)

P_{total}	=	P_{el}	+	2 x P_{valve}	+	1 x $P_{valve\ ON}$	+ 1 x P_{LED}
3,6 W	=	1.0 W	+	2 x 0.6 W	+	1 x 0.9 W	+ 1 x 0.5 W
or							
I_{total} @ 24 V	=	I_{el}	+	2 x I_{valve}	+	1 x $I_{valve\ ON}$	+ 1 x I_{LED}
151 mA	=	42 mA	+	2 x 25 mA	+	1 x 38 mA	+ 1 x 21 mA

Example 2:
3 valves have been activated, one position is reported (persistent state):

P_{total}	=	P_{el}	+	3 x P_{valve}	+	1 x P_{LED}
3,3 W	=	1.0 W	+	3 x 0.6 W	+	1 x 0.5 W
or						
I_{total} @ 24 V	=	I_{el}	+	3 x I_{valve}	+	1 x I_{LED}
138 mA	=	42 mA	+	3 x 25 mA	+	1 x 21 mA

11.5.5. Electrical Installation

For IO-Link devices with M12 connection (4-pole, male) on a 80 cm cable, no internal cabling work is required, which makes installation and start-up on site considerably easier and quicker, reducing the risk of leaks.

The pin assignment (see “Table 4”) corresponds to the IO-Link specification (see chapter “11.4”).

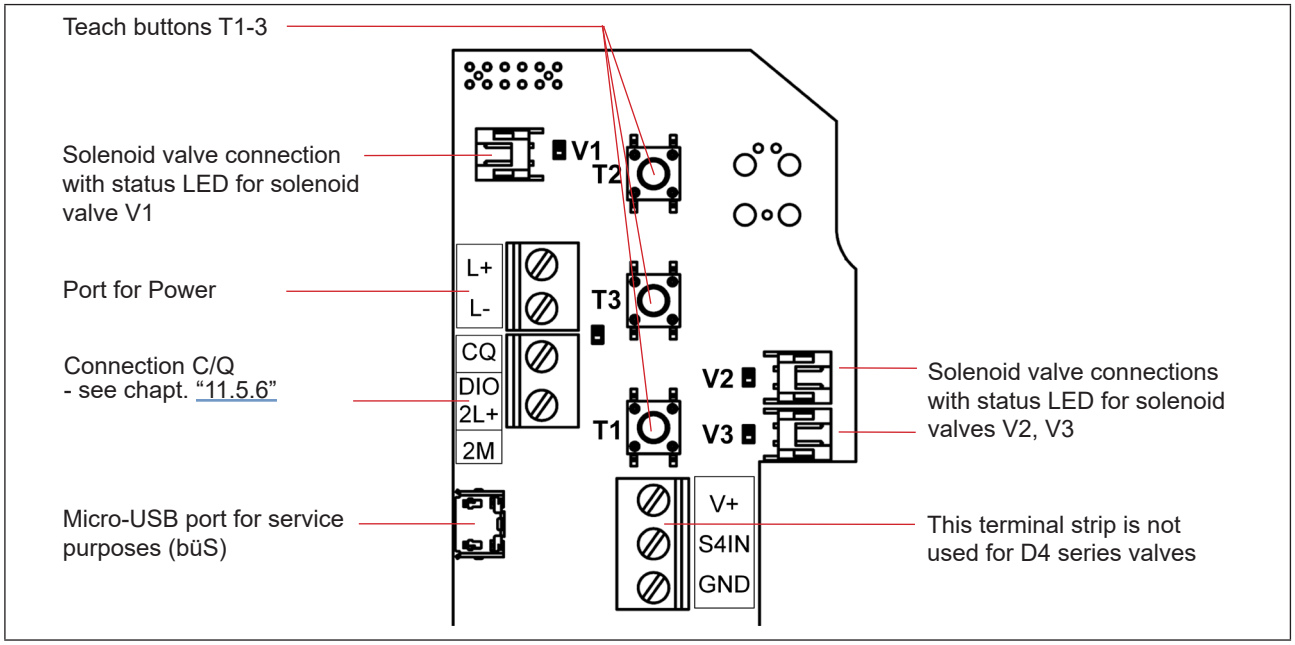
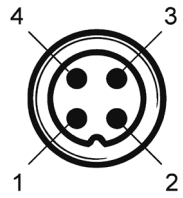


Fig. 34: Electronic module IO-Link (Port Class A)

For service technicians only: The **micro USB connection** is used for service purposes (e.g. parameterisation of the Control Unit, firmware update) – see also chapter “11.3” and “11.7.2”.

11.5.6. Pin assignment



Pin	Designation	Assignment (IO-Link operation mode)	Wire colour
1	L+	24 V DC	brown
2	DIO / 2L+	not used	(white)
3	L-	0 V (GND)	blue
4	C/Q	IO-Link	black

Table 4: Pin assignment for Port Class A connection (M12 plug, 4-pole)

11.6. Logic tables for the valve D4 serie

The following logic tables work internally in the device, the combination of the single (target) signals S1-S4 results in the final signal for the valve state or sensor state for SPX D4PMO (indicated with the device status LED/Top LED).

The combination of the target signals S1-S4 for a special valve state depends on the valve type - see the following tables:

11.6.1. Logic tables for SPX D4

valve state	**linear sensor 2 (teach data)** (external position sensor)		**linear sensor 1 (teach data)** (internal position sensor)	
	S1	**S2**	**S3**	**S4**
closed	1	0	1	0
open	0	0	0	1

Process Input Data („PDin“)		**Value 0: OFF, Value 1: ON**
Bit offset	(Data type: BooleanT)	
0	sensor state	S1
1		S2
2		S3
3		S4
...	(see “PDin” in IODD description: “23”)	
80	valve state	**closed**
81		**open**
82		0 (not used)
83		0 (not used)

Process Output Data („PDout“)	**Pilot V1** (main stroke)
Bit offset	(Data type: BooleanT)
0	1
1	0
2	0
3	Localisation function
4-7	not used

11.6.2. Logic tables for SPX DA4

valve state	linear sensor 2 (teach data) (external position sensor)		linear sensor 1 (teach data) (internal position sensor)	
	S1	S2	S3	S4
closed	1	0	0	0
open	0	0	0	1
upper seat lift	0	1	0	0
lower seat lift	1	0	1	0

Process Input Data („PDin“)		Value 0: OFF, Value 1: ON
Bit offset	(Data type: BooleanT)	
0	sensor state	S1
1		S2
2		S3
3		S4
...	(see “PDin” in IODD description: “23”)	
80	valve state	**closed**
81		**open**
82		upper seat lift
83		lower seat lift

Process Output Data („PDout“)	Pilot V1 (main stroke)	Pilot V2 (upper seat lift)	Pilot V3 (lower seat lift)
Bit offset	(Data type: BooleanT)		
0	1	0	0
1	0	1	0
2	0	0	1
3	Localisation function		
4-7	not used		

11.6.3. Logic tables for SPX D4SL

valve state	**linear sensor 2 (teach data)** (external position sensor)		**linear sensor 1 (teach data)** (internal position sensor)	
	S1	**S2**	**S3**	**S4**
closed	1	0	1	0
open	0	0	0	1
upper seat lift	0	1	1	0
lower seat lift	1	0	0	0

Process Input Data („PDin“)		**Value 0: OFF, Value 1: ON**
Bit offset	(Data type: BooleanT)	
0	sensor state	S1
1		S2
2		S3
3		S4
...	(see “PDin” in IODD description: “23”)	
80	valve state	**closed**
81		**open**
82		upper seat lift
83		lower seat lift

Process Output Data („PDout“)	**Pilot V1** (main stroke)	**Pilot V2** (upper seat lift)	**Pilot V3** (lower seat lift)
Bit offset	(Data type: BooleanT)		
0	1	0	0
1	0	1	0
2	0	0	1
3	Localisation function		
4-7	not used		

11.6.4. Logic tables for SPX D4PMO

The process input data of the control unit - for this valve type - are the sensor signals of the taught position, not the valve status - see the following tables.

The valve state combination table must be implemented in the PLC software.

The opposite valve stem remains in “closed position” during seat lifting - this can be monitored by observing the corresponding sensor position signal.

valve state	**linear sensor 2 (teach data)** (external position sensor)		**linear sensor 1 (teach data)** (internal position sensor)	
	S1	**S2**	**S3**	**S4**
closed	1	0	1	0
open	0	0	0	1
upper seat lift	0	1	1	0
lower seat lift	1	0	0	0

Process Input Data („PDin“)		**Value 0: OFF, Value 1: ON**
Bit offset	(Data type: BooleanT)	
0	sensor state	S1
1		S2
2		S3
3		S4
...	(see “PDin” in IODD description: “23”)	
80	valve state	0 (not used)
81		0 (not used)
82		0 (not used)
83		0 (not used)

Process Output Data („PDout“)	**Pilot V1** (main stroke)	**Pilot V2** (upper seat lift)	**Pilot V3** (lower seat lift)
Bit offset	(Data type: BooleanT)		
0	1	0	0
1	0	1	0
2	0	0	1
3	Localisation function		
4-7	not used		

11.7. Software / Firmware updates

11.7.1. Software / software descriptions

The necessary start-up files and descriptions for operating the IO-Link devices can be downloaded as a ZIP file from the following website:

ioddfinder.io-link.com

For further questions, please contact the SPX FLOW service.

11.7.2. Firmware updates

Firmware updates may only be made by service technicians or trained personnel!

Firmware updates can only be done via the service interface (micro USB connection, see „Fig. 34“ on page 77) on the electronic module.

Accessories and the **Bürkert Communicator** are required for this (see chapter „11.8“).

Connection of the device with a PC via service interface:

Connect the device via the service interface (micro USB connection) **via büS stick** to the PC on which the “Bürkert Communicator” program is installed (compare chapter “11.1. Network principle / interfaces” on page 72 and chapter „11.8“).

Because no voltage is transmitted via this micro USB connection, the device must be additionally supplied with voltage, e.g. via the IO-Link connection.

For a firmware update, please contact the SPX FLOW service.

11.8. Accessories

To connect the IO-Link device to the PC, a set with the following components is required **additionally to the Bürkert Communicator:**

- **büS stick,**
- **Programming cable** with M12 socket on mini-USB plug and 24 V DC socket
- **büS adapter** with M12 plug to micro USB plug

For further questions, please contact the SPX FLOW service.

12. POSITION MEASURING SYSTEM / INDUCTIVE POSITION SENSORS

12.1. Operating principle of the position measuring system

The position measurement is based on recording the change in position of two ferromagnetic targets inside the device, which are independent from each other. The geometry and the material of the targets to be used are synchronized with the sensitivity of the system.

The measurement precision is determined by the ferromagnetic properties of the targets and all other parts in the system. While the targets must be ferromagnetic, the other components are ideally made of materials that do not have ferromagnetic properties – see therefor chapter “4.6. Data of position sensors”.

The state (switching positions) of the process valve and also of the valve seats are reported to the higher-level control by feedback signals from the two inductive position sensors. The connection to the device is done by means of a simple adaptation to the process valve shaft (see also chapter “5. Assembly” on page 27).

12.2. Stroke range / feedback signals

The recordable stroke range for the
- internal position sensor (for target positions S3 + S4) is between 0 ... 80 mm,
- external position sensor (for target positions S1 + S2) is between 0 ... 40 mm.

4 discrete feedback signal are evaluated:
- Target position 1
- Target position 2
- Target position 3
- Target position 4

The valve state results from a combination of the target positions S1... S4. See therefor the respective “logic tables”
for 24 V DC design: “8.6. Logic tables for the valve D4 series” on page 42 or
for AS-i design: “9.10. Logic tables for the valve D4 series” on page 52 or
for DeviceNet: “10.12. Logic tables for the valve D4 series” on page 64
for IO-Link: “11.6. Logic tables for the valve D4 serie” on page 78.

The target positions are reported within a certain feedback field which can be adapted - see chapter “4.7.1. Feedback fields (tolerance band) of the position sensors” on page 24.

13. TEACH PROCEDURE

13.1. Teach buttons / Teach functions

In order to be able to display the valve and seat positions or switching states via the Top LED, the position of the valve and seat must be recorded via the targets of the two position sensors.

To teach the corresponding target positions for “valve closed/open” and “upper/lower seat lift”, an Autotune function is used - described in chapter “13.2”.

For special applications (to be performed by service personnel only) the teach procedure can be done manually - described in chapter “13.3. Manual teach procedure”.

On the electronic module inside the device are three Teach buttons T1 ... T3 to start the teach procedure or to reset the taught target positions (“Teach reset”) – see chapter “13.2.3”. The Teach buttons are accessible after removing the housing of the device (see chapter “6. Opening and Closing the Housing”).

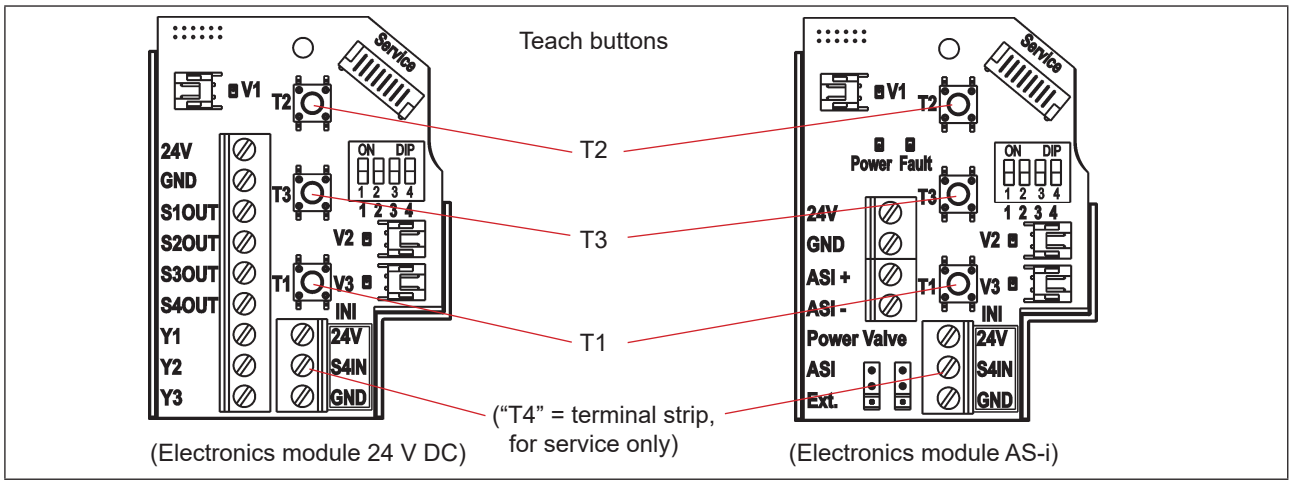


Fig. 35: Teach buttons on the electronic modules (in the example of the electronic modules for 24 V DC and AS-i)

13.2. Autotune function

13.2.1. Autotune mode / Autotune function

→ Ensure that the **pneumatic connections** have been made correctly, considering: A1 = V1 | A2 = V2 | A3 = V3, compare chapter “7.2. Pneumatic connection of 8681 Control Unit - D4” on page 35

→ Ensure that **control air** is supplied

→ Open the housing following the instructions in chapter “6. Opening and Closing the Housing”.

→ **Electrical power** has to be switched on (for the function of position measuring system and Top LED).

→ Ensure that the **valve type** is correctly set via DIP switches DIP3+4 (see “5.5. Selection of the process valve type (D4 series)” on page 32).

→ Ensure that **process valve is at closed position** before starting the Autotune mode and function.

→ **First start the Autotune mode** by pressing the buttons T2+T3 simultaneously for minimum 2.5 seconds.

→ **Then start the Autotune function** by pressing button T1 for ca. 0.5 seconds. (If the Autotune function has not been started 10 seconds after the change to Autotune mode, that mode will be exited.)

Teach button	Activation duration	Mode	Optical feedback		Teach button	Activation duration	Function	Optical feedback
T2 + T3	2.5 s	to start Autotune **mode**	red + yellow + green flashing sequentially (500 ms per colour)	+	T1	0.5 s	to start Autotune **function**	red + yellow + green flashing sequentially (200 ms per colour)

The Autotune function starts now the automatic teach procedure which is described in detail in “13.2.2”.

→ If required, return the device and system to normal operating state (switching position, power supply).

→ Close the housing following the instructions in chapter “6. Opening and Closing the Housing”.

If the Autotune function does not run properly or is aborted (if e.g. no compressed air is connected), the target positions already taught are deleted again, the Autotune function is left and switched to normal operation.

The target positions (S1 ... S4) are set to "not taught", i.e. the Top LED blinks in the fault colour.

13.2.2. Autotune function procedure

There is *one* autotune function. Depending on which process valve of the D4 series is used or selected (see chapter “5.5” on page 32), the autotune function will last differently:

Autotune function / procedure:

Control	Effect on the process valve	Internal program	Error
T2 + T3	**Autotune mode starts**		
T1	Autotune function starts		
	Start at closed position	Teach respective target position(s)	
	To open valve	Activate pilot valve 1	
		Wait period 10 s (+ 5 s***)**)	
	To teach open position	Teach respective target position(s)	
	To close valve	Deactivate pilot valve 1	
	Valve closes	Wait for closed position	Timeout 15s
Autotune function and mode completed if D4 valve type was connected - otherwise it continues with:			
	To bring upper seat in position	Activate pilot valve 2	
		Wait period 10 s (+ 5 s***)**)	
	To teach upper seat lift position	Teach respective target position(s)	
	To close upper seat	Deactivate pilot valve 2	
		Wait for closed position	Timeout 15s
	To bring lower seat in position	Activate pilot valve 3	
		Wait period 10 s (+ 5 s***)**)	
	To teach lower seat lift position	Teach respective target position(s)	
		Check process valve selection	Wrong process valve selection via DIP switch
	To close lower seat	Deactivate pilot valve 3	
		Wait for closed position	Timeout 15s
Autotune function completed and Autotune mode finished **)			

***)** *additional dynamic timeout, in case process valve movement was detected after 10 s timeout*

**) *This applies for IO-Link devices:*
After the Autotune procedure described above, a reference run is carried out during which the teach positions (taught in the respective Autotune function) are approached again one after the other. The travel times are determined and stored as reference values in the Autotune function.

In the event that a timeout occurs (after 15 seconds wait period) or a **wrong process valve selection** via DIP switch 3+4 was detected, the corresponding Autotune function will be exited and switched to normal operation.

Furthermore, the Teach positions are set to "not taught", i.e. the Top LED blinks in the fault colour - see chapter “14.3. Blinking pattern & fault signaling” and “16.5. Malfunctions” on page 100.

The autotune mode and function can also be activated in the same way via the PC service programm, therefor interconnect the device with the PC via the Service interface connection (see “Fig. 35”).

13.2.3. Autotune reset (Teach reset)

The Teach buttons can be used to reset the positions already taught by the autotune function:

→ To activate the **Teach reset**, press the buttons T1+T2 simultaneously for minimum 2.5 seconds (therefor you needn't to be in Autotune mode).

Teach button	Activation duration	"Teach reset"	Optical feedback
T1 + T2	2.5 s	Teach reset of all valve positions (S1, S2, S3 and S4)	If the Top-LED blinks in the fault colour (no position taught) - see chapter: "14.1. Top-LED display for 24 V DC / AS interface / DeviceNet devices" on page 90 "14.2. Top-LED display for IO-Link devices" on page 91 "14.3. Blinking pattern & fault signaling" on page 95

13.3. Manual teach procedure

The individual valve positions can be taught **manually** via the Teach buttons and these valve positions can be also reset (Teach reset - see chapter “13.2.3”).

The **manual teach procedure** should **only** be carried out under defined conditions **by trained personnel. The production process must not be disturbed.** If a device is exchanged under production conditions and therefore a teach procedure is necessary, the positions may only be taught if the process valve is in the defined position - see “Table 5: Teach buttons functions for manual teach procedure”.

Procedure:

→ Ensure that the **pneumatic connections** have been made correctly, considering: A1 = V1 | A2 = V2 | A3 = V3, compare chapter “7.2. Pneumatic connection of 8681 Control Unit - D4” on page 35

→ Ensure that **control air** is supplied

→ Open the housing following the instructions in chapter “6. Opening and Closing the Housing”.

→ **Electrical power** has to be switched on (for the function of position measuring system and Top LED).

→ Ensure that the **valve type** is correctly set via DIP switches DIP3+4
(see “5.5. Selection of the process valve type (D4 series)” on page 32).

→ If the production process will not be disturbed and if the **process valve / seat** is not in the **right position**, activate the process valve / seat to bring it in the defined position for the teach procedure:

This may occur via the pilot valves 1 to 3 (to be seen in “Fig. 1” on page 13) which can be activated via hand lever (see “Fig. 17” on page 37).
The functionality of each pilot valve (V1 to V3) is described in the table in chapter “13.2.2” on page 86 or observe when the valve/seat is in the right position and follow next step(s):

→ If the **process valve / seat** is in a defined position, **press the appropriate Teach button** (see “Table 5”) for approx. 1.5 seconds.
Teach button “T4” will be realised using the terminal strip (with the connections S4IN and 24 V / V+)

→ If required, return the device and system to normal status (switching position, power supply).

→ Close the housing following the instructions in chapter “6. Opening and Closing the Housing”.

Teach button	Function	Activation duration	Optical feedback	Remarks
T1	manual teach function for closed position	1.5 s	TOP LED pauses and flashes quickly during teach process, then continuously in the encoded colour for the taught position.	
T2	manual teach function for open position	1.5 s		
T3	manual teach function for upper seat lift	1.5 s		Not available, if valve type D4 selected by DIP switches 3, 4 (see chapter “5.5”). No check of right process valve selection via DIP switches 3, 4 during the teach process. Terminal strip: connection S4IN needs to be externally connected to 24V / V+ for activation duration.
“T4” = S4In (for service only)	manual teach function for lower seat lift	1.5 s		
T1 + T2	**Teach reset** of all valve positions	**2.5 s**	Flashes in the fault colour – see chapter “14”	

Table 5: Teach buttons functions for manual teach procedure

14. LED COLOUR ASSIGNMENTS / DISPLAY VIA TOP LED

The switching states of the process valves as well as the device states are signalled to the outside via the central multi-colour status display (device status LED / Top LED), so that quick visual control is possible also for large systems.

Colours and blinking patterns have been assigned to the signals of the process valve positions and device states. But there are differences between the device designs 24 V DC, AS-i, DeviceNet on the one hand and on the other hand with the IO-Link design - see the following chapters.

14.1. Top-LED display for 24 V DC / AS interface / DeviceNet devices

14.1.1. DIP switches for setting the colour coding and the process valve type

The DIP switches DIP 1 and DIP 2 are used for colour coding/assignment. In order to be able to react to different process valve designs or customer signalling philosophies in the systems, the colour assignments can be changed on site using these DIP switches (see "Table 6")

The DIP switches DIP3 and DIP4 are used to set the valve type – see chapter "5.5. Selection of the process valve type (D4 series)" on page 32.

Delivered state (factory setting): **DIP1 - 3:** position 0 = **OFF** and
DIP4: position 1 = **ON**

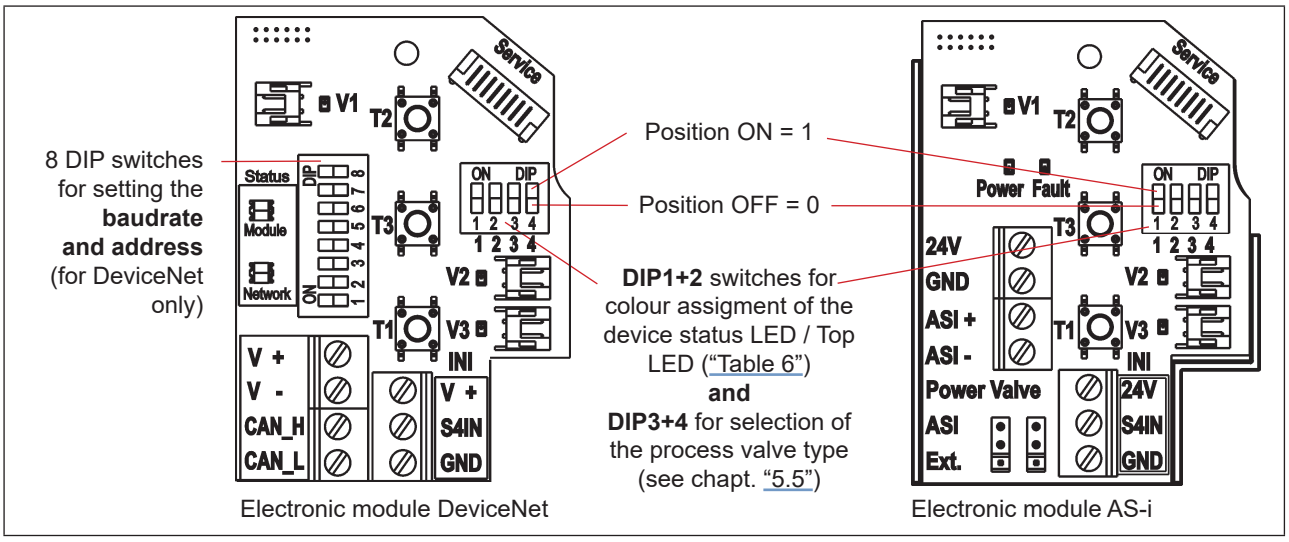


Fig. 36: DIP switches for setting the colour assignment (in the example: electronic modules for DeviceNet and AS-i)

14.1.2. Colour coding / "device-specific LED mode"

DIP 1	DIP 2	Mode	Valve closed	Valve open	Upper seat lift (125 ms on / 125 ms off)	Lower seat lift (250 ms on / 250 ms off)	error/ fault
0	**0**	**0**	**steady green**	**steady yellow**	**Fast flashing yellow**	**Slow flashing yellow**	**red**
1	0	1	steady yellow	steady green	Fast flashing green	Slow flashing green	red
0	1	2	steady green	steady red	Fast flashing red	Slow flashing red	yellow
1	1	3	steady red	steady green	Fast flashing green	Slow flashing green	yellow

Table 6: Device-specific LED mode (here abbreviated to „mode"; factory setting mode = „0")

14.2. Top-LED display for IO-Link devices

The **factory setting** is the **"device-specific LED mode"** (*LED mode 7* in "Table 7" or the *"Mode 0"* according to "Table 6"). This display is identical to the devices of the designs for 24 V DC, AS-i, DeviceNet.

For IO-Link devices, the Top LED settings can be changed comparably as the 24V / AS-i / DeviceNet devices, but not via DIP switches, but via the **object 0x2C11** (see IODD description: page 117).

For IO-Link devices, additional (Top) LED modes are available: see "Table 7" (object 0x2120). For the LED modes 1, 2 and 3 (valve mode ...), the colour coding and blinking patterns can be individually adjusted if required. For more details, see the respective chapter "14.2.2" or "14.2.3" or "14.2.4".

LED mode	Description of the LED mode	Meaning
0	"NAMUR" mode	see chapter "14.2.1"
1	Valve mode	see chapter "14.2.2"
2	Valve mode + errors	see chapter "14.2.3"
3	Valve mode + errors + warnings	see chapter "14.2.4"
4	Setting of a fixed colour	see chapter "14.2.7" (IODD: object 0x2122, LED extern colour)
5	---	
6	Top LED off	no indication via the Top LED
Default: 7	**Device-specific LED mode**	see chapter "14.1.2" (IODD: object 0x2C11)

Table 7: Available LED modes for IO-Link devices (object 0x2120)

14.2.1. NAMUR mode

The device status LED (Top LED) indicates the device states only and changes the colour according to NAMUR NE 107 (edition 2006-06-12). There is no feedback on the process valve positions.

If several device states exist simultaneously, the device status with the highest priority is displayed. The priority is determined by the severity of the deviation from normal operation (red LED = failure = highest priority) – see following "Table 8" and also chapter "14.2.5".

colour	Priority	Description	Meaning
rot	1	Failure, error, malfunction	Controlled operation is not possible due to a malfunction in the device or its peripheral devices.
orange	2	Function check	Work is being carried out on the device; controlled operation is therefore not currently possible (this includes "automatic Teach function (Autotune) active").
gelb	3	Out of specification	The ambient conditions or process conditions for the device are outside the specified area (this includes "manual Teach function or automatic Teach function (Autotune) required").
blau	4	Maintenance required	The device is in controlled operation, but a function is presently restricted. → Service the device!
grün	5	Diagnostics active (controlled operation)	Device is operating faultlessly (controlled). Status changes are indicated in different colours. Messages are transmitted via a fieldbus if connected.

Table 8: Description of the colours in the „NAMUR" mode

14.2.2. Valve mode

The device status LED (Top LED) indicates the **assigned colour of the process valve** (PV) **position only** (see "Table 9"). There is no display of error and warning messages in this mode.

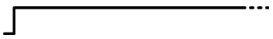
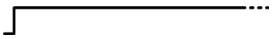
Prozess valve position, e.g.:	Colour of the PV position	Blinking pattern of the position feedback
closed	green	continuously lit 
open	yellow	continuously lit 
lower seat lift	green	continuously blinking slowly (250 ms ON, 250 ms OFF) 
upper seat lift	green	continuously blinking quickly (125 ms ON,125 ms OFF) 
Intermediate position: If there is no feedback of the process valve positions, i.e. the process valve is in intermediate positions of the defined teach positions, the Top LED is off.		

Table 9: Description of the colours and blinking patterns in the "Valve mode" (factory settings)

The factory setting or the delivery status is shown in the table above. For further setting options of the devices, see chapter „14.2.6".

14.2.3. Valve mode + Error

The device status LED (Top LED) indicates **beside the assigned colour of the process valve** (PV) **position also the error signals** (see "Table 10").

If an **error** (i.e. internal error, bus error, error with manual or automatic Teach function, signal errors of the internal or external positions sensors) occurs, this is also displayed alternately according to the scheme:
1 second position feedback / 1 second error display.

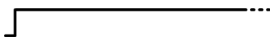
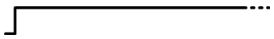
Prozess valve position, e.g.:	Colour of the PV position	Blinking pattern of the position feedback	Error display
closed	green	continuously lit 	is lit red  alternating with the colour and in the blinking pattern of the respective process valve position
open	yellow	continuously lit 	
lower seat lift	green	continuously blinking slowly (250 ms ON, 250 ms OFF) 	
upper seat lift	green	continuously blinking quickly (125 ms ON,125 ms OFF) 	
Intermediate position: If there is no feedback of errors or of process valve positions, i.e. the process valve is in intermediate positions of the defined teach positions, the Top LED is off.			

Table 10: Description of the colours and blinking patterns in the "Valve mode + Error" (factory settings)

The factory setting or the delivery status is shown in the table above. For further setting options of the devices, see chapter „14.2.6".

14.2.4. Valve mode + Error + Warnings

The device status LED (Top LED) indicates **beside the assigned colour of the process valve** (PV) **position also the error and warnings signals** (see "Table 11").

If an **error or a warning** (see also "Table 8") occurs, this is also displayed alternately according to the scheme: **1 second position feedback / 1 second error or warning display** analogue to „NAMUR".

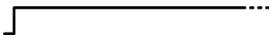
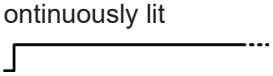
Prozess valve position, e.g.:	Colour of the PV position	Blinking pattern of the position feedback	Error display (see "14.2.5")	Warning display (see "14.2.5")
closed	green	ontinuously lit 	is lit red  alternating with the colour and in the blinking pattern of the respective process valve position	is lit in the warning colour  alternating with the colour and in the blinking pattern of the respective process valve position
open	yellow	ontinuously lit 		
lower seat lift	green	ontinuously blinking slowly (250 ms ON, 250 ms OFF) 		
upper seat lift	green	ontinuously blinking quickly (125 ms ON,125 ms OFF) 		
Intermediate position: If there is no feedback of errors or warnings or of process valve positions, i.e. the process valve is in intermediate positions of the defined teach positions, the Top LED is off.				

Table 11: Description of the colours and blinking patterns in the "Valve mode + Error + Warnings" (factory settings)

The factory setting or the delivery status is shown in the table above. For further setting options of the devices, see chapter „14.2.6".

14.2.5. Display of Errors and Warnings – definition and colours

Errors:

Errors are displayed in the respective defined error colour (see chapter „14.1.2" and „14.2.6"). In „NAMUR" mode, this is always red.

As an error will be displayed: internal error, bus error, error with manual or automatic Teach function, signal errors of the internal or external positions sensors

Warnings:

Warnings are displayed according to the „NAMUR" definition – alternating with the process valve position.

The following events are defined as a warning:

Orange: Function check (service mode/manual control active, automatic Teach function (Autotune) active

Yellow: Out of specification (storage error of the operating hour/cycle counter, manual or automatic Teach function required (no position "taught"))

Blue: Maintenance required (Service/maintenance notification)

14.2.6. Top LED – further setting options

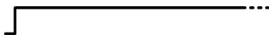
Adjustable colours of the TopLED *)	Adjustable blinking patterns for the position feedback **)
white, green, blue, yellow, orange, red, LED off *)	**continuously lit** 
	continuously blinking slowly (250 ms ON, 250 ms OFF) 
	continuously blinking quickly (125 ms ON,125 ms OFF) 

Table 12: Top LED - setting options / adjustable colours and blinking patterns

***)** *see IODD, objects: 0x2120 (LED modi), 0x2122 (fixed colour / external colour), 0x2C11 (device-specific LED mode), 0x2C12 (Process valve feedback)*

****)** *see IODD, object: 0x2C13 (Blinking pattern)*

14.2.7. Display of a „fixed colour“

The Top LED indicates **no feedback on the process valve positions** and **no errors and warnings.**

A fixed colour can be assigned to the unit, then device is lit continuously in this fixed colour.

Adjustable colours: see “Table 12”.

14.2.8. Localisation function

This function can be used to locate a device in the system via the control. However, the locating function must be activated for this - see the respective IODD description (*“Process output data”*) or the non-cyclical parameters (“*Locating Function”* 0x2101).

The Top LED then starts blinking for approx. 10 seconds. If there are several messages, the signal with the highest priority (see “Table 8”) is displayed.

In the LED modes *“Valve mode + Error”* and *“Valve mode + Error + Warnings”*, any error or warning messages that occur are displayed in the respective colour “single flashing” alternating with the respective feedback of the valve status.

Blinking pattern	Description (factory settings)
 1 x 25 ms ON per sec.	**single flashing:** in white colour: no (taught) position active in colour of the process valve state: respective process valve state (open, closed) active in colour of the device state: “NAMUR” (see “14.2.1” on page 91)
 2 x 25 ms ON per sec.	**double flashing:** in colour of the process valve seat state: upper seat lift
 3 x 25 ms ON per sec.	**triple flashing:** in colour of the process valve seat state: lower seat lift

Table 13: Display during active localisation function

14.3. Blinking pattern & fault signaling

The device status LED / Top LED flashes in different "blinking patterns" in the event of a fault or in various states. These are factory settings (which can be partially changed):

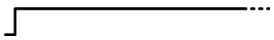
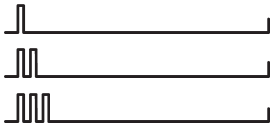
Blinking patterns	ON	OFF	Note
	ON		**continuously lit** in the respective colour for valve state “valve closed” or “valve open”
	100 ms	100 ms	**Flashes three times** in the **colour of the valve state** to confirm the teaching of a target position **Flashes three times** in the corresponding **fault colour:** **-** if target could not be located in the measuring area during teaching or - if teach position is too close (±0.5 mm) to a previously defined teach position or - if magnetic manual control is used, even though manual control function was disabled by software
 (fast flashing)	125 ms	125 ms	**permanent flashing** (in the colour for “valve open”): Signal for “upper seat lift”
 (slow flashing)	250 ms	250 ms	**permanent flashing** (in the colour for “valve open”): Signal for “lower seat lift” **permanent flashing** in the **fault colour:** - Teaching does not occur or - Autotune function error or - invalid signal from internal position sensor or - Teach Reset implemented or - Bus error or - Device Reset implemented
	450 ms	50 ms	**permanent flashing** in the **fault colour:** Internal Fault
	50 ms	450 ms	**permanent flashing** in the **fault colour:** Device in service mode/manual control active
	1 s	3 s	**permanent flashing** in the **fault colour:** Service/maintenance notification (maintenance / service required); Position feedback occurs during OFF phase
	1 s / 1 s	--	permanently flashing alternately in the error/warning colour and in the colour of the process valve status (**only for IO-Link devices** - see „14.2.3“ to „14.2.5“)
	1-fold, 2-fold, 3-fold flashing per second		Localisation function (**only for IO-Link devices** - see „14.2.8“)

Table 14: Blinking pattern and error / fault signaling

For troubleshooting see also chapter “16.5. Malfunctions” on page 100.

15. SERVICE MODE / MANUAL CONTROL

By default, the device provides (e.g. for service purposes) the following:

- a *magnetic manual control* which is easily accessible from the outside for Pilot Valve 1 (2/A1)*) as well as
- a *mechanical manual control* accessible when the hood is open on each equipped pilot valve – see chapter “15.2. Mechanical manual control”.

15.1. Magnetic manual control

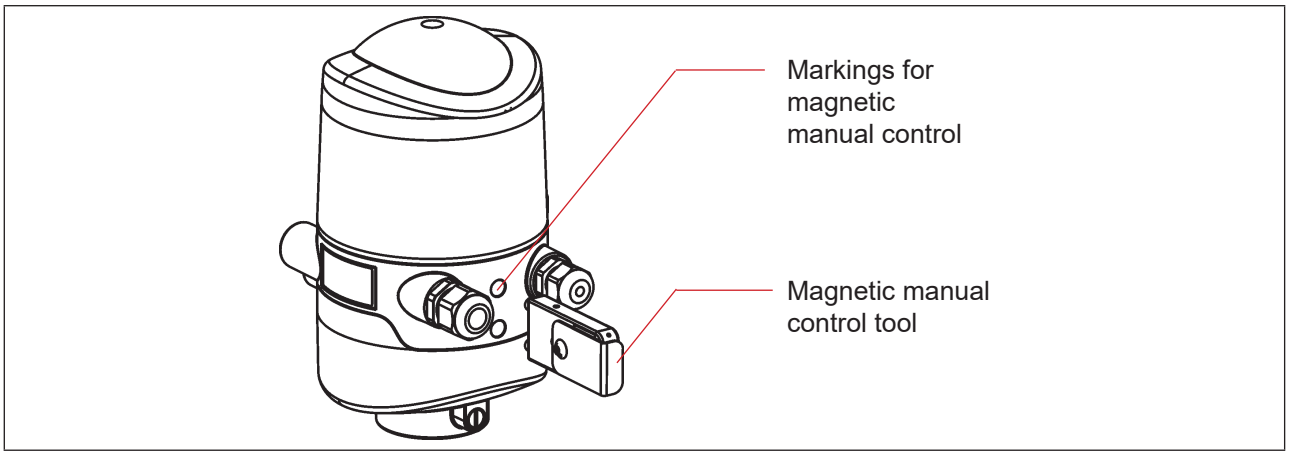


Fig. 37: Manual control on the basis of encoded magnetic fields

Irrespective of the signal of the higher-level control, in the Automatic operating mode the magnetic manual control sets the output of the pilot valve V1 electrically to an ON signal and, if control pressure is present, switches the 2/A1 output. The magnetic manual control cannot be used in manual operating mode.

However, if the output of pilot valve 1 is activated by the control (ON signal from the higher-level control), this switching state cannot be set to an OFF signal with the manual control!

Activation/deactivation of this function is possible using the PC service program. The factory setting is “magnetic manual control function active”, i.e. the function can be used, it is not disabled. (For IO-Link devices, this is done via object 0x2C04, sub 0x1).

The connection to the PC is made via the service interface. Details are described in the “PC Service Program” software manual under the “SYSTEM/Start-up” menu option.

Caution!

When the magnetic manual control (for pilot valve V1) will be activated:

- the peripheral fault bit is set on the AS interface design,
- the mode is switched to "Manual control active" for the DeviceNet design and can be read out,
- the feedback signals (valve positions) function as per normal operation.

Always observe the safety guidelines and the system states!

The *activation of the magnetic manual control* or errors when using magnetic manual control are indicated by device status LED / Top LED – see chapter “14.3. Blinking pattern & fault signaling”.

Procedure for activating & deactivating the magnetic manual control for pilot (solenoid) valve location 2/A1:

→ Observe safety guidelines for the system prior to using the manual control!

→ Activating the magnetic manual control (only possible in automatic operating mode):
Hold the magnetic manual control tool on the identification points between the cable glands for three seconds
(see "Fig. 37"),
feedback signal of the activation by device status LED / Top LED – see chapter "14.3. Blinking pattern & fault signaling".

→ Once the measure has been completed, deactivate the magnetic manual control:
Hold the manual control tool on the identification points between the cable glands for another three seconds (see "Fig. 37").

After a power failure the magnetic manual control is reset and the device restarts in standard operating mode, i.e. the signal of the higher-level control is accepted.

15.2. Mechanical manual control

If additional manual controls are required for additional service purposes or in the event of a failure of the electrical energy, it is possible for all voltage and communication designs to switch the connected process valve using the mechanical manual control of the respective pilot valves V1 to V3 after opening the housing.

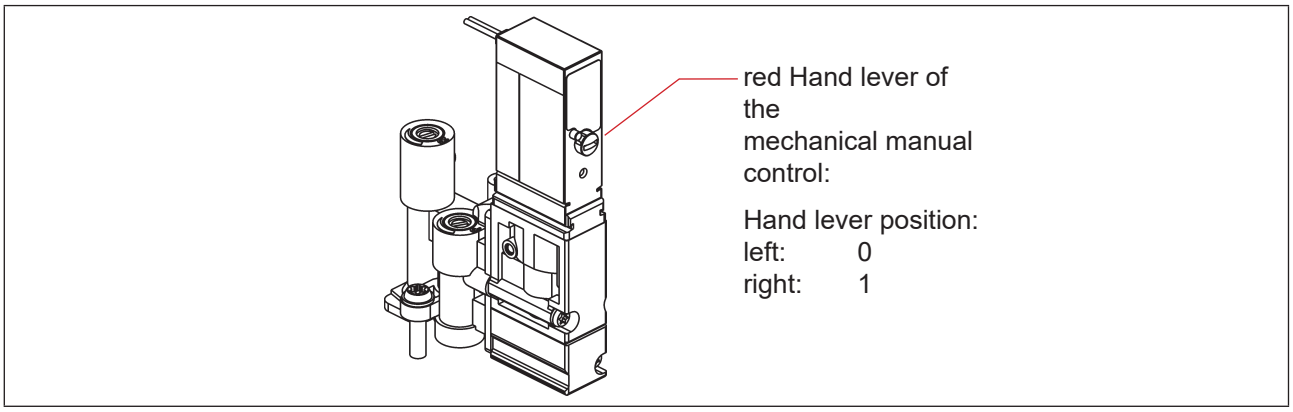


Fig. 38: Mechanical manual control of the pilot valves

When the service measures have been completed, reset all manual controls to "0" for controlled operation of the system!

16. MAINTENANCE / TROUBLESHOOTING

16.1. Safety instructions

DANGER!

Risk of injury due to electric shock!

- Before reaching into the system, switch off the power supply and secure it to prevent restarting!
- Observe applicable accident prevention and safety regulations for electrical equipment!
- When setting the position measuring system (Teach), do not contact any live components!

WARNING!

Risk of injury due to high pressure in the system!

- Before loosening lines and valves, turn off the pressure and vent the lines.

Risk of injury due to unintentional activation of the system and uncontrolled restart!

- Secure system against unintentional activation.
- Following assembly, ensure a controlled restart.

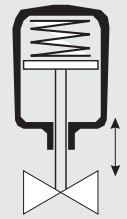
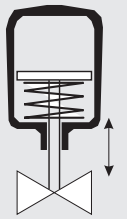
CAUTION!

Risk of injury due to improper maintenance!

- Maintenance may only be carried out by trained technicians and with the appropriate tools!

16.2. Safety positions

Safety positions of the pilot valves after failure of the electrical or pneumatic auxiliary power:

Operating mode	Process valve design	Safety positions after failure of the auxiliary power	
		electrical	pneumatic
 up down	single-acting Control function A • air opening • spring closing	down	down
 up down	single-acting Control function B • air closing • spring opening	up	up

If process valves with several switching positions (e.g. double-seated valves) are connected, the safety positions of the individual actuators can be viewed according to the same logic as for a classical single-seated valve.

Safety positions of the pilot valves after failure of the bus communication:

AS interface:
If the Watchdog is activated (default), behavior is the same as a failure of the auxiliary electrical power, i.e. all pilot valve outputs are set to "0".

DeviceNet:
See chapter “10.13.1. Configuration of the safety position of pilot valves during a bus error”.

IO-Link:
See chapter “11.5.3. Safety position if the bus fails”.

16.3. Maintenance / service

When used properly, the device operates maintenance and trouble-free.

For service work, please contact SPX Flow.

If the service/maintenance notification function is active (see chapter”4.7. Factory settings in the firmware”), a maintenance prompt is issued – indicated by a specific "blinking pattern" – see chapter “14.3. Blinking pattern & fault signaling”.

16.4. Cleaning

NOTE!

Aggressive cleaning agents may damage the material!

- The customary cleaning agents and foam cleaners can be used to clean the outside. We recommend checking that the cleaning agents are compatible with the housing materials and seals before using the cleaning agent.

→ Clean the device and rinse it thoroughly with clean water to safeguard against the formation of deposits in grooves and recesses.

If cleaning agent is not rinsed off properly, its concentration may considerably exceed the concentration for use when the water has evaporated. The chemical effect will thus be several times stronger!

Observe the specifications of the manufacturer and the recommendations for use of the cleaning agent manufacturer!

16.5. Malfunctions

In the event of any malfunctions in spite of a correct installation, proceed according to the fault analysis described in the table below. See also chapter “14.3. Blinking pattern & fault signaling” on page 95.

Fault description	Possible cause of the fault	Troubleshooting
Autotune procedure fails	Valve type selection via DIP switch DIP3, DIP4 does not comply with physical process valve	Check DIP switches for valve type selec-tion - refer to chapter “5.5. Selection of the process valve type (D4 series)”
	Confused pneumatic connection lines	Check the correct pneumatic con-nection of the device to the process valve (for fluid diagrams see chapter “3.3.3. Fluid diagram” and the operating instructions of the corresponding process valves)
	No or insufficient pneumatic supply of the device	Check the pressure supply and ensure that supply is sufficient
	Manual flow restriction screws (for setting the flow-rate) set too tight, process valve still moves despite autotune timeout	Check the flow-rate via setting of the flow restriction screws - refer to “7.3. Flow restriction function of the pilot valves”
Autotune or manual teach procedure fails	Targets are not mounted on the process valve's shaft or target faulty	Check the target for correct mounting and condition (see chapter “4.6. Data of position sensors”).
	Two positions on the same position measuring system are too close to each other	Check correct process valve position

Fault description	Possible cause of the fault	Troubleshooting
No feedback signal	Position of the position sensors (Teach procedure) not appropriate for the shaft position (see “5.2”)	Perform / repeat the Teach procedure (see chapter “13. Teach procedure”)
	No or faulty associated feedback signals	Set the connections according to the pin and plug configurations described in these operating instructions (for the respective voltage / communication design).
	Targets are not mounted on the process valve's shaft or target faulty	Check the target for correct mounting and condition (see chapter “4.6. Data of position sensors”).
Feedback signal is "lost" in system operation	Position in the limit range of the feedback field	Repeat the Teach procedure (see chapter “13. Teach procedure”)
		Check the process valve end positions during operation against the end positions in non-operative state of the system.
		Check the pressure supply.
Valve output 2/A1 cannot be switched off with the control	Magnetic manual control is still activated	Deactivate the manual control - compare chapter “15.1. Magnetic manual control”
Valve outputs cannot be switched off by the control	Mechanical manual control at the pilot valve is still activated	Deactivate the mechanical manual controls on the pilot valves - compare chapter “15.2. Mechanical manual control”
Faults are signaled by means of device status LED / Top LED	Possible causes may vary depending on the version	Please read the corresponding descriptions of the respective communication design in these operating instructions (see also chapter)
No or faulty function of the process valves	No electrical power supply or communication for the device	Check the power supply and the communication settings (also refer to detailed descriptions of the respective designs in these operating instructions)
	No or insufficient pneumatic supply of the device	Check the pressure supply and ensure that supply is sufficient
Incorrect function of the process valves	Confused pneumatic connection lines	Check the correct pneumatic connection of the device to the process valve (for fluid diagrams see chapter “3.3.3. Fluid diagram” and the operating instructions of the corresponding process valves)
	Valves not correctly connected on electronic module	Check the correct electrical connection of the pilot valves - compare e.g. “Fig. 19: 24 V DC electronic module”

In the event of any undefined faults, be sure to contact the service department of SPX Flow.

17. REPLACEMENT OF COMPONENTS AND MODULES

If components or modules need to be replaced for maintenance or service reasons, please observe the following notes and descriptions.

17.1. Safety instructions

DANGER!

Risk of injury due to electric shock!

- Before reaching into the system, switch off the power supply and secure it to prevent restarting!
- Observe applicable accident prevention and safety regulations for electrical equipment!

WARNING!

Risk of injury due to high pressure!

- Before loosening lines and valves, turn off the pressure and vent the lines.

Risk of injury due to unintentional activation of the system and uncontrolled restart!

- Secure system against unintentional activation.
- Following maintenance, ensure a controlled restart.

CAUTION!

Risk of injury due to improper maintenance!

- Maintenance may only be carried out by trained technicians and with the appropriate tools!

NOTE!

IP65 / IP67 protection

- During all work steps, make sure that IP65 / IP67 protection is once again ensured for the device when used as intended!

Opening and closing the device

- During all work which requires opening and closing of the device, also observe the notes and comments in chapter “6. Opening and Closing the Housing”!

17.2. Changing the electronic module

NOTE!

Electrostatic sensitive components/modules!

- The device contains electronic components which react sensitively to electrostatic discharge (ESD). Contact with electrostatically charged persons or objects may be hazardous to these components. In the worst case scenario, they will be destroyed immediately or will fail after start-up.
- Observe the requirements in accordance with DIN EN 61340-5-1 to minimize or avoid the possibility of damage caused by sudden electrostatic discharge!
- Also ensure that you do not touch electronic components when the supply voltage is on!

Removal procedure:

→ Open the housing following the instructions in chapter “6. Opening and Closing the Housing”.

→ If necessary, mark the electrical connections to ensure correct assignment during reinstallation!

→ If necessary, note the set position of the 4 DIP switches (for colour code and valve type) and on the DeviceNet electronic module the DIP switches (8-switch block) for baud rate and address. On the AS-i electronic module, note the AS interface address and the jumper positions (power supply to AS interface).

→ If required, read out and note special settings by the PC service program.

→ Loosen all electrical connections on the electronic module (plug-type connections, screw-type terminal connections).

→ Loosen the screw-type connection (Torx T10 screw) of the electronic module and store the screw in a safe place.

→ Carefully press the electronic module forwards so that the contact pins on the internal position sensor are exposed.

→ Carefully lift the electronic module upwards.

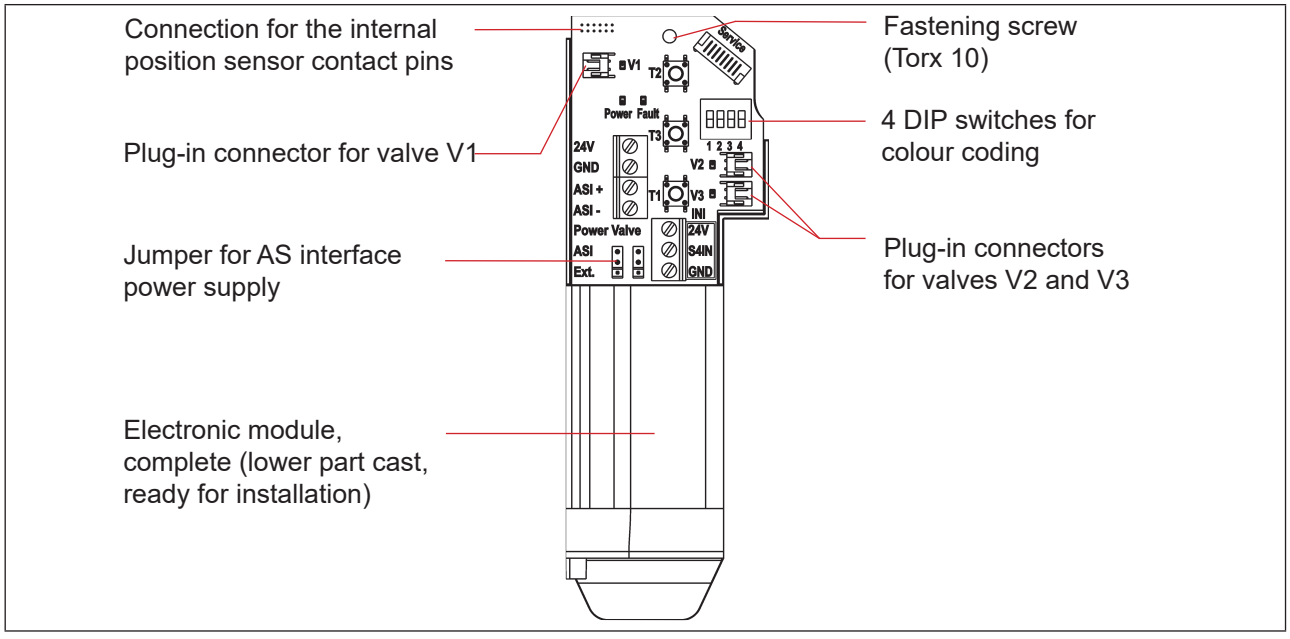


Fig. 39: Electronics module (here example of AS interface)

Installation procedure:

→ Carefully insert the entire electronic module into the recess in the lower housing part.

→ Plug the electronic module carefully onto the contact pins for the position measuring system.

→ Refasten the electronic module with the Torx T10 screw (torque 0.4 Nm).

→ Reattach the electrical connections.

→ Check DIP switch positions (4-switch block for colour and valve type coding, 8-switch block on DeviceNet electronic module for address and Baud rate) and set the previously noted switch settings, if necessary.

→ If necessary, set AS interface address and jumper positions.

→ If required, make settings again, read out by the PC service program, using the PC service program.

→ Perform Autotune procedure (see chapter “13.2. Autotune function” on page 85).

Be sure to work carefully and cautiously, so that the electronics are not damaged.

→ Close the housing following the instructions in chapter “6. Opening and Closing the Housing”.

17.3. Changing the valves (Type 6524)

According to the design, 1 or 3 pilot valves Type 6524 (V1 ... V3) have been installed in the device. The pilot valves have been designed with the flow restriction equipment for intake and exhaust air and must be installed as a valve module.

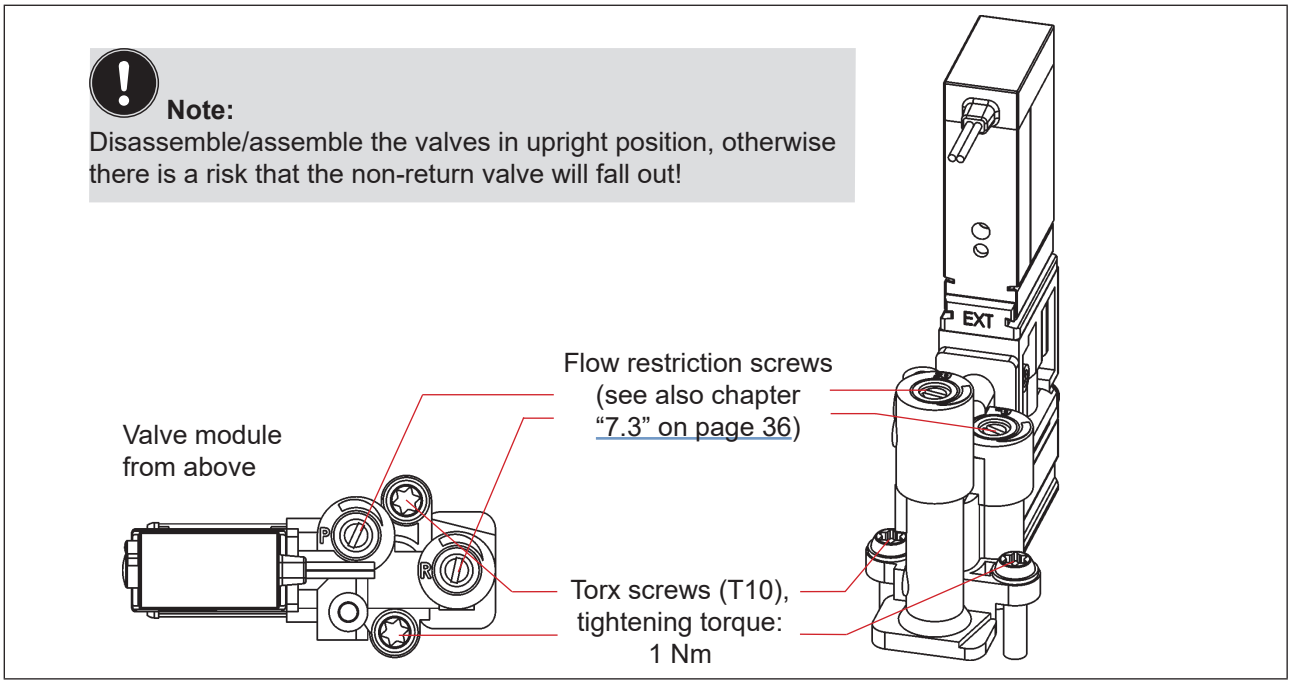


Fig. 40: Valve module Type 6524

Procedure:

→ Open the housing following the instructions in chapter “6. Opening and Closing the Housing”.

→ If necessary, mark the electrical connections to ensure correct assignment during reinstallation.

→ Loosen the electrical connections.

→ Loosen the connecting screws (Torx T10) for the corresponding valve module.

→ Take out the valve module and replace it with the spare part set.

→ When inserting the valve module, make sure that the form seal fits correctly and fully on the lower side of the respective pilot valve flange!

→ To fix the valve module: to do this, insert the screws (Torx T10) into the existing threading by turning them backwards and tighten them to a torque of 1.2 Nm.

→ Reattach the electrical connections.
(If other connections, apart from the pilot valve connections, have been removed, read the corresponding chapters on the electrical installation of the respective voltage / bus / connection version)

→ Adjust the flow restriction screws as described in chapter “7.3. Flow restriction function of the pilot valves” on page 36.

→ Close the housing following the instructions in chapter “6. Opening and Closing the Housing”.

17.4. Changing the internal position sensor

The internal position sensor consists of a housing, with a PCB mounted above with LEDs and light conductor. There are 4 snap-fit hooks, which secure the internal position sensor in the lower housing part, by snapping them into place.

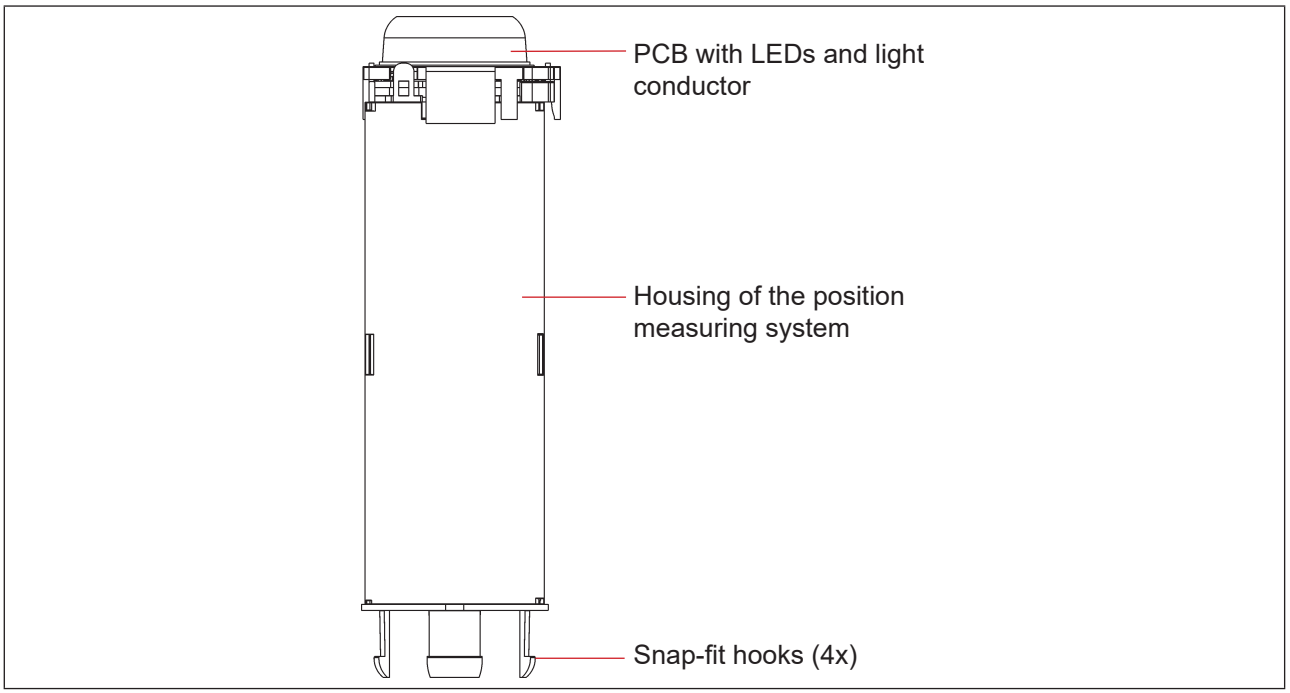


Fig. 41: Internal position sensor

WARNING!

Risk of injury due to high pressure!

▸ Before loosening lines and valves, turn off the pressure and vent the lines.

NOTE!

Electrostatic sensitive components/modules!

- Before changing the internal position sensor, switch the electrical power for the device off so that destruction of the PCB and electronic module is avoided.
- The device contains electronic components which react sensitively to electrostatic discharge (ESD). Contact with electrostatically charged persons or objects may be hazardous to these components. In the worst case scenario, they will be destroyed immediately or will fail after start-up.
- Observe the requirements in accordance with DIN EN 61340-5-1 to minimize or avoid the possibility of damage caused by sudden electrostatic discharge!
- Also ensure that you do not touch electronic components when the supply voltage is on!

Deinstallation procedure:

→ Switch the electrical power to the Control Unit - D4 off!

→ Loosen the device (upper part) from the external position sensor (see “Fig. 11” on page 28).

→ Open the housing following the instructions in chapter “6. Opening and Closing the Housing”.

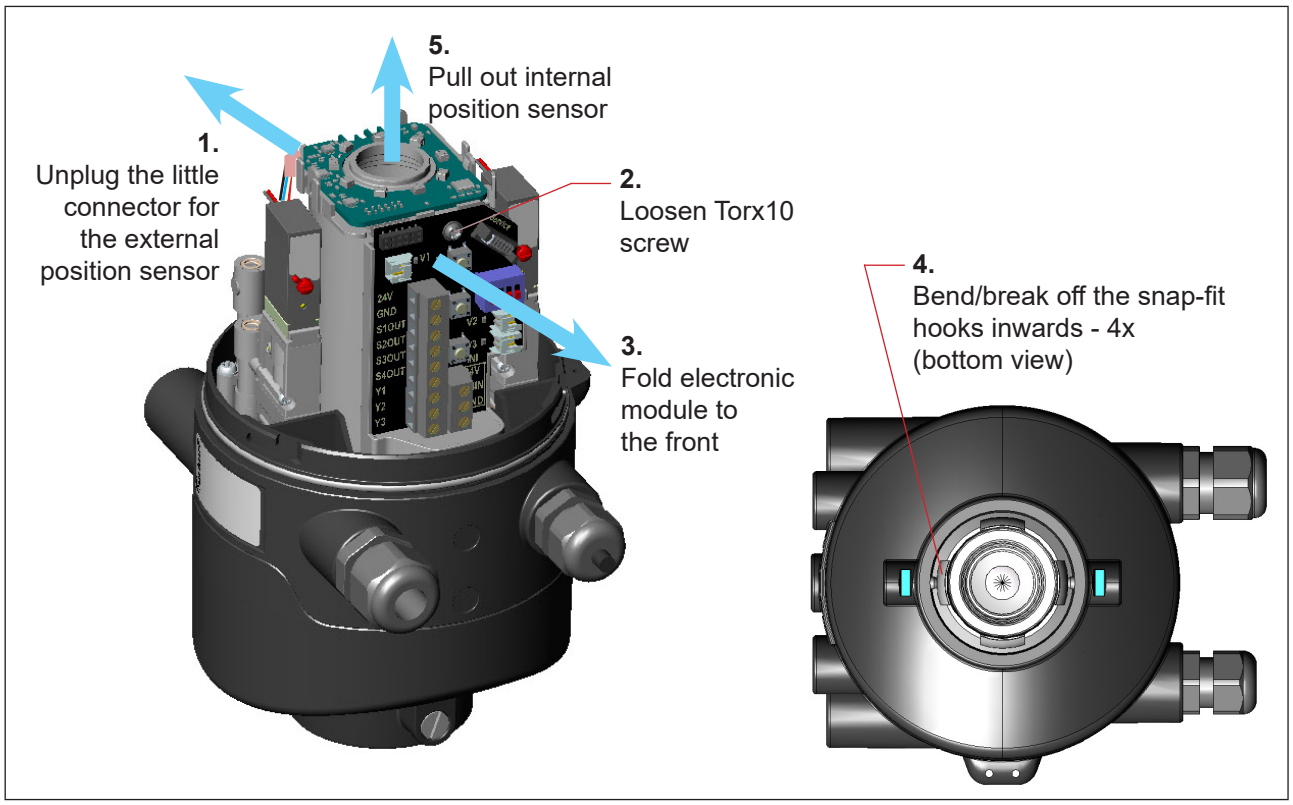


Fig. 42: Dismantling the internal position sensor

→ (1) Unplug carefully the litte 4-wire-connector for the external position sensor.

→ (2) Loosen the fastening screw (Torx 10) of the electronic module (see chapter “17.2. Changing the electronic module”).

→ (3) Tilt the electronics forwards to loosen the internal position sensor's contact pins from the electronic module.

→ (4) Bend the snap-fit hooks on the bottom end of the internal position sensor inwards or - in some cases - break them off.

→ (5) Pull the internal position sensor upwards out of the guide.

Installation procedure:

→ Insert the new internal position sensor from above so that the contact pins are located on the side of the electronic module.

→ Carefully push the housing of the internal position sensor downwards until the snap-fit hooks snap into place.

→ Slide the electronic module carefully onto the contacts pins and fasten the electronic module using the Torx screw.

→ Plug the little 4-wire-connector for the external position sensor carefully into the little socket.

→ Remount the device (upper part) to the external position sensor as described in chapter “5. Assembly”.

→ Adjust internal position sensor to the process valve via the Autotune function (see chapter “13.2. Autotune function”)

→ Close the housing following the instructions in chapter “6. Opening and Closing the Housing”.

17.5. Spare parts

Order no.	Position number	Description
H342939	1	Control Unit 8681+ D4 (24 V design, 3 pilot valves)
H342940	1	Control Unit 8681+ D4 (AS-i design, 3 pilot valves)
H342941	1	Control Unit 8681+ D4 (DeviceNet design, 3 pilot valves)
H342871	1	Control Unit 8681+ D4 (IO-Link design, 3 pilot valves)
H342943	1	Control Unit 8681+ D4 (24 V design, 1 pilot valve)
H342944	1	Control Unit 8681+ D4 (AS-i design, 1 pilot valve)
H342945	1	Control Unit 8681+ D4 (DeviceNet design, 1 pilot valve)
H342872	1	Control Unit 8681+ D4 (IO-Link design, 1 pilot valve)
H342873	2	Pilot valve (Type 6524, solenoid valve module incl. flow restrictor module)
H342874	3	Cable with 12-pole plug M12, approx. 80 cm (for 24 V DC)
H342875	3	Cable with 4-pole plug M12, approx. 80 cm (for AS interface and IO-Link)
H342876	3	Cable with 5-pole plug M12, approx. 80 cm (for DeviceNet)
H342877	4	Cable complete for external position sensor
H342878	5	Hood, coated (SPX logo)
H342879	6	Set target for CU D4 (external + internal position sensor targets, shaft extension)
H342880	7	External position sensor (incl. 4 fixation screws M8, all O-rings, flat seal EPDM)
H342881	8	Flat seal EPDM (set of 20 pieces) - compare also “Fig. 12” on page 29
H342882	9	O-ring for hood (set of 50 pieces)
H342883	10	Silencer
H342884		Plombe twist seal (set of 20 pieces)

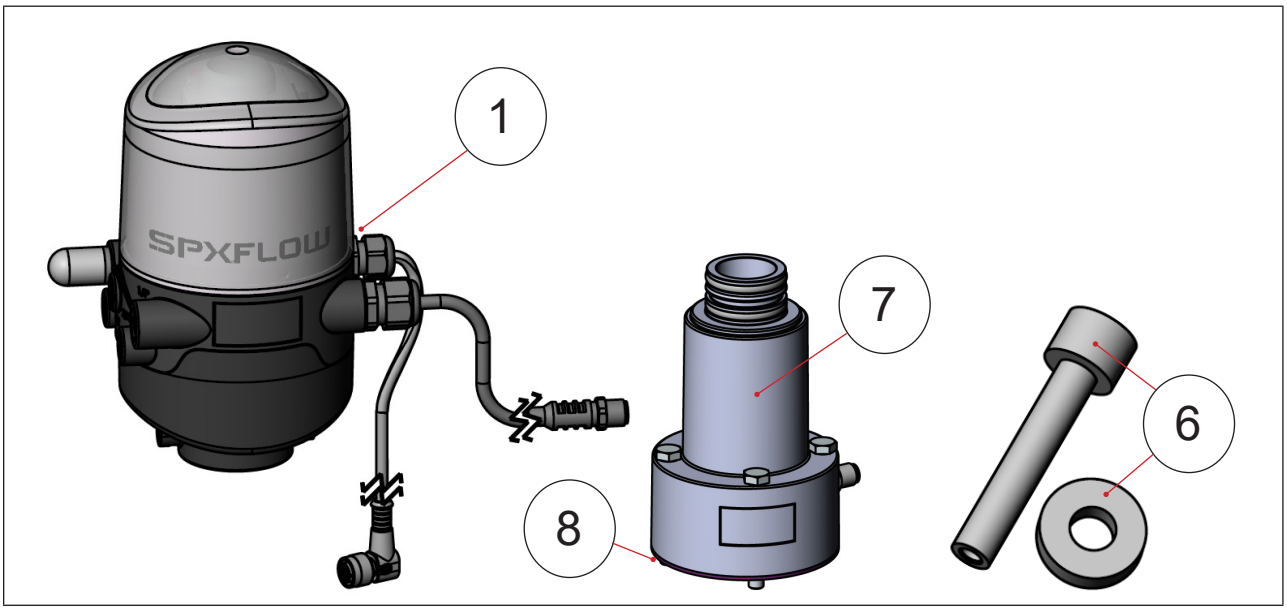


Fig. 43: Spare parts I

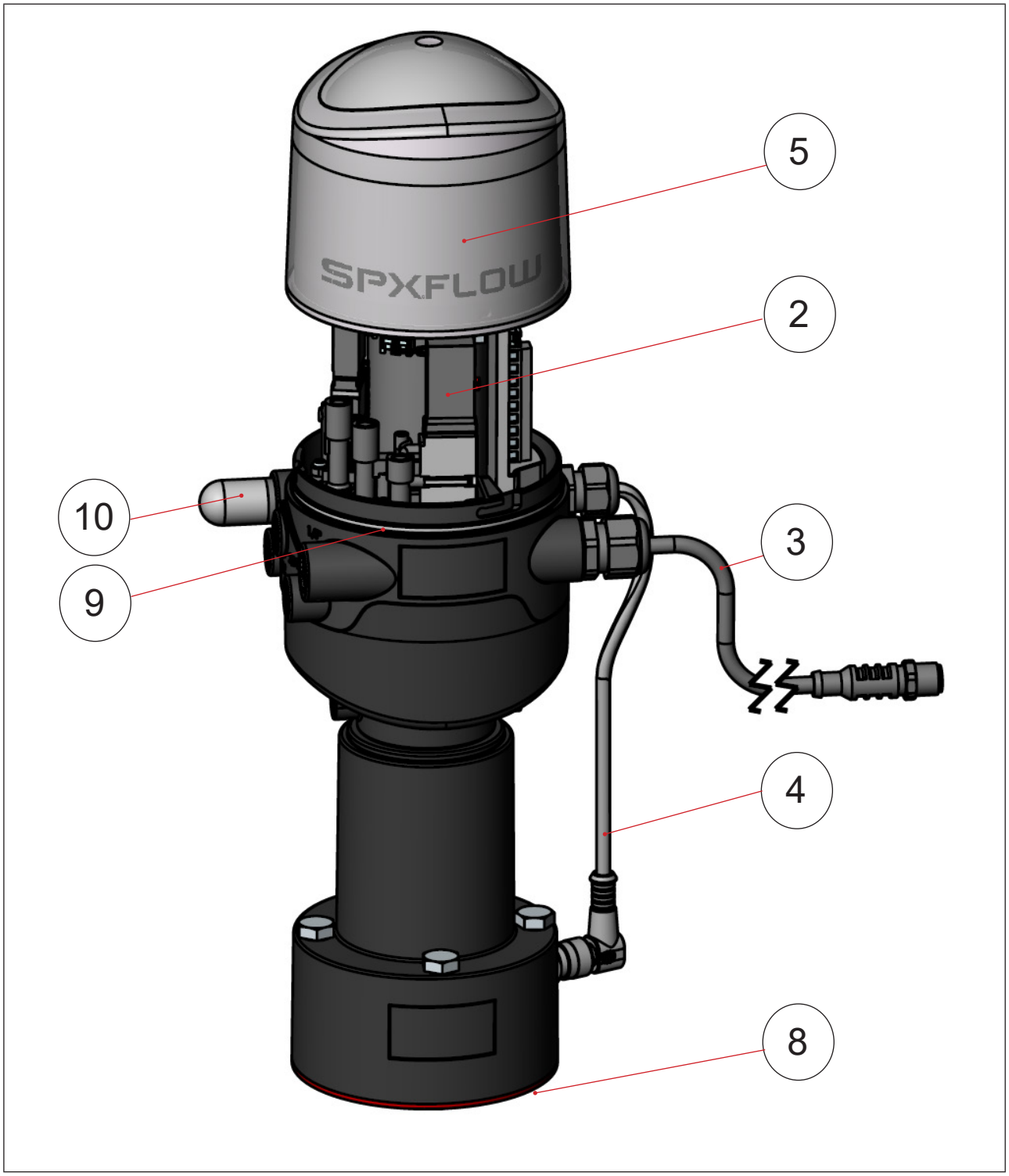


Fig. 44: Spare parts II

18. SHUTDOWN

18.1. Safety instructions

DANGER!

Risk of injury due to electric shock!

- Before reaching into the system, switch off the power supply and secure it to prevent restarting!
- Observe applicable accident prevention and safety regulations for electrical equipment!

WARNING!

Risk of injury due to high pressure!

- Before loosening lines and valves, turn off the pressure and vent the lines.

Risk of injury due to improper disassembly!

- Disassembly work may be carried out by trained technicians only and with the appropriate tools!

18.2. Dismantling the 8681 Control Unit - D4

Prior to starting with the work, check the system status!

Procedure:

→ Remove the multi-pole plugs.

→ Loosen the pneumatic connections (for a detailed description, see chapter “7. Pneumatic Installation”).

→ Loosen the locking screws (2 x shoulder screws M5) to dismantle the control unit (upper part) only – or loosen the fixation srews (4 x M8) to dismantle the whole device.

→ Pull the device upwards and off the adaptation,
remove the flat seal.

19. PACKAGING AND TRANSPORT

NOTE!

Transport damage!

Inadequately protected devices may be damaged during transportation.

- During transportation protect the device against moisture and dirt in shock-resistant packaging.
- Avoid the effects of heat and cold which could result in temperatures above or below the permitted storage temperature.

Approved non-return and reusable transport containers are used for the transport ex factory and storage of the device. Preferably use this packaging.

If the device is stored for further pre-assembly of a system, for example as part of a process valve module, kindly make sure:

→ that the device has been secured sufficiently!

→ that the electrical and pneumatic lines cannot be accidentally damaged and / or cannot indirectly damage the device!

→ that the device is not used as support during packaging and transport!

→ that the device is not exposed to any mechanical stress!

20. STORAGE

NOTE!

Incorrect storage may damage the device.

- Store the device in a dry and dust-free location!
- Storage temperature: -20 ... +65 °C.

Kindly make sure that the devices, following storage at low temperatures, are heated slowly to room temperature before you carry out any assembly work on the devices or start operation of the devices!

21. DISPOSAL

→ Dispose of the device and packaging in an environmentally friendly manner.

NOTE!

Damage to the environment caused by device components contaminated with media.

- Observe the relevant disposal and environmental protection regulations.

Note:

Observe the national waste disposal regulations.

22. APPENDIX 1 - EDS DESCRIPTION FOR DEVICENET

EDS description for DeviceNet devices
See the EDS description for devices of the DeviceNet design on the following pages.

ID (Param. in EDS file)	Class	In-stance	Attri-bute	Data type	Data size	Parameter description	Details	Default value	Reset to default by *)
1	150	1	5	USINT	1	Active input assembly	0 = Sensor state, valve state	0	
2	150	1	6	USINT	1	Safety mode	Bit 0: bus fault 0 = safety position (defined by class 150, instance 1, attribute 7). 1 = last valve position	0	
3	150	1	7	USINT	1	Process valve safety position	Maximum 1 pilot valve ON. 0 = all pilot valves V1, V2, V3 OFF 1 = pilot valve V1 ON, V2 and V3 OFF 2 = pilot valve V2 ON, V1 and V3 OFF 3 = pilot valve V3 ON, V1 and V2 OFF	0	
4	150	1	8	USINT	1	Teach function	Manual teach function. 0 = Don't teach 1 = Start Teach 1 (closed position) 2 = Start Teach 2 (open position) 3 = Start Teach 3 (upper seat lift) 4 = Start Teach 4 (lower seat lift)	0	
5	150	1	9	BYTE	1	Teach state	Bitcoded overview of teach positions: 0 = not taugt, 1 = taught Bit0: closed position Bit1: open position Bit2: upper seat lift Bit3: lower seat lift	0	A, B
6	150	1	10	USINT	1	Teach Reset	Reset teach positions 1-4 0 = Don´t reset / done 1 = Start reset	0	
7	150	1	11	USINT	1	Device Reset	Reset selected device parameters. 0 = Don´t reset / done. 1 = Start reset.	0	
9	150	1	13	UDINT	4	ID 1 Device	Device identifcation number 1	99999999	
10	150	1	14	UDINT	4	ID 1 Board	Board identification number 1	99999999	
11	150	1	15	UDINT	4	ID 2 Device	Device identifcation number 2 (SPX H-number)	99999999	

*) Reset to default by: A = Factory reset | B = Device reset | C = Counter reset

ID (Param. in EDS file)	Class	In-stance	Attri-bute	Data type	Data size	Parameter description	Details	Default value	Reset to default by *)
12	150	1	16	UDINT	4	ID 2 Board	Board identification number 2	99999999	
13	150	1	17	UDINT	4	S/N Device	Serial number device	0	
14	150	1	18	UDINT	4	S/N Board	Serial number board	0	
15	150	1	19	DATE	2	Assembly date device	Assembly date device	0	
16	150	1	20	REAL	4	Firmware	Firmware version	0	
17	150	1	21	USINT	1	Autotune	Autotune 0 = Don`start / done. 1 = Start autotune	0	
19	150	1	23	USINT	1	Service indication Time	0 = Disabled 1 = Enabled Activation / deactivation of service indication after expired time. If enabled, service indication via Top LED will be raised after time “Maintenance after days” (class 150, instance 1, attribute 39) expired. Expired time is counted by “Operating hours resettable” (class 150, instance 1, attribute 32).	0	A, B
20	150	1	24	USINT	1	Service indication Cycles	0 = Disabled 1 = Enabled Activation / deactivation of service indication after expired pilot valve switching cycles V1, V2 or V3. If enabled, service indication via Top LED will be raised if at least one of the resettable switching cycle counter (V 1/ V2 / V3: class 150, instance 1, attribute 34 / 36 / 38) exceeds its corre-sponding limit “Maintenance after cycles Vx” (V1 / V2 / V3: class 150, instance 1, attribute 40 / 41 / 42).	0	A, B
21	150	1	25	USINT	1	TP1 positive	Feedback field range Teach Position 1 positive in 0.1 mm	10	A, B

*) Reset to default by: A = Factory reset | B = Device reset | C = Counter reset

ID (Param. in EDS file)	Class	In-stance	Attri-bute	Data type	Data size	Parameter description	Details	Default value	Reset to default by *)
22	150	1	26	USINT	1	TP1 negative	Feedback field range Teach Position 1 negative in 0.1 mm	10	A, B
23	150	1	27	USINT	1	TP2 positive	Feedback field range Teach Position 2 positive in 0.1 mm	10	A, B
24	150	1	28	USINT	1	TP2 negative	Feedback field range Teach Position 2 negative in 0.1 mm	10	A, B
25	150	1	29	USINT	1	TP3 positive	Feedback field range Teach Position 3 positive in 0.1 mm	10	A, B
26	150	1	30	USINT	1	TP3 negative	Feedback field range Teach Position 3 negative in 0.1 mm	10	A, B
27	150	1	50	USINT	1	TP4 positive	Feedback field range Teach Position 4 positive in 0.1 mm	10	A, B
28	150	1	51	USINT	1	TP4 negative	Feedback field range Teach Position 4 negative in 0.1 mm	30	A, B
29	150	1	31	UDINT	4	Operation hours total	Operation hours total	0	A
30	150	1	32	UDINT	4	Operation hours resettable	Operation hours resettable	0	A, B, C
31	150	1	33	UDINT	4	Cycles V1 total	Switching cycles V1 total	0	A
32	150	1	34	UDINT	4	Cycles V1 resettable	Switching cycles V1 resettable	0	A, B, C
33	150	1	35	UDINT	4	Cycles V2 total	Switching cycles V2 total	0	A
34	150	1	36	UDINT	4	Cycles V2 resettable	Switching cycles V2 resettable	0	A, B, C
35	150	1	37	UDINT	4	Cycles V3 total	Switching cycles V3 total	0	A
36	150	1	38	UDINT	4	Cycles V3 resettable	Switching cycles V3 resettable	0	A, B, C
37	150	1	39	USINT	1	Maintenance after days	Limit for Service indication Time. Refer to class 150, instance 1, attribute 23.	365	A, B
38	150	1	40	USINT	1	Maintenance after cycles V1 x1000	Switching cycles limit V1 for Service indication Cycles. Refer to class 150, instance 1, attribute 24.	10	A, B

*) Reset to default by: A = Factory reset | B = Device reset | C = Counter reset

ID (Param. in EDS file)	Class	In-stance	Attri-bute	Data type	Data size	Parameter description	Details	Default value	Reset to default by *)
39	150	1	41	USINT	1	Maintenance after cycles V2 x1000	Switching cycles limit V2 for Service indication Cycles. Refer to class 150, instance 1, attribute 24.	50	A, B
40	150	1	42	USINT	1	Maintenance after cycles V3 x1000	Switching cycles limit V3 for Service indication Cycles. Refer to class 150, instance 1, attribute 24.	50	A, B
41	150	1	43	USINT	1	Mode	Current device mode: 0 = Automatic mode 1 = Test mode 1 2 = Test mode 2 3 = Service mode (magnetic manual mode) (activated by magnetic manual control tool) 4 = Manual mode (PC Service Program) 5 = Autotune mode 6 = Reserved 7 = Device Reset mode	0	
43	150	1	47	BYTE	1	Counter Reset	Bitcoded reset of resettable operation hour and valve switching cycle counters: 0 = don´t reset, 1 = reset Bit0: Operation hours resettable (Param 30) Bit1: Cycles V1 resettable (Param 32) Bit2: Cycles V2 resettable (Param 34) Bit3: Cycles V3 resettable (Param 36)	0	
44	150	1	48	USINT	1	Magnetic manual control active?	Magnetic manual control function active 0 = inactive 1 = active (can be used with magnetic manual control tool)	1	A, B

*) Reset to default by: A = Factory reset | B = Device reset | C = Counter reset

23. APPENDIX 2 - IODD DESCRIPTION FOR IO-LINK

IODD Description for IO-Link Devices
The IODD description is only available in English and can be found in the part that is attached in the following.

Appendix 2
IO-Link IODD Description – 8681 CU - D4

CONTENTS

1 History

Document version	IODD version / Firmware version	Date	Changes
1.0	V1.0 and higher/ A.02.18 and higher	2023-06-02	History cleared; 5.14: 0x2C03: note (*) relating feedback fields added 5.15: 0x2C03subA: note (*) relating feedback fields added
1.0	V1.0 and higher/ A.02.18 and higher	2023-04-28	5.28: 0x2C43subC: Switching Timeout Detection description enhanced

2 Abbreviations

Following datatype abbreviations are used in this document:

Abbreviation	IO-Link type	Length
BOOL	BooleanT	1 bit
UI8	UIntegerT	1 byte (8 bit)
SI8	SIntegerT	1 byte (8 bit)
UI16	UIntegerT	2 bytes (16 bit)
UI32	UIntegerT	4 bytes (32 bit)
UI64	UIntegerT	8 bytes (64 bit)
FL32	Float32T	Real32 (Float, 32bit)
STR	StringT	20 characters characters coded with “US-ASCII”

Following abbreviations are used for expressing conditions:

Abbreviation	Meaning
!=	Not equal
==	Equals

Description of used table columns:

Column label	Description
Sub	Sub-index of object
Name	Name of object in IODD file
Description	Object description
Access type	IO-Link access rights: RO = read only, RW = read write
Data type	Data type of sub index / object (if only sub index 0 exists)
Data memory	Data storage
Reset group	Sub index will be reset to factory default settings, if corresponding reset group is reset. (Refer to reset group overview below.)

Reset group overview:

Reset Group	Description	For details refer to description of object
A	Factory reset	0x2C16 Factory Reset
B	Partial factory reset (device reset function)	0x2C16 Factory Reset
C	Teach reset	0x2C15 Teach functions: sub0x4 Teach reset command
D	Counter reset	0x2C43 Advanced Diagnostics Limits / Control: sub0x10 Reset command
E	Feedback Field reset	0x2C03 Feedback Field: sub0xD Reset Command

3 Process Data, IO-Link

3.1 Process input data (PDin)

Length: 11 bytes

Sub-index	Bit offset	Length (bits)	Data type	Description
1	83	1	BooleanT	Valve State: Lower Seat Lift *)
2	82	1	BooleanT	Valve State: Upper Seat Lift *)
3	81	1	BooleanT	Valve State: Open *)
4	80	1	BooleanT	Valve State: Closed *)
5	48	32	Float32T	Position external sensor in mm (resolution 0.1mm)
6	16	32	Float32T	Position internal sensor in mm (resolution 0.1mm)
7	8	8	UIntegerT	Device status 0: normal 1: diagnose active 2: maintenance required 3: out of specification 4: warning 5: error Bit 4-7 reserved
8	4	4	UIntegerT	Valve Mode 0: Initialization 1: Normal operation 2: Teach function active 3: SafePos active 4: Manual control active 5: Service Mode active 6: Internal SafePos active (all valves off)
9	3	1	BooleanT	Feedback Position 4 (S4) (internal position sensor) True = On False = Off
10	2	1	BooleanT	Feedback position 3 (S3) (internal position sensor) True = On False = Off
11	1	1	BooleanT	Feedback position 2 (S2) (external position sensor) True = On False = Off
12	0	1	BooleanT	Feedback position 1 (S1) (external position sensor) True = On False = Off

*) used for valve type D4, DA4, D4SL. Always set to false in case of D4PMO.

				↓ Bitoffset Lower Seat Lift		↓ Bitoffset Upper Seat Lift		↓ Bitoffset Open	↓ Bitoffset Closed			↓ Bitoffset Position external sensor
Bits	87	..	84	83		82		81	80	79	..	48
Sub index				1		2		3	4		5	
Data type				BooleanT		BooleanT		BooleanT	BooleanT		Float32T	
Name	Not used			Lower Seat Lift *)		Upper Seat Lift *)		Open *)	Closed *)		Position external sensor	
Length [Bits]	4			1		1		1	1		32	

*) used for valve type D4, DA4, D4SL. Always set to false in case of D4PMO.

				↓ Bitoffset Position internal sensor			↓ Bittoffset Device Status			↓ Bittoffset Valve Mode			↓ Bitoffset Position S4	↓ Bitoffset Position S3	↓ Bitoffset Position S2	↓ Bitoffset Position S1
Bits	47	..	16	15	…	8	7	..	4	3	2	1	0
Sub index	6			7			8			9	10	11	12
Data type	Float32T			UIntegerT			UIntegerT			BooleanT	BooleanT	BooleanT	BooleanT
Name	Position internal sensor			Device Status			Valve Mode			S4	S3	S2	S1
										Internal position sensor		External position sensor	
Length [Bits]	32			8			4			1	1	1	1

3.2 Process output data (PDout)

Length: 1 byte

Sub-index	Bit offset	Length (bits)	Data type	Description
4	3	1	BooleanT	Locating function (fast flashing LEDs) True = Activated False = Deactivated
3	2	1	BooleanT	Set point valve 3 (V3): True = Open False = Closed
2	1	1	BooleanT	Set point valve 2 (V2): True = Open False = Closed
1	0	1	BooleanT	Set point valve 1 (V1): True = Open False = Closed

					↓ Bitoffset Locating function	↓ Bitoffset Set point V3	↓ Bitoffset Set point V2	↓ Bitoffset Set point V1
Bits	7	6	5	4	3	2	1	0
Sub-index					4	3	2	1
Data type					BooleanT	BooleanT	BooleanT	BooleanT
Name	Not used				Locate	V3	V2	V1
Length[Bits]	4				1	1	1	1

4 Supported IO-Link system commands

command	description
128	Device reset (restart)
130	Restore factory settings
160	Start automatic teach function
166	Start manual teach function Closed position
167	Start manual teach function Open position
168	Start manual teach function Upper seat lift
169	Start manual teach function Lower seat lift

5 Non-cyclic parameters (On-Request Data (ISDU))

Following datatype abbreviations are used in this document:

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UI32	UIntegerT	4 bytes (32 bit)
UI64	UIntegerT	8 bytes (64 bit)
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Following abbreviations are used for expressing conditions:

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Description of used table columns:

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Data type	Data type of sub index / object (if only sub index 0 exists)
Data memory	Data storage
Reset group	Sub index will be reset to factory default settings, if corresponding reset group is reset. (Refer to reset group overview below.)

Reset group overview:

Reset Group	Description	For details refer to description of object
A	Factory reset	0x2C16 Factory Reset
B	Partial factory reset (device reset function)	0x2C16 Factory Reset
C	Teach reset	0x2C15 Teach functions: sub0x4 Teach reset command
D	Counter reset	0x2C43 Advanced Diagnostics Limits / Control: sub0x10 Reset command
E	Feedback Field reset	0x2C03 Feedback Field: sub0xD Reset Command

5.1 Supported common data objects

Index (dec)	Object name	Access	Length	Data type	Remark *)
0x0000 (0)	*Direct Parameter Page 1*	R		RecordT	*Redirected to the page communication channel, see 10.7.5*
0x0001 (1)	*Direct Parameter Page 2*	R/W		RecordT	*Redirected to the page communication channel, see 10.7.5*
0x0002 (2)	*System-Command*	W	1 octet	UIntegerT	*Command Code Definition (See B.2.2)*
0x0003 (3)	*Data Storage Index*	R/W	variable	RecordT	*Set of data objects for storage (See B.2.3)*
0x000C (12)	*Device Access Locks*	R/W	2 octets	RecordT	*Standardized Device locking functions (See B.2.4)*
0x0010 (16)	*Vendor Name*	R	max. 64 octets	STR	*Informative (See B.2.8)*
0x0011 (17)	*Vendor Text*	R	max. 64 octets	STR	*Additional vendor information (See B.2.9)*
0x0012 (18)	*Product Name*	R	max. 64 octets	STR	*Detailed product or type name (See B.2.10)*
0x0013 (19)	*Product ID*	R	max. 64 octets	STR	*Product or type identification (See B.2.11 for details)*
0x0014 (20)	*Product Text*	R	max. 64 octets	STR	*Description of Device function or characteristic (See B.2.12)*
0x0015 (21)	*Serial- Number*	R	max. 16 octets	STR	*Vendor specific serial number (See B.2.13)*
0x0016 (22)	*Hardware Revision*	R	max. 64 octets	STR	*Vendor specific format (See B.2.14)*
0x0017 (23)	*Firmware Revision*	R	max. 64 octets	STR	*Vendor specific format (See B.2.15)*
0x0018 (24)	*Application Specific Tag*	R/W	19 octets	STR	*Tag location or tag function defined by user (See B.2.16)*
0x0024 (36)	*Device Status*	R	1 octet	UIntegerT	*Contains current status of the Device (See B.2.18)* *Supported since firmware revision A.0.3.0*
0x0025 (37)	*Detailed Device Status*	R	variable	ArrayT of OctetStringT3	*See B.2.19*

*) Referenced chapters refer to "*IO-Link Interface and System Specification*"
(File name: IOL-Interface-Spec_10002_V112_Jul13)

5.2 0x2000 Device Description Object

Index: 0x2000 (8192)

sub	name	description	access type	data type	data memory	reset group
0x1	Device Name	*Used to identify the device in Service-Tool via special service interface)*	RO	STR		
0x2	Manufacture ident. number	*Manufacture specific device identification number*	RO	UI32		
0x3	Manufacture Date	*Manufacture Date*	RO	STR		
0x4	Software Ident Number	*Identification number of firmware*	RO	UI32		
0x5	Software Version	*Firmware version number*	RO	UI32		
0x6	Hardware Version	*Hardware version number*	RO	UI32		
0x7	Serial Number	*Serial number of device*	RO	UI32		
0x8	Product Code	*Manufacture specific type of product (type code) *)*	RO	UI32		
0x9	Product Group	*Manufacture specific product group *)*	RO	UI8		

*) These sub objects are not displayed in the IODD menus.

5.3 0x2002 User Configuration Object

Index: 0x2002 (8194)

sub	name	description	access type	data type	data memory	reset group
0x1	Unique Device Name	*Do not change.* <ID><SN> with <ID> device ident number (8digits, with leading zeros) <SN> device serial number (8digits, with leading zeros)	RW	STR	x	A
0x2	Location Information	*Additional user information about the devices location*	RW	STR	x	A
0x3	User Description	*Additional user information about the device*	RW	STR	x	A
0x4	Displayed Device Name	*Device (TAG) name* *(also used for display in service tool via service interface)*	RW	STR	x	A

5.4 0x2004 Device Status Object

Index: 0x2004 (8196)

sub	name	description	access type	data type	data memory	reset group
0x1	Device Status NamurNe107	*Corresponds to the device status *)*	RO	UI8		
0x2	Device Temperature	*Temperature of the device in kelvin*	RO	FL32		
0x3	Device Supply Voltage	*Supply voltage in volt*	RO	FL32		
0x4	Operation Time_[s]	*Device operating time counter in seconds*	RO	UI32		
0x5	Maximum Device Temperature	*Maximum internal device temperature in kelvin throughout the device's service life*	RO	FL32		
0x6	Minimum Device Temperature	*Minimum internal device temperature in kelvin throughout the device's service life*	RO	FL32		
0x7	Maximum Device Supply Voltage	*Maximum device power supply voltage since start-up in volt*	RO	FL32		
0x8	Minimum Device Supply Voltage	*Minimum device power supply voltage since start-up in volt*	RO	FL32		
0xD	Device Boot Counter	*Number of device starts*	RO	UI32		
0x13	Actuator Supply Voltage	*Class A devices: Supply voltage for actuators in volt.*	RO	FL32		

*) Details of Device Status NamurNe107:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	Namur mode: 0 – auto 1 – manual 2 – flashing		Namur state: 0 – diagnose passive (normal) 1 – diagnose active 2 – maintenance required 3 – out of specification 4 – check function (warning) 5 – error			

5.5 0x200A Power Supply Alarm Values

Index: 0x200A (8202)

sub	name	description	access type	data type	data memory	reset group
0x1	Voltage error limit high	*In volt. If the supply voltage exceeds this value, an error message is output.*	RO	FL32		
0x2	Voltage error limit low	*In volt. If the supply voltage falls below this value, an error message is output.*	RO	FL32		
0x3	Voltage warning limit high	*In volt. If the supply voltage exceeds this value, a warning message is output.*	RW	FL32	x	A
0x4	Voltage warning limit low	*In volt. If the supply voltage falls below this value, a warning message is output.*	RW	FL32	x	A
0x5	Voltage hysteresis	*In volt. 1.0 means limit +/- 0.5 volts.*	RO	FL32		

5.6 0x200B Temperature Alarm Values

Index: 0x200B (8203)

sub	name	description	access type	data type	data memory	reset group
0x1	Temperature error limit high	*In kelvin. If the temperature exceeds this value, an error message is output.*	RO	FL32		
0x2	Temperature error limit low	*In kelvin. If the temperature falls below this value, an error message is output.*	RO	FL32		
0x3	Temperature warning limit high	*In kelvin. If the temperature exceeds this value, a warning message is output.*	RO	FL32		
0x4	Temperature warning limit low	*In kelvin. If the temperature falls below this value, a warning message is output.*	RO	FL32		
0x5	Temperature hysteresis	*In kelvin. 4.0 means limit +/-2 kelvin.*	RO	FL32		
0x6	Calibration temperature	*For future use.*	RO	FL32		
0x7	Calibration offset	*For future use.*	RO	FL32		

5.7 0x2101 Locating Function

Index: 0x2101 (8449)

sub	name	description	access type	data type	data memory	reset group
0x1	call/cancel	*Activate or deactivate locating function :* *This function enables a device in the system to be located using the PLC. The top LED indicator will briefly start to flash for about 10 seconds when the locating function is activated (fast flashing LEDs)* *1 = activated* *0 = deactivated* *Use this function only if device is in DL (Data Link layer) state "PreOperate".* *In DL state "Operate" use the locating function in the cyclic process output data (PDout), refer also to chapter 3.2.*	RW	UI8		

5.8 0x210A Trigger Maintenance Function

Index: 0x210A (8458)

sub	name	description	access type	data type	data memory	reset group
0x1	call/cancel	*Trigger a maintenance signal from extern:* *0: Deactivated.* *1: Activated.* *The top LED indicator shows a maintenance required signal until reboot or set 0 to the call/cancel Object, if* • *there is no warning / error to be indicated* *AND* • *one of the following LED modes is selected by 0x2120 LED Modi:* *0 – NAMUR mode* *3 – Valve mode + errors + warnings* *7 – Device specific* *Additionally a warning is output.*	RW	UI8		

5.9 0x2120 LED Modi

Index: 0x2120 (8480)

sub	name	description	access type	data type	data memory	reset group	factory setting
0x0	LED Modi	*Select LED indicator mode.* *Please refer to the operating instructions for a description of the possible indicator modes.* *0 – NAMUR mode* *1 – Valve mode (position signal, no errors) *)* *2 – Valve mode + errors (red) *)* *3 – Valve mode + errors (red) + warnings (orange, yellow, blue) *)* *4 – Fixed color mode configured by object 0x2122 (LED Extern Color)* *6 – (Top) LEDs off* *7 – Device specific, position / fault colors configured by object 0x2C11 (Device Specific LED Mode)* **) Position colors and blink modes can be configured by objects 0x2C12 (Valve Mode Feedback Colors) and 0x2C13 (Valve Mode Feedback Blink Modes)*	RW	UI32	x	A	7

5.10 0x2122 LED Extern Color

Index: 0x2122 (8482)

sub	name	description	access type	data type	data memory	reset group	factory setting
0x0	LED Extern Color	*In case of setting object 0x2120 LED Modi to 4 (Fixed Color) the color of TOP LEDs is controlled externally by writing a corresponding value to this object *)*	RW	UI32	x	A	White

*) Details on color value:

Byte 3		Byte 2	Byte 1	Byte 0
Bit 4-7	Bit 0-3	Bit 0-7	Bit 0-7	Bit 0-7
0x0	Blink mode *0x0: Always on* *0x1: Slow flashing* *0x2: Fast flashing* *0x3: Double flashing*	RGB: blue component	RGB: green component	RGB: red component
0x1		0x00	0x00	Fixed color list: *0x00: Off* *0x01: White* *0x02: Green* *0x03: Blue* *0x04: Yellow* *0x05: Orange* *0x06: Red*

Example values:

TOP LED Color (Always on)	Value	Byte 3	Byte 2	Byte 1	Byte 0
White	0x10000001	0x10	0x00	0x00	0x01
Red	0x10000006	0x10	0x00	0x00	0x06
Orange	0x10000005	0x10	0x00	0x00	0x05
Yellow	0x10000004	0x10	0x00	0x00	0x04
Green	0x10000002	0x10	0x00	0x00	0x02
Blue	0x10000003	0x10	0x00	0x00	0x03
LED Off	0x10000000	0x10	0x00	0x00	0x00

5.11 0x2C00 Additional Device Identity

Index: 0x2C00 (11264)

sub	name	description	access type	data type	data memory	reset group
0x2	Device Ident Number	*Device identification number (SPX H-number)*	RO	UI32		
0x5	PCB ID1	*PCB identification number 1 (Manufacturer specific)*	RO	UI32		
0x6	PCB ID2	*PCB identification number 2*	RO	UI32		
0x7	PCB Serial Number	*PCB serial number*	RO	UI32		
0x8	PCB Hardware Version	*PCB hardware version*	RO	UI8		
0x9	PCB Hardware Index	*PCB hardware index*	RO	UI8		

5.12 0x2C01 Life Data

Index: 0x2C01 (11265)

sub	name	description	access type	data type	data memory	reset group
0x1	Operation Hours Total	*Operation hours total.*	RO	UI32		A
0x2	Operation Hours Resettable	*Resettable operation hours. *)*	RO	UI32		A, B, D
0x3	Cycles V1 Total	*Total switching cycles of solenoid valve V1.*	RO	UI32		A
0x4	Cycles V1 Resettable	*Resettable switching cycles of solenoid valve V1.*)*	RO	UI32		A, B, D
0x5	Cycles V2 Total	*Switching cycles of solenoid valve V2.*	RO	UI32		A
0x6	Cycles V2 Resettable	*Resettable switching cycles of solenoid valve V2.*)*	RO	UI32		A, B, D
0x7	Cycles V3 Total	*Switching cycles of solenoid valve V3.*	RO	UI32		A
0x8	Cycles V3 Resettable	*Resettable switching cycles of solenoid valve V3.*)*	RO	UI32		A, B, D

*) *Can be reset e.g. with Advanced Diagnostics Limits / Control (refer to 0x2C43sub0x10)*

5.13 0x2C02 CMD set point

Index: 0x2C02 (11265)

sub	name	description	access type	data type	data memory	reset group	factory setting
0x1	CMD set point value source	*Select CMD set point value source:* *Configure the source of the control signal for solenoid valves* *0 – IO-Link* *1 – Manual set point value (see sub index 0x2) *)* *Selection is stored persistently.* *CMD set point value source is reset to IO-Link during Automatic teach function, Service Mode, Device Reset Mode.*	RW	UI8	x	A	0
0x2	Manual CMD set point	*Manual set point value for solenoid valves *) *\)* *Value is stored persistently.*	RW	UI8		A	0

*) When *0x2C02sub1 CMD set point value source* is switched from *IO-Link* to *Manual set point value*, *0x2C02sub2 Manual CMD set point* is updated with latest solenoid valve set points to provide bumpless switching to manual valve control.

**) Details on solenoid valves setpoint bits in manual mode:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Not used					Solenoid Valve 3	Solenoid Valve 2	Solenoid Valve 1
					0 = OFF, 1 = ON		

5.14 0x2C03 Feedback Fields

Index: 0x2C03 (11267)

sub	name	description	access type	data type	data memory	reset group	factory setting
0x7	TP1 Positive	*Feedback field size at top of position S1 in mm *).*	RW	FL32	x	A, B, E	1.0
0x8	TP1 Negative	*Feedback field size at bottom of position S1 in mm *).*	RW	FL32	x	A, B, E	1.0
0x9	TP2 Positive	*Feedback field size at top of position S2 in mm *).*	RW	FL32	x	A, B, E	1.0
0xA	TP2 Negative	*Feedback field size at bottom of position S2 in mm *).*	RW	FL32	x	A, B, E	1.0
0xB	TP3 Positive	*Feedback field size at top of position S3 in mm *).*	RW	FL32	x	A, B, E	1.0
0xC	TP3 Negative	*Feedback field size at bottom of position S3 in mm *).*	RW	FL32	x	A, B, E	1.0
0xD	Reset Command	*Bit mask, which feedback fields shall be reset to default values **)*	RW	UI8			
0xE	TP4 Positive	*Feedback field size at top of position S4 in mm *).*	RW	FL32	x	A, B, E	1.0
0xF	TP4 Negative	*Feedback field size at bottom of position S4 in mm *).*	RW	FL32	x	A, B, E	3.0

*) resolution: 0.1 mm; check / ensure the correct tolerance band setting of the feedback fields for valve type setting "D4PMO" during start-up.

**) Feedback Field Reset Command - details

Bit	Bit = 1	Affected objects
0	Reset Feedback fields S1	0x2C03sub7, 0x2C03sub8
1	Reset Feedback fields S2	0x2C03sub9, 0x2C03subA
2	Reset Feedback fields S3	0x2C03subB, 0x2C03subC
3	Reset Feedback fields S4	0x2C03subE, 0x2C03subF

5.15 0x2C04 Control head settings (Service Parameters)

Index: 0x2C04 (11268)

sub	name	description	access type	data type	data memory	reset group	factory setting
0x1	Magnetic Manual Control Active	*Activation / Deactivation: 1 - On, 0 - Off*	RW	UI8	x	A,B	1
0x2	Service Indication Time Active	*Activation / Deactivation of service indication after expired time : 1 - On, 0 - Off* *Expired time is counted by "Operating Hours Resettable" (0x2C01 sub 2).* *If enabled, service indication / warning will be raised after time "Maintenance At Days" (0x2C04 sub 4) expired.*	RW	UI8	x	A,B	0
0x3	Service Indication Cycles Active	*Activation / Deactivation of service indication after expired solenoid valve cycles V1, V2 or V3 : 1 - On, 0 - Off* *Cycles are counted by "Cycles Vx Resettable" (V1: 0x2C01 sub 4, V2: 0x2C01 sub 6, V3: 0x2C01 sub 8).* *If enabled, service indication / warning will be raised if at least one of the resettable cycle counter exceeds its corresponding limit "Maintenance At Cycles Vx" (V1: 0x2C04 sub 0x11, V2: 0x2C04 sub 0x12, V3: 0x2C004 sub 0x13)*	RW	UI8	x	A,B	0
0x4	Maintenance At Days	*Time based service indication interval in days.* *Refer to 0x2C04 sub 2 for details.*	RW	UI16	x	A,B	365
0x8	Set-point error (Safety Mode)	*Select reaction in the event of a set point error (bus error or invalid process data):* *0 – Safety Position* *Solenoid valves are controlled by value from "Valves Safety Position" (refer to object 0x2C04 sub 9)* *1 – Maintain Position (Last position)* *Solenoid valves are controlled by hold set point values V1, V2, V3 of process output data (PDout) from before the communication loss.*	RW	UI8	x	A	0
0x9	Valves Safety Position	*Control bits for solenoid valves safety position (used only in case set point error (Safety Mode, 0x2C04 sub 8) is set to 0 "Safety Position")* Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 Not used | Solenoid Valve: V3 | V2 | V1 0 = OFF, 1 = ON	RW	UI8	x	A	0
0xA	Valve Type	*Process valve type (D4 series)* *0 – D4 (DIP3 = 0, DIP4 = 0)* *1 – DA4 (DIP3 = 1, DIP4 = 0)* *2 – D4SL (DIP3 = 0, DIP4 = 1)* *3 – D4PMO (DIP3 = 1, DIP4 = 1) *)* **) check / ensure the correct tolerance band setting of the feedback fields for valve type setting "D4PMO" during start-up – see also chapter 5.14 (0x2C03)*	RW	UI8	x	A	2 (D4SL)
0xB	Spare	*Currently not used*	RW	UI8		A, B	0
0xE	WMS Filter	*Filter for position measuring system (WMS).* *0 – Standard, 1 – Array, 2 – Special*	RW	UI8	x	A	0
0xF	Service Indication Display Option	*Optical display of service indication via top LED indicator if 0x2120 LED Modi is set to* *3 – "Valve Mode + errors + warnings" **or*** *7 – "Device specific" (8681 Classic (LED) modes)* *0 – Enabled* *1 – Disabled*	RW	UI8	x	A,B	0

sub	name	description	access type	data type	data memory	reset group	factory setting
0x10	Local control lock (Device lock)	*Activate or deactivate local operation:* *Buttons for manual operation (manual teach / reset functions) inside the device are deactivated to prevent unintentional operation* *0 = Not deactivated (buttons are enabled)* *1 = Deactivated (buttons are disabled)*	RW	UI8	x	A	0
0x11	Maintenance At Cycles V1	*Cycle based service indication interval for solenoid valve V1. Refer to 0x2C04 sub 3 for details.*	RW	UI32	x	A,B	10000
0x12	Maintenance At Cycles V2	*Cycle based service indication interval for solenoid valve V2. Refer to 0x2C04 sub 3 for details.*	RW	UI32	x	A,B	50000
0x13	Maintenance At Cycles V3	*Cycle based service indication interval for solenoid valve V3. Refer to 0x2C04 sub 3 for details.*	RW	UI32	x	A,B	50000

5.16 0x2C06 Diagnose

Index: 0x2C06 (11270)

sub	name	description	access type	data type	data memory	reset group
0x1	ErrorByte	*Description of bits refer to *)*	RO	UI32		
0x2	Info/WarningByte	*Description of bits refer to **)*	RO	UI32		

***) Details of ErrorByte**

Bit	Bitmask	Description
0	0x00000001	Teach function required (No position taught)
1	0x00000002	IO-Link set-point value error (Bus error)
2	0x00000004	Internal - Reserved
3	0x00000008	Internal - Reserved
4	0x00000010	Internal - Reserved
5	0x00000020	Teach function error
6	0x00000040	Internal WMS (position measuring system) signal error
7	0x00000080	External WMS (position measuring system) signal error
8	0x00000100	Error persistent memory
16	0x00010000	Switching timeout error
20	0x00100000	Error power supply measurement
21	0x00200000	Internal common error
22	0x00400000	Internal - Reserved
23	0x00800000	Error power supply
24	0x01000000	Error device temperature

****) Details of Info/WarningByte**

Bit	Bitmask	Description
0	0x00000001	--
1	0x00000002	Solenoid valves in safety position
2	0x00000004	Service / maintenance required
4	0x00000010	Internal safety position active: all solenoid valves off
5	0x00000020	Internal - Reserved
8	0x00000100	Internal - Reserved
12	0x00001000	Internal - Reserved
13	0x00002000	Internal - Reserved
14	0x00004000	Internal - Reserved
16	0x00010000	Travel accumulator threshold reached
17	0x00020000	Valve switching cycle threshold reached
18	0x00040000	Operating time threshold reached
19	0x00080000	Travel Timeout threshold reached
20	0x00100000	Trigger Maintenance Function active

5.17 0x2C07 Device State

Index: 0x2C07 (11271)

<table>
<tr><th>sub</th><th>name</th><th>description</th><th>access type</th><th>data type</th><th>data memory</th><th>reset group</th></tr>
<tr><td>0x1</td><td>Mode</td><td>Current device mode:
0 Automatic mode
1 Test mode
2 Test mode
3 Service mode
4 Manual mode
5 Autotune mode
6 (reserved)
7 Device Reset mode</td><td>RO</td><td>UI8</td><td></td><td></td></tr>
<tr><td>0x2</td><td>Teach State</td><td>Current teach state of valve positions – bit coded
Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0
Not used
Valve position: Lower seat lift | Upper seat lift | Open | Closed
0 – not taught
1 – taught</td><td>RO</td><td>UI8</td><td></td><td></td></tr>
<tr><td>0x4</td><td>Valves State</td><td>Current state of the solenoid valves – bit coded
Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0
Not used
Solenoid valve: V3 | V2 | V1
0 – not activated
1 – activated</td><td>RO</td><td>UI8</td><td></td><td></td></tr>
<tr><td>0x7</td><td>Service Indication State</td><td>Current state of service indication
0 – disabled
1 – enabled
2 - enabled and maintenance required
The status of “Trigger Maintenance Function” (0x210A) is not considered.</td><td>RO</td><td>UI8</td><td></td><td></td></tr>
<tr><td>0xA</td><td>Position internal sensor</td><td>Position internal sensor (WMS1) in mm (resolution 0.1mm)</td><td>RO</td><td>FL32</td><td></td><td></td></tr>
<tr><td>0xD</td><td>Valve Mode</td><td>Valve mode
0: Initialization
1: Normal operation
2: Teach function active
3: SafePos active
4: Manual control active
5: Service Mode active
6: Internal SafePos active (all valves off)</td><td>RO</td><td>UI8</td><td></td><td></td></tr>
<tr><td>0xF</td><td>Position external sensor</td><td>Position internal sensor (WMS2) in mm (resolution 0.1mm)</td><td>RO</td><td>FL32</td><td></td><td></td></tr>
</table>

5.18 0x2C08 WMS

Index: 0x2C08 (11272)
WMS = position measuring system
WMS1 = internal position sensor
WMS2 = external position sensor

sub	name	description	access type	data type	data memory	reset group
0x1	Feedback position S1	*WMS2 value of teach position S1 in digits; 0 if not taught*	RO	UI16		A, B, C
0x2	Feedback position S2	*WMS2 value of teach position S2 in digits; 0 if not taught*	RO	UI16		A, B, C
0x3	Feedback position S3	*WMS1 value of teach position S3 in digits; 0 if not taught*	RO	UI16		A, B, C
0x4	Feedback field S1 upper limit	*WMS2 value of upper feedback limit of S1 in digits*	RO	UI16		A, B, C
0x5	Feedback field S1 lower limit	*WMS2 value of lower feedback limit of S1 in digits*	RO	UI16		A, B, C
0x6	Feedback field S2 upper limit	*WMS2 value of upper feedback limit of S2 in digits*	RO	UI16		A, B, C
0x7	Feedback field S2 lower limit	*WMS2 value of lower feedback limit of S2 in digits*	RO	UI16		A, B, C
0x8	Feedback field S3 upper limit	*WMS1 value of upper feedback limit of S3 in digits*	RO	UI16		A, B, C
0x9	Feedback field S3 lower limit	*WMS1 value of lower feedback limit of S3 in digits*	RO	UI16		A, B, C
0xA	WMS1 Position	*WMS1 position value in digits*	RO	UI16		
0xB	Feedback position S4	*WMS1 value of teach position S4 in digits; 0 if not taught*	RO	UI16		A, B, C
0xC	Feedback field S4 upper limit	*WMS1 value of upper feedback limit of S4 in digits*	RO	UI16		A, B, C
0xD	Feedback field S4 lower limit	*WMS1 value of lower feedback limit of S4 in digits*	RO	UI16		A, B, C
0xE	WMS2 Position	*WMS2 position value in digits*	RO	UI16		

5.19 0x2C10 Maintenance

Index: 0x2C10 (11280)

sub	name	description	access type	data type	data memory	reset group	factory setting
0x1	Last Maintenance Date	*Date of last maintenance*	RW	STR		A	--
0x2	Last Maintenance By	*Name of person / company who performed last maintenance*	RW	STR		A	--
0x3	Cycles V1 To Next Maintenance	*Left switching cycles of solenoid valve Vx (x=1, 2, 3) to next maintenance notification.* *Calculation:* *0x2C01sub4/6/8 (Cycles V1/2/3 Resettable) – 0x2C04sub11/12/13 (Maintenance At Cycles V1/2/3)* *A value of 0 indicates maintenance required.* *A value of 0xFFFFFFFF indicates disabled service notification function for valve cycles. (object 0x2C04sub3 Service Indication Cycles Active).*	RO	UI32			
0x4	Cycles V2 To Next Maintenance		RO	UI32			
0x5	Cycles V3 To Next Maintenance		RO	UI32			
0x6	OpHours To Next Maintenance	*Left operation hours to next maintenance notification.* *Calculation: 0x2C01sub2 (Operation Hours Resettable) – 24h/day * 0x2C04sub4 (Maintenance At Days)* *A value of 0 indicates maintenance required.* *A value ≥ 99999999 indicates disabled service notification function for operation hours (object 0x2C04sub2 Service Indication Time Active).*	RO	UI32			

5.20 0x2C11 Device Specific LED Mode

Index: 0x2C11 (11281)

sub	name	description	access type	data type	data memory	reset group	factory setting
0x0	Device Specific LED Mode	*Selection of device specific LED mode *).* *Selected mode gets only active in case Object 0x2120 (LED Modi) is set to 7 (Device specific)*	RW	UI8	x	A	0

*) Details on available device specific LED modes:

Value	Device specific LED mode	Valve closed	Valve open	Upper seat lift	Lower seat lift	Fault
0	Mode 0	Steady green	Steady yellow	Fast flashing yellow	Slow flashing yellow	Red
1	Mode 1	Steady yellow	Steady green	Fast flashing green	Slow flashing green	Red
2	Mode 2	Steady green	Steady red	Fast flashing red	Slow flashing red	Yellow
3	Mode 3	Steady red	Steady green	Fast flashing green	Slow flashing green	Yellow

Refer to operating instructions for details.

5.21 0x2C12 Valve Mode Feedback Colors

Index: 0x2C12 (11282)

sub	name	description	access type	data type	data memory	reset group	factory setting
0x1	Color Position Closed	*Color for indication of closed position *)*	RW	UI32	x	A	Green
0x2	Color Position Open	*Color for indication of open position *)*	RW	UI32	x	A	Yellow
0x3	Color Lower seat lift	*Color for indication of lower seat lift *)*	RW	UI32	x	A	Green
0x4	Color Upper seat lift	*Color for indication of upper seat lift *)*	RW	UI32	x	A	Green
0x5	Color Position None	*Color for indication of no active position *)*	RW	UI32	x	A	Off

*) Settings used only for 5.9 0x2120 LED Modi = 1, 2, 3 (Valve mode, Valve mode + errors, Valve mode + errors + warnings)
Details on color value:

Byte 3		Byte 2	Byte 1	Byte 0
Bit 4-7	**Bit 0-3**	**Bit 0-7**	**Bit 0-7**	**Bit 0-7**
0x0	0x0	RGB: blue component	RGB: green component	RGB: red component
0x1	0x0	0x00	0x00	*Fixed color list:* *0x00: Off* *0x01: White* *0x02: Green* *0x03: Blue* *0x04: Yellow* *0x05: Orange* *0x06: Red*

Example values:

TOP LED Color	Value	Byte 3	Byte 2	Byte 1	Byte 0
White	0x10000001	0x10	0x00	0x00	0x01
Red	0x10000006	0x10	0x00	0x00	0x06
Orange	0x10000005	0x10	0x00	0x00	0x05
Yellow	0x10000004	0x10	0x00	0x00	0x04
Green	0x10000002	0x10	0x00	0x00	0x02
Blue	0x10000003	0x10	0x00	0x00	0x03
LED Off	0x10000000	0x10	0x00	0x00	0x00

5.22 0x2C13 Valve Mode Feedback Blink Modes

Index: 0x2C13 (11283)

sub	name	description	access type	data type	data memory	reset group	factory setting
0x3	Blink Mode Lower Seat Lift	*Blink mode for indication of position 'Lower seat lift' **)*	RW	UI8	x	A	1
0x4	Blink Mode Upper Seat Lift	*Blink mode for indication of position 'Upper seat lift' **)*	RW	UI8	x	A	2

**) Settings used only for 5.9 0x2120 LED Modi = 1, 2, 3 (Valve mode, Valve mode + errors, Valve mode + errors + warnings)
Details on blinking mode value:
0: Permanent on
1: Blinking 250 ms ON, 250 ms OFF
2: Blinking 125 ms ON, 125 ms OFF

5.23 0x2C15 Teach functions

Index: 0x2C15 (11285)

sub	name	description	access type	data type	data memory	reset group
0x1	Teach function state	*State of teach function* *0: Complete* *1: Initialization* *2: Process valve Open* *3: Process valve Close* *4: Process valve Open upper seat* *5: Process valve Close upper seat* *11: Process valve Teach closed position* *12: Process valve Teach open position* *14: Process valve Teach upper seat lift* *15: Process valve: Open lower seat* *16: Process valve: Close lower seat* *17: Process valve: Teach lower seat lift* *-1: Abort by user* *-2: Timeout reaching Closed position* *-4: Error teaching Closed position* *-5: Error teaching Open position* *-6: Error teaching Upper seat lift* *-7: Error teach reset* *-8: Reserved teach function.* *-9: Error storing values* *-11: Function not started (not all solenoid valves off)* *-12: Error determining switching times* *-13: Error teaching Lower seat lift* *-14: Error - reversed air supply detected* *-15: Error - invalid valve type setting detected*	RO	SI8		
0x2	Teach function start	*Start teach function* *Automatic teach function measure* • *positions Sx according to the selected valve type (0x2C04subA Valve type)* • *travelling times assigned to actuated valve* *Manual teach functions assign the current position value to the selected position* 0: Finished / teach function aborted 1: Start automatic teach function 11: Start manual teach function Closed position 12: Start manual teach function Open position 13: Start manual teach function Upper seat lift 14: Start manual teach function Lower seat lift	RW	UI8		
0x3	Is taught (Teach state)	*Indicates, which valve positions are taught – bit coded:* *Bit0 = Closed position* *Bit1 = Open position* *Bit2 = Upper seat lift* *Bit3 = Lower seat lift* *Values:* 0 – not taught 1 – taught	RO	UI8		

sub	name	description	access type	data type	data memory	reset group
0x4	Teach reset command	*Reset automatic or manually taught values* 0: Finished / teach reset function aborted 1: Reset all taught positions 2: Reset all taught positions and travelling times 0x2C15sub5 - subA	RW	UI8		
0x5	Travel Time V1 On	*If solenoid valve V1 was switched on:* *Time (in ms) measured during automatic teach function* *from leaving static position (tolerance band)* *until reaching static position (tolerance band)*	RO	UI16		
0x6	Travel Time V1 Off	*If solenoid valve V1 was switched off:* *Time (in ms) measured during automatic teach function* *from leaving static position (tolerance band)* *until reaching static position (tolerance band)*	RO	UI16		
0x7	Travel Time V2 On	*Refer to Travel Time V1 On (0x2C15sub5), but with solenoid valve V2*	RO	UI16		
0x8	Travel Time V2 Off	*Refer to Travel Time V1 Off (0x2C15sub6), but with solenoid valve V2*	RO	UI16		
0x9	Travel Time V3 On	*Refer to Travel Time V1 On (0x2C15sub5), but with solenoid valve V3*	RO	UI16		
0xA	Travel Time V3 Off	*Refer to Travel Time V1 Off (0x2C15sub6), but with solenoid valve V3*	RO	UI16		

5.240x2C16 Factory Reset

Index: 0x2C16 (11286)

Attention: Refer to operating instructions of SPX 8681 CU D4 before starting this function!

The device requires a restart afterwards to apply the changed settings.

Warning: It is possible that your settings for the device are changed and the communication with device fails with the restored settings.

sub	name	description	access type	data type	data memory	reset group
		Factory reset parameters *Refer to operating instructions of SPX 8681 CU D4 before starting this function!* *0: Finished* *99: Partial factory reset (reset group B) start (device reset function)* *111: Factory reset (reset group A) start*	RW	UI8		

5.25 0x2C40 Advanced Diagnostics Totalizers

Index: 0x2C40 (11328)

sub	name	description	access type	data type	data memory	reset group
0x1	Travel accumulator WMS1	*Travel accumulator total [mm] of internal position sensor.* *Travel distance of the valve spindle is added up since factory default / last factory reset.*	RO	FL32		A
0x2	Travel accumulator WMS1 resettable	*Travel accumulator resettable [mm] of internal position sensor.* *Travel distance of the valve spindle is added up since last reset (e.g. once maintenance is complete).*	RO	FL32		A,D
0x3	Travel accumulator WMS2	*Travel accumulator total [mm] of external position sensor.* *Travel distance of the valve spindle is added up since factory default / last factory reset.*	RO	FL32		A
0x4	Travel accumulator WMS2 resettable	*Travel accumulator resettable [mm] of external position sensor.* *Travel distance of the valve spindle is added up since last reset (e.g. once maintenance is complete).*	RO	FL32		A,D
0x5	Not used		RO	FL32		
0x6	Not used		RO	FL32		
0x7	Not used		RO	FL32		
0x8	Not used		RO	FL32		

5.26 0x2C41 Advanced Diagnostics Counters

Index: 0x2C41 (11329)

sub	name	description	access type	data type	data memory	reset group
0x1	Travel time V1 On Error counter	*Number of times "Travel Time Limit V1 On" threshold exceeded (resettable):* *Value (0x2C43sub5 "Travel Time Limit V1 On") + "Time Tolerance" (0x2C43subB) has been exceeded*	RO	UI32		A, D
0x2	Travel time V1 Off Error counter	*Number of times "Travel Time Limit V1 Off" threshold exceeded (resettable):* *Value (0x2C43sub6 "Travel Time Limit V1 Off") + "Time Tolerance" (0x2C43subB) has been exceeded*	RO	UI32		A, D
0x3	Travel time V2 On Error counter	*Number of times "Travel Time Limit V2 On" threshold exceeded (resettable):* *Value (0x2C43sub7 "Travel Time Limit V2 On") + "Time Tolerance" (0x2C43subB) has been exceeded*	RO	UI32		A, D
0x4	Travel time V2 Off Error counter	*Number of times "Travel Time Limit V2 Off" threshold exceeded (resettable):* *Value (0x2C43sub8 "Travel Time Limit V2 Off") + "Time Tolerance" (0x2C43subB) has been exceeded*	RO	UI32		A, D
0x5	Travel time V3 On Error counter	*Number of times "Travel Time Limit V3 On" threshold exceeded (resettable):* *Value (0x2C43sub9 "Travel Time Limit V3 On") + "Time Tolerance" (0x2C43subB) has been exceeded*	RO	UI32		A, D
0x6	Travel time V3 Off Error counter	*Number of times "Travel Time Limit V3 Off" threshold exceeded (resettable):* *Value (0x2C43subA "Travel Time Limit V3 Off") + "Time Tolerance" (0x2C43subB) has been exceeded*	RO	UI32		A, D
0x7	Switching Timeout Counter V1	*Number of switching timeouts, if solenoid valves V1 was switched on / off*	RO	UI32		A, D
0x8	Switching Timeout Counter V2	*Number of switching timeouts, if solenoid valves V2 was switched on / off*	RO	UI32		A, D
0x9	Switching Timeout Counter V3	*Number of switching timeouts, if solenoid valves V2 was switched on / off*	RO	UI32		A, D
0xA	Teach function counter	*Number of teach functions performed*	RO	UI32		A

5.27 0x2C42 Advanced Diagnostics Values

Index: 0x2C42 (11330)

sub	name	description	access type	data type	data memory	reset group
0x1	Travel Time V1 On	*If solenoid valve V1 was switched on:* *Time (in ms) measured* *from leaving static position (tolerance band or S4)* *until reaching static position (tolerance band or S4)*	RO	UI16		
0x2	Travel Time V1 Off	*If solenoid valve V1 was switched off:* *Time (in ms) measured* *from leaving static position (tolerance band or S4)* *until reaching static position (tolerance band or S4)*	RO	UI16		
0x3	Travel Time V2 On	*Refer to Travel Time V1 On, but with solenoid valve V2*	RO	UI16		
0x4	Travel Time V2 Off	*Refer to Travel Time V1 Off, but with solenoid valve V2*	RO	UI16		
0x5	Travel Time V3 On	*Refer to Travel Time V1 On, but with solenoid valve V3*	RO	UI16		
0x6	Travel Time V3 Off	*Refer to Travel Time V1 Off, but with solenoid valve V3*	RO	UI16		

5.28 0x2C43 Advanced Diagnostics Limits / Control

Index: 0x2C43 (11331)

sub	name	description	access type	data type	data memory	reset group	factory setting
0x1	Travel accumulator limit WMS1	*Travel accumulator of internal position sensor:* *Activate or deactivate maintenance threshold [mm]* *0: Diagnostics deactivated* *>0: Diagnostics activated* *Warning is output when the resettable travel accumulator reaches this threshold*	RW	FL32	x	A	0.0
0x2	Travel accumulator limit WMS2	*Travel accumulator of external position sensor:* *Activate or deactivate maintenance threshold [mm]* *0: Diagnostics deactivated* *>0: Diagnostics activated* *Warning is output when the resettable travel accumulator reaches this threshold*	RW	FL32	x	A	0.0
0x3	Not used		RW	FL32	x	A	0.0
0x4	Not used		RW	FL32	x	A	0.0
0x5	Travel Time Limit V1 On	*Maximum travel time if solenoid valve V1 is actuated [ms]:* *Adjustable travel time from which a warning (active) should be generated to indicate potential faults in the system (e.g. pilot pressure too low, excessive friction in actuator, etc.).* *A warning is generated if travel time exceeds limit + time tolerance (0x2C43subB).* *Value 0 [ms] disables this travel time monitoring function.* *A teach function may evoke a travel time warning, if travel time monitoring function was already activated*	RW	UI16	x	A	0
0x6	Travel Time Limit V1 Off	*Maximum travel time if solenoid valve V1 is switched off [ms]: Refer to Travel Time Limit V1 On for further details*	RW	UI16	x	A	0
0x7	Travel Time Limit V2 On	*Refer to Travel Time Limit V1 On, but with solenoid valve V2*	RW	UI16	x	A	0
0x8	Travel Time Limit V2 Off	*Refer to Travel Time Limit V1 Off, but with solenoid valve V2*	RW	UI16	x	A	0
0x9	Travel Time Limit V3 On	*Refer to Travel Time Limit V1 On, but with solenoid valve V3*	RW	UI16	x	A	0
0xA	Travel Time Limit V3 Off	*Refer to Travel Time Limit V1 Off, but with solenoid valve V3*	RW	UI16	x	A	0
0xB	Time tolerance	*Tolerance for configurable Travel Time Limits [%]:* *Specifies the tolerance for the parameters "Travel Time Limit V1/V2/V3 On/Off" (0x2C43sub5 – subA), from which point an active warning is generated.*	RW	UI8	x	A	50

sub	name	description	access type	data type	data memory	reset group	factory setting
0xC	Switching timeout detection	*Activate or deactivate switching time timeout detection:* *If activated, switching time timeouts will be detected whenever the end position is not reached within a certain time (refer to sub index 0xD – 0xF) and an error is output.* *Requires at least two detectable end positions.* *Not active during automatic teach function.* *Switching timeouts are measured, if only 1 solenoid valve is switched on / off and max. 1 solenoid valve is active.* *Switching timeout detection of activated channels starts with next single switch on command of corresponding solenoid valve.* *Bit – coded:* *Bit0 = Switching timeout detection V1* *Bit1 = Switching timeout detection V2* *Bit2 = Switching timeout detection V3* *Value:* *0: Deactivated* *1: Activated*	RW	UI8	x	A	0
0xD	Switching timeout V1	Select maximum time by which the end position should be reached [ms]	RW	UI16	x	A	15000
0xE	Switching timeout V2	Select maximum time by which the end position should be reached [ms]	RW	UI16	x	A	15000
0xF	Switching timeout V3	*Select maximum time by which the end position should be reached [ms]*	RW	UI16	x	A	15000
0x10	Diagnosis command	*Reset counters / Import vales.* *Selection is bit-coded.* *All bits = 0: command finished* *For details refer to table *) below.*	RW	UI32			

*) Reset command - details

Bit	Bit = 1	Affected objects
0	Reset operation hour counter	0x2C01sub2
1	Reset switching cycles V1	0x2C01sub4
2	Reset switching cycles V2	0x2C01sub6
3	Reset switching cycles V3	0x2C01sub8
4	Reset travel accumulator WMS1	0x2C40sub2
5	Reset travel accumulator WMS2	0x2C40sub4
6	Not used	
7	Not used	
8	Reset number of Travel timeouts V1 On	0x2C41sub1
9	Reset number of Travel timeouts V1 Off	0x2C41sub2
10	Reset number of Travel timeouts V2 On	0x2C41sub3
11	Reset number of Travel timeouts V2 Off	0x2C41sub4
12	Reset number of Travel timeouts V3 On	0x2C41sub5
13	Reset number of Travel timeouts V3 Off	0x2C41sub6
14	Reset number of switching time timeouts V1	0x2C41sub7
15	Reset number of switching time timeouts V2	0x2C41sub8
16	Reset number of switching time timeouts V3	0x2C41sub9
17	Copy measured travel times V1 On / Off from 0x2C42sub1, 0x2C42sub2	0x2C43sub5 0x2C43sub6
18	Copy measured travel times V2 On / Off from 0x2C42sub3, 0x2C42sub4	0x2C43sub7 0x2C43sub8
19	Copy measured travel times V3 On / Off from 0x2C42sub5, 0x2C42sub6	0x2C43sub9 0x2C43subA

6 Events

Event Code	Event Type	Description	Action
0x1000 (4096)	*ERROR*	*General malfunction - unknown error*	*Restart device* *If fault persists, contact Service.*
0x4000 (16384)	*ERROR*	*Temperature error overload - device temperature for operation too high*	*Modify ambient temperature.* *If fault persists, contact Service.*
0x4210 (16912)	*WARNING*	*Temperature warning upper threshold exceeded - ambient temperature too high or excessive friction in actuator*	*Reduce ambient temperature.* *If fault persists, contact Service.*
0x4220 (16928)	*WARNING*	*Temperature warning lower threshold exceeded - ambient temperature too low.*	*Increase ambient temperature*
0x5100 (20736)	*ERROR*	*General power supply error - supply voltage for operation of device too low*	*Check supply voltage* *If fault persists, contact Service.*
0x5110 (20752)	*WARNING*	*Voltage warning upper threshold exceeded - supply voltage too high*	*Check supply voltage*
0x5111 (20753)	*WARNING*	*Voltage warning lower threshold exceeded - supply voltage too low*	*Check supply voltage*
0x6000 (24576)	*ERROR*	*Internal software error*	*Restart device* *If fault persists, contact Service.*
0x1801 (6145)	*ERROR*	*General power supply error - supply voltage for operation of device too high*	*Check supply voltage* *If fault persists, contact Service.*
0x1802 (6146)	*ERROR*	*Temperature error lower threshold exceeded - ambient temperature too low*	*Increase ambient temperature*
0x1804 (6148)	*ERROR*	*Internal position sensor: signal error*	*Check the target for correct mounting and condition* *If fault persists, contact Service.*
0x1809 (6153)	*ERROR*	*Non-volatile storage memory isn't usable*	*Restart device* *If fault persists, contact Service.*
0x180A (6154)	*WARNING*	*Teach function required*	*Starting teach function*
0x180B (6155)	*ERROR*	*Teach function error*	*Check pilot pressure* *Check pilot valves* *Restart teach function* *If fault persists, contact Service.*
0x180C (6156)	*WARNING*	*Exceed travel accumulator limit*	*Where appropriate, check wear-and-tear parts in pneumatic actuator and valve*
0x180D (6157)	*WARNING*	*Exceed valve cycle limit*	*Where appropriate, check wear-and-tear parts in pneumatic actuator and valve*
0x180E (6158)	*WARNING*	*Exceed operation time limit*	*Perform maintenance as appropriate*
0x180F (6159)	*WARNING*	*At least one travel time threshold (specified travel time and tolerance) exceeded*	*1. Check compressed air supply* *2. Check actuator and valve for friction*

Event Code	Event Type	Description	Action
0x1811 (6161)	*ERROR*	*Switching timeout - end position not reached*	*Check pilot pressure* *Check pilot valve* *Restart teach function* *If fault persists, contact Service.*
0x1813 (6163)	*WARNING*	*Automatic teach function active*	*Wait until automatic teach function has been completed*
0x1814 (6164)	*ERROR*	*IO-Link error*	*Check IO-Link connection*
0x1815 (6165)	*WARNING*	*Manual valve control active (Valves Mode = MAN)*	*To disable manual valve control, refer to description of object 0x2C02.*
0x1816 (6166)	*WARNING*	*Service Mode active*	*To disable Service Mode apply the magnetic service tool or restart device.*
0x1817 (6167)	*ERROR*	*PCB not supported by current firmware*	*Restart device.* *If fault persists, contact Service.*
0x1818 (6168)	*WARNING*	*User triggered maintenance signal* *Device marked e.g. for maintenance purposes.*	*To disable signal refer to description of object 0x210A or restart device.*
0x181C (6172)	*ERROR*	*Error power supply measurement*	*Check supply voltage.* *Restart device.* *If fault persists, contact Service.*
0x181F (6175)	*ERROR*	*External position sensor: signal error.* *External position sensor may not be properly connected.*	*Check wiring of external position sensor.* *If fault persists, contact Service.*

8681 Control Unit - D4

Control Unit for D4 series valves

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