PENTAIR

SÜDMO INTELLITOP®2.0

IntelliTop® 2.0
Control Head

Operating instructions

We reserve the right to make technical changes without notice.
Technische Änderungen vorbehalten.
Sous resérve de modification techniques.

Operating Instructions 20-12/11_EN_00805843 / Original DE

Control Head IntelliTop 2.0

Content

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!

Failure to observe these instructions and notes may result in hazardous situations.

- The operating instructions must be read and understood.

Symbols

DANGER!

Warns of an immediate danger!

- Failure to observe these instructions will result in death or serious injuries.

WARNING!

Warns of a potentially hazardous situation!

- Failure to observe these instructions may result in serious injuries or death.

CAUTION!

Warns of a potential danger!

- Failure to observe these instructions may result in moderate or minor injuries.

NOTE!

Warns of damage to property!

- Failure to observe these instructions may result in damage to the device or the system.

Indicates important additional information, tips and recommendations.

Refers to information in these operating instructions or in other documentation.

→ Highlights a procedure which you must carry out.

2 INTENDED USE

Unauthorized use of the control head IntelliTop 2.0 may be dangerous to people, nearby equipment and the environment.

- Only use the device for its intended purpose.
- The control head has been designed for use as an actuator for pneumatically operated process valves and / or for recording their switching states.
- When using the control head, observe the authorized data, operating conditions and deployment conditions specified in the contract documents and in the operating instructions. These are described in Chapter “6 Technical data”.
- In view of the large number of application options, check and, if required, test prior to installation whether the control head is suitable for the specific application case. If you are unsure, please contact your Pentair-Südmo contact.
- Use the device only in conjunction with third-party devices and components recommended or approved by Pentair Südmo.
- Any unauthorized modifications and changes to the control head are prohibited for safety reasons.
- Prerequisites for safe and trouble-free operation are correct transportation, correct storage and installation as well as careful operation and maintenance.
- For connecting the control head, use line installations that do not cause any mechanical stresses.
- Devices without a separate Ex type label must not be used in a potentially explosive atmosphere!

Export restrictions

Observe any restrictions that may exist when exporting the system / device.

3 BASIC SAFETY INSTRUCTIONS

These safety instructions do not take account of any

- contingencies or events which may occur during installation, operation and maintenance of the devices;
- local safety regulations that are within the operator's scope of responsibility, including those relating to the installation personnel.

DANGER!

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- Opening the hood or the housing in a potentially explosive atmosphere is only allowed in a not energized state!
- Secure the housing with a lead seal or optionally with plastic self-cutting screws (diameter 3 mm, length approx. 10 mm; e.g. Ejot PT screw K 30 x 10) to prevent it from being opened without a tool!
- Activating the DIP switches on the PCB, using the service interface and the teach buttons, is **not** permitted in a potentially explosive atmosphere!
- Layers of dust on the housing may not exceed 5 mm! Lint, conductive and non-conductive dust particles are allowed. The inside of the housing must not be dirty!
- When wiping the control head, use a damp or anti-static cloth in a potentially explosive atmosphere to prevent electrostatic charges!
- Use only cables and cable glands which have been approved for the respective application area and which have been screwed into place according to the respective installation instructions!
- Close all unnecessary openings with locking screws / sealing plugs approved for potentially explosive atmospheres!

WARNING!

Danger due to electrical voltage!

- Before reaching into the system (except for the teach procedure in a non-explosive atmosphere), switch off the power supply and secure it to prevent restarting!
- Observe the applicable accident prevention and safety regulations for electrical devices!

Danger from high pressure!

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

General hazardous situations.

To prevent injuries, ensure that:

- The system cannot be activated unintentionally.
- Installation and maintenance as well as operator control actions may be performed by authorized and qualified technicians only and with the appropriate tools.
- Do not make any unauthorized internal or external changes to the device!
- The process must be restarted in a defined or controlled manner after an interruption to the power supply or pneumatic supply.

- The device may be installed and operated only when in perfect condition and in consideration of the operating instructions.
- The general rules of technology apply to application planning and operation of the device.

NOTE!

Electrostatically sensitive components / assemblies!

- The device contains electronic components that are susceptible to the effects of electrostatic discharging (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 minimise or avoid the possibility of damage caused by a sudden electrostatic discharge!
- Ensure that you do not touch the electronic components when the power supply voltage is applied!

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 control head.
- Do not supply the medium connections of the system with liquids or aggressive or flammable media!
- Do not place the housing under mechanical stress (e.g. by placing objects on it or standing on it).
- Do not make any external changes to the device housings. Do not paint housing parts or screws.
- Only use compatible cleaning agents for cleaning the securely closed control head and always rinse thoroughly with clean water.

4 GENERAL INFORMATION

4.1 Contact address

After receipt of the shipment, immediately check that the contents are not damaged and that they correspond with the type and quantity on the delivery note or packing list.
If there are any inconsistencies, please contact us immediately.

Contact address.

Pentair Südmo GmbH
Industriestrasse 7
D-73469 Riesbürg
P: +49 (0)9081 803 - 0
F: +49 (0)9081 803 - 158
E: E-mail: info@suedmo.de
Website: www.suedmo.com

4.2 Warranty

Please refer to our general terms of sales and business.
The warranty is only valid if the control head is used as intended in accordance with the specified application conditions.

The warranty extends only to defects in the control head IntelliTop 2.0 and its components.

No liability is accepted for consequential damage of any kind that may result from failure or malfunctioning of the device.

4.3 Information on the Internet

The operating instructions and data sheets for IntelliTop 2.0 can be found on the Internet at:

https://foodandbeverage.pentair.com/en/products/sudmo-valve-control-units

5 SYSTEM DESCRIPTION

5.1 Intended area of application

The control head IntelliTop 2.0 has been designed for use as an actuator for pneumatically operated process valves and / or for recording their switching states.

5.2 General description

The control head IntelliTop 2.0 is used for actuating pneumatically operated process valves. To do this, the control head can be equipped with up to 3 solenoid valves (V1 ... V3).

For the recording and feedback of the process valve switching positions to a higher-level controller, the control head has been equipped with a contact-free position measuring system which operates with 3 discrete, adjustable feedback signals (teach function).

The control head and the process valve are interconnected by an adapter. This produces an integrated, compact and decentralized system of feedback, actuation and valve function. The following advantages over centralized solutions working with valve islands are achieved:

- low installation expenditure
- easy start-up
- shorter switching times and less air consumption due to shorter distances between the pilot valves and the process valve. Up to 3 solenoid valves in the control head serve as solenoid valves.

Various pneumatic and electrical connection designs are available.

5.3 Structure and fluidics

5.3.1 Structure of the control head (1 to 3 solenoid valves)

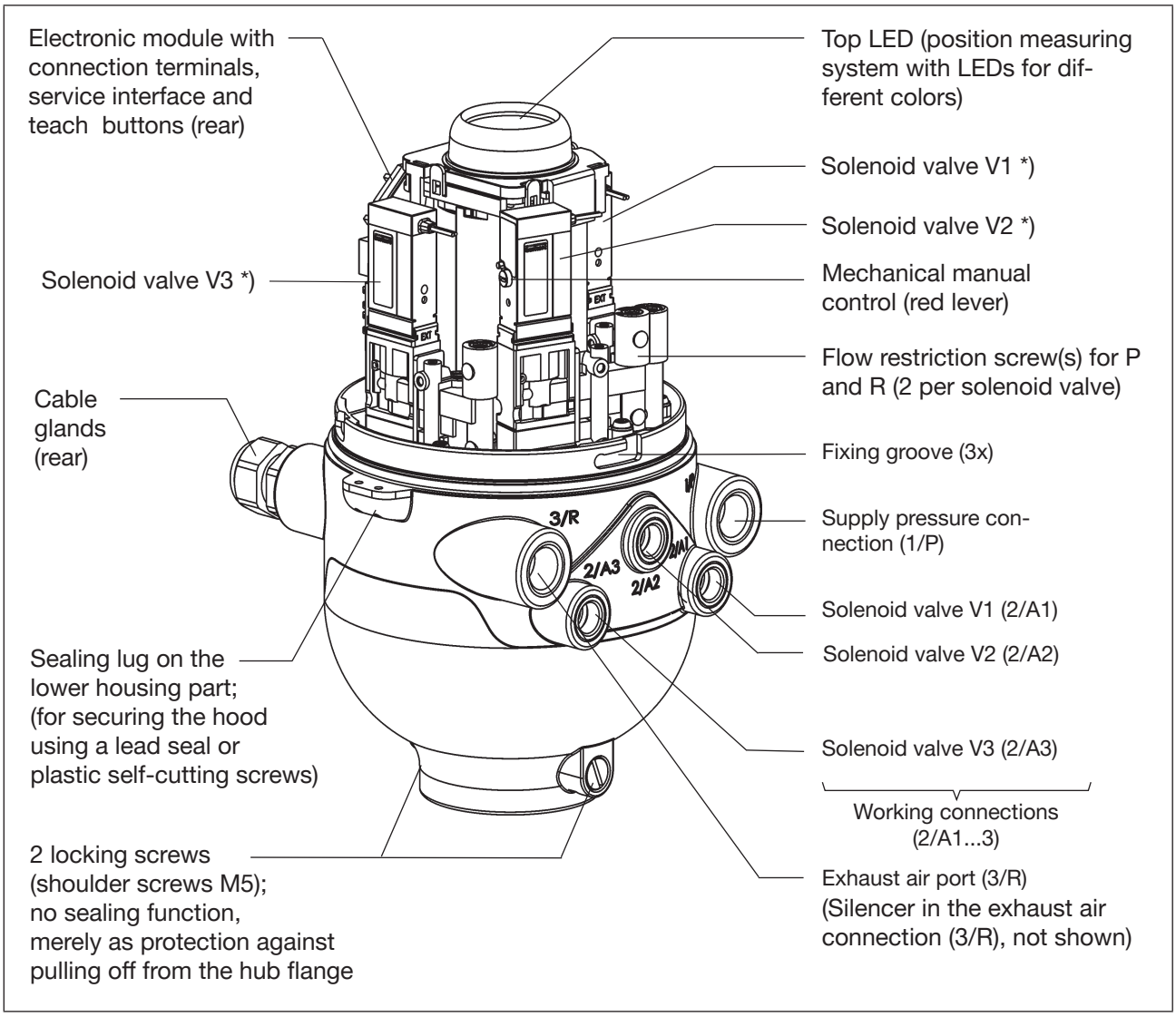


Fig. 1: Structure of control head IntelliTop 2.0 (with 3 solenoid valves)

***)** If a solenoid valves is not present, the connection is sealed tightly with a cover plate. Control head versions without solenoid valves (i.e. "position feedback") do not have any pneumatic connections at the housing, see also "Fig. 2" and chapter "5.3.4 Number of solenoid valves" on page 18.
The retrofitting of special cover plates is described in chapter "9.2.2 Retrofitting in case of intensive external cleaning" on page 41.

5.3.2 Structure of the control head (position feedback)

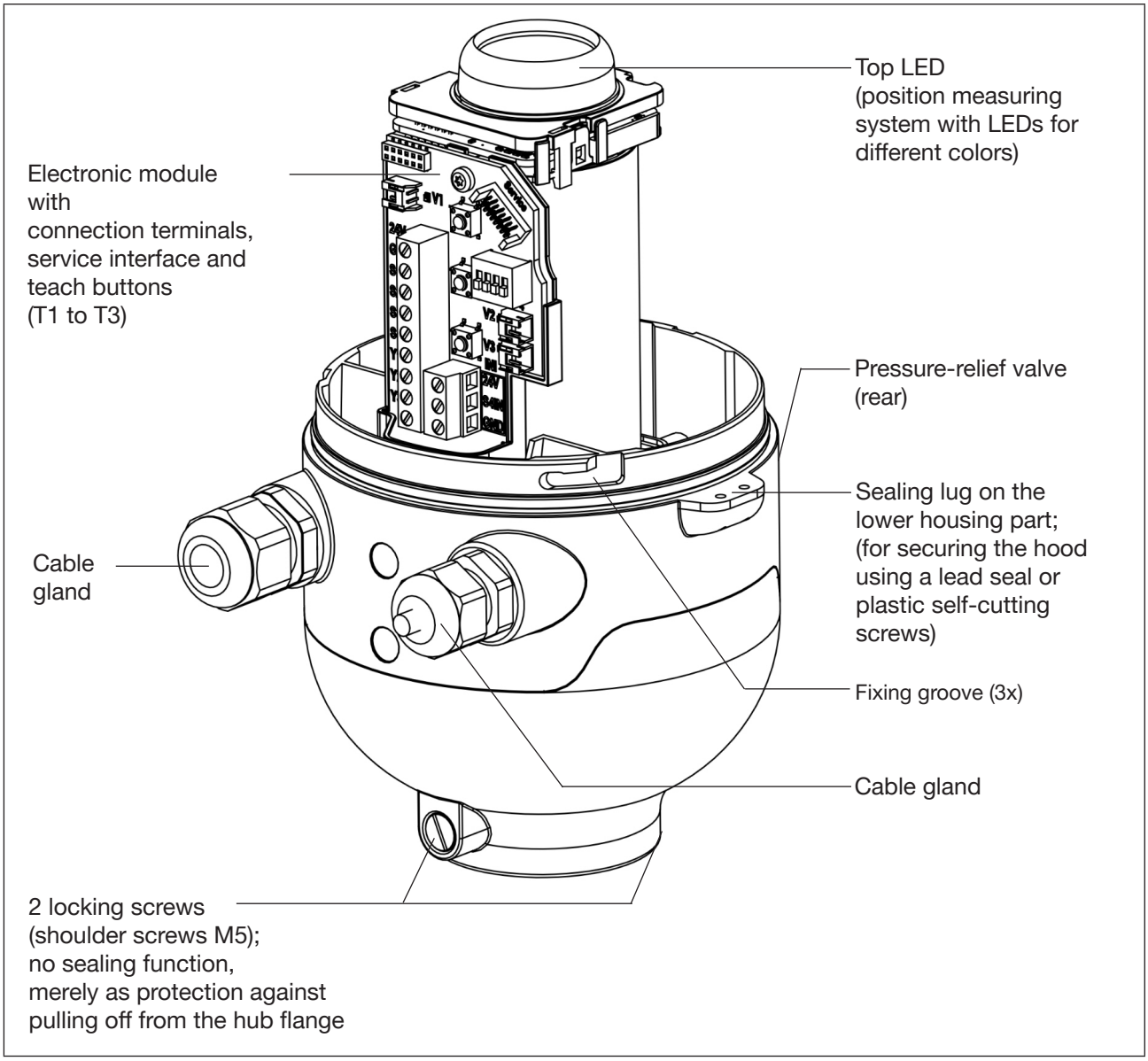


Fig. 2: Structure of a position feedback (IntelliTop 2.0 without solenoid valves)

5.3.3 Fluid diagrams - examples

The following fluid diagrams show the internal pneumatic circuitry of the solenoid valves of the control head to the process valve being controlled.

Design with 3 solenoid valves - e.g. for double seat valves:

with restriction capability for each solenoid valve (see"Fig. 7" on page 28)

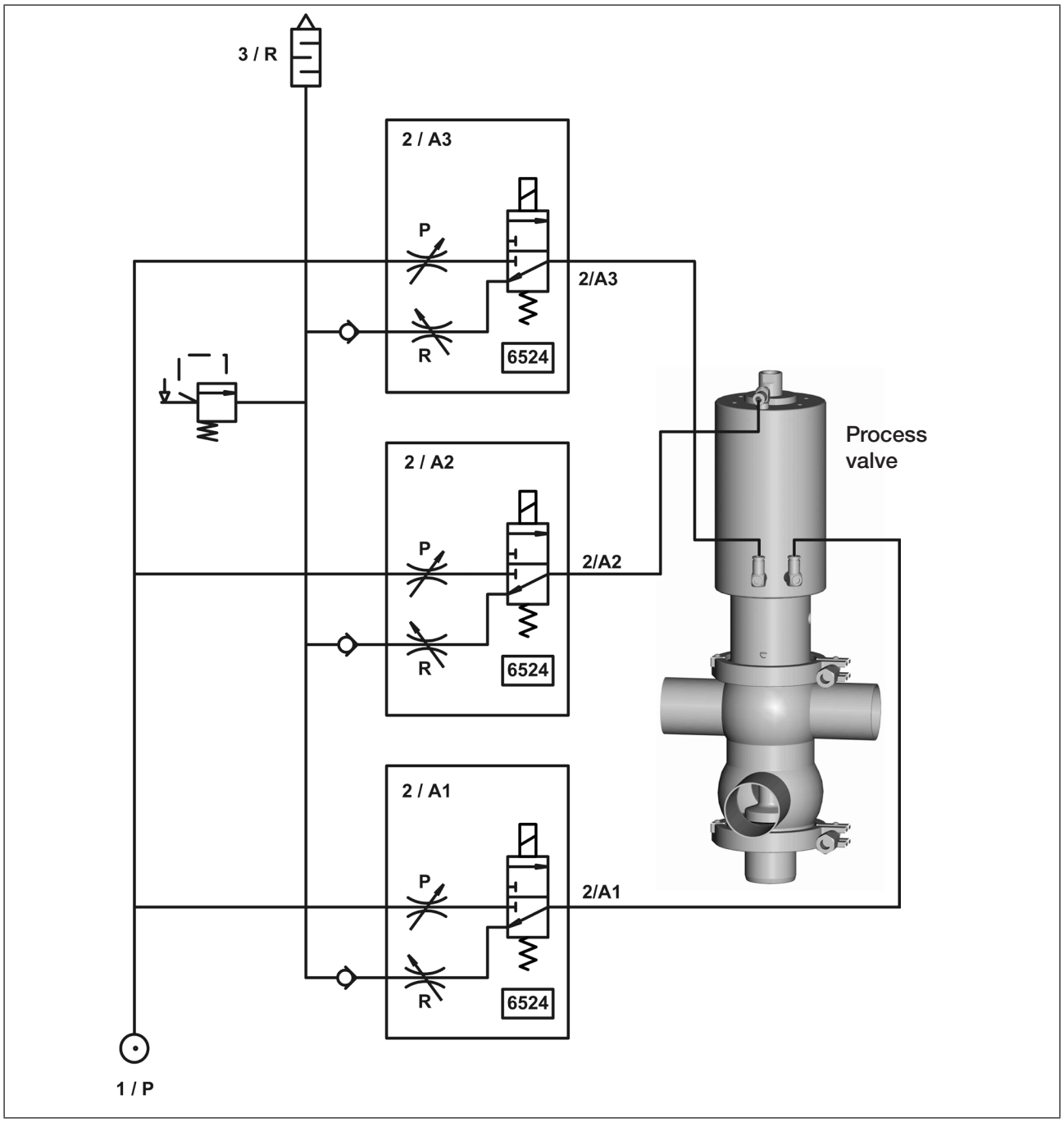


Fig. 3: Fluid diagram (design: 3 solenoid valves)

Design with 2 solenoid valves - e.g. for double-acting actuators:

- with restriction capability for each solenoid valve (see “Fig. 7” on page 28)
- for safety position: Solenoid valve 1: as NC valve, solenoid valve 2 as NO valve
- see also chapter “16 Design for double-acting actuators” on page 91.

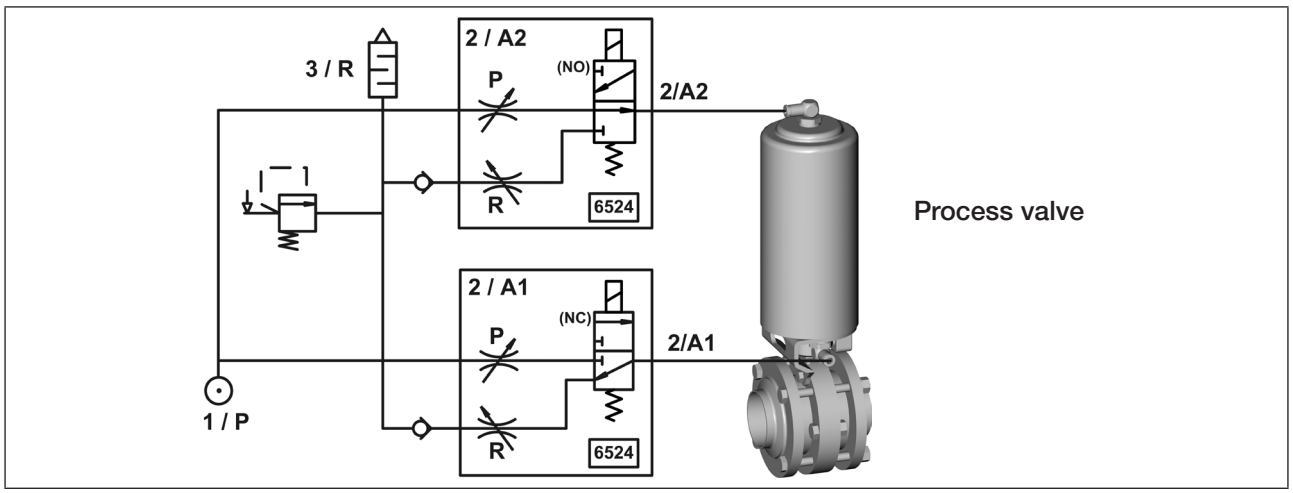


Fig. 4: Fluid diagram (design for double-acting actuators: 2 solenoid valves, NC + NO**)*

5.3.4 Number of solenoid valves

Depending on the number of solenoid valves in the control head, the control head can control various process valves (single-acting and double-acting valve actuators as well as double seat and multi-position valves) or act as a mere position feedback without solenoid valves:

Type of use	Number of solenoid valves V1...3
Position feedback	0
Control head for single-acting actuators	1 (NC*)
Control head for actuators with 2 actuator chambers (both actuator chambers not energized and deaerated)	2 (2 x NC*)
Control head for double seat valves with integrated aeration of both valve seats	3 (3 x NC*)
Control head for double-acting actuators (with rest position)	2 (1 x NC* + 1 x NO**)

Details on design for double-acting actuators (1 solenoid valve NC*, 1 solenoid valve NO**) - see chapter “16 Design for double-acting actuators” on page 91.

5.3.5 Pneumatic interfaces

- Intake and exhaust air connections (1/P, 3/R): G1/4
  Working connections (2/A1...3): G 1/8
- Integrated non-return valves in the solenoid valves' exhaust air duct

* *NNC = 3/2-way valve; closed in rest position, outlet A relieved*
** *NO = 3/2-way valve; opened in rest position, outlet A pressurized*

- Actuation of connection 2/A1 (solenoid valve 1; main stroke of the process valve) using the magnetic manual override that is externally accessible via the manual override tool (both solenoid valves are actuated simultaneously via the manual override tool for the design for double-acting actuators).
- A special silencer with a high flow-rate capacity to connection 3/R has already been mounted.
- The interior of the housing is protected against excessive overpressure, for example due to leakages, by a pressure-relief valve with outlet into the joint exhaust air connection 3/R.

5.4 Special functions / options

5.4.1 “Intelli Pulse Flush” (IPF)

This function – implemented as of firmware C.08.00 – enables particularly effective and chemical-saving cleaning of process valves with seat lift function. The total duration of the cleaning process is controlled by the PLC, but the direct pulse control is carried out in a time-saving manner via the control head using solenoid valve V2 or V3.

The **IPF function** is only available in automatic mode. It must first be activated – see table below (**factory setting: inactive**).

While the cleaning process with Intelli Pulse Flush is running, this is indicated by the Top LED (IPF V2 as feedback from S3, IPF V3 as feedback from S4).

The process valve must be closed when starting the cleaning process. The positions S1 and S3 must have been taught beforehand (for IPF V3 at least S1) – if not yet taught, V2 or V3 are controlled according to the PLC signal.
When the cleaning process is terminated by the PLC, the control head completes the cleaning cycle that has been started.

No other solenoid valve must be controlled during the cleaning process.

(The seat lift function for the cleaning process is interrupted if you switch to another operation/setting mode (manual operation/ feedback field mode/ “device function” mode) in the meantime).

Table for the display / selection / activation of the IPF function:

Before selecting the IPF function, activate the “Device Function” mode.

The IPF function (IPF V2 and/or IPF V3) is activated / selected either directly on the control head or via the service interface using PC software or, in the case of IO-Link devices, also by acyclic data access via IO-Link or by means of the “Bürkert Communicator” – see chapter “14.4 IO-Link master / communication / configuration” on page 81.

Activation / selection of the IPF function does not trigger the cleaning process; the cleaning process is triggered by the PLC.

Note on automatic return to automatic mode!

In “Device Function” mode and when selecting the IPF function, the following always applies: If no further valid selection is made within approx. 10 seconds, the program returns to automatic mode.

The following is a brief summary of the operations required to access **“Device Function” mode**, which includes the **IPF function selection menus.**

Teach buttons	„Device Function“ mode	
T1+T2+T3 simultaneously for > 2.5 s	**Access to “Device Function” mode** (see also chapter “6.9” on page 32) **Display** via flashing pattern / color: 500 ms RED / 500 ms GREEN (alternating) **By pressing additional buttons / button combinations** in the “Device Function” mode, you can select the IPF function menus described below and change their current settings:	
	Teach buttons	**Selection of the IPF functions / Device Reset**
	T2 for > 2.5 s	Access to the **IPF V2** “Lower-Seat-Lift” **menu** For details on displaying the current settings and changing the selection – see „Tab. 2“
	T3 for > 2.5 s	Access to the **IPF V3** “Upper-Seat-Lift” **menu** For details on displaying the current settings and changing the selection – see „Tab. 3“
	T2+T3 simultaneously for > 2.5 s	Access to the **IPF V2 + IPF V3 menu** “Lower-Seat-Lift” + “Upper-Seat-Lift” For details on displaying the current settings and changing the selection – see „Tab. 4“
	T1+T2+T3 simultaneously for > 2.5 s	Resetting the device **(Device Reset)** – see chapter”6.9” on page 32 **Display** via flashing pattern / color: 250 ms ON (in **fault color)** / 250 ms OFF (alternating)

Tab. 1: Access to “Device Function” mode / Functions in “Device Function” mode

Menu of IPF V2 “Lower-Seat-Lift”	
Display of the current IPF V2 selection*) via flashing pattern / color: IPF V2 for **D620, D365it*)** 125 ms in **S2 color** / 875 ms break IPF V2 for **D600, secure*)** 125 ms in **S1 color** / 875 ms break IPF V2 - **individual delay time setting** (only via PC software or IO-Link) 125 ms in **S2 color** / 125 ms in **S1 color** / 750 ms break IPF V2 **inactive** 125 ms in **fault color** / 875 ms break **By pressing another button,** the current settings can be changed:	
Selection via Teach button	**Change of the current IPF V2 selection*)**
	Display of the following selection / activation or deactivation via: 3x short confirmation flashing in the respective color (S2 or S1 or fault), then immediate return to automatic mode
T2 (> 2.5 s)	Selection / Activation of IPF V2 for **D620, D365it** (S2 color)
T3 (> 2.5 s)	Selection / Activation of IPF V2 for **D600, Secure** (S1 color)
T1 (> 2.5 s)	**Deactivation** of IPF V2 (fault color)

Tab. 2: IPF V2 menu – Display / Teach button functions

*)

IPF V2 “Lower-Seat-Lift” – **standard setting** when activating the IPF function via teach buttons:		**IPF V3** “Upper-Seat-Lift” – **factory setting:**	
Delay for D620, D365it:	70 ms	Delay with upper seat detection:	700 ms
Delay for D600, secure:	350 ms	Delay without upper seat detection:	800 ms

Menu of IPF V3 “Upper-Seat-Lift”	
Display of the current IPF V3 selection*) via flashing pattern / color: IPF V3 **active *)** 125 ms in **S2 color** / 875 ms break IPF V3 **inactive** 125 ms in **fault color** / 875 ms break **By pressing another button,** the current settings can be changed:	
Selection via Teach button	**Change of the current IPF V3 selection*)**
	Display of the following selection / activation or deactivation via: 3x short confirmation flashing in the respective color (S2 or fault), then immediate return to automatic mode
T2 (> 2.5 s)	Selection / Activation of IPF V3 (S2 color)
T1 (> 2.5 s)	**Deactivation** of IPF V3 (fault color)

Tab. 3: IPF V3 menu – Display / Teach button functions

Menu of IPF V3 + IPF V3 “Lower-Seat-Lift” + “Upper-Seat-Lift”	
Display of access to this selection menu via flashing pattern / color: 500 ms in **S2 color** / 500 ms break **By pressing another button,** the current settings can be changed:	
Selection via Teach button	**Change of the current IPF V2 + IPF V3 selection*)**
	Display of the following selection / activation or deactivation via: 3x short confirmation flashing in the respective color (S2 or S1 or fault), then immediate return to automatic mode
T2 (> 2.5 s)	Selection / Activation of **IPF V3 + IPF V2 for D620, D365it** (S2 color)
T3 (> 2.5 s)	Selection / Activation of **IPF V3 + IPF V2 for D600, Secure** (S1 color)
T1 (> 2.5 s)	**Deactivation** of IPF V3 + IPF V2 (fault color)

Tab. 4: IPF V2+V3 menu – Display / Teach button functions

Activation of Intelli Pulse Flush (IPF V2 and IPF V3) via PC software:

Activation / selection of the “Intelli Pulse-Flush” function and the possible modification of pre-settings and factory settings (see ***)** below) using PC software is described in detail in the “PC software manual” (applies to 24 V DC, AS-i, DeviceNet, 120 V AC designs).

The following applies to IO-Link devices: acyclic data access (index 0x2C0A) via IO-Link or via the “Bürkert Communicator” (for details, see chapter “14.4 IO-Link master / communication / configuration” on page 81).

*)

IPF V2 “Lower-Seat-Lift” – **standard setting** when activating the IPF function via teach buttons:		**IPF V3** “Upper-Seat-Lift” – **factory setting:**	
Delay for D620, D365it:	70 ms	Delay with upper seat detection:	700 ms
Delay for D600, secure:	350 ms	Delay without upper seat detection:	800 ms

5.4.2 Manual override

The control head provides the following as standard:

- *magnetic manual override for solenoid valve V1*
  (via magnetic manual override tool):easily accessible from the outside; on the basis of encoded magnetic fields; switches the solenoid valve (connection 2/A1) as well as
- *mechanical manual override:*
  accessible only when the hood is open; on each equipped solenoid valve (see “Fig. 7” on page 28).

Magnetic manual override (for 2/A1 or V1) has the following advantages:

- the control head does not need to be opened
- simple actuation tool for opening / closing solenoid valve V1 (main stroke) - helpful for service / maintenance work on the process valve (V2 and V3 are switched off at the same time;with the double-acting actuator design, both solenoid valves V1, V2 are actuated simultaneously with the magnetic manual override tool)
- Top LED display for the “activated manual override” status = service mode
  (see chapters “18 Top LED color assignments” and “19 Service mode / manual override”)

Magnetic manual override is only applicable in automatic operating state; in manual mode, V1 cannot be switched using the magnetic manual override tool.

For a detailed description of manual override, see chapter “19 Service mode / manual override”.

5.4.3 Position measuring system

The switching positions of the process valves are reported back to the controller by feedback signals from the non-contact position measuring system.

The connection to the control head is done by means of a simple adaptation to the process valve's actuator. Details are described in chapters “6.7 Position measuring system data” and “17 Position measuring system”.

5.4.4 Other features

- Central optical position indicator (Top LED) for showing the process valve switching positions:
  Positions and status information are generally indicated by 3 signal colors.
  The assignment of the LED colors and the “flashing patterns” indicating the status or type of fault are described in detail in chapter “18 Top LED color assignments”.
- Simple adaptation of the control head (of the position measuring system) to the process valve piston rod (chapter “7”).
- Simple adjustment of the position measuring system by means of 3 teach buttons on the electronic module - either manually (directly using the teach buttons T1 .. T3) or automatically using the Autotune function) - see chapter “17 Position measuring system” on page 92.
- The capability of restricting the pilot valves (solenoid 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 - “Fig. 6”.
- More energy efficient solenoid valve actuation by lowering the holding current during long-term operation.
- Various pneumatic and electrical connection and communication options (24 V DC, AS-Interface, DeviceNet, 120 V AC, IO-Link).

6 TECHNICAL DATA

6.1 Operating conditions

DANGER!

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- In a potentially explosive atmosphere, only use devices that are approved for this purpose. These devices are identified by a separate Ex type label. Before use, note the information on the separate Ex type label and in the Ex additional instructions.
- Observe the instructions on operating the device in a potentially explosive atmosphere in chapter “3 Basic safety instructions”!

WARNING!

Risk of injury from overheating of the control head.

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:	Standard version:	-10 ... +55 °C
	Potentially explosive atmosphere (Zone 2):	+5 ... +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 adaptation to the process valve has been carried out 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)

Version for use in a potentially explosive atmosphere (Zone 2):

IP64 according to EN 60529 and requirements EN 60079-0: 2009
(only if cables, plugs and sockets have been connected correctly, the hood has been sealed correctly and adaptation to the process valve has been carried out correctly)

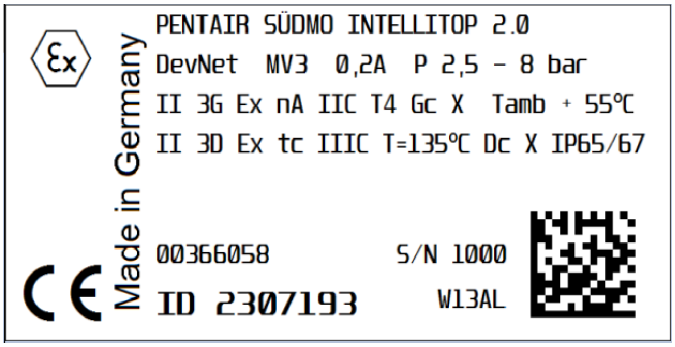
6.2 Conformity / standards

The control head IntelliTop 2.0 conforms to the EU Directives as per the EU Declaration of Conformity.

The applied standards, which are used to verify compliance with the directives, can be found in the EC Declaration of Conformity.
This may be requested from Pentair Südmo (see “4.1 Contact address”).

6.3 Type label details

The specifications on the type label indicate the technical data and approvals applicable to the respective control head. The symbols on the type label (example) mean:

Type label	
Line 1 Line 2 Line 3 Line 4 Line 5 Line 6	
Line 1	Device designation
Line 2	Supply voltage or type of communication (24 V DC, AS-i, DevNet, 120 V DC) / Number of solenoid valves (MV): MV0 = no solenoid valve; MV1 = 1 solenoid valve, single-acting; MV2 = 2 solenoid valves, not double-acting; MV3 = 3 solenoid valves; MVD = 2 solenoid valves, double-acting) Pressure range
Line 3	Any specifications, if applicable, according to ATEX Directive 94/9/EC (gas) / ambient temperature (Tamb)
Line 4	Any specifications, if applicable, according to ATEX Directive 94/9/EC (dust) / degree of protection specification (IP)
Line 5	Additional ID number / serial number S/N
Line 6	**ID number** (Pentair Südmo) / manufacturer's specifications
	Further symbols and information on the type label indicate special approvals or relevant approval information for this device

Further possible symbols on the type label or additional label:	
CE	Device complies with European standards according to EC Declaration of Conformity
Ex	Approval according to (potentially explosive atmospheres) "ATEX" Directives
FM APPROVED	FM approval for explosion-proof equipment
c UL us LISTED	UL approval for USA and Canada

Details of the Directives:

ATEX Directive 2014/34/EU			
	Type of protection:	Gas ATEX category 3G	Ex nA IIC T4 Gc X
		Dust ATEX category 3D	Ex tc IIIC T135°C Dc X
FM - Factory Mutual			
	NI/I/2/ABCD/T5; +5°C < Ta < 55°C IP64 (cables and cable glands are not part of the FM approval of the device and are therefore not fitted at the factory.)		
c UL us - Underwriters Laboratories (Canada and USA)			
	UL 61010-1 AND CSA C22.2 NO. 61010-1		
	Restrictions:	Application range: 0 to +55°C, Indoor use, power supply with class-2 power supply unit	

6.4 Additional labels

Additional labels indicate additional approvals and special operating conditions.

Warning sign for use of the device in a potentially explosive atmosphere	
Line 1 Line 2 Line 3 Line 4	Ex nA IIC T4 Gc X Tamb +55°C Ex tc IIIC T 135°C Dc X **WARNING – POTENTIAL ELECTROSTATIC CHARGING** **HAZARD – SEE INSTRUCTIONS**
Line 1	Specifications according to ATEX directive (gas) / ambient temperature
Line 2	Specifications according to ATEX directive (dust) / degree of protection specification
Line 3	WARNING – POTENTIAL ELECTROSTATIC CHARGING
Line 4	HAZARD – SEE INSTRUCTIONS
	(Warning - potential electrostatic charging / hazard - See instructions)

Additional label for devices with UL approval	
UL label with UL file no. Note on use of power supply unit according to NEC Class 2 Permissible supply voltage	c UL us LISTED NEC Class 2 only E506035 supply voltage: 11...25V ⎓ PENTAIR SUEDMO DVN

6.5 Mechanical data

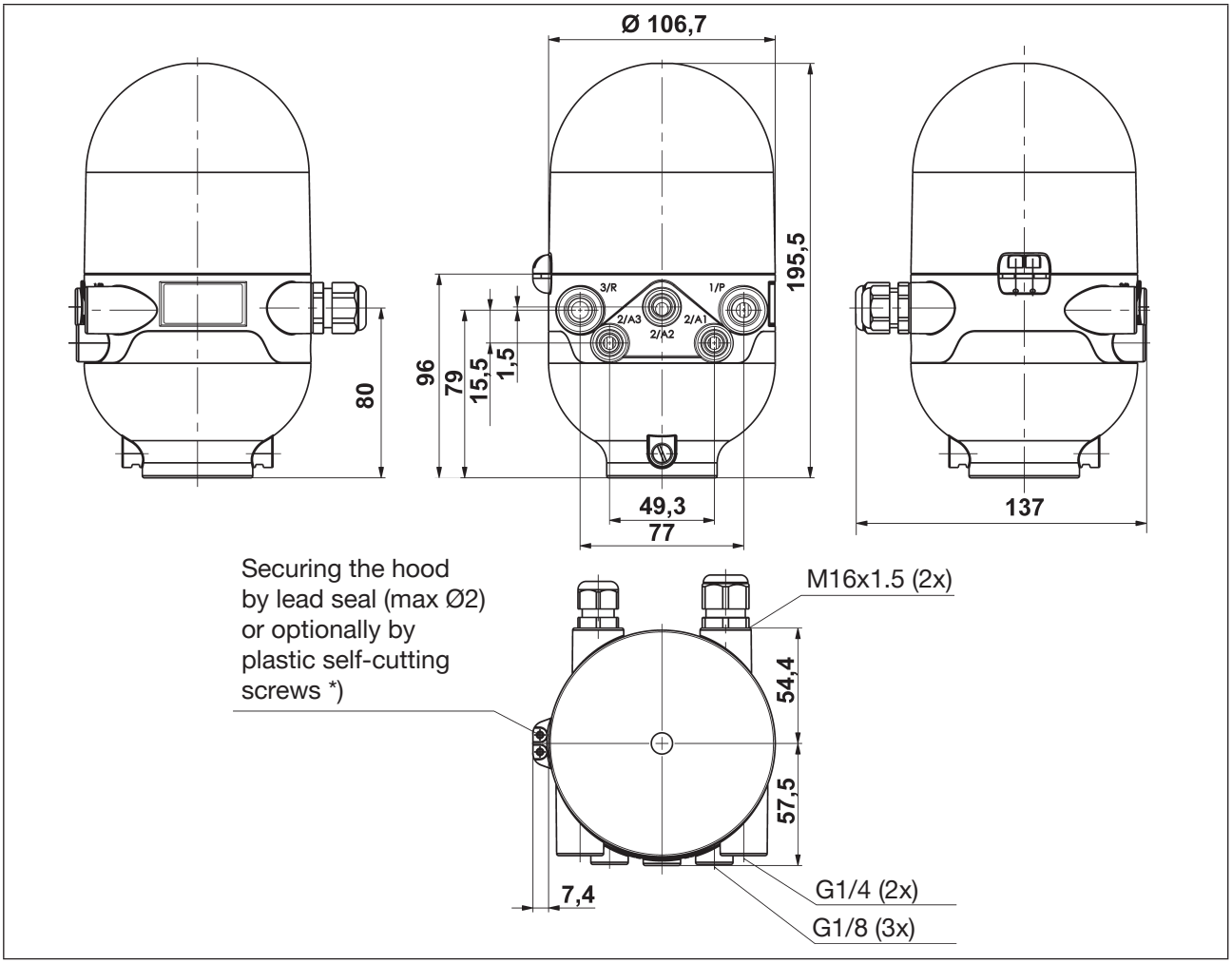


Fig. 5: Dimensional drawing (for designs with 1 to 3 solenoid valves)

*) Plastic self-cutting screws:
Diameter 3 mm, length approx. 10 mm; e.g. Ejot PT screw K 30 x 10;
max. tightening torque 0.4 Nm
(after completely screwing in the screw, loosen it again by half a turn)!

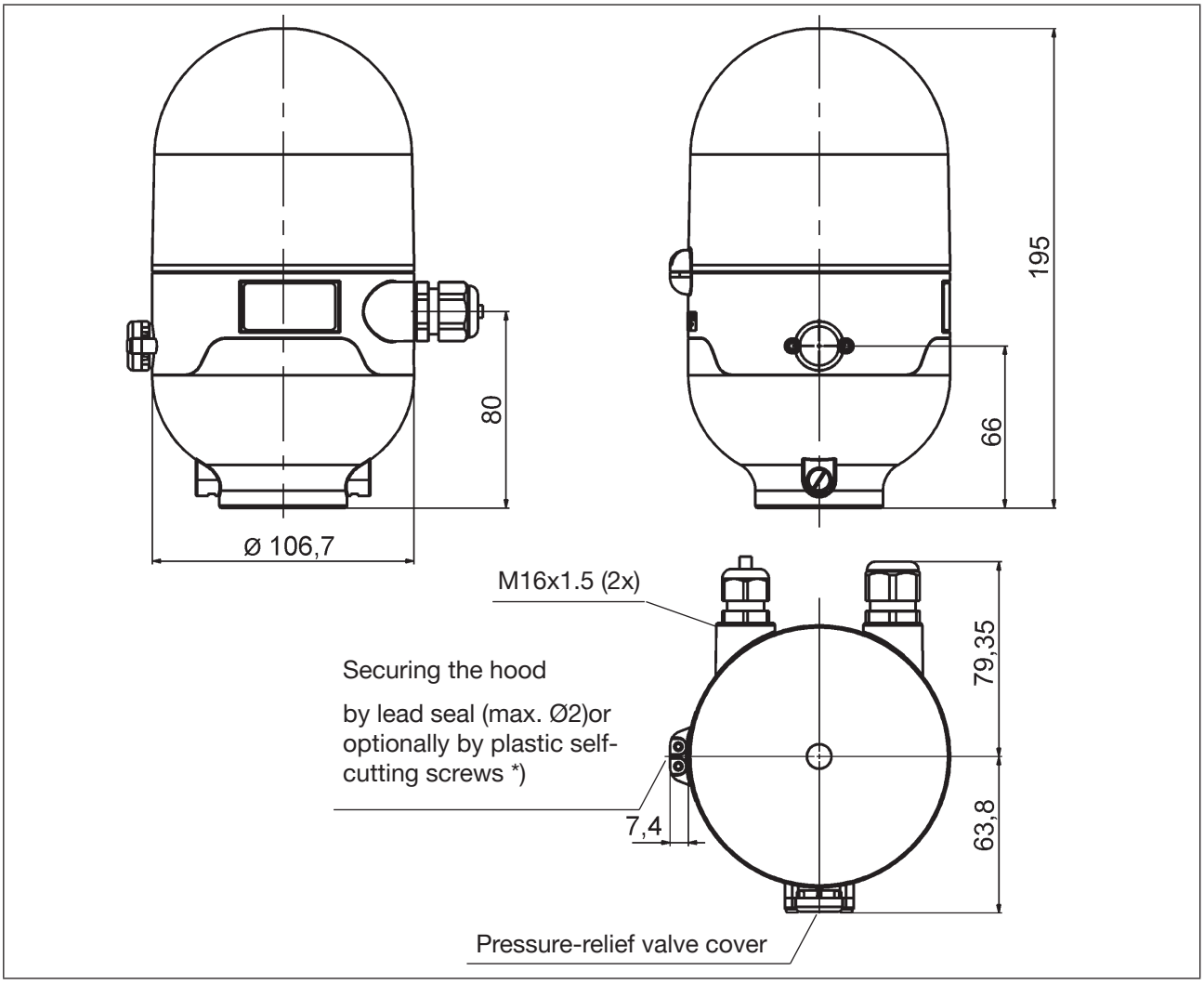


Fig. 6: Dimensional drawing (for designs without solenoid valves)

Weight:	approx. 0,8 kg	
Housing material:	outside:	PA, PC, PPO, VA
	inside:	ABS, PA, PMMA
Seal material:	outside:	CR, EPDM
	inside:	EPDM, FKM, NBR

*) see note on "Fig. 5"

6.6 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 the compressed air:		-10 ... +50 °C
Pressure range:		2.5 ... 8 bar
Air flow rate solenoid valve:		**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 G1/4 Working connections G1/8

Setting the intake and exhaust air at the solenoid valve using flow restriction screws

The intake and exhaust air can be set separately for each solenoid valve using flow restriction screws in order to be able to influence the expansion and retraction rates of the process valve.
For details, see “9.3 Flow restriction function of the solenoid valves” on page 42

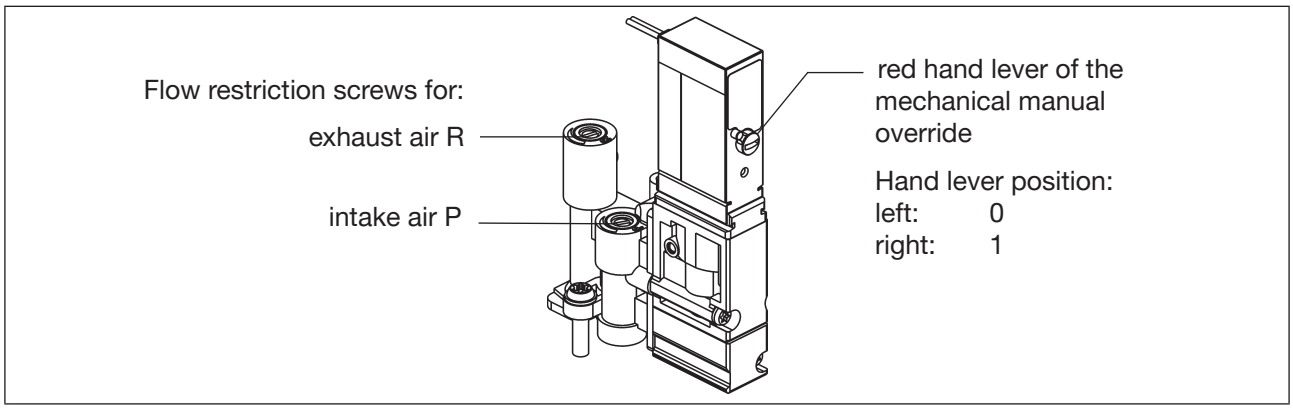


Fig. 7: Flow restriction screws and mechanical manual override of the solenoid valves

6.7 Position measuring system data

Stroke range (measuring range):	0 ... 85 mm
Total fault:	±0.5 mm - when using a specification-compliant attachment set (fault refers to the reproducibility of a taught position)
Target material:	ferromagnetic material (stainless steel 1.4021)
Piston rod material:	non-ferromagnetic material – see notes below **(*)**

The diagram in "Fig. 8" shows the dimensional relationships between the control head and the piston with target.

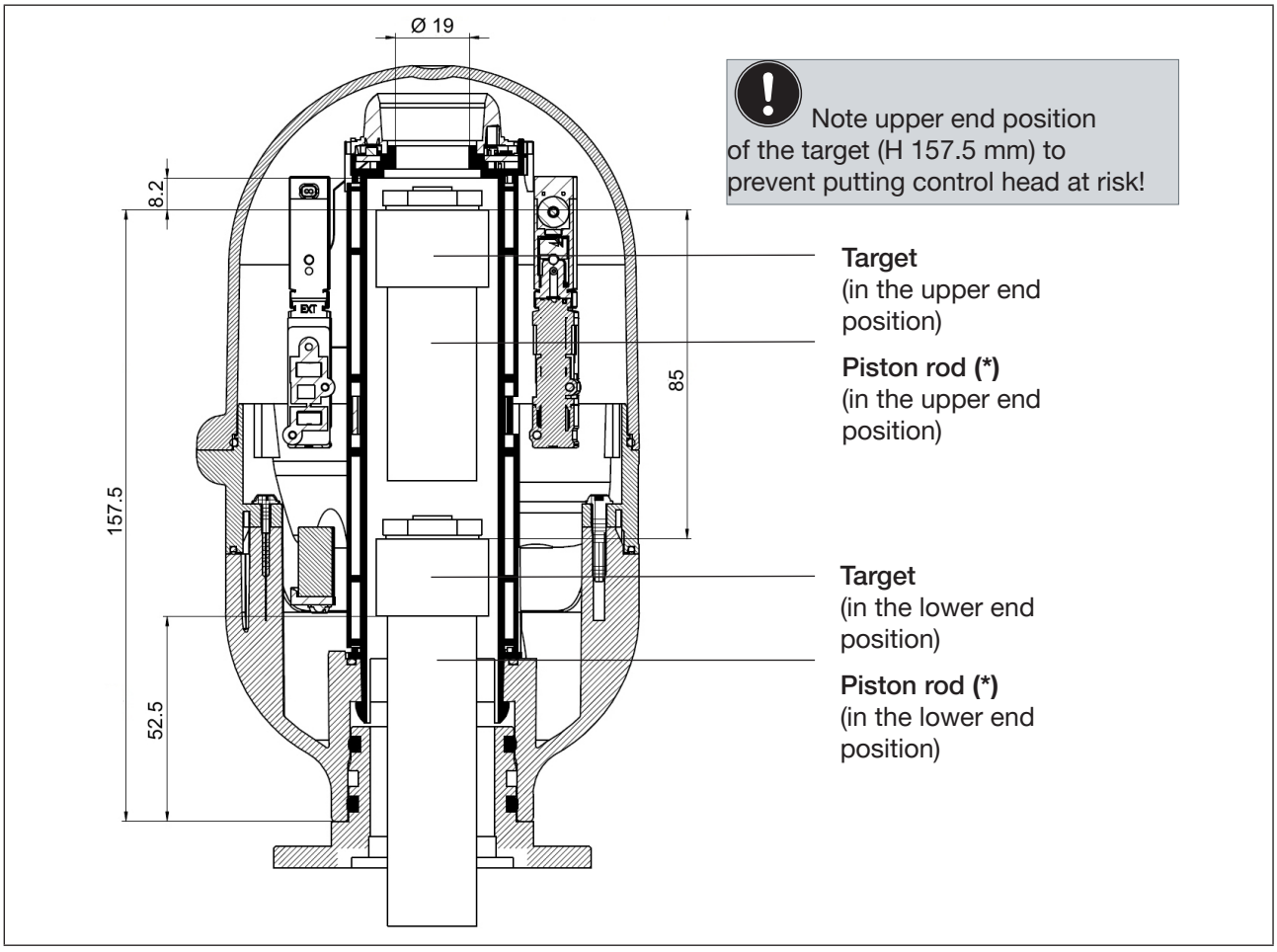


Fig. 8: Sectional view of the control head and piston rod with target (in upper and lower end position)

The details for the assembly of the control head to the process valve are described in chapter "7.2 Installation of the control head".

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

6.8 Factory settings in the firmware

The control head is supplied with the following firmware factory settings.

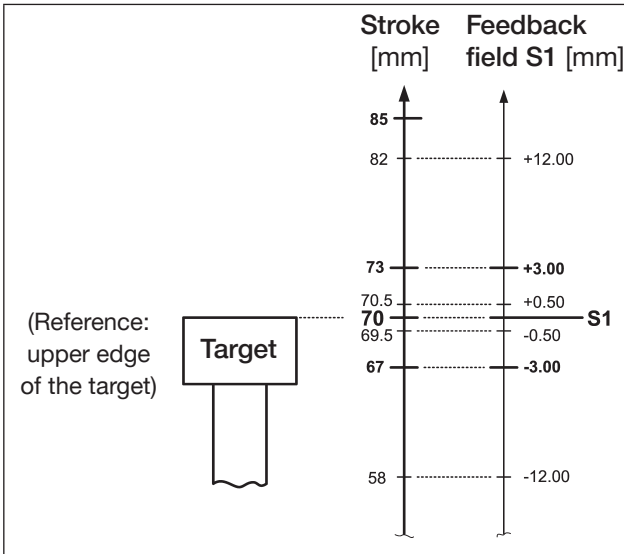
Changes to the factory settings for the 24 V DC, AS-i, DeviceNet, 120 V AC designs are possible via the PC software (see “PC software manual”). To do so, the control head is connected to the PC via the service interface on the electronic module – “Fig. 10”. This involves removing the plastic cover (see chapter “8”). With IO-Link designs, the factory settings can be changed by acyclic data access via IO-Link. Alternatively, the “Bürkert Communicator” service program can be used – for this purpose, the control head is also connected to the PC via a service interface on the electronic module (see “Fig. 36” on page 86 and chapter “14.4” on page 81).

The service interface may only be used in a non-explosive atmosphere, as the plastic cover must be removed – see chapter “8”.

6.8.1 Feedback fields (position measuring system)

A feedback field is the area within which a position (e.g. S1) is reported back.

Signal	Feedback field at top (positive)		Feedback field at bottom (negative)	
	Factory setting [mm]	Adjustment range [mm]	Factory setting [mm]	Adjustment range [mm]
S1	+ 3.00	+0.50 ... +12.00	- 3.00	-0.50 ...-12.00
S2	+ 3.00	+0.50 ... +12.00	- 3.00	-0.50 ...-12.00
S3	+ 1.00	+0.50 ... +12.00	- 1.00	-0.50 ...-12.00



Ensure that the teach points, including their feedback fields, are within the measuring range.

Fig. 9: Schematic diagram of the feedback fields using the example of position S1 (not to scale)

Overlaps of S1/S2/S3 are possible (see chapter “18.3 Signal priorities”).

The factory settings for the feedback fields can be changed using the PC software (or for IO-Link devices via IO-Link or using the “Bürkert Communicator” – see chapter) “14.4” on page 81) or using the “Feedback Field Mode” (see chapter) “17.2” on page 99) or using the Autotune function **6** (see chapter “17.1.3” on page 95).

6.8.2 Service / maintenance notification

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

When service / maintenance notification is activated, this is indicated by a special flashing pattern - see chapter “18.2 Flashing pattern / fault signalling” on page 102.

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 software is used to adjust the service / maintenance interval (number of days or switching cycles) as well as to activate / deactivate the “Service / maintenance notification” function. Connection to the PC is via the Service interface - see “Fig. 10”. Details are described under the “Service” menu option in the “PC software manual”.
For configuration for IO-Link devices, see chapter “14.4” on page 81.

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	Adjustment range (IO-Link only)
Switching cycle counter V1	10 000	(1 ... 255) x 1000	1 ... 4 294 967 295
Switching cycle counter V2	50 000	(1 ... 255) x 1000	1 ... 4 294 967 295
Switching cycle counter V3	50 000	(1 ... 255) x 1000	1 ... 4 294 967 295
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.

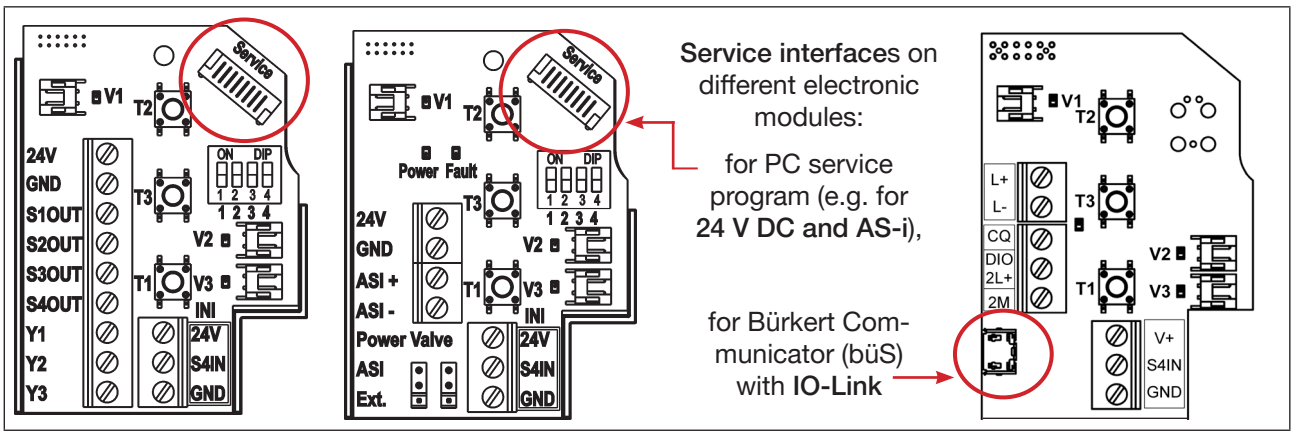


Fig. 10: Location of the service interface on different electronic modules

6.8.3 Manual override function (magnetic)

Factory setting for the magnetic manual override function: **active.**
Details are described in chapter “19.1 Magnetic manual override” on page 109.

Deactivation with the classic designs is possible **using the PC software**. Connection to the PC is via the Service interface - see “Fig. 10”. Details are described in the “PC software manual” under the “SYSTEM / Start-up (gen.)” menu option. With the IO-Link design, deactivation takes place via IO-Link or using the “Bürkert Communicator” – see chapter “14.4” on page 81.

The **Autotune function 6** also deactivates the magnetic manual override function – see chapter “17.1.4 Sequence of the automatic teach functions (Autotune)” on page 96, (sequence for “Autotune 6”). See also chapter “19.1”.

6.8.4 “Cycle stroke color S3/S4 different” function

Factory setting of this function: **not active**

To make the position feedback of S3 and S4 more clearly distinguishable than only in the flashing frequency,
the “Cycle stroke color S3/S4 different” function can be selected via the PC software. This function reports back the position of S3 and S4 in different colors but with the same flashing frequency (250 ms ON / 250 ms OFF).

Details on color coding for this function can be found in chapter “18.1.2” on page 101.

6.8.5 “Top LED color assignments” function (IO-Link design only)

Factory setting: Top LED mode (0x2C11): **0 (DIP color 0000)**

Details on this function can be found in chapters “18” on page 100 and “18.1.1” on page 101.

6.8.6 “Intelli Pulse Flush” function (IPF V2, IPF V3)

Factory setting of this function: **not active**

Preset values (see note below “Tab. 2” on page 20) can be selected directly on the control head using the teach buttons (see chapter “5.4.1” on page 19).

Preset values and factory settings can only be changed using the PC software (applies to 24 V DC, AS-i, DeviceNet, 120 V AC designs) – see “PC software manual”. The factory settings are also listed there.
With IO-Link devices, the preset values and factory settings can be changed via IO-Link or via the service interface using the “Bürkert Communicator”.

6.9 Resetting the device (Device Reset)

The device can be reset in the **“Device Function” mode** to factory settings directly on the control head or using the PC software.

Procedure - Device Reset directly on the control head:

→ Simultaneously actuate T1 + T2 + T3 (approx. 2.5 s long) - to access the “Device Function” mode - the corresponding flashing pattern is: always alternating 500 ms RED, 500 ms GREEN. If the device is not reset 10 s after switching to the “Device Function” mode, this mode is automatically left.

→ Actuate simultaneously T1 + T2 + T3 again (approx. 2.5 s long) – this will reset the device. The flashing pattern 250 ms ON / 250 ms OFF in the error color indicates that the device was reset.

Procedure - Device Reset using the PC software:

→ To do this, select the “General start-up” submenu in the “SYSTEM” main menu and press the “DEV RESET” button (see also “PC software manual”).

Device Reset resets the following values to the factory setting:

• Teach positions S1...S3	all positions “not taught”
• Feedback fields from S1...S3	(see chapter “6.8.1” on page 30)
• Resettable switching cycle counters V1...V3	(see chapter “6.8.2” on page 31)
• Resettable operating duration	(see chapter “6.8.2” on page 31)
• Service intervals switching cycles V1...V3	(see chapter “6.8.2” on page 31)
• Service interval operating duration	(see chapter “6.8.2” on page 31)
• Service / maintenance notification (signalling of elapsed maintenance intervals)	not active (see chapter “6.8.2” on page 31)
• Intelli Pulse Flush (IPF)	not active (see chapter “6.8.6” on page 32)
• Manual override function	active (see chapter “6.8.3” on page 31)
• Monitoring with external initiator S4 whether upper valve plate has been closed	(see chapter “18.3” on page 106, example 2)
• Feedback external initiator S4 as S1	not active (see “PC software manual”)
• All valves can be actuated (simultaneously)	not active (see “PC software manual”, but setting has no function for the design for double-acting actuators - see chapter “16” on page 91)

Device Reset does not reset,e.g., the following values to the factory setting:

• all hardware configured values (i.e. set via DIP switches)	
• Switching cycle counter Total V1...V3	
• Operating duration	
• Cycle stroke color S3/S4 different	(see chapter “18.1.2” on page 101 and PC software)
• AS-i address	(see chapter “11.9” on page 59)
• AS-i profile	
• DeviceNet Input Assembly	(see chapter “12.11.1” on page 68)
• Top LED color assignments	(see chapter “18” on page 100 – IO-Link design only)

7 INSTALLATION

7.1 Safety instructions

DANGER!

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- Opening the hood or the housing in a potentially explosive atmosphere is only allowed in a not energized state!
- When used in a potentially explosive atmosphere (Zone 2), the devices must be installed in a protected installation location according to IEC/EN 60079-0.

WARNING!

Risk of injury from electric shock!

- Before reaching into the system (except for the teach procedure in a non-explosive atmosphere), switch off the power supply and secure it to prevent restarting!
- Observe the applicable accident prevention and safety regulations for electrical devices!

Risk of injury from high pressure in the system!

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

Risk of injury due to improper installation!

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

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

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

NOTE!

Danger of damage to property due to improper installation!

Failure to observe these instructions may result in damage to the device or the system.

- Do not improperly stress the control head.
- Do not apply any leverage effect on the head and do not climb on it.
- When sealing the flange 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 control head is sealed.

7.2 Installation of the control head

The control head 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.

7.2.1 Hub flange

For the installation of the control head IntelliTop 2.0 to a process valve, you will require a process valve-specific hub flange as an adapter.

The hub flange must be adapted to the design of the process valve and produces the mechanical connection between the process valve and the control head. The axial fastening is done by 2 locking screws (shoulder screws M5), which engage in the middle groove of the hub flange (protection against pulling off). The control head can radially slide into any position in 360° arc, seamlessly.

The hub flange and non ferromagnetic piston rod with the target which is used to record the position must comply with the specifications with regard to material and stability - only specification-compliant attachment sets may be used.

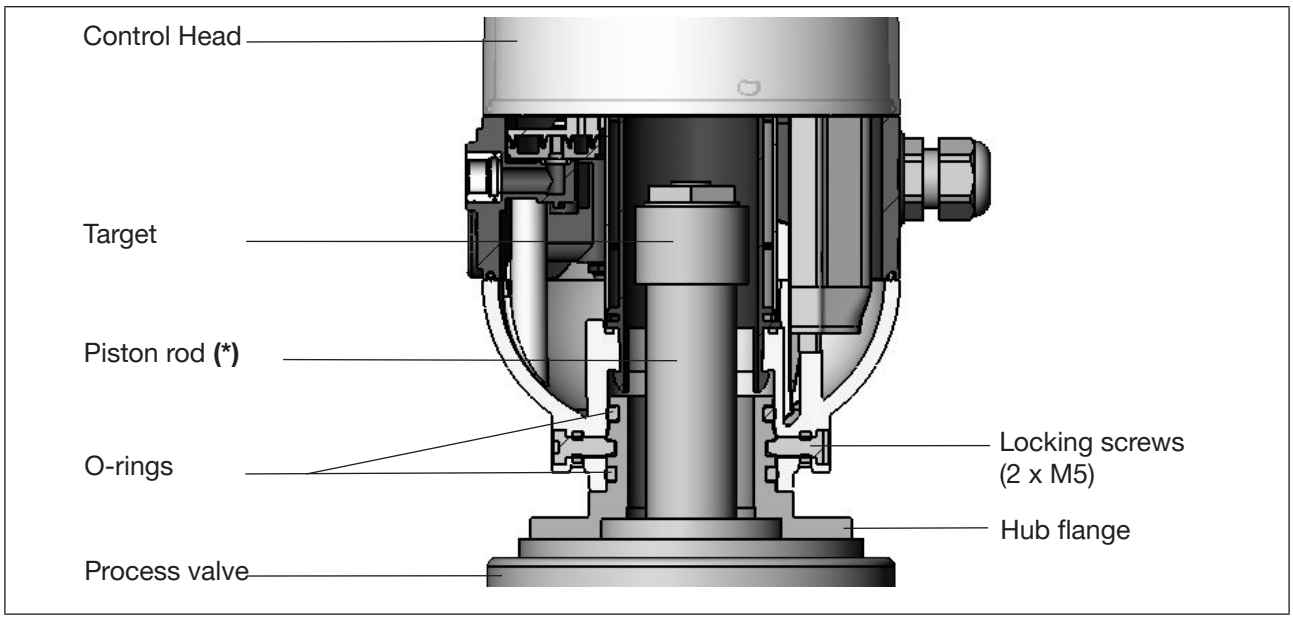


Fig. 11: Schematic diagram of the control head - process valve adaptation

- To ensure the proper function of the position measuring system, the axial deviation of the adapter must be less than ± 0.1 mm to the process valve spindle when mounted!
- Use Pentair Südmo adaptations only.
- Prior to installing the control head onto the hub flange, lightly grease the O-rings with a silicone grease (e.g. Paraliq GTE 703).
- The hood must be lead-sealed in a potentially explosive atmosphere to prevent the housing from being opened without a tool! (Optionally the hood can also be locked with plastic self-cutting screws, see note on “Fig. 5” on page 26.)

For dimensional relationships, see also chapter “6.7 Position measuring system data”.

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

7.2.2 Installation sequence in the example of a double seat valve

Procedure:

→ Mount the piston rod with the target on the process valve spindle. Observe reference dimensions!

→ Fasten the hub flange on the process valve - see "Fig. 11".
During this, observe central alignment and sealing conditions!

→ Check the secure fit of the sealing rings (in the upper and lower grooves).

→ Mount the control head on the hub flange (seamlessly 360° rotatable).

→ Secure the control head with the 2 locking screws (shoulder screws M5) in the middle groove of the hub flange to prevent it from being pulled off the hub flange - tightening torque: max. 3.2 Nm (see "Fig. 11: Schematic diagram of the control head - process valve adaptation") and chapter "7.2.3".

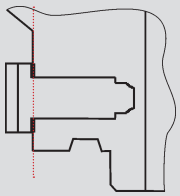
7.2.3 Realignment of the control head

If necessary, the control head can be realigned, 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 override) and because of electrical connection possibilities.

Procedure:

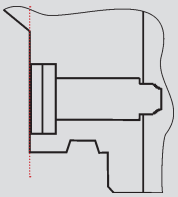
→ Loosen the locking screws (shoulder screws M5 - see "Fig. 11") slightly until the underside of the screw head is flush with the auxiliary surface of the housing.

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 control head until the desired alignment has been achieved.

→ Secure the control head with locking screws again until the upper side of the screw head is flush with the auxiliary surface of the housing. The locking screws have **no sealing function.** The control head is **not fixed in place** by the locking screws but is merely secured against being pulled off the hub flange

7.2.4 Installation of the pneumatic and electrical connections

Pneumatic installation:

see chapter “9 Pneumatic installation”

Electrical installation:

24 V DC: see chapter “10 24 V DC - design”

AS-Interface: see chapter “11 AS-Interface design”

DeviceNet: see chapter “12 DeviceNet design”

120 V AC: see chapter “13 120 V AC design”

IO-Link: see chapter “14 IO-Link design”

7.2.5 Recommended auxiliary materials

Silicone grease (e.g. Paraliq GTE 703) for easy lubrication of the EPDM seals.

8 OPENING AND CLOSING THE HOUSING

8.1 Safety instructions

DANGER!

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- Opening the hood or the housing in a potentially explosive atmosphere is only allowed in a not energized state!

WARNING!

Risk of injury from electric shock!

- Before opening the hood and prior to reaching into the system (aside from a teach procedure in a non-explosive atmosphere), switch off the power supply and secure to prevent restarting!
- Observe the applicable accident prevention and safety regulations for electrical devices!

Risk of injury from high pressure in the system!

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

Risk of injury due to improper installation!

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

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

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

8.2 Opening the housing

NOTE!

Improper handling will damage the plastic hood / seal!

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

Procedure:

→ Remove the lead seal (or plastic self-cutting screws) if the housing is secured (see “Fig. 11”).

→ 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.

8.3 Closing the housing

If necessary, clean the seal contour of the seal and of the hood and lightly lubricate it using a silicone grease (e.g. Paraliq GTE 703).

Please note:
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 seal (O-ring) of the lower part - see “Fig. 12”.
The O-rings and seals are wearing parts.

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

→ If required, attach a lead seal (or plastic self-cutting screws, see note to “Fig. 5” on page 26) to prevent it from being opened without a tool.

The hood must be lead-sealed / secured in a potentially explosive atmosphere to prevent the housing from being opened without a tool!

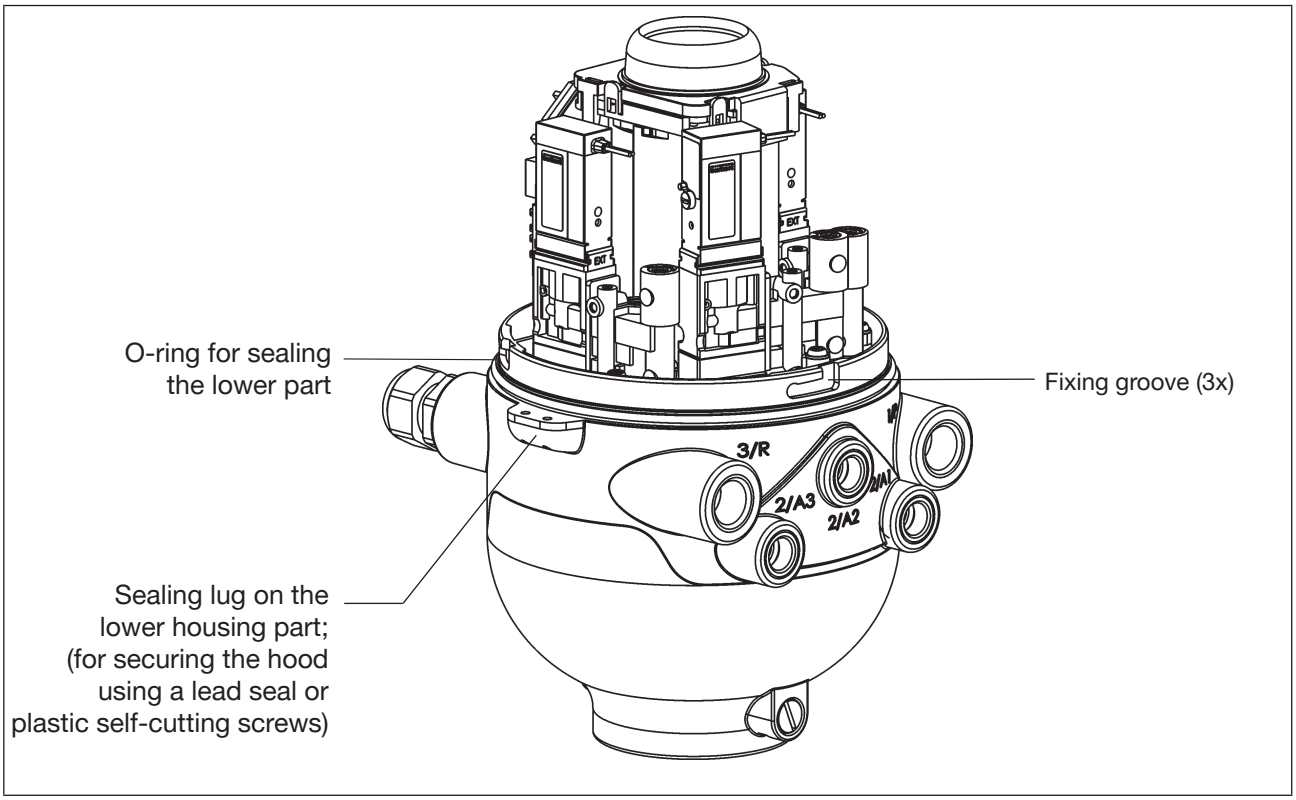


Fig. 12: Lead seal and locking grooves

9 PNEUMATIC INSTALLATION

9.1 Safety instructions

WARNING!

Risk of injury from high pressure in the system!

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

Risk of injury due to improper installation!

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

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

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

9.2 Pneumatic connection of the control head

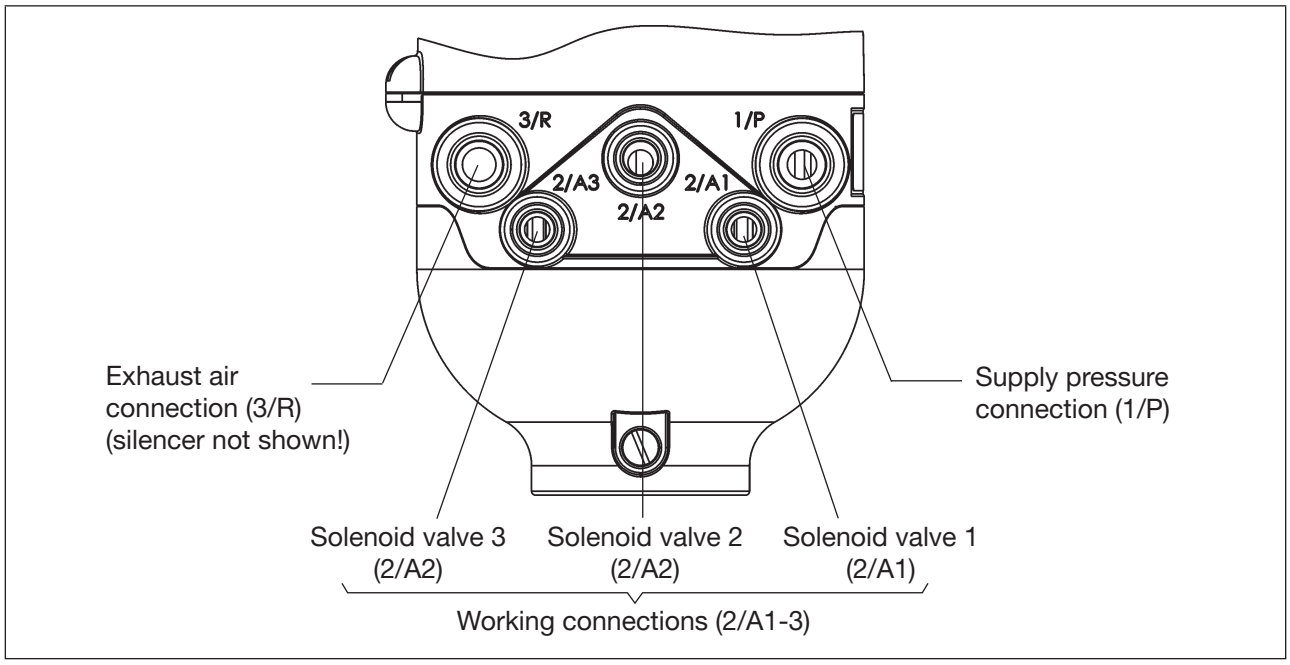


Fig. 13: Pneumatic connection

9.2.1 Pneumatic installation (standard)

Procedure:

→ If required, realign the control head (see chapter “7.2.3 Realignment of the control head”)

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

→ Connect the required **working connections 2/A1 to 2/A3** (depending on the number of solenoid valves V1 ... V3 in the control head) with the corresponding connections on the process valve.

→ Connect the supply line to s**upply pressure connection 1/P** (2.5 … 8 bar).

NOTE!

Notes on hose pipes

- Only use calibrated hose pipes with ∅6 mm (or 1/4") or ∅8 mm (or 5/16") outer diameters (tolerance: +0.05 / -0.1 mm).
- 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).
- Only use suitable hose qualities (in particular for high ambient temperatures) that bear up under common stresses caused by the quick connector.

Application of silencer or exhaust air hose?

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

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

9.2.2 Retrofitting in case of intensive external cleaning

In the case of very frequent intensive external cleaning, moisture, water or cleaning agents can enter the actuators of the process valves through the ventilation plug of the spring chamber. This can lead to malfunctions or failure of the actuator in the long term.

That can be prevented by venting the spring chamber via the control head.

For this purpose, a free valve seat in the control head will be equipped with a special cover plate (with connection A-R) so that the process valve can be connected to the corresponding working connection 2/AX of the control head.

Procedure:

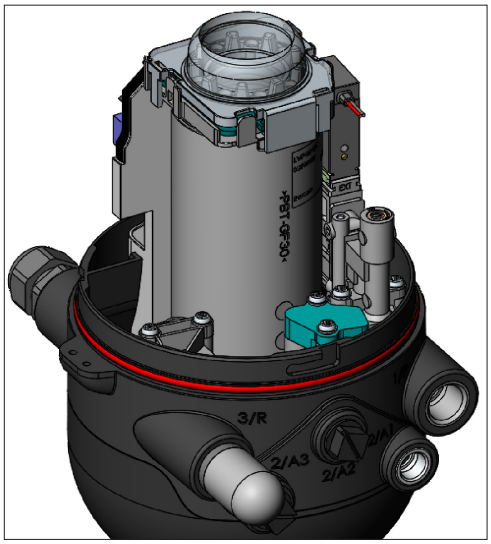
→ Open the housing (see chapter "8 Opening and closing the housing").

→ Unscrew the cover plate of an unused valve seat, ensure that the white non-return valve underneath does not fall out.

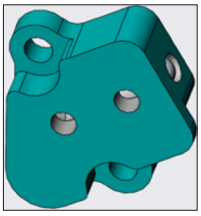
→ Fasten the cover plate with connection A-R instead of the previous cover plate (max. torque: 1 Nm) – see "Fig. 14".

→ Close the housing again (see chapter "8 Opening and closing the housing").

→ Replace the dummy plug on the corresponding working connection 2/AX with a suitable air connection and connect it to the process valve actuator.



Cover plate with connection A-R
for a free valve seat
(shown in green)



(Order no. 2333187)

Fig. 14: Cover plate with connection A-R

Recommendation!
Because **moist air can still be drawn through the silencer** into the exhaust air connection (3/R) of the control head during external cleaning and thus could enter the control head via the non-return valve, it is recommended not to screw the silencer directly into the 3/R connection, but to connect and fix it, e. g., to an **interposed angular quick fitting gland** and a piece of hose (with the opening downwards).

9.3 Flow restriction function of the solenoid valves

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

The flow restriction screws of the solenoid valves (see “Fig. 15: Flow restriction screws and mechanical manual override of the solenoid valves”) are used for setting the air intake and exhaust for the working connections and so be able to influence the expansion and retraction rates of the process valve:

- Factory setting: 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 2 flow restriction screws initially to 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.

Minimising the flow rate:	Turn clockwise
Maximising the flow rate:	Turn counterclockwise

→ Open the housing following the instructions in chapter “8 Opening and closing the housing”.

→ Observing the safety guidelines, activate the respective valve location (V1, V2 or V3) to be set (either using the system controller or the respective mechanical override on the solenoid valve - see “Fig. 15”).

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

→ Deactivate the valve location.

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

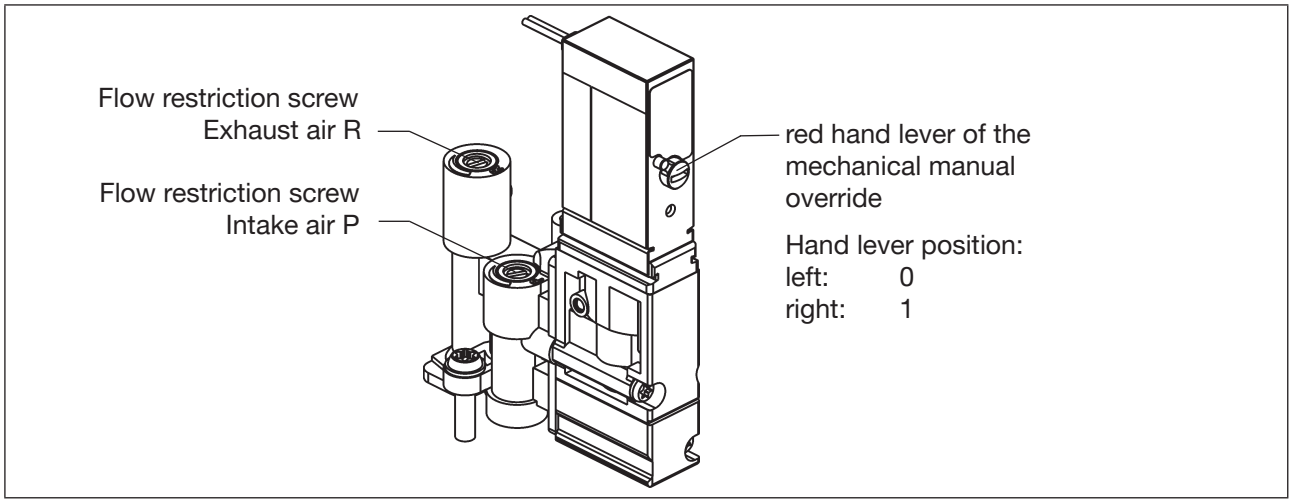


Fig. 15: Flow restriction screws and mechanical manual override of the solenoid valves

NOTE!

To avoid unintentional switching of the process valve:

- Make sure that all manual overrides have been deactivated (hand lever all the way left, as shown) after the setting work has been completed!

→ If no further installation work is required, close the housing following the instructions in chapter “8 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 (chapter “3 Basic safety instructions”)!

10 24 V DC - DESIGN

10.1 Electrical connection options

The following connection concepts are available for the electrical connection of the control head:

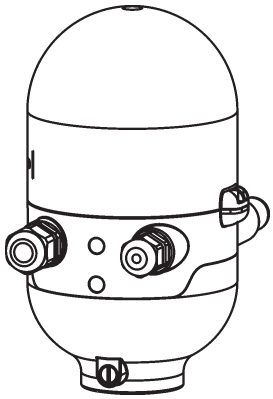
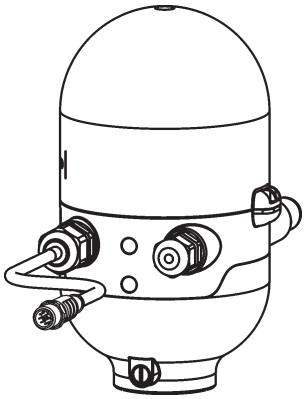
	
Cable gland	**Cable gland with multi-pole connection** (M12 plug according to IEC 61076-2-101, 12-pole)
Connection left: Voltage, signals Connection right: External initiator	Connection left: Voltage, signals Connection right: External initiator

Fig. 16: Connection concepts 24 V DC

10.2 Electrical data

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

Connections:

Cable gland design: 1 x M16 x 1.5 cable gland / AF22 – for power supply and signals, (only for transportation safety device sealed with dummy plug, remove it before use!), for cable diameter 5 ... 10 mm, for wire cross-section 0.14 ... 1.5 mm²

1 x M16 x 1.5 – connection option for external initiator (sealed with dummy plug - remove it before use!)

Multi-pole connection design: 1 x M16 x 1.5 cable gland / AF22 with multi-pole connection (M12 plug according to IEC 61076-2-101, 12-pole) for power supply and signals, cable length approx. 15 cm

1 x M16 x 1.5 sealed with dummy plug (connection option for external initiator)

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

Solenoid valves:

Max. switching capacity:	max. 0.9 W (per solenoid valve, for 200 ms after switching on)
Typ. continuous output:	0.6 W (per solenoid valve, from 200 ms after switching on)
Current consumption per solenoid valve:	50 mA at 12 V DC 25 mA at 24 V DC 22mA at 28 V DC
Operating mode:	Continuous operation (100% duty cycle)

Central display of the switching states: 42 mA with a power supply of 24 V DC per illuminated display; for color switching, see chapter “18 Top LED color assignments”

Outlets / binary feedback signals:	S1 out - S4 out
Design:	Normally open contact, PNP outlet, 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 the unloaded state

Input / proximity switch (external initiator: S4 in):

Power supply:	Voltage present at the control head - 10%
Current carrying capacity sensor supply:	max. 90 mA
short-circuit protection	
Design:	DC 2 and 3-wire, Normally open contact, PNP outlet
Input current 1 signal:	**I**Sensor > 6.5 m A, limited internally to 10 mA
Input voltage 1 signal:	U_{Sensor} > 10 V
Input current 0 signal:	I_{Sensor} < 4 mA
Input voltage 0 signal:	U**Sensor** < 5 V

Inputs for valve actuation (Y1 - Y3):

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

10.3 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 feedback:								
P_{LED}	=	1.0 W	or	I_{LED}	=	42 mA	at	24 V

Also, if several control head valves are activated simultaneously, the switch signal will be sent staggered to the valves. Only **one** valve will ever take up 0.9 W.

Calculation examples:

Example 1: 3 valves are activated simultaneously, 1 position is reported back (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, 1 position is reported back (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	

When using an external initiator, its power requirement should be added

10.4 Safety instructions

DANGER!

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- Opening the hood or the housing in a potentially explosive atmosphere is only allowed in a not energized state!

WARNING!

Risk of injury from electric shock!

- Before reaching into the system (except for the teach procedure in a non-explosive atmosphere), switch off the power supply and secure it to prevent restarting!
- Observe the applicable accident prevention and safety regulations for electrical devices!
- When setting the position measuring system (teach procedure), do not contact any live components!

Risk of injury due to improper installation!

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

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

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

10.5 Electrical installation / start-up

10.5.1 Cable gland with screw terminals

Procedure:

→ Open the housing following the instructions in chapter “8 Opening and closing the housing”.

→ Assemble connection cables for signals and power supply as well as for the external initiator where necessary in observance of the rules of technology.

→ Insert cables through the respective cable glands into the interior of the housing.

→ Connect the wires to the connection terminals according to the connection assignment described in “Fig. 17”.

If required, secure the cable with a cable clip!

→ Close the housing following the instructions in chapter “8 Opening and closing the housing”.

NOTE!

Ensure IP protection!

- To ensure IP protection, the union nuts of the cable glands must be tightened in accordance with the cable sizes or dummy plugs used (approx. 1.5 Nm).
- If no external initiator is used, the right connection opening must be sealed with a dummy plug!

NOTE!

Use of the control head in a potentially explosive atmosphere

- Only use cables and cable glands which are approved for the respective application area and fit the cable glands according to the respective operating instructions!
- Close all unnecessary openings with lock screws / plugs approved for potentially explosive atmospheres!

24 V DC electronic module, terminal strip assignment:

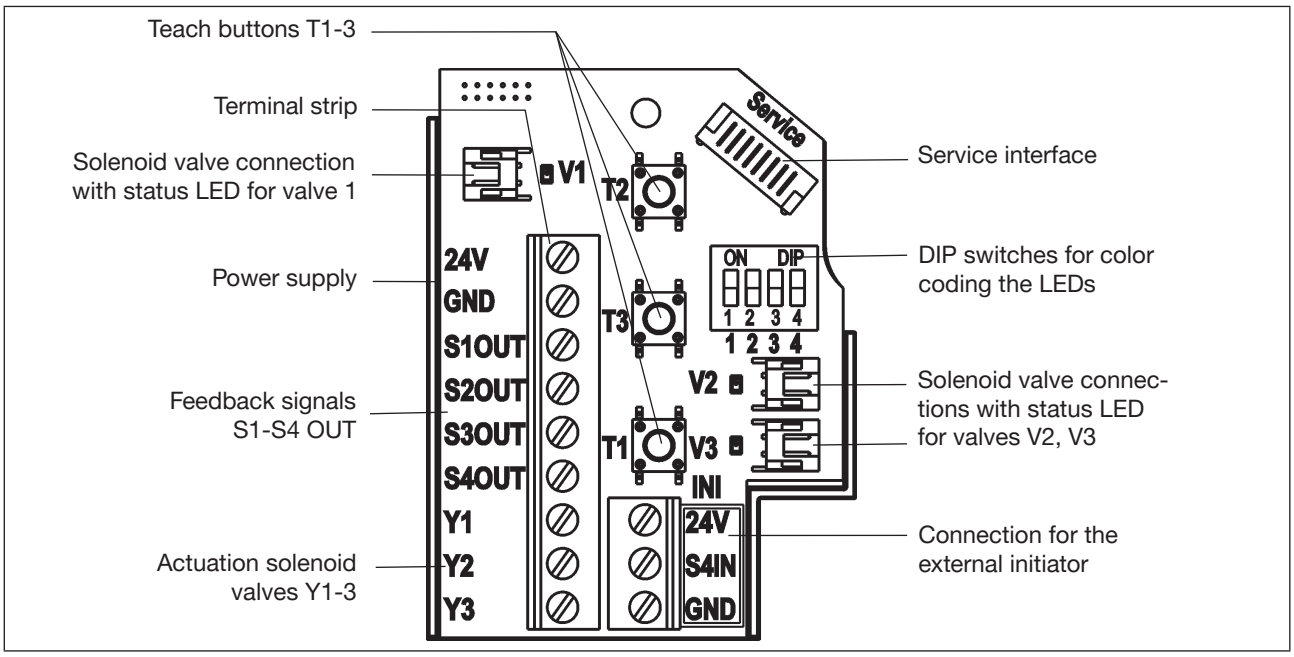


Fig. 17: 24 V DC electronic module

Designation terminal strip	Assignment
24 V	Power supply 24 V
GND	GND
S1 OUT	Outlet position 1
S2 OUT	Outlet position 2
S3 OUT	Outlet position 3
S4 OUT	External initiator outlet
Y1	Solenoid valve V1 input
Y2	Solenoid valve V2 input
Y3	Solenoid valve V3 input

Designation terminal strip	Assignment for external initiator
24 V	Power supply 24 V
S4 IN	External initiator input
GND	GND external initiator

Circuit diagram 24 V DC:

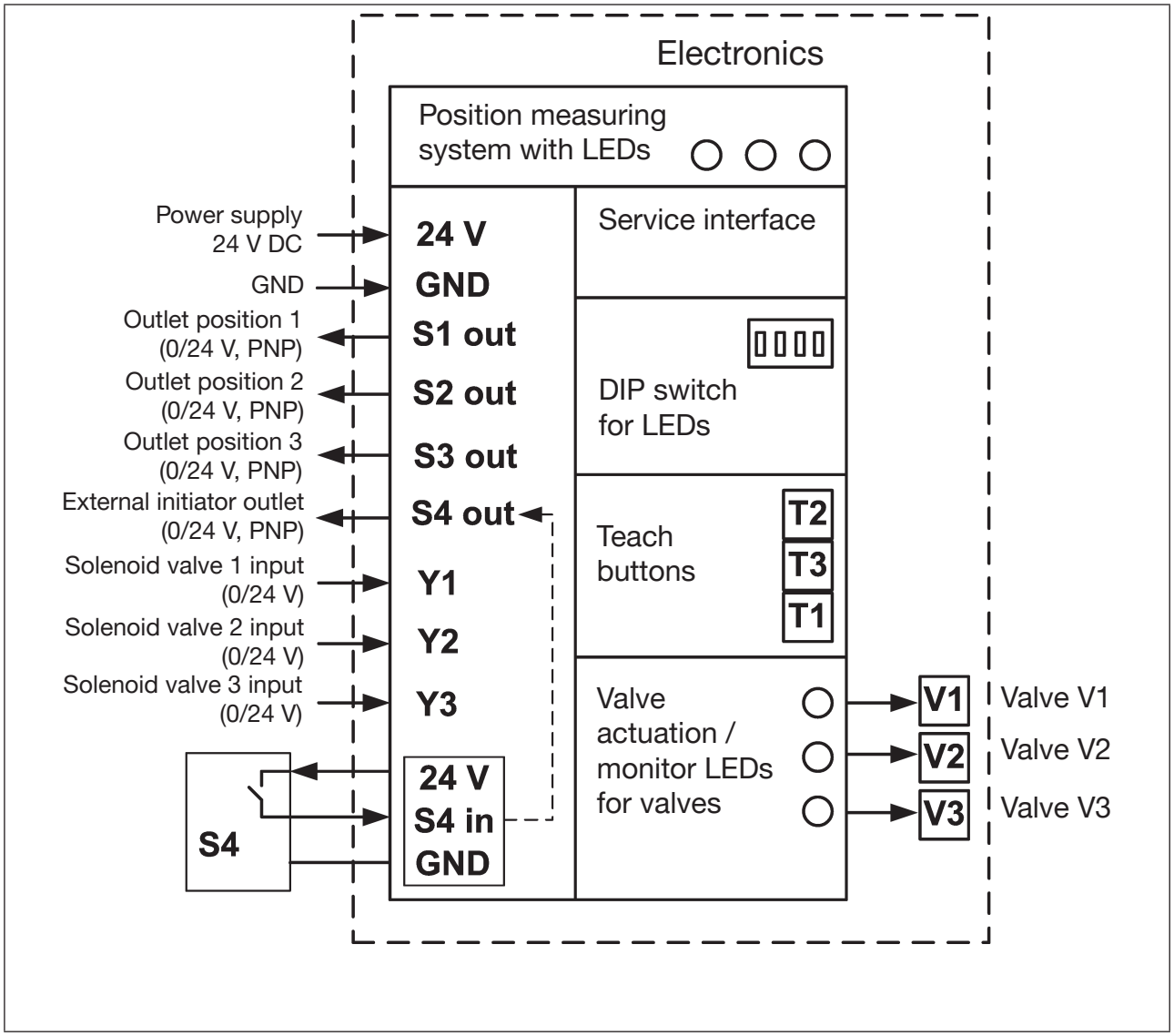


Fig. 18: Circuit diagram 24 V DC

10.5.2 Multi-pole connection

Internal cabling work is not required for 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 assignment:

Input and output signals to the higher-level controller (PLC):
12-pole circular plug-in connector M12 x 1.0 (acc. to IEC 61076-2-101)

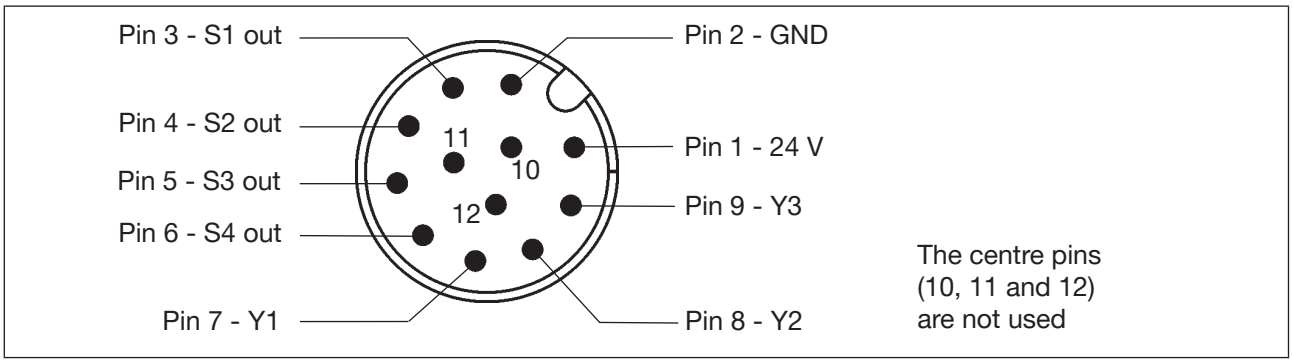


Fig. 19: 12-pole multi-pole connection (view onto the plug pins)

Pin	Designation	Assignment
1	24 V	Power supply 24 V
2	GND	GND
3	S1 out	Outlet position S1
4	S2 out	Outlet position S2
5	S3 out	Outlet position S3
6	S4 out	External initiator outlet S4
7	Y1	Solenoid valve V1 input
8	Y2	Solenoid valve V2 input
9	Y3	Solenoid valve V3 input
10		Not used
11		Not used
12		Not used

11 AS-INTERFACE DESIGN

11.1 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 controller (master).

Connecting the control heads 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 flat cable) 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 design complies with the version 3.0 specification).

Observe the maximum length of the bus cable – see chapter “11.4 Maximum length of the bus line”.

The control heads 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 “11.9 Programming data”.

11.2 Electrical connection options for AS-Interface

The following connection concepts are available for the electrical connection of the control head:

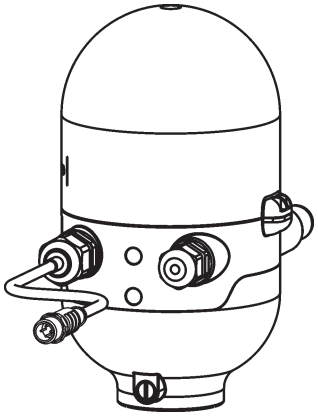
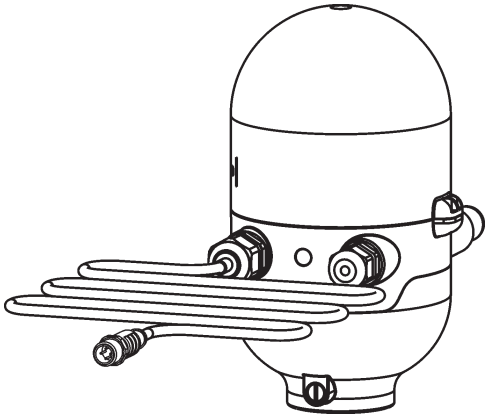
	
Cable gland with multi-pole connection (M12 plug according to IEC 61076-2-101, 4-pole), cable length approx. 15 cm	**Cable gland with multi-pole connection** (M12 plug according to IEC 61076-2-101, 4-pole), cable length approx. 80 cm
Connection left: AS-Interface Connection right: External initiator	Connection left: AS-Interface Connection right: External initiator

Fig. 20: Connection concepts for AS-Interface

11.3 Number of connectable control heads

The level of expansion that is actually possible depends on the total number of all individual operating currents for each control head, which are supplied via the bus at the common AS-Interface bus segment - see example calculation in chapter “11.6 Design aid” on page 55.

Standard: AS-Interface / 62 slaves
(AS-Interface version with extended address 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 address range)
In this case, a maximum of 31 control heads can be connected to a bus line (address range restriction).

11.4 Maximum length of the bus line

The maximum bus cable length is 100 m. 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 and the cabling inside the control heads.

When designing the system, the **calculated line length of the cable at the control head must be either 0.3 or 1 m** (see the following table). This takes into account the outer and inner cable lengths (see also the following example calculation).

Design	Calculated line length (including internal cabling)
Multi-pole (cable length, outside, approx. 15 cm)	0.3 m
Multi-pole (cable length, outside, approx. 80 cm)	1.0 m

Tab. 5: Calculated cable length at the control head (cable length inside + outside)

Examplecalculation for cable lengths :
For multi-pole connection with an outside cable length of 15 cm:
When using 62 control heads, the AS-Interface flat cable may still be (100 m - 62 * 0.3 m) = 81.4 m long.

If the calculated total line length of 100 m is 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 “11.5” and “11.8”.)

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

11.5 Electrical data

Notes / comments:

Outlets (from master perspective):	0 to 3 solenoid valves
Inputs (from master perspective):	3 binary feedback signals and 1 external initiator
Watchdog:	If bus communication fails for more than 50 to 100 ms, the outlets are set to 0

Setting the valve’s power supply using jumpers on the AS-Interface electronic module:

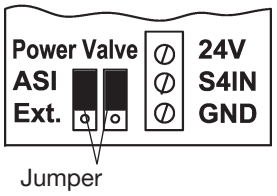
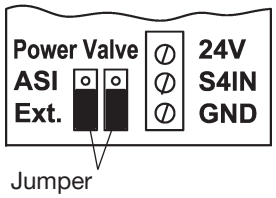
Power supply via AS-Interface	External power supply (For connection, see chapter “11.8 Electrical installation - AS-Interface”)
	

Fig. 21: Jumper settings for power supply via AS-Interface or via external power supply

The control head IntelliTop 2.0 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.

Connections:

Multi-pole connection design	1 x M16 x 1.5 cable gland / AF19 with multi-pole connection (M12 plug according to IEC 61076-2-101, 4-pole) for power supply and signals, cable length approx. 15 cm or approx. 80 cm
	1 x M16 x 1.5 – connection option for external initiator (sealed with dummy plug - remove it before use!)
Power supply:	29.5 ... 31.6 V DC (according to specification), 21.0 ... 31.6 V DC (according to specification Power24)

Input / proximity switch (external initiator: S4 in):

Power supply:	AS-Interface voltage present at control head - 10%
Current carrying capacity sensor supply:	max. 30 mA
Short-circuit protection Design:	DC 2 and 3-wire, Normally open contact, PNP outlet
Input current 1 signal:	ISensor > 6.5 m A, limited internally to 10 mA
Input voltage 1 signal:	U_{Sensor} > 10 V
Input current 0 signal:	I_{Sensor} < 4 mA
Input voltage 0 signal:	USensor < 5 V

Inputs (from master perspective) /binary feedback signals:
The recovery of the 3 valve positions reported back in binary format is described in chapter “17 Position measuring system”.

Outlets (from master perspective) / solenoid valves:

Max. switching capacity:	Max. 0.9 W (per solenoid valve, for 200 ms after switching on)
Typ. continuous output:	0.6 W (per solenoid valve, from 200 ms after switching on)
Watchdog function:	Integrated
Power reduction:	Integrated via AS-Interface electronics
Pull-in current:	30 mA or 0.9 W / 200 ms (at 30.5V-AS-i voltage)
Holding current:	20 mA or 0.6 W (at 30.5V-AS-i voltage)
Operating mode:	Continuous operation (100% duty cycle)
Valve type:	Type 6524

Central display of the switching states:

Current consumption from AS-i at 30.5V-AS-i voltage:	Max. 33 mA or 1 W per illuminated display
Number of colors which can be displayed:	2 colors for process valve switching states 1 color for signalling a fault For “universal color switching”, see chapter.

Power supply via AS-Interface bus (without external power supply):

Max. current consumption from AS-i: 200 mA (incl. external initiator with 30 mA)
Current consumption during normal operation from AS-i (after current reduction): ≤ 150 mA
3 valves activated, 1 position reported back by LED display, no external initiator

Integrated short-circuit protection

NOTE!

Protection against excessive currents

- If all 3 solenoid valves are simultaneously controlled via the AS-Interface, the electronics will activate the valves successively with a 200 ms time delay to protect the bus from overloads.

External power supply for solenoid valves:

External power supply:	19.2 V DC to 31.6 V DC The power supply unit must include a secure disconnect according to IEC 364-4-41. It must conform to the SELV standard. The ground potential must not have a ground connection.
max. current consumption from external power supply for outlets (solenoid valves) - without integrated current limiting:	≤ 110 mA at 24 V DC (for 200 ms after switching on the 3rd valve)
Max. power consumption from AS-i for inputs and display:	≤ 150 mA (incl. external initiator, feedback, fault display)
Integrated short-circuit protection	

Please observe the following notes on power requirement and on maximum expansion stage of the AS-Interface network contained in chapter "11.3 Number of connectable control heads" and in the AS-Interface specifications, where applicable.

11.6 Design aid

Design aid for 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 feedback:								
P_{LED}	=	1.0 W	or	I_{LED}	=	33 mA	at	30.5 V

For the design of the **maximum line lengths,** observe the chapter "11.4 Maximum length of the bus line".

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

Calculation examples:

Example 1: 3 valves are activated simultaneously, 1 position is reported back (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, 1 position is reported back (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		

When using an external initiator, its power requirement should be added.

11.7 Safety instructions

DANGER!

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- Opening the hood or the housing in a potentially explosive atmosphere is only allowed in a not energized state!

WARNING!

Risk of injury from electric shock!

- Before reaching into the system (except for the teach procedure in a non-explosive atmosphere), switch off the power supply and secure it to prevent restarting!
- Observe the applicable accident prevention and safety regulations for electrical devices!

Risk of injury due to improper installation!

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

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

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

11.8 Electrical installation - AS-Interface

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 or fitted cable sets with the following pin assignments. Likewise, the jumpers on the electronic module must be set correspondingly (see figures below).

NOTE!

Use of the control head in a potentially explosive atmosphere

- Only use cables and cable glands which are approved for the respective application area and fit the cable glands according to the respective operating instructions!
- Close all unnecessary openings with lock screws / plugs approved for potentially explosive atmospheres!

Bus connection AS-Interface (power supply via bus / external power supply)
M12 x 1 circular plug, 4-pole (according to IEC 61076-2-101)

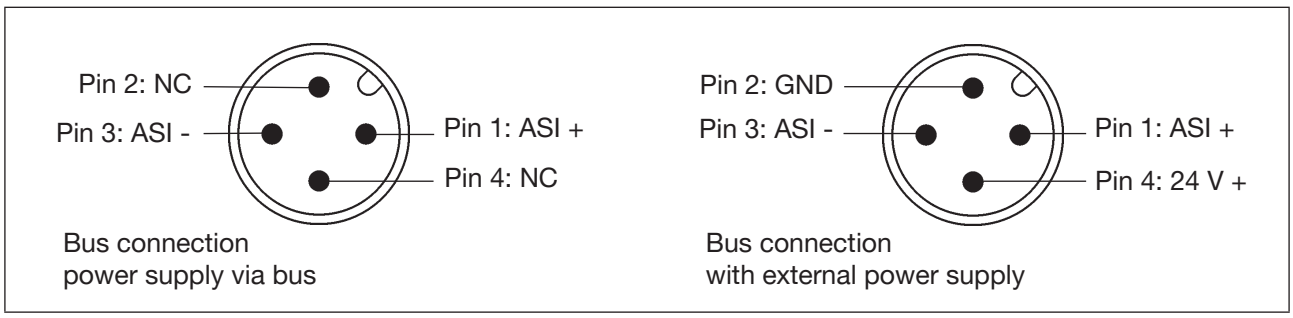


Fig. 22: AS-Interface bus connection (power supply via bus / external power supply)

Pin	Assignment (supply via bus)	Assignment (external power supply)	Wire color
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

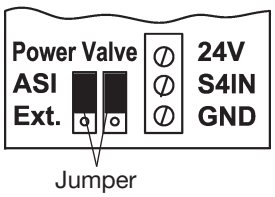
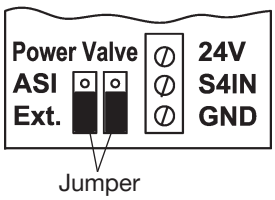
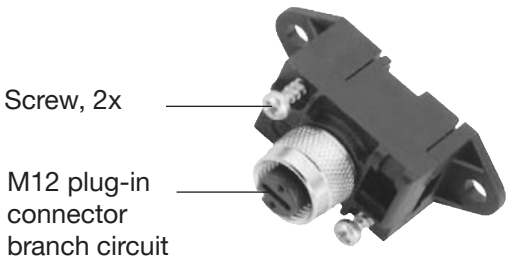
Power supply to the solenoid valves via the bus	External power supply to the solenoid valves
	

Fig. 23: Jumper setting on AS-Interface electronic module: Power supply to the valves via the bus or externally

The cable with multi-pole connection design is especially suited for direct and flexible connection to the AS-Interface flat cable using the flat cable terminal that is optionally available.

The optional flat cable terminal contacts the AS-Interface cable harness by means of penetration technology which allows installation by “clipping in” the AS-Interface flat cable without cutting and without removing insulation.



Procedure:

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

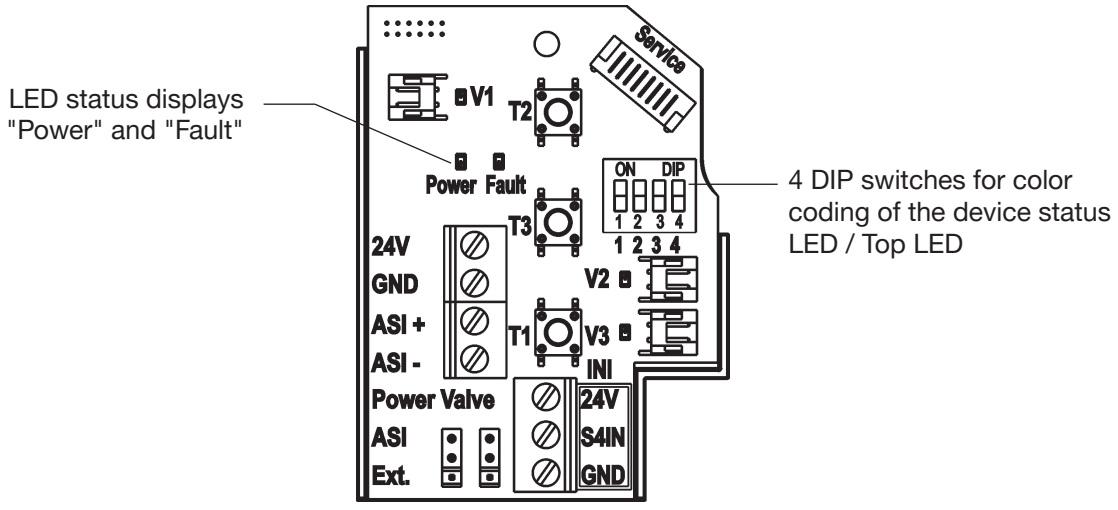
→ Insert flat cable

→ Close the flat cable terminal again

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

Fig. 24: Optional flat cable terminal for the AS-Interface flat cable

AS-Interface electronic module - LED status displays:



LED 1 “Power” (green)	LED 2 “Fault” (red)	Signalized status
Off	Off	Power OFF
On	On	No data traffic (expired Watchdog at slave address does not equal 0)
On	Off	OK
Flashes	On	Slave address = 0
Flashes	Flashes	Sensor supply overload / manual override activated / untaught / service/ maintenance request / PC software service mode

The central multi-color illuminated display (Top LED) flashes in the error color (see chapter “18.2 Flashing pattern / fault signalling”) if the status LED 2 “Fault” is active.

11.9 Programming data

The control heads 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 the two configurations in the control head is only possible by exchanging the electronic PCB.

If one control head is replaced with another control head 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 fault 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

Programming data table

	Programming data with 62 slaves AS-Interface - device for A/B slave addressing (standard device)	Programming data with 31 slaves AS-Interface (optional)
I/O configuration	7 hex (4 inputs / 4 outputs) see below: Bit assignment table	7 hex (4 inputs / 4 outputs) see below: Bit assignment 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

Bit assignment table

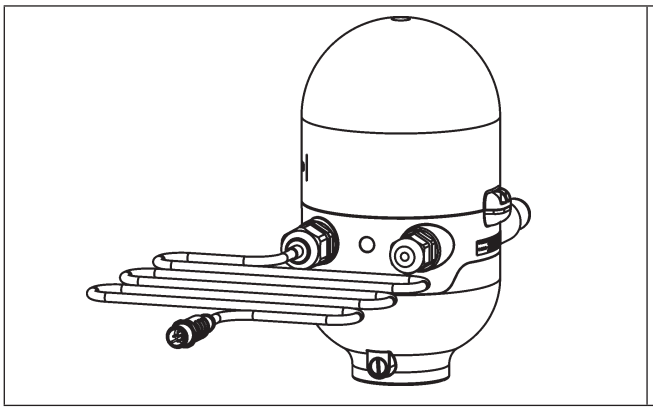
Data bit	D3	D2	D1	D0
Input	External initiator S4	Position S3	Position D2	Position D1
Outlet	Not used	Solenoid valve V3	Solenoid valve V2	Solenoid valve V1
Parameter bit	**P3**	**P2**	**P1**	**P0**
Outlet	Not used	Not used	Not used	Not used

12 DEVICENET DESIGN

12.1 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 control head 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 designs.
- 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.**

12.2 Electrical connection option



Cable gland with multi-pole connection
(M12 plug according to IEC 61076-2-101, 5-pole), cable length approx. 80 cm

Connection left: Voltage, signals

Connection right: External initiator

Fig. 25: Connection concept DeviceNet

12.3 DeviceNet specification

EDS file	INTELLITOP2.EDS
Icons	INTELLITOP2.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 “12.10.2 Setting the baud rate”)
Address	0 ... 63 (can be adjusted via DIP switches 1 ... 6); factory setting: 63 (see chapter “12.10.1 Settings of the DeviceNet address”)
Process data	2 static input assemblies (Input: from IntelliTop 2.0 to DeviceNet master/scanner) 1 static output assembly (Output: From DeviceNet master/scanner to control head)

Inputs	3 discrete feedback signals of the position measuring system (positions S1 - S3) 1 discrete feedback signal of the external initiator (S4) 1 analog position signal in mm supply via DeviceNet string (11 ... 25 V DC) Switch level high signal ≥ 5 V Switch level low signal ≤ 1.5 V
Outputs	3 solenoid valves
Power consumption from the bus:	Max. output 5 W, if all valves are switched (3 x Type 6524 with 0.6 W each)

12.3.1 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 system, the **calculated line length of the cable at the control head must be 1 m** - this takes into account the outer and the inner cable lengths.

Baud rate	Maximum total line length*)		
	Thick cable**)	Mid cable**)	Thin cable**)
125 kBaud	500 m	300 m	100 m for all baud rates
250 kBaud	250 m	250 m	
500 kBaud	100 m	100 m	

12.3.2 Drop line length

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

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

12.4 Electrical data

Connections:

"Multi-pole"	1 x M16 x 1.5 cable gland / AF22 with multi-pole connection (M12 plug according to IEC 61076-2-101, 5-pole) for DeviceNet bus and power supply, cable length approx. 80 cm
	1 x M16 x 1.5 – connection option for external initiator (sealed with dummy plug - remove it before use!)
Power supply:	11 … 25 V DC (according to specification)
Max. current consumption:	200 mA at 24 V DC

Input / proximity switch (external initiator: S4 in):

Power supply:	Via DeviceNet power supply - 10%
Current carrying capacity sensor supply: short-circuit protection	Max. 30 mA
Design:	DC 2 and 3-wire, Normally open contact, PNP outlet
Input current 1 signal:	ISensor > 6.5 m A, limited internally to 10 mA
Input voltage 1 signal:	U_{Sensor} > 10 V
Input current 0 signal:	I_{Sensor} < 4 mA
Input voltage 0 signal:	USensor < 5 V

Inputs (from master perspective) / binary or analog feedback signals:
The recovery of the 3 valve positions reported back in binary format is described in chapter "17 Position measuring system".

Outputs (from master perspective) / solenoid valves:

Max. switching capacity:	1.0 W (per solenoid valve, for 200 ms after switching on)
Typ. continuous output:	0.6 W (per solenoid valve, from 200 ms after switching on)
Power reduction:	Integrated via DeviceNet electronics
Pull-in current:	120 mA typ. / 200 ms (3 valves)
Holding current:	100 mA typ. at 24 V DC (3 valves)
Operating mode:	Continuous operation (100% duty cycle)
Valve types:	6524

Central display of the switching states:

Current consumption from DeviceNet at 24 V DC:	42 mA with a power supply of 24 V DC per illuminated display; for color switching, see chapter "18 Top LED color assignments"

12.5 Safety position if the bus fails

If the bus fails, the solenoid valve is switched to a programmable safety position (default: solenoid valve not energized). For configuration data, see chapter "12.12.1 Configuration of the safety position of solenoid valves in case of a bus error".

12.6 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):									
$P_{Valve-ON}$	=	1.0 W		or	$I_{Valve-ON}$	=	42 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}	=	1.0 W		or	I_{LED}	=	42 mA	at	24 V

Calculation examples:

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

Example 2: 3 valves have been activated simultaneously, 1 position is reported back (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		

When using an external initiator, its power requirement should be added.

12.7 Safety instructions

DANGER!

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- Opening the hood or the housing in a potentially explosive atmosphere is only allowed in a not energized state!

WARNING!

Risk of injury from electric shock!

- Before reaching into the system (except for the teach procedure in a non-explosive atmosphere), switch off the power supply and secure it to prevent restarting!
- Observe the applicable accident prevention and safety regulations for electrical devices!
- When setting the position measuring system (teach procedure), do not contact any live components!

Risk of injury due to improper installation!

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

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

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

12.8 Electrical installation - DeviceNet

No internal cabling work is 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 pin assignments described below. The assignment conforms to the DeviceNet specification.

Multi-pole connection DeviceNet

View of plug from the front onto the pins:

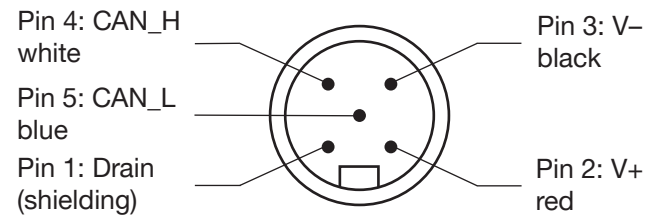


Fig. 26: Bus connection of DeviceNet with power supply

Pin	1	2	3	4	5
Signal	Shielding	V +	V –	CAN_H	CAN_L
Wire color		Red	Black	White	Blue

DeviceNet electronic module

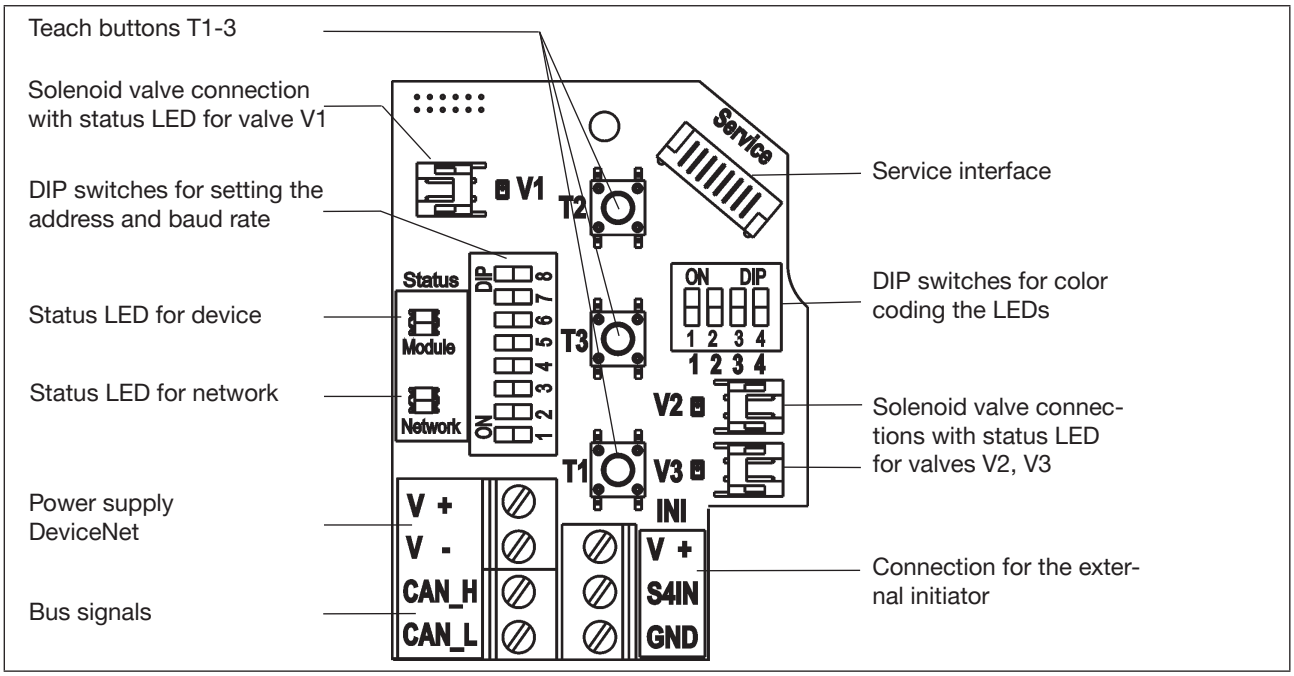


Fig. 27: DeviceNet electronic module

Terminal strip assignment:

Designation terminal strip	Assignment
V+	Power supply DeviceNet
V-	Power supply DeviceNet
CAN_H	Bus signal CAN high
CAN_L	Bus signal CAN low

Designation terminal strip	Assignment
V+	Power supply for external initiator
S4 IN	External initiator input
GND	GND external initiator

12.9 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”).

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

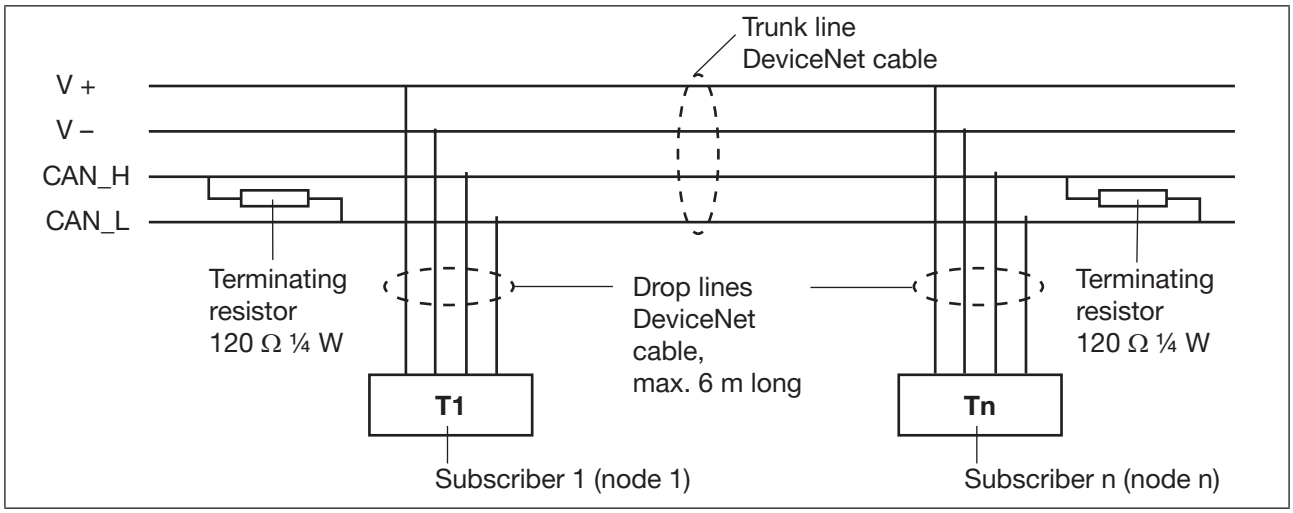


Fig. 28: Network topology

12.10 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

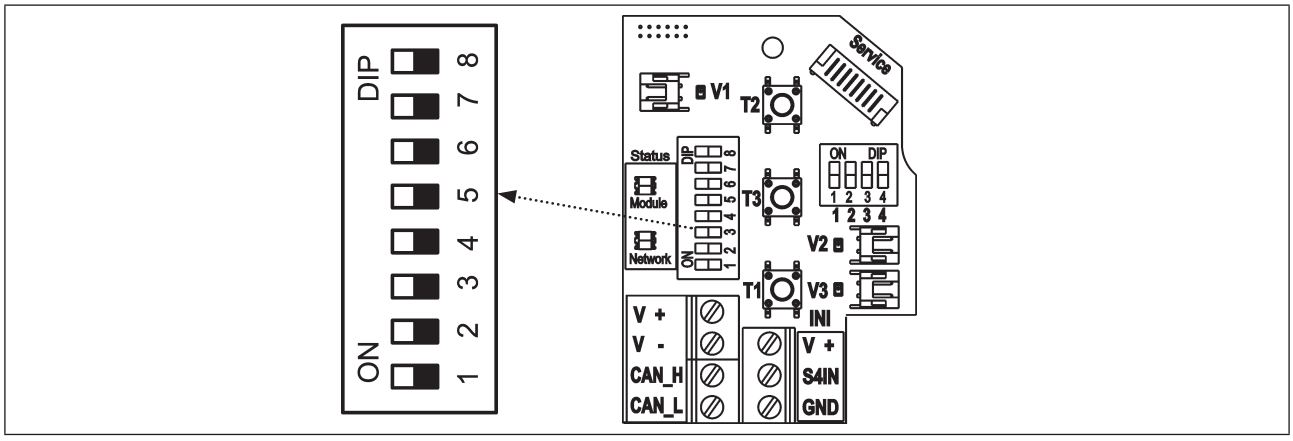


Fig. 29: Position of the DIP switches for baud rate and addressing

12.10.1 Settings 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

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

Tab. 6: Setting of the DeviceNet address via DIP switch DIP1...6

12.10.2 Setting the baud rate

The control head must receive the same baud rate as the network. The setting is made via DIP7...8:

Baud rate	DIP 7	DIP 8
125 kBaud	off	off
250 kBaud	on	off
500 kBaud	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 control head from the power supply and reconnect or
- switch the power supply off/on or
- transmit an appropriate reset message.

12.11 Configuration of the process data

To **transmit process data** via an I/O connection, 2 static input assemblies 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.

12.11.1 Static input assemblies

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
S1…S4 (factory setting)	4, 1, 3	**Byte 0:** Bit 0: Position S1 Bit 1: Position S2 Bit 2: Position S3 Bit 3: Position S4
S1…S4 + POS (with POS: Actual position)	4, 2, 3	**Byte 0:** Bit 0: Position S1 Bit 1: Position S2 Bit 2: Position S3 Bit 3: Position S4 Bit 4…7: Not used **Byte 1:** POS in mm

The address listed in the table above (“Static input assemblies”) 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.

12.11.2 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
Solenoid valve 1...3	4, 21, 3	**Byte 0:** Bit 0: MV1 Bit 1: MV2 Bit 2: MV3 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.

12.12 Configuration of the device

12.12.1 Configuration of the safety position of solenoid valves in case of a bus error

The valve safety position and safety module attributes can be used to configure the solenoid valves in case of a bus error.

The configuration data of the solenoid valves in case of a bus error can be accessed acyclically via Explicit Messages.

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

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

Bit	Mode	Value assignment
Bit 0	Character-istics in case of a bus error	0 Approach safety position 1 Retain last valve position
Bit 1...7	Not used	0 (always)

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

Bit	Solenoid valve	Value assignment
Bit 0	Y1 (solenoid valve 1)	Value 0: OFF / Value 1: ON
Bit 1	Y2 (solenoid valve 2)	Value 0: OFF / Value 1: ON
Bit 2	Y3 (solenoid valve 3)	Value 0: OFF / Value 1: ON
Bit 3...7	Not used	0 (always)

12.12.2 Configuration example

The example describes the principle procedure when configuring the device using the RSNetWorx software for DeviceNet (revision 4.21.00).

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 parameterisation 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, an input assembly which deviates from the factory setting (input process
data can be transferred via I/O connection) can be selected. However, ensure that the length of the process data during a subsequent configuration of the DeviceNet master / scanner is adjusted accordingly.

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

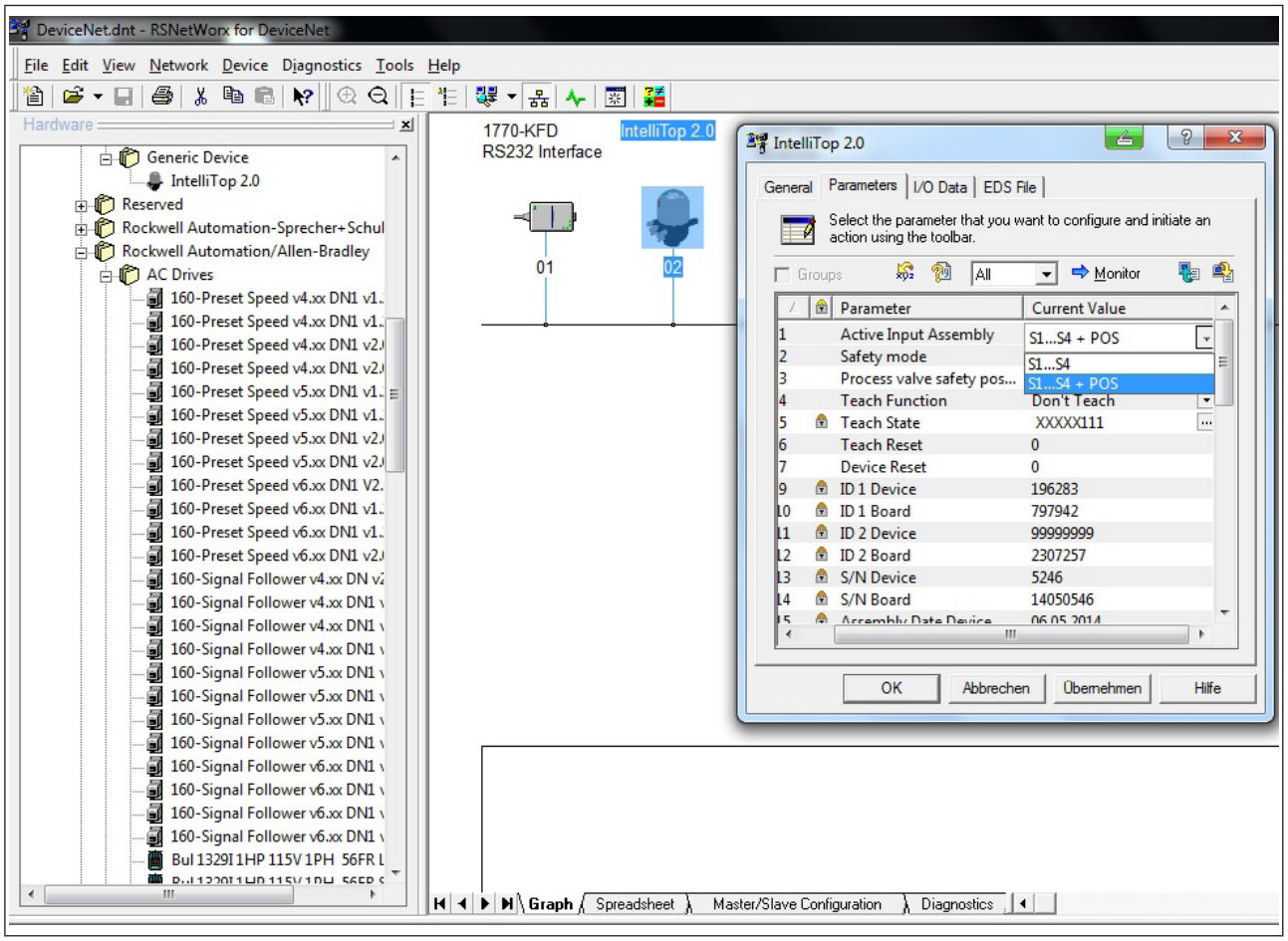


Fig. 30: Selecting the input assembly (screenshot)

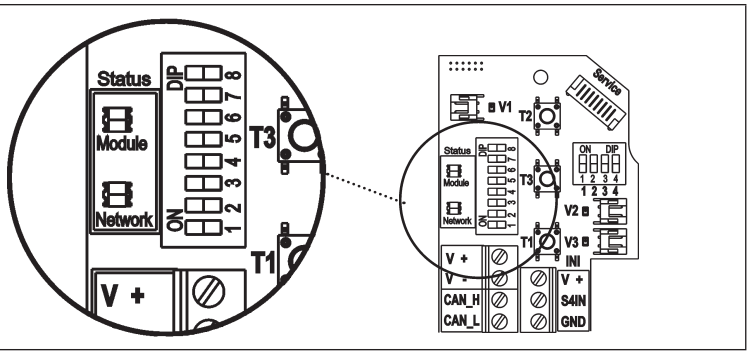
Online parameterisation of the device

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.

12.13 Display of the status LEDs in case of a bus error

Bus errors are also indicated on the central three-colored status display - see chapter “18.2 Flashing pattern / fault signalling”!

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

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

Status LED	Colors of the LED	Function test
“Modules”	Green	• 250 ms ON (green)
“Network”	Green / red	• 250 ms ON (green) • 250 ms ON (red)

Then another function test is run during which the LEDs light up briefly.

When the test has been completed, the status LEDs indicate the device statuses which are described in the following tables.

12.13.1 State of device status LED “Modules”

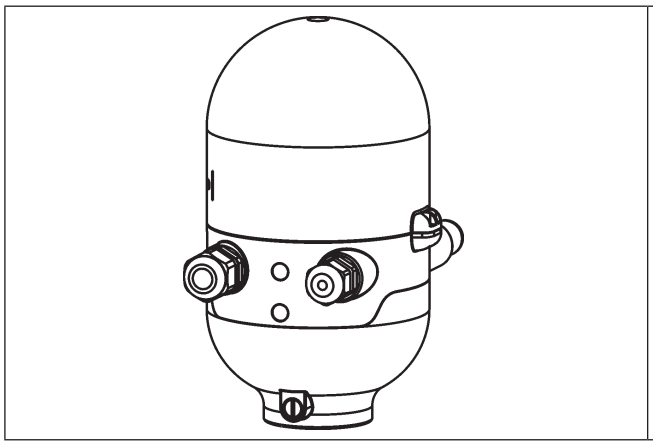
LED	Device status	Explanation
Off	No supply	• Device is not supplied with voltage
Green	Device is working	• Normal operating state

12.13.2 State of bus status LED “Network”

LED	Device status	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 the master exists	• Normal operating state with established connection to the master	
Flashes green	Online, without connection to the 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 the 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

13 120 V AC DESIGN

13.1 Electrical connection options



Cable gland:

Connection left: Voltage, signals

Connection right: External initiator

Fig. 31: Connection concept 120 V AC

13.2 Electrical data

Central power supply: 110 ... 130 V AC, 50/60 Hz

Connections: Cable gland

1 x M16 x 1.5 cable gland / AF22 – for power supply and signals (only for transportation safety device sealed with dummy plug, remove it before use!),
for cable diameter 5 ... 10 mm,
for wire cross-sections 0.5 ... 1.5 mm^2,.
including PE connection terminal
(tightening torque of the clamping screws max. 0.5 Nm)

1 x M16 x 1.5 – connection option for external initiator (sealed with dummy plug - remove it before use!)

Current consumption (standby current): 10 mA at 120 V AC

Solenoid valves:

Max. switching capacity:	1.7 VA (per solenoid valve, for 200 ms after switching on)
Typ. continuous output:	1.4 VA (per solenoid valve, from 200 ms after switching on)
Current consumption per solenoid valve:	12 mA at 120 V AC
Operating mode:	Continuous operation (100% duty cycle)

Central display of the switching states: 13 mA with a power supply of 120 V AC per illuminated display;
for color switching, see chapter “18 Top LED color assignments”

Outlets / binary feedback signals: S1out - S3out

Design:	Normally open contact, L switching, short-circuit protection via automatically resetting fuse
Switchable output current:	Max. 50 mA per feedback signal

Output voltage - active:	≥ (operating voltage - 2 V)
Output voltage - inactive:	Max. 1 V in the unloaded state

Feedback signal output: S4 out is directly connected to S4in

Input / proximity switch (external initiator: S4 in):

Power supply:	Voltage present at control head $U_{Nominal}$ = 120 V AC, 50/60 Hz
Design:	DC 2 and 3-wire, Normally open contact, L-switching
Input current 1 signal:	I**Sensor** < 2 m A

Inputs for valve actuation (Y1 - Y3):

Signal level - active:	U > 60 V AC
Signal level - inactive:	U < 20 V AC
Impedance:	> 40 kOhm

13.3 Design aid

Power consumption of the electronics:									
P_{EI}	=	1.2 VA		or	I_{EI}	=	10 mA	at	120 V AC
Power consumption of a valve during activation (200 ms):									
$P_{Valve-ON}$	=	1.7 VA		or	$I_{Valve-ON}$	=	14 mA	at	120 V AC
Power consumption of a valve after reduction:									
P_{Valve}	=	1.4 VA		or	I_{Valve}	=	12 mA	at	120 V AC
Power consumption of an optical position feedback:									
P_{LED}	=	1.6 VA		or	I_{LED}	=	13 mA	at	120 V AC

Also, if several control head valves are activated simultaneously, the switch signal will be sent staggered to the valves. Only **one** valve will ever take up 1.7 W.

Calculation examples:

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

P_{Total}	=	P_{EI}	+	1 x $P_{Valve-ON}$	+	2 x P_{Valve}	+	1 x P_{LED}
7.3 VA	=	1.2 VA	+	1 x 1.7 VA	+	2 x 1.4 VA	+	1 x 1.6 VA
or								
I_{Total}	=	I_{EI}	+	1 x $I_{Valve-ON}$	+	2 x I_{Valve}	+	1 x I_{LED}
61 mA	=	10 mA	+	1 x 14 mA	+	2 x 12 mA	+	1 x 13 mA

Example 2:
3 valves have been activated simultaneously, 1 position is reported back (persistent state):

P_{Total}	=	P_{EI}	+	3 x P_{Valve}	+	1 x P_{LED}		
7.0 VA	=	1.2 VA	+	3 x 1.4 VA	+	1 x 1.6 VA		
or								
I_{Total}	=	I_{EI}	+	3 x I_{Valve}	+	1 x I_{LED}		
59 mA	=	10 mA	+	3 x 12 mA	+	1 x 13 mA		

When using an external initiator, its power requirement should be added.

13.4 Safety instructions

DANGER!

Risk of injury due to electric shock (110 ... 130 V AC)!

- Before reaching into the system (except for the teach procedure in a non-explosive atmosphere), switch off the power supply and secure it to prevent restarting!
- Observe the applicable accident prevention and safety regulations for electrical devices!
- When setting the position measuring system (teach procedure), do not contact any live components!

Risk of electric shock if the PE connection is not connected!

- The PE connection must be connected!

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- Opening the hood or the housing in a potentially explosive atmosphere is only allowed in a not energized state!

WARNING!

Risk of injury due to improper installation!

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

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

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

13.5 Electrical installation / start-up

DANGER!

Risk of injury due to electric shock (110 ... 130 V AC)!

- Before reaching into the system (except for the teach procedure in a non-explosive atmosphere), switch off the power supply and secure it to prevent restarting!
- Observe the applicable accident prevention and safety regulations for electrical devices!
- When setting the position measuring system (teach procedure), do not contact any live components!

Procedure:

→ Open the housing following the instructions in chapter “8 Opening and closing the housing”.

→ Assemble connection cables for signals and power supply as well as for the external initiator where necessary in observance of the rules of technology.

→ Insert cables through the respective cable glands into the interior of the housing.

→ Connect the wires to the connection terminals according to the connection assignment described in “Fig. 32”. If required, secure the cable with a cable clip.

DANGER!

Risk of electric shock if the PE connection is not connected!

- The PE connection must be connected!

→ Clamp the protective conductor to the PE connection.

→ Check correct earthing.

→ Close the housing following the instructions in chapter "8 Opening and closing the housing".

NOTE!

Ensure IP protection!

- To ensure IP protection, the union nuts of the cable glands must be tightened in accordance with the cable sizes or dummy plugs used (approx. 1.5 Nm).
- If no external initiator is used, the right connection opening must be sealed with a dummy plug!

NOTE!

Use of the control head in a potentially explosive atmosphere

- Only use cables and cable glands which are approved for the respective application area and fit the cable glands according to the respective operating instructions!
- Close all unnecessary openings with lock screws / plugs approved for potentially explosive atmospheres!

120 V AC electronic module, terminal strip assignment:

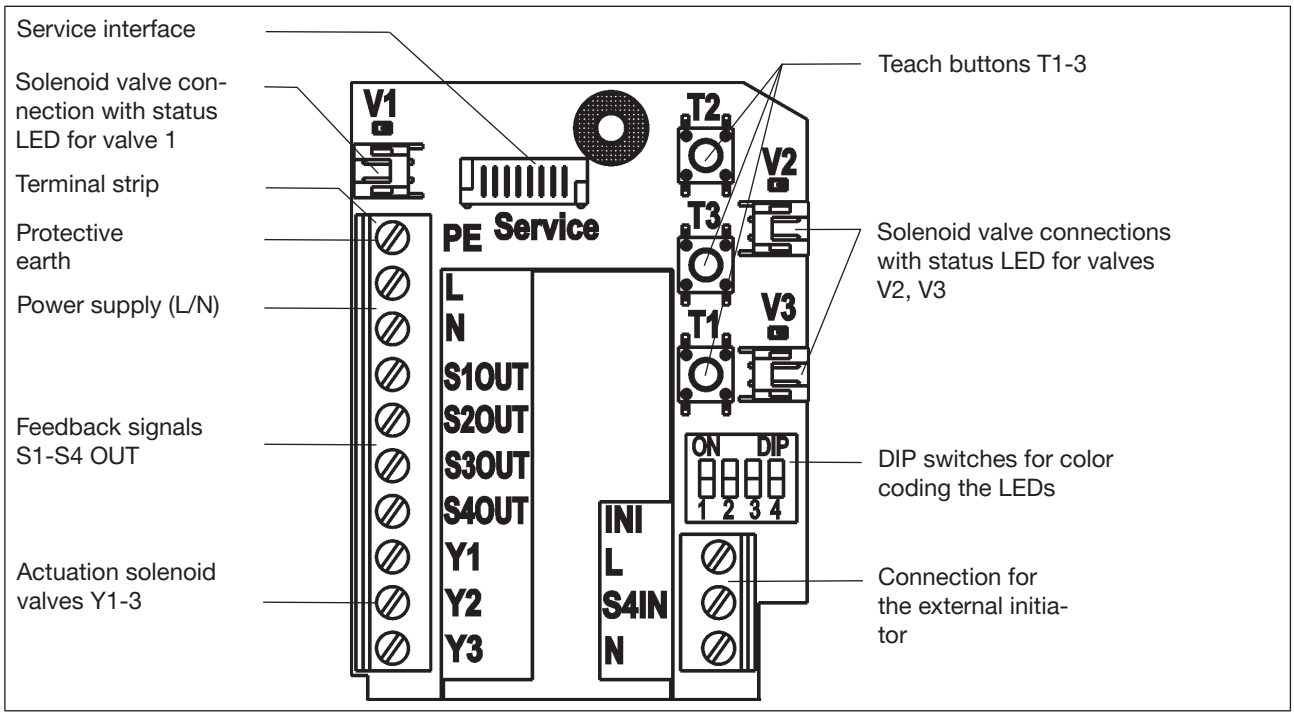


Fig. 32: 120 V AC electronic module

Designation terminal strip	Assignment	
PE	Protective earth	
L	Conductor	Power
N	Neutral conductor	supply 120 V AC
S1 OUT	Outlet position S1	
S2 OUT	Outlet position S2	
S3 OUT	Outlet position S3	
S4 OUT	External initiator outlet S4	
Y1	Solenoid valve V1 input	
Y2	Solenoid valve V2 input	
Y3	Solenoid valve V3 input	

Designation terminal strip	Assignment for external initiator
L	Power supply - conductor
S4 IN	External initiator input
N	Power supply - neutral conductor

Circuit diagram 120 V AC:

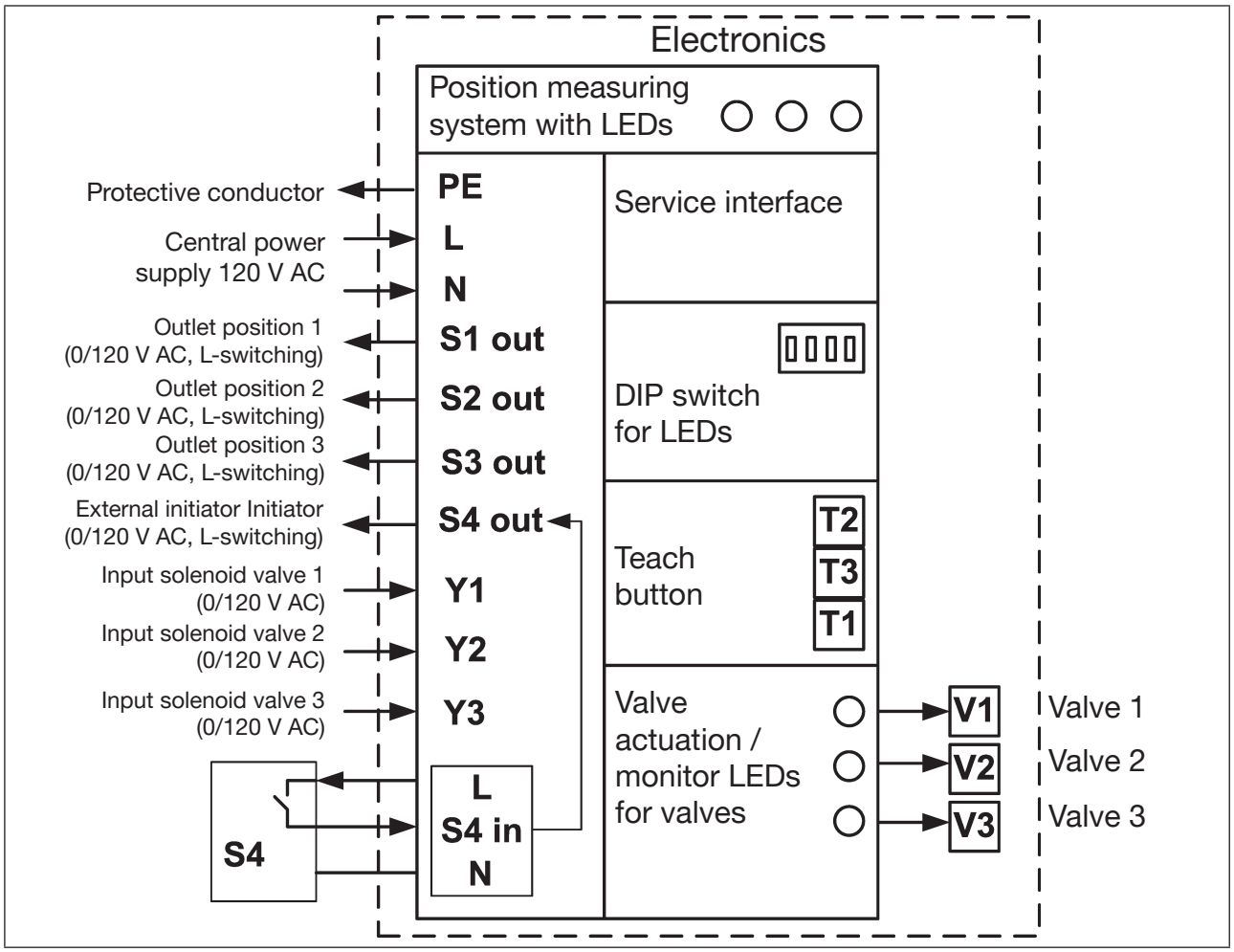


Fig. 33: Circuit diagram 120 V AC

14 IO-LINK DESIGN

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

The control head IntelliTop 2.0 (IO-Link) is available in 2 designs:

- **Port Class A:** with a shared power supply (Power 1) for powering the system and actuators (solenoid valves)
  or
- **Port Class B:** with power supply (Power 1) for powering the system and Power 2 for separately powering the actuators (solenoid valves), which allows for a safety shutdown of the solenoid valves.

The devices conform to the specifications as described in greater detail in chapter “14.3” .

14.1 Network principle / interfaces

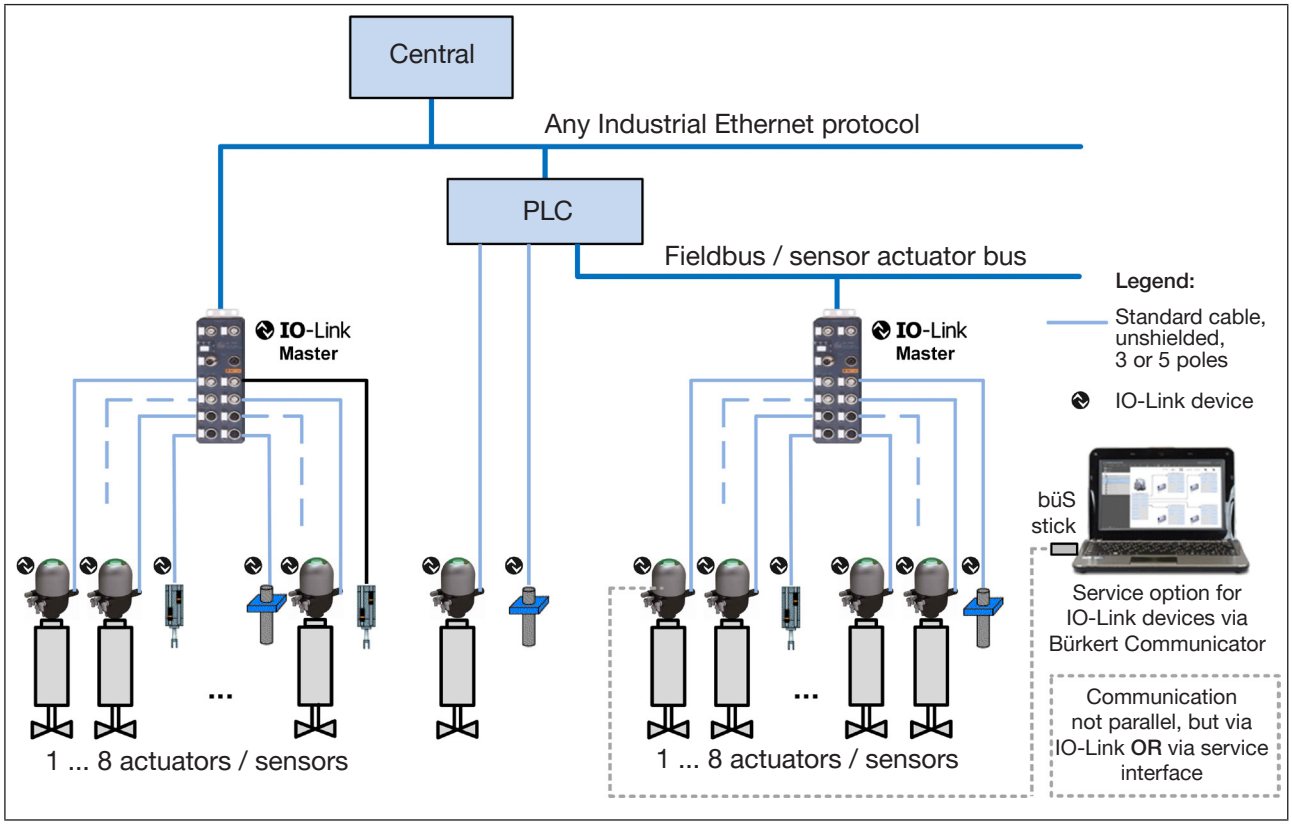


Fig. 34: Network principle of IO-Link

IO-Link control heads can also be connected individually with the “Bürkert Communicator” service program for configuration and firmware update: via the **“büS” stick** to the micro-USB port for service purposes (büS) on the electronic module (see “Fig. 36” and chapter “14.4”).

Since no voltage is transferred via this interface, the control head must also be supplied with voltage, for example via the IO-Link port.

Note, however, that **device parameterisation is not possible simultaneously** via IO-Link and the “Bürkert Communicator” - see also information box in chapter “14.4”.

14.2 Quickstart for initial start-up

Network layout:

IO-Link devices are connected with conventional IO-Link masters and can be integrated easily into any conventional fieldbus or automation system.

The network is structured similarly to the diagram in “Fig. 34”.
4 or 5-pole unshielded standard cables with a max. length of 20 m between the IO-Link device and IO-Link master are sufficient for connecting IO-Link devices with IO-Link masters.

The IO-Link control heads are either equipped with M12 plugs (design with multi-pole plug) or can be wired themselves (design with cable gland). For details, see chapter “14.5”.

Configuration:

The network is configured by the higher-level controller.

To ensure unambiguous communication, IO-Link devices should not be configured simultaneously using the global controller (PLC) via the IO-Link master and using the “Bürkert Communicator” (via the service interface). For details, see chapter “14.4”.

Software download / firmware updates:

Download the required software files and IODD (IO Device Description) from the website – for details, see chapter “14.6”.

14.3 Technical data / specification

IO-Link specification:	Version 1.1.2
Port Class:	**A:** shared power supply (Power 1) for powering the system and actuators (solenoid valves) **or** **B:** separate power supply for the system (Power 1) and for the actuators / solenoid valves (Power 2)
Power supply:	Port Class **A:** Via IO-Link port (M12x1, 4-pole, A-coded); Port Class **B:** Via IO-Link port (M12x1, 5-pole, A-coded), For details, see chapter “14.5.5” and “Fig. 37” on page 87.
Operating mode:	IO-Link mode (SIO mode is not supported)
IODD file:	Download: See chapter “14.6”
VendorID:	0x78, 120
DeviceID:	See relevant IODD file (Port Class A or B)
Transmission speed:	COM3 (230.4 kbit/s)
M-sequence type in Operate Mode:	TYPE_2_V
Min. cycle time:	2 ms
Data storage:	Yes
Max. line length:	20 m each between IO-Link master and IO-Link device

14.4 IO-Link master / communication / configuration

IO-Link master

IO-Link masters are used as the interface between the control heads IntelliTop 2.0 (IO-Link) and the higher-level controller. All commonly used IO-Link masters in accordance with the specification (see chapter "14.3") can be used.

"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 master or devices.

IO-Link master / communication / parameterisation

After the network has been set up (see for example "14.1 Network principle / interfaces") and the correct software has been installed in the IO-Link devices (IODD taking into consideration the port class), the network is configured using the higher-level controller.

Cyclical process communication takes place via IO-Link. Configuration / parameterisation is possible through acyclic data access via IO-Link or alternatively via the "Bürkert Communicator" service program.

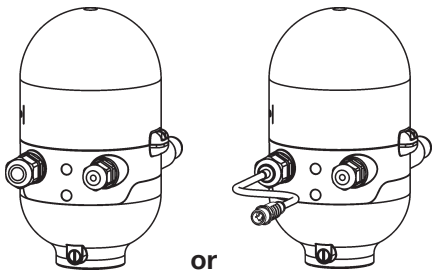
The required software download is described in "14.6.1 Software download" on page 88.

The control head is connected to the "Bürkert Communicator" using special accessories ("14.6.3 Accessories") via the service interface on the electronic module (see "Fig. 36" on page 86).

To ensure **unambiguous communication**, IO-Link devices should not be configured simultaneously using the higher-level controller (PLC) via the IO-Link master **and using the** "Bürkert Communicator" (via the service interface).

14.5 Electrical data of the control head (IO-Link)

14.5.1 Electrical connection options / interfaces



With cable glands

or

with cable glands and multi-pole connection
(M12 plug according to IEC 61076-2-101, 4-pole (Port Class A) or 5-pole (Port Class B), cable length approx. 15 cm)

Connection left: Voltage, signals (IO-Link port)
Connection right: External initiator

Fig. 35: Connection options

Connections:

Cable gland design: 1 x M16 x 1.5 cable gland / AF22 – for power supply and signals (only for transportation safety device sealed with dummy plug, remove it before use!), for cable diameter 5 ... 10 mm, for wire cross-sections 0.14 ... 1.5 mm^2

1 x M16 x 1.5 cable gland / AF19 - connection option for external initiator (sealed with dummy plug, remove it before use)

Multi-pole connection design:	1 x M16 x 1.5 cable gland / AF22 with M12 plug according to IEC 61076-2-101, 4-pole (Port Class A) or 5-pole (Port Class B) for power supply and signals (IO-Link), cable length approx. 15 cm
	1 x M16 x 1.5 cable gland / AF19 - connection option for external initiator (sealed with dummy plug, remove it before use)
Connection lines:	IO-Link devices and IO-Link masters are connected by unshielded 3 or 5-wire standard lines with a maximum length of 20 m and a cross-section of ≥ 0.34 mm²
IO-Link port (left cable gland):	IO-Link communication and power supply (Power 1 for Port Class A or Power 1 and 2 for Port Class B)
Service interface (büS) (on electronic module):	Micro-USB interface on the electronic module for software updates (see "Fig. 36" on page 86) – for connection to the büS stick

14.5.2 Electrical data of the control head

Protection class: 3 according to DIN EN 61140 (VDE 0140-1)

Connections: Circular plug-in connector M12 x 1, 4-pole, Port Class A or circular plug-in connector M12 x 1, 5-pole, Port Class B

Operating voltage: 18...30 V DC (according to specification)

Current consumption for Port Class A (supply of the system and actuators (solenoid valves) via Power 1) **and Port Class B** (system supply via Power 1, supply of actuators (solenoid valves) via Power 2) – see "Fig. 37" on page 87 and chapter "14.5.3 Design aid":

Max. current consumption: i.e. 2 solenoid valves active, 1 solenoid valve switches on (for 200 ms), 1 position feedback via LED display, no external initiator:

Port Class A (Power 1):	< 151 mA at 24 V DC
Port Class B (Power 1):	< 63 mA at 24 V DC
Port Class B (Power 2):	< 97 mA at 24 V DC

Current consumption in persistent state: i.e. 3 solenoid valves active, 1 position feedback via LED display, no external initiator:

Port Class A (Power 1):	< 138 mA at 24 V DC
Port Class B (Power 1):	< 63 mA at 24 V DC
Port Class B (Power 2):	< 84 mA at 24 V DC

Idle current: i.e. no solenoid valve active, no position feedback via LED display, no external initiator:

Port Class A (Power 1):	< 42 mA at 24 V DC
Port Class B (Power 1):	< 42 mA at 24 V DC
Port Class B (Power 2):	< 9 mA at 24 V DC

Input / proximity switch (external initiator: S4 in):

Power supply:	Via IO-Link power supply - 10%
Current carrying capacity of sensor supply:	Max. 30 mA
Short-circuit protection	

Design:	DC 2 and 3-wire, Normally open contact, PNP outlet
Input current 1 signal:	I_{Sensor} > 6.5 m A, limited internally to 10 mA
Input voltage 1 signal:	U_{Sensor} > 10 V
Input current 0 signal:	I_{Sensor} < 4 mA
Input voltage 0 signal:	U_{Sensor} < 5 V

Inputs (control head –> IO-Link master/PLC) / 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 “17 Position measuring system” on page 92. The analog target position signal (resolution: 0.1 mm) is available as a cyclic value/ parameter.

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

Typ. switching capacity:	0.9 W (per solenoid valve, for 200 ms after switching on)
Typ. continuous capacity:	0.6 W (per solenoid valve from 200 ms after switching on)
Power reduction:	Integrated via the IO-Link electronics
Typ. pull-in current:	38 mA or 0.9 W / 200 ms (per solenoid valve) Holding current:
25 mA or 0.6 W at 24 V DC (per solenoid valve)	
Operating mode:	Continuous operation (100% duty cycle)
Valve types:	6524

Central display of the switching states:

Current consumption from IO-Link at 24 V DC:	Approx. 21 mA with a power supply of 24 V DC for each illuminated display shown; for color switching – see chapter “18 Top LED color assignments” on page 100

14.5.3 Design aid

The values were determined for the design voltage of 24 V DC. The different power supply of the system and actuators (solenoid valves) for Port Class A and B (see “Fig. 37”) must be taken into consideration when designing the voltage sources.

Power / current consumption for Port Class A:

Power consumption of the electronics:							
P_{EI}	=	1.0 W	or	I_{EI}	=	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 (Port Class A):

Example 1:
3 valves are activated, 1 position is reported back (status for 200 ms): The control head 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 (currently switching)

P_{Total}	=	P_{EI}	+	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_{EI}	+	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 already been activated, 1 position is reported back (persistent state):

P_{Total}	=	P_{EI}	+	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_{EI}	+	3 x I_{Valve}	+	1 x I_{LED}	
138 mA	=	42 mA	+	3 x 25 mA	+	1 x 21 mA	

When using an external initiator, its power requirement should be added.

Power / current consumption for Port Class B:

Power 1: Electronics supply (1) + display LED
Power 2: Electronics supply (2) + actuators (solenoid valves in the control head)

Power 1:	**Power consumption of the electronics (1):**							
	$P_{El\ 1}$	=	1.0 W	or	$I_{El\ 1}$	=	42 mA	at 24 V
	Power consumption of an optical position feedback:							
	P_{LED}	=	0.5 W	or	I_{LED}	=	21 mA	at 24 V
Power 2:	**Power consumption of the electronics (2):**							
	$P_{El\ 2}$	=	0.22 W	or	$I_{El\ 2}$	=	9 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

Calculation examples (Port Class B):

Example 1:
3 valves are activated, 1 position is reported back (status for 200 ms): The control head switches automatically one valve after another to keep the current consumption low - i.e. for:

Power 1: Max. current consumption $I_{Power\ 1}$ = Current consumption of electronics (1) + display LED

Power 2: Max. current consumption $I_{Power\ 2}$ = Current consumption of electronics (2) + 2 valves (already activated) + 1 valve (currently switching)

$P_{Power\ 1}$	=	$P_{El\ 1}$	+	1 x P_{LED}	$P_{Power\ 2}$	=	$P_{El\ 2}$	+	2 x P_{Valve}	+	1 x $P_{Valve-ON}$
1.5 W	=	1.0 W	+	1 x 0.5 W	2.3 W	=	0.22 W	+	2 x 0.6 W	+	1 x 0.9 W
or											
$I_{Power\ 1}$ @ 24 V	=	$I_{El\ 1}$	+	1 x I_{LED}	$I_{Power\ 2}$ @ 24 V	=	$I_{El\ 2}$	+	2 x I_{Valve}	+	1 x $I_{Valve-ON}$
63 mA	=	42 mA	+	1 x 21 mA	97 mA	=	9 mA	+	2 x 25 mA	+	1 x 38 mA

Example 2:
3 valves have already been activated, 1 position is reported back (persistent state):

$P_{Power\ 1}$	=	$P_{El\ 1}$	+	1 x P_{LED}	$P_{Power\ 2}$	=	$P_{El\ 2}$	+	3 x P_{Valve}
1.5 W	=	1.0 W	+	1 x 0.5 W	2.02 W	=	0.22 W	+	3 x 0.6 W
or									
$I_{Power\ 1}$ @ 24 V	=	$I_{El\ 1}$	+	1 x I_{LED}	$I_{Power\ 2}$ @ 24 V	=	$I_{El\ 2}$	+	3 x I_{Valve}
63 mA	=	42 mA	+	1 x 21 mA	84 mA	=	9 mA	+	3 x 25 mA

When using an external initiator, its power requirement should be added.

14.5.4 Electrical installation - IO-Link

For the designs with cable glands:

→ Open the housing (see chapter “8 Opening and closing the housing” on page 38) so that the electronic module is visible – see “Fig. 36” below.

→ Connect the different wires of the cable (unshielded 3 or 5-wire standard lines) to the connection terminals on the left side as described in chapter “14.5.5”. The assignment conforms to the IO-Link specification.

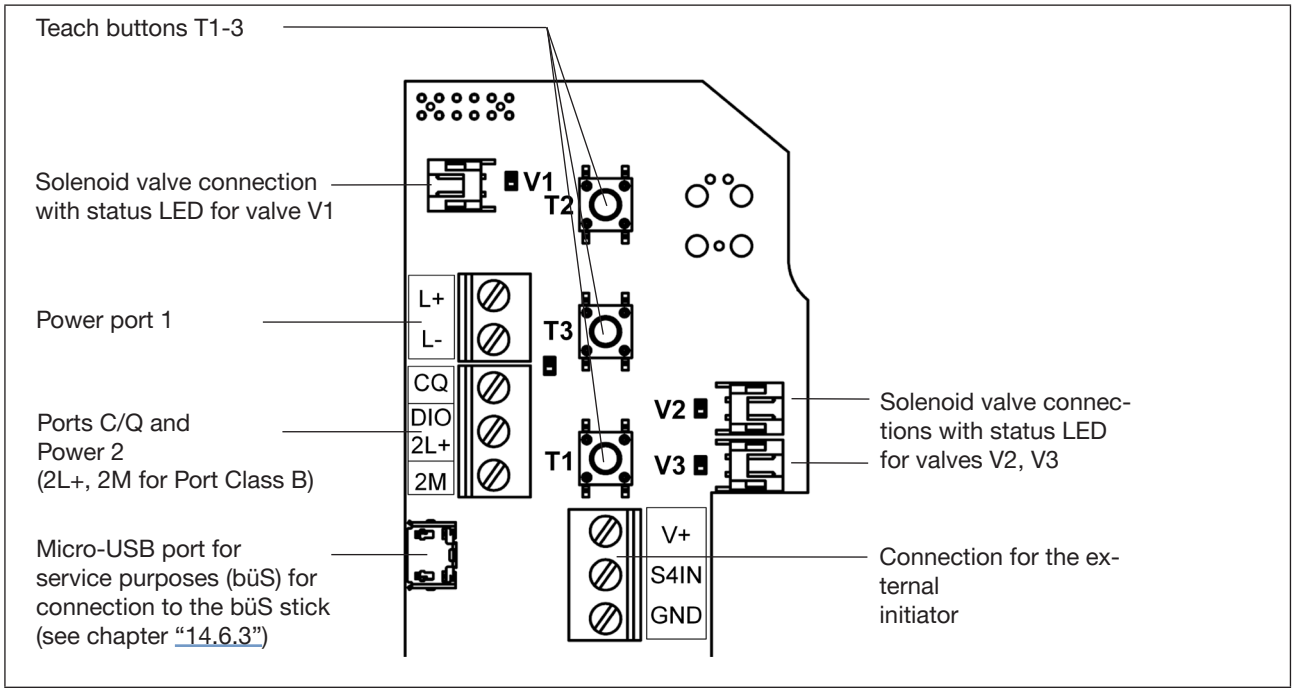


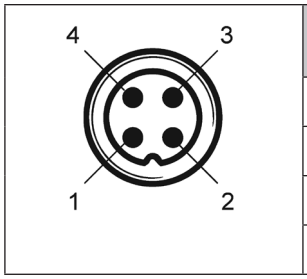
Fig. 36: Electronic module IO-Link (in the example: Port Class B)

For the multi-pole connection designs:

No internal cabling work is required for any of the IO-Link designs with multi-pole connection, which makes installation and start-up on site considerably easier and quicker, reducing the risk of leaks.

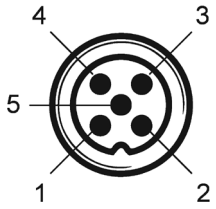
The control head features a multi-pole circular plug (M12 x 1, 4 or 5-pole), cable length approx. 15 cm. The assignment corresponds to the IO-Link specification, or see also the next chapters “14.5.5”.

14.5.5 Pin assignments (Port Class A or B)



Pin	Designation	Assignment (IO-Link mode)	Wire color
1	L+	24 V DC	Brown
2	DIO / 2L+	Not used	(white)
3	L-	0 V (GND)	Blue
4	C/Q	IO-Link	Black

Tab. 7: Pin assignment for connecting Port Class A (M12 plug, 4-pole)



Pin	Designation	Assignment (IO-Link mode)	Wire color
1	L+	24 V DC (Power 1)	Brown
2	DIO / 2L+	24 V DC (Power 2)	White
3	L-	0 V (GND – Power 1)	Blue
4	C/Q	IO-Link	Black
5	2M	0 V (GND – Power 2)	Grey or yellow / green

Tab. 8: Pin assignment for connecting Port Class B (M12 plug, 5-pole)

The diagram below illustrates the difference between Port Class A and B:

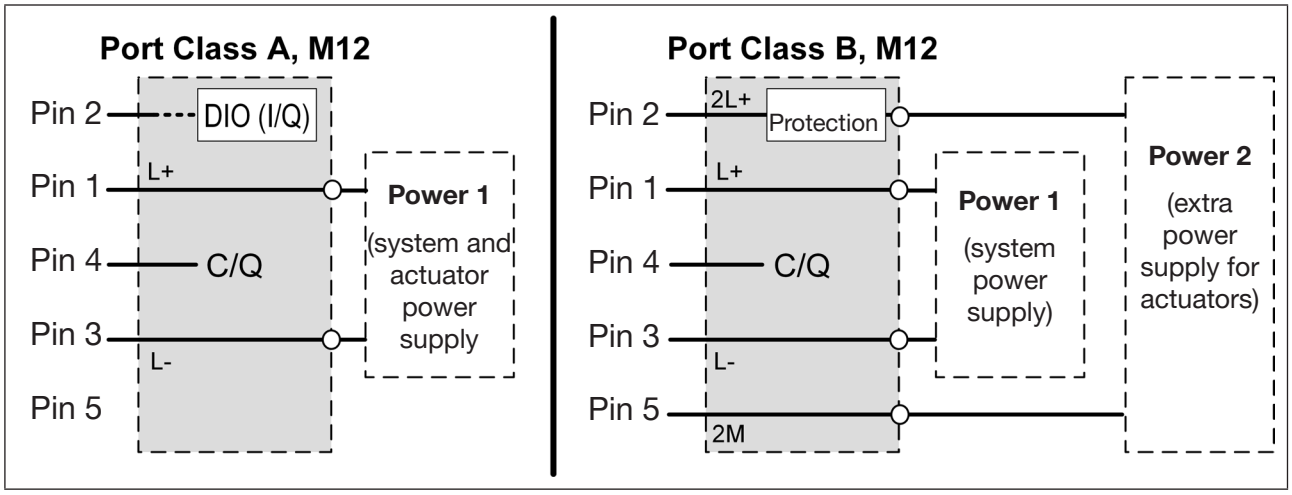


Fig. 37: Assignment principles for Port Class A and B

14.6 Software / firmware updates / accessories

14.6.1 Software download

The necessary **start-up files** for the IO-Link devices and the **description of the process data and acyclic parameters (index, subindex)** in the "Supplement to Operating Instructions" can be downloaded from the following website:

https://foodandbeverage.pentair.com/en/products/sudmo-valve-control-units

for Port Class A: Buerkert_Werke_GmbH-PentairSuedmo_IntelliTop2_0_ClassA-YYYYMMDD-IODD1.1.xml
for Port Class B: Buerkert_Werke_GmbH-PentairSuedmo_IntelliTop2_0_ClassB-YYYYMMDD-IODD1.1.xml

The corresponding icons and image files must also be downloaded.

The **"Bürkert Communicator"** to be used for service purposes and the corresponding software user manual can be downloaded from the Bürkert website under the search terms "Bürkert Communicator" or "Type 8920": www.burkert.com/en

14.6.2 Firmware updates

Firmware updates can only be made using the service interface (micro-USB port for service purposes (büS)) on the electronic module – see "Fig. 36". The **büS stick** (or the USB-büS-Interface set 2 – see "14.6.3") and the "Bürkert Communicator" are required for this - see "14.6.1".

For connecting the control head using the "Bürkert Communicator", see chapter "14.1 Network principle / interfaces" on page 79.

14.6.3 Accessories

Order no.	Necessary accessories for firmware updates and service purposes for IO-Link devices
on request	**USB-büS-Interface set 2** – contains: büS stick, programming cable M12 socket to mini-USB plug and 24 V DC socket, büS adapter M12 plug to micro-USB plug (for devices with service büS port

14.7 Safety position if the bus fails

A bus failure or bus error is indicated by the central multicolor Top LED. Bus errors can occur, for example, due to communication problems with the IO-Link master or PLC.

If the bus fails, the solenoid valves are switched to a programmable safety position – default: Solenoid valves de-energized.

Internal safety position

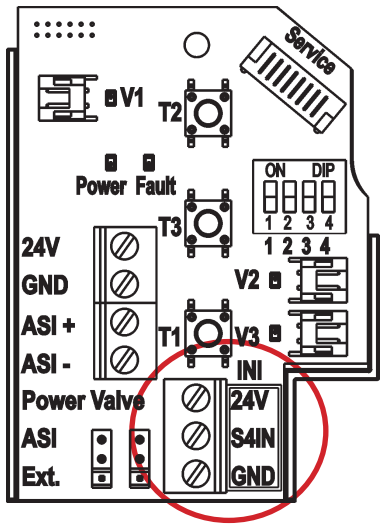
If internal faults are detected by the device, or if the power supply of the solenoid valves cannot be ensured, for example due to (massively) exceeding or falling short of the permitted power supply, the "internal safety position" of the solenoid valves is approached (i.e. all solenoid valves off) as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

15 CONNECTION OF AN EXTERNAL INITIATOR

DANGER!

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- Opening the hood or the housing in a potentially explosive atmosphere is only allowed in a not energized state!



An external initiator can be connected via the small 3-fold screw terminal - at bottom right on the respective electronic module (in the example: AS-i).

The control head is supplied with a dummy plug on the right connection which is intended for the external initiator.

To connect an external initiator, a cable gland (AF19, Ø 3 - 6 mm) with suitable clamping range is required.

Due to the size of the screw terminals, the wire cross-sections of the external initiator have the following values for the different designs:

0.14 ... 1.5 mm² for designs: 24 V, AS-i, DeviceNet, IO-Link;

0.5 ... 1.5 mm² for design: 120 V

Designation of the screw terminals on the different electronic modules:

Designation - according to design			Assignment
24 V DC, AS-i	DevNet, IO-Link	120 V AC	
24 V	V+	L	Power supply - according to design!
S4 IN	S4 IN	S4 IN	External initiator input
GND	GND	N	GND external initiator (24 V DC, AS-i, DevNet, IO-Link) or power supply (120 V AC design)

Electrical requirements of the external initiator for the different designs:

The electrical requirements of the external initiator can be found in the respective subchapters “Electrical data” under the headword “Input / proximity switch (external initiator: S4 in)”:

24 V design: see Page 44,
AS-i design: see Page 53,
DeviceNet design: see Page 62,
120 V design: see Page 73,
IO-Link design: see Page 82.

Connection procedure

→ Open the housing following the instructions in chapter “8 Opening and closing the housing”.

→ Assemble the connection cables according to the general rules of technology.

→ Insert cables through the cable gland (connection on right) into the interior of the housing.

→ Connect the wires to the connection terminals according to the pin assignment.

→ Close the housing following the instructions in chapter “8 Opening and closing the housing”.

NOTE!

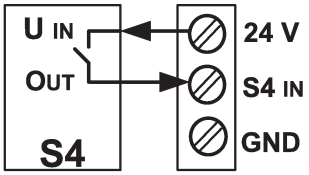
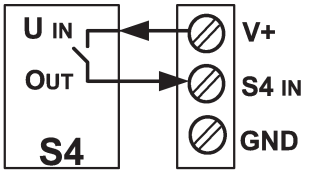
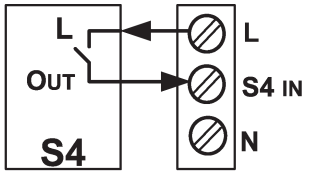
Ensure IP protection!

- To ensure IP protection, the union nuts of the cable glands must be tightened in accordance with the cable sizes or dummy plugs used (approx. 1.5 Nm).
- If no external initiator is used, the right connection opening must be sealed with a dummy plug!

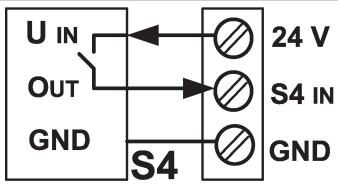
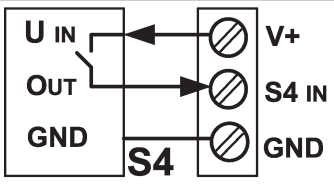
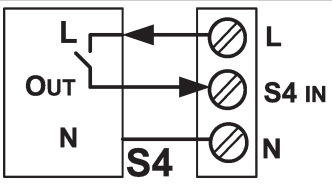
Use of the control head in a potentially explosive atmosphere

- Only use cables and cable glands which are approved for the respective application area and fit the cable glands according to the respective operating instructions!
- Close all unnecessary openings with lock screws / plugs approved for potentially explosive atmospheres!

Connection of a 2-wire initiator:

24 V DC, AS-i	DeviceNet, IO-Link	120 V AC
		

Connection of a 3-wire initiator:

24 V DC, AS-i	DeviceNet, IO-Link	120 V AC
		

16 DESIGN FOR DOUBLE-ACTING ACTUATORS

This control head has been configured for process valves actuated pneumatically (AA) on both sides. Of the two internal solenoid valves, one is designed for NC mode of operation and the other for NO mode of operation.

16.1 Specifics

This design can be configured for all electrical designs.

This control head differs from IntelliTop 2.0 (standard) in the following points:

- Solenoid valve 1: NC / Normally Closed;
  Solenoid valve 2: NO / Normally Open (as a result safety position)
- The flow rate from P to A2 may be restricted to 50 l/min only, otherwise a reliable switchover (from A2 to R) cannot be guaranteed!
- Only automatic teach function (Autotune function) 1 and 2 possible
- The setting “All valves can be actuated (simultaneously)” has no function.

16.2 Fluid diagram

See “Fig. 4: Fluid diagram (design for double-acting actuators: 2 solenoid valves, NC* + NO**)” on page 18.

16.3 Electrical connection (24-V / 120-V design)

To open or close the process valve, both solenoid valves V1 and V2 are switched simultaneously by the software. When a signal is applied to Y1, valves V1 and V2 are actuated simultaneously by software for the “24 V” and “120 V” designs.

Input valve control Y1	Solenoid valves
Y1 ON	V1 and V2 ON
Y1 OFF	V1 and V2 OFF

16.4 Programming data (AS-i design)

To open or close the process valve, both solenoid valves V1 and V2 are switched simultaneously by the software. In the case of the “AS-i” design, the solenoid valves V1 and V2 are switched ON simultaneously when data bit D0 = 1 and both solenoid valves are switched OFF when D0 = 0.

Data bit D0	Solenoid valves
D0 ON	V1 and V2 ON
D0 OFF	V1 and V2 OFF

See also chapter “11.9 Programming data” on page 59 for the standard designs, “Bit assignment” table.

17 POSITION MEASURING SYSTEM

Operating principle of the position measuring system

The position measurement is based on recording the change in position of the ferromagnetic target inside the system. The geometry and the material of the target to be used are synchronized with the sensitivity of the system.

The measurement precision is determined by the ferromagnetic properties of the target and all other parts in the system. While the target must be ferromagnetic, the other components are ideally made of materials that do not have ferromagnetic properties - see chapter “6.7 Position measuring system data” on page 29.

The switching positions of the process valves are reported back to the controller by feedback signals from the non-contact position measuring system. Connection to the control head is done by means of a simple adaptation to the process valve piston.

Stroke range / feedback / teach functions

The recordable **stroke range** is between 0 ... 85 mm.

The valve positions / positions S1 to S3 are reported back within a certain tolerance range, this feedback field can be adapted - see chapter “6.8.1 Feedback fields (position measuring system)” on page 30.

3 discrete feedback signals are evaluated:

- Valve position / position 1 (discrete signal S1OUT)
- Valve position / position 2 (discrete signal S2OUT)
- Valve position / position 3 (discrete signal S3OUT)

A discrete, external feedback signal (standard proximity switch / external initiator) can also be processed: S4IN, S4OUT.

3 teach buttons T1 to T3 have been provided for comparison with the actual stroke range.

If a potentially explosive atmosphere is present, the housing must not be opened when voltage is present!

These teach buttons or the PC software can be used to determine the switching positions for the position measuring system by **manual or automatic teach functions** – see next chapter.

To use the PC software (for the 24 V DC, AS-i, DeviceNet, 120 V AC designs), the control head is connected to the PC via the service interface on the respective electronic modules.
With the IO-Link design, the “Bürkert Communicator” can be used for this purpose in addition to acyclic data access via IO-Link - see chapter “14.4” on page 81. In addition to the program, special accessories are also required (see chapter”14.6.3”).

For a detailed description of the individual control head designs – see
chapter “10 24 V DC - design” or
chapter “11 AS-Interface design” or
chapter “12 DeviceNet design” or
chapter “13 120 V AC design” or
chapter “14 IO-Link design”.

17.1 Teach buttons / teach button functions

The **Teach buttons** enable:

- The **setting of the position measuring system:** manual (“17.1.2”) or automatic Autotune) (“17.1.3” + “17.1.4”)
- **Teach Reset** (“17.1.1”)
- **IPF (Intelli Pulse Flush)** (“17.1.5”)
- **Device Reset** (“6.9”)
- **Feedback Field Mode** (FFM) (“17.2”)

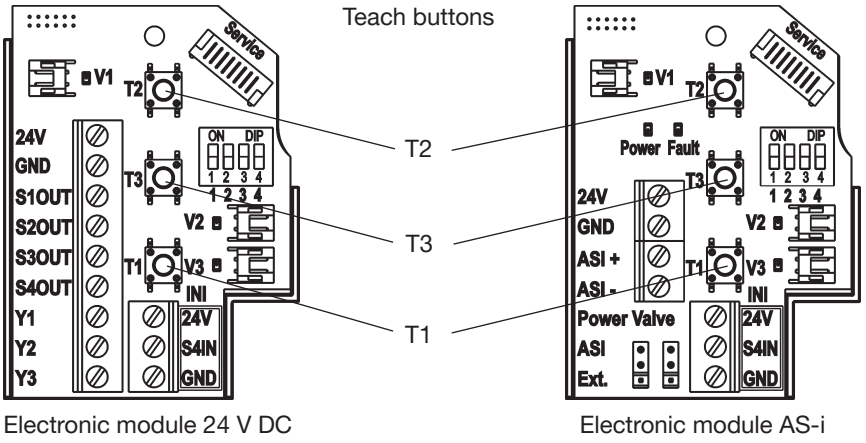


Fig. 38: Teach buttons on the electronic modules (in the example of the electronic modules for 24 V DC and AS-i)

17.1.1 Teach functions - manual and automatic (Autotune) and Teach Reset

The teach buttons can be used to teach the individual positions S1 to S3 (described in detail in chapter “17.1.2”) and to reset (Teach Reset) all valve positions:

Manual teach procedure:

Brief description in the table below - described in detail in the next section (“17.1.2”):

Teach button	Activation duration	Function	Optical feedback
T1	1.5 s	Teach function S1	S1 flashes quickly three times, then continuously in the encoded color for S1
T2	1.5 s	Teach function S2	S2 flashes quickly three times, then continuously in the encoded color for S2
T3	1.5 s	Teach function S3	S3 flashes quickly three times, then slowly in the encoded color für S3
T1 + T2	2.5 s	Teach Reset of all positions S1/S2/S3	Flashes in the error color (see chapter “18.2 Flashing pattern / fault signalling”)

The **color coding / color assignment** for the individual valve positions (S1 to S3) are described in chapter “18.1 Setting the color combinations”. The valve positions as well as various faults and warnings are distinguished by various “flashing patterns” – see chapter “18.2 Flashing pattern / fault signalling”.

Automatic teach procedure:

Furthermore, the teach procedure can also be automated; the **automatic teach functions (Autotune)** programmed for this purpose are described in detail in chapters “17.1.3” and “17.1.4”.

The 6 different teach functions (Autotune) are pre-programmed for various process valve types (e.g. single-acting or double-acting actuators, double seat valves, etc.) and for various starting positions of the process valves (open, closed) – the teach function (Autotune) to be used must be selected according to the process valve type and application.

17.1.2 Setting the position measuring system (manual teach procedure)

DANGER!

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- Opening the hood or the housing in a potentially explosive atmosphere is only allowed in a not energized state!

Example procedure (for 3 valve positions):

→ Open the housing following the instructions in chapter “8 Opening and closing the housing”.

→ Supply electrical power so that the position measuring system and the Top LED display can function.

→ Position the process valve at the lower switching position.

→ Depress the lower teach button (T1) for approx. 1.5 seconds:
The Top LED (color) corresponding to this position will flash quickly 3 times during the teach procedure. When this position has been saved, the corresponding Top LED will remain continuously lit until the position of the target is changed.

→ Afterwards, position the process valve at the upper switching position to be recorded.

→ Depress the upper teach button (T2) for approx. 1.5 seconds:
The Top LED (color) corresponding to this position will flash quickly 3 times during the teach procedure. When this position has been saved, the corresponding Top LED will remain continuously lit until the position of the target is changed.

→ The process valve can now be moved into a third, defined position.

→ Depress the middle teach button (T3) for approx. 1.5 seconds:
The Top LED (color) corresponding to this position will flash quickly 3 times during the teach procedure. When this position has been saved, the corresponding Top LED will remain continuously lit until the position of the target is changed.

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

→ Close the housing following the instructions in chapter “8 Opening and closing the housing”.

- If the piston rod or the target is outside the measuring area during teaching, the Top LED will flash in the defined error color.
- If the piston rod or target is outside the measuring area, no position signals will be reported back, i.e. the Top LED will not be lit.
- The teach buttons can be assigned to any of the positions of the piston rod or target, i.e. T1 does not have to correspond to the lower piston position, etc.

17.1.3 Automatic teach functions (Autotune)

The automatic teach procedure of the valve positions S1 to S3 can be implemented using the pre-set automatic teach functions (Autotune). A detailed description is given in chapter “17.1.4”.

The optical feedback of the classic designs (24 V DC, AS-i, DeviceNet, 120 V AC) via the Top LED differs slightly from the feedback of the newer IO-Link designs. This is due to the modified structure of the Top LED, which has been optimized for the display according to “NAMUR” (NE 107, edition 2006-06-12).

While the Top LEDs of the classic designs have 3 LEDs that can display 3 colors (green, yellow, red) simultaneously, the Top LED of the IO-Link designs has only 2 LEDs, but these can, however, change their color spectrum (regarding “NAMUR” requirements).

Procedure:

Change to Autotune mode (mode to start the automatic teach functions):

Teach buttons	Mode	Activation duration	Optical feedback (classic designs)	Optical feedback (IO-Link)
T2 + T3	Autotune mode	2.5 s	green + yellow + red all LEDs permanently ON	red + yellow + green flashing in succession (500 ms per color)

Then one of the 6 Autotune functions can be selected according to the following table :

Teach buttons	Function	Activation duration	Optical feedback (classic designs)	Optical feedback (IO-Link)
T1	Autotune 1	each 0.5 s	green + yellow + red “running light” (i.e. alternating display)	red + yellow + green flashing in succession (200 ms per color)
T2	Autotune 2			
T3	Autotune 3			
T1 + T2	Autotune 4			
T1 + T3	Autotune 5			
T2 + T3	Autotune 6			

The following also applies to IO-Link devices:

Following the Autotune procedure, a reference run is carried out during which the teach positions taught in the respective automatic teach function (Autotune) are approached again one after the other. The travel times are determined and stored as reference values in the teach function.

Irregularities with the automatic teach functions (Autotune)?

If no automatic teach function has been started 10 s after switching to Autotune mode, the Autotune mode is exited automatically.

If a teach function (Autotune) does not run properly or is aborted (if e.g. no compressed air is connected), the positions already taught are deleted again, the teach function is exited and it is switched to normal operation.
The teach positions are set to “not taught”, i.e. the Top LED flashes in the error color.

In the case of the design for double-acting actuators (solenoid valves NC+NO), only automatic teach functions (Autotune) 1 and 2 are possible (see chapter “16.1” on page 91).

17.1.4 Sequence of the automatic teach functions (Autotune)

Autotune 1:
Single seat valves NC,
butterfly valves NC,
double seat valves without seat lift function

Control	Effect on the process valve	Internal program		Fault
T2 + T3	**Autotune mode starts**			
T1	Autotune 1 starts			
	Closed position	Teach	T1	
	Open valve	Activate	V1	
		Wait period	10s	
	Open position	Teach	T2	
	Close valve	Deactivate	V1	
	Valve closes	Wait on position S1	S1	Timeout 15s
Autotune mode completed				

Autotune 2:
Single seat valves NO,
butterfly valves NO

Control	Effect on the process valve	Internal program		Fault
T2 + T3	**Autotune mode starts**			
T2	Autotune 2 starts			
	Open position	Teach	T2	
	Close valve	Activate	V1	
		Wait period	10s	
	Closed position	Teach	T1	
	Open valve	Deactivate	V1	
	Valve opens	Wait on position S2	S2	Timeout 15s
Autotune mode completed				

Autotune 3:
Double seat valves with seat lift function

Control	Effect on the process valve	Internal program		Fault
T2 + T3	**Autotune mode starts**			
T3	Autotune 3 starts			
	Closed position	Teach	T1	
	Open valve	Activate	V1	
		Wait period	10s	
	Open position	Teach	T2	
	Close valve	Deactivate	V1	
	Valve closes	Wait on position S1	S1	Timeout 15s
	Pulse, open valve plate	Activate	V2	
		Wait period	10s	
	Pulse, valve plate	Teach	T3	
	Close valve	Deactivate	V2	
	Valve closes	Wait on position S1	S1	Timeout 15s
Autotune mode completed				

Autotune 4:
Single seat valves AA,
butterfly valves AA

Control	Effect on the process valve	Internal program		Fault
T2 + T3	**Autotune mode starts**			
T1 + T2	Autotune 4 starts			
	Close valve	Activate	V2	
		Wait period	10s	
	Closed position	Teach	T1	
	Open valve	Deactivate	V2	
		Activate	V1	
		Wait period	10s	
	Open position	Teach	T2	
	Close valve	Deactivate	V1	
		Activate	V2	
	Valve closes	Wait on position S1	S1	Timeout 15s
	Neutral position	Deactivate	V2	
Autotune mode completed				

Autotune 5:
Single seat valves NC with 3-position actuator,
butterfly valves NC with 3-position actuator

Control	Effect on the process valve	Internal program		Fault
T2 + T3	**Autotune mode starts**			
T1 + T3	Autotune 5 starts			
	Closed position	Teach	T1	
	Open valve	Activate	V1	
		Wait period	10s	
	Open position	Teach	T2	
	Close valve	Deactivate	V1	
	Valve closes	Wait on position S1	S1	Timeout 15s
	Open intermediate position	Activate	V2	
		Wait period	10s	
	Intermediate position	Teach	T3	
	Close valve	Deactivate	V2	
	Valve closes	Wait on position S1	S1	Timeout 15s
Autotune mode completed				

Autotune 6:
PMO double seat valves with seat lift function

Autotune 6 is identical to Autotune 3, but with feedback fields for S1 changed in comparison to the factory settings (see chapter “6.8” on page 30): ± 1.0 mm.

The feedback fields are already switched during the Autotune process. However, if the Autotune 6 process is aborted (e.g. power failure) or is not successful, the feedback fields set previously are accepted again.

After a successful Autotune 6, the **(magnetic) manual override function is deactivated.**

These settings made by Autotune 6 can be changed if required as follows:

- The magnetic manual override function can only be re-activated **using the PC software or via DeviceNet or via IO-Link.**
- The feedback fields changed by Autotune function 6 can be changed to the original or another value **using the PC software or DeviceNet or IO-Link or using Feedback Field Mode** (see chapter “17.2” on page 99).
- A **Device Reset** will also reset all settings made by Autotune function 6 (see chapter”6.9 Resetting the device (Device Reset)” on page 32).

Control	Effect on the process valve	Internal program		Fault
T2 + T3	**Autotune mode starts**			
T2+T3	Autotune 6 starts			
	Closed position	Teach	T1	
	Open valve	Activate	V1	
		Wait period	10s	
	Open position	Teach	T2	
	Close valve	Deactivate	V1	
	Valve closes	Wait on position S1	S1	Timeout 15s
	Pulse, open valve plate	Activate	V2	
		Wait period	10s	
	Pulse, valve plate	Teach	T3	
	Close valve	Deactivate	V2	
	Valve closes	Wait on position S1	S1	Timeout 15s
Autotune mode completed		- Feedback fields for **S1: ± 1.0 mm;** - Feedback fields for **S2 und S3:** Resetting S2 and S3 to **factory settings (S2: ± 3.0 mm; S3: ± 1.0 mm** - see FFM3 in chapter “17.2”) - Magnetic manual override: **deactivated**		

In the event that a **timeout** occurs, the corresponding Autotune function will be exited and it is switched to normal operation.
Furthermore, the teach positions are set to “not taught”, i.e. they flash in the error color.

17.1.5 Device Reset and Intelli Pulse Flush (IPF)

These two functions are achieved by accessing the “Device Function” mode.

Teach button	Function	Activation duration	Optical feedback
T1+T2+T3 (simultaneously, > 2.5 s)	Access to **”Device Function”** mode	>2.5 s	500 ms red , 500 ms green (alternating)
Then further selection possible:			
T1+T2+T3 (simultaneously, > 2.5 s)	**Device Reset**	>2.5 s	250 ms ON , 250 ms OFF (alternating, in error color), **details** in chapter “6.9” on page 32
T2 or T3 or T2+T3 (simultaneously) for > 2.5 s	**Intelli Pulse Flush function** (from firmware C.08.00) – **details** in chapter “5.4.1” on page 19 While the cleaning process is running, this is indicated by the Top LED: IPF V2 as feedback from S3, IPF V3 as feedback from S4.		

17.2 Changing the feedback field - Feedback Field Mode (FFM)

The size of the feedback fields for sensor positions S1 to S3 can be changed - either using the PC software or using the “Feedback Field Mode”.

Procedure:

→ Open the housing following the instructions in chapter “8 Opening and closing the housing”.

→ Supply electrical power so that the position measuring system and the Top LED display can function.

→ Press down the teach buttons T1 and T3 simultaneously for approx. 2.5 s:
Flashing pattern for optical confirmation of this mode (Top LED): see following table
(more flashing patterns in chapter “18.2 Flashing pattern / fault signalling”)

Teach button	Activation duration	Mode	Optical feedback (with classic designs)	Optical feedback (with IO-Link design)
T1 + T3	2.5 s	Feedback Field Mode	500 ms red + yellow + green, 500 ms OFF	successively: 500 ms red / 500 ms yellow / 500 ms green / 1 s OFF

→ To select certain settings for the feedback fields, press one of the teach buttons for 3 s according to the table below:
The successful change of the feedback field for the three sensor positions is displayed by the following flashing pattern: See table below

FFM no.	Teach button (> 3 s)	Optical feedback via the Top LED	Feedback field S1 [mm]	Feedback field S2 [mm]	Feedback field S3 [mm]
FFM 1	T1	3 s **red** / 3 ms OFF	+/- 1.00	+/- 3.00	+/- 0.50
FFM 2	T2	3 s **green**/ 3 ms OFF	+/- 5.00	+/- 3.00	+/- 1.00
FFM 3 *)	T3 *)	3 s **yellow** / 3 ms OFF	+/- 3.00	+/- 3.00	+/- 1.00
FFM 4	T1 + T2	**Classic designs:** 3 s **red + green** / 3 s OFF	+ 3.00 / -12.00	+/- 3.00	+/- 1.00
		IO-Link design: 1.5 s **green** / 1.5 s **rot** / 3 s OFF			

→ The new feedback field is now active and the device will automatically switch back to normal operation.

If no button is pressed within 10 s after activation of the “Feedback Field Mode”, the device will automatically exit this mode and switch back to normal operation.

With the commands DeviceReset and FactoryReset, the feedback fields are reset to the factory settings (see FFM 3).

*) *FFM 3 or T3 corresponds to the factory setting or the delivery status*

18 TOP LED COLOR ASSIGNMENTS

The switching states of the feedback positions are signalled centrally to the outside by super-bright LEDs of the control head's Top LED so that quick visual control is possible also for large systems.

Colors and flashing patterns have been assigned to the signals of the process valve positions and device statuses – see next chapters „18.3 Signalprioritäten“ and . When several signals are overlapped, a priority list applies (“18.3 Signal priorities”).

In order to be able to react to various process valve designs or customer signalling philosophies in the systems, the **color assignments** can be changed on site **using the DIP switches for color coding** – except for the IO-Link design, which does not have DIP switches (see note below “Fig. 39”).

(Factory setting DIP 1 - 4: 0000 (i.e. DIP 1 to 4 in position 0 = OFF)

When using the control head in a potentially explosive atmosphere, the housing may only be opened in a not energized state!

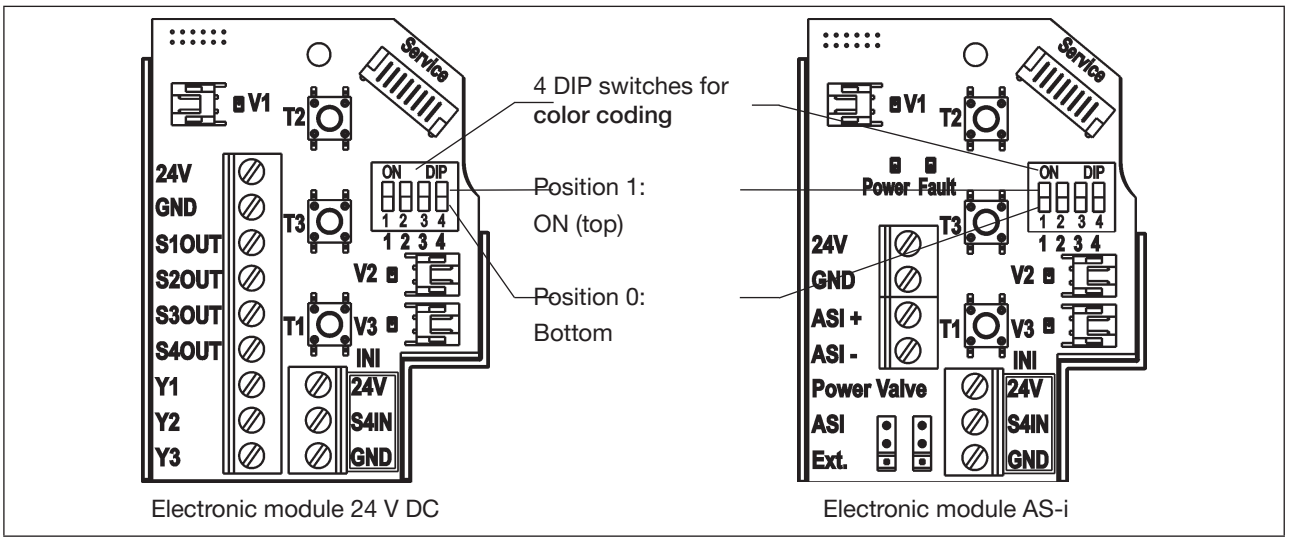


Fig. 39: DIP switches for setting the color coding (in the example of the electronic modules 24 V DC and AS-i)

The following applies to IO-Link devices:

The color coding can only be changed by configuring / parameterising the devices, as there are no DIP switches – this is done via the “Top LED Mode” (index 0x2C11) – for details, refer to the description of process data and acyclic parameters – see chapter “14.6 Software / firmware updates / accessories” on page 88.

General notes on S4 (using an external initiator):

S4IN reacts like a “normally open contact” (NO) or a “normally closed contact” (NC) – the **factory setting is: Normally open contact (NO).**

External initiator S4/S4IN as:	Position feedback “0”	Position feedback “1”
“Normally open contact”	“S4 active”	“S4 not active”
“Normally closed contact”	“S4 not active”	“S4 active”

Tab. 9: Position feedback of the external initiator (S4/S4IN) depends on the mode of operating

18.1 Setting the color combinations

18.1.1 Setting of possible color combinations

The color combinations will be set via the four color DIP switches (see "Fig. 39") according to the following scheme; with IO-Link devices, the Top LED display is selected via the "Top LED Mode" (index 0x2C11, see "14.6"):

S1	S2	S3	S4 *)	Fault	DIP1	DIP2	DIP3	DIP4	Designation of the Top LED Mode
Green	Yellow	Green		Red	0	0	0	0	0 (DIP color 0000)
Yellow	Green	Yellow		Red	1	0	0	0	1 (DIP color 1000)
Green	Red	Green		Yellow	0	1	0	0	2 (DIP color 0100)
Red	Green	Red		Yellow	1	1	0	0	3 (DIP color 1100)
Green	Yellow	Yellow		Red	0	0	1	0	4 (DIP color 0010)
Yellow	Green	Green		Red	1	0	1	0	5 (DIP color 1010)
Green	Red	Red		Yellow	0	1	1	0	6 (DIP color 0110)
Red	Green	Green		Yellow	1	1	1	0	7 (DIP color 1110)
Green	Yellow	Green	Green	Red	0	0	0	1	8 (DIP color 0001)
Yellow	Green	Yellow	Yellow	Red	1	0	0	1	9 (DIP color 1001)
Green	Red	Green	Green	Yellow	0	1	0	1	10 (DIP color 0101)
Red	Green	Red	Red	Yellow	1	1	0	1	11 (DIP color 1101)
Green	Yellow	Yellow	Yellow	Red	0	0	1	1	12 (DIP color 0011)
Yellow	Green	Green	Green	Red	1	0	1	1	13 (DIP color 1011)
Green	Red	Red	Red	Yellow	0	1	1	1	14 (DIP color 0111)
Red	Green	Green	Green	Yellow	1	1	1	1	15 (DIP color 1111)

*) *Color of S4 as S3 if the "Cycle stroke color S3/S4 different" function is not active*

S4IN is always a normally open contact - details are described in "Tab. 9" on page 100.
Factory setting for color combinations: DIP 1 - 4: **0000** (i.e. DIP 1 to 4 in position 0 = OFF)

18.1.2 Color combinations with active "Cycle stroke color S3/S4 different" function

When the function is active, position S4 flashes in another color as position S3, but with the same flashing pattern (250 ms ON, 250 ms OFF): - see table below). The "Cycle stroke color S3/S4 different" function can only be (de)activated via PC software - with IO-Link devices, this is done via the acyclic parameters (index 0x2C04sub0x14) – see chapter "14.6 Software / firmware updates / accessories" on page 88.

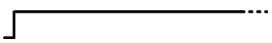
S1	S2	S3	S4	Fault	DIP1	DIP2	DIP3	DIP4
Green	Yellow	Green	Yellow	Red	0	0	0	1
Yellow	Green	Yellow	Green	Red	1	0	0	1
Green	Red	Green	Red	Yellow	0	1	0	1
Red	Green	Red	Green	Yellow	1	1	0	1
Green	Yellow	Yellow	Green	Red	0	0	1	1
Yellow	Green	Green	Yellow	Red	1	0	1	1
Green	Red	Red	Green	Yellow	0	1	1	1
Red	Green	Green	Red	Yellow	1	1	1	1

18.2 Flashing pattern / fault signalling

The central optical display (Top LED) displays the position feedback (positions) S1, S2, S3 of the process valve, the feedback S4IN from the external initiator as well as fault and warning messages, partly using special “flashing patterns”.

The **“Intelli Pulse Flush” (IPF) function** is assigned **special flashing patterns and color combinations,** these are described in chapter “5.4.1” on page 19.

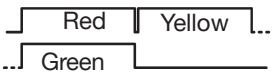
18.2.1 Position feedback in normal operation

No.	Flashing pattern	ON	OFF	Comment
1		ON		**Continuously lit** in the respective position color: **Signal from S1 and S2** (factory setting)
2		250 ms	250 ms	**Continuously flashing** in the respective position color: **Signal from position S3** (factory setting)
3		125 ms	125 ms	**Continuously flashing** in the respective position color: **Signal from external initiator S4** (factory setting)

Tab. 10: Pfeedback in normal operation

18.2.2 Display of device status / faults / warnings

No.	**Flashing pattern/color** (for reasons of space, the “color of the valve position” is called **position color**)	ON	OFF	Comments	Classic *)	IO-Link *)
1	 in position color	100 ms	100 ms	**3 x flashing:** Teach confirmation	x	x
2	 in error color	100 ms	100 ms	**3 x flashing:** - 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 override is used, even though manual override function has been disabled by software	x	x
3	 in position color	125 ms	125 ms	**Continuous flashing:** Signal from external initiator S4 (factory settings – see line 3 in “Tab. 10”)	x	x

No.	**Flashing pattern/color** (for reasons of space, the "color of the valve position" is called **position color**)	ON	OFF	Comments	Classic *)	IO-Link *)
4	 in position color	250 ms	250 ms	**Continuous flashing:** Signal from position S3 (factory setting – see line 2 in "Tab. 10")	x	x
5	 in error color	250 ms	250 ms	**Continuous flashing:** - Teaching does not occur or - Automatic teach function (Autotune) fault or - Teach Reset implemented or - Bus error or - Device Reset implemented or - Position measuring system signal fault (only with IO-Link design)	x	x
6	 in error color	50 ms	450 ms	**Continuous flashing:** Device in service mode / manual override active	x	x
7	 in error color	450 ms	50 ms	**Continuous flashing:** Internal fault	x	x
8	 Simultaneously in red, yellow, green	500 ms	500 ms	**Flashing** (until timeout or FFM selection): Feedback Field Mode active (for classic designs)	x	
9		500 ms	1 **sec.**	**Flashing** (until timeout or FFM selection): Feedback Field Mode active (for IO-Link design)		x
10	 in **error color** or in blue (IO-Link) (position feedback during OFF phase)	1 **sec.**	3 **sec.**	**Continuous flashing:** Service / maintenance notification (maintenance / service required) (in **error color** for designs (24 V, AS-i, DeviceNet, 120 V), in **blue** for IO-Link design) (Position feedback occurs during OFF phase)	x	x
11	 In assigned color	3 **sec.**	3 **sec.**	**Lit:** Feedback Field Mode - change of the feedback fields "FFM 1...4" completed successfully (T1 – red, T2 – green, T3 – yellow)	x	x
				(T1+T2 – red+green)	x	
12		1.5 **sec.** +1.5 **sec.**	3 **sec.**	**Flashing:** Feedback Field Mode - change of the feedback field "FFM 4" completed successfully (T1+T2 – 1.5 s green + 1.5 s red + 3 s OFF)		x

No.	Flashing pattern/color (for reasons of space, the "color of the valve position" is called **position color**)	ON	OFF	Comments	Classic *)	IO-Link *)
13	 alternately red / green (500 ms per color)			**Continuous flashing:** Device Function Mode active (for Device Reset press again within 10 s)	x	x
14	 alternately red / yellow / green (500 ms per color)			**Continuous flashing:** Autotune mode active (see "17.1.3") (for starting an Autotune function, press appropriate buttons within 10 s)		x
15	 alternately red / yellow / green (200 ms per color)			**Continuous flashing:** Automatic teach function active (Autotune function active) – see also "17.1.3"	(x)	x

Tab. 11: Display of device status / faults / warnings

***)** *These abbreviations mean:*
Classic - Classic display of the "Top LED Mode" of the Top LED for the designs 24 V DC, AS-i, DeviceNet, 120 V AC
*IO-Link - Display of the "Top LED Mode" of the Top LED for the IO-Link design - see also note **) in "18.1.1"*
Due to the different structure of the Top LED described below:

The optical feedback of the classic designs (24 V DC, AS-i, DeviceNet, 120 V AC) via the Top LED differs from the feedback of the newer IO-Link designs. This is due to the modified structure of the Top LED, which has been optimized for the display according to "NAMUR" (NE 107, edition 2006-06-12).

While the Top LEDs of the classic designs have 3 LEDs that can display 3 colors (green, yellow, red) simultaneously, the Top LED of the IO-Link designs has only 2 LEDs, but these can, however, change their color spectrum (regarding "NAMUR" requirements).

The **"Intelli Pulse Flush" (IPF) function** is assigned **special flashing patterns and color combinations**, these are described in chapter "5.4.1" on page 19.

18.2.3 Localisation function (only IO-Link devices)

This function can be used to locate a device in the system via the controller or via the “Bürkert Communicator”. However, the localisation function must be activated – see details in the description of the process data and acyclic parameters (index 0x2101) – see chapter “14.6 Software / firmware updates / accessories” on page 88.

The Top LED then starts to “flash” according to signal priority (see chapter “18.3 Signal priorities”) according to the following logic – see “Tab. 12”:

No.	Flashing pattern	Comments
1	 every second: 1 x 25 ms ON	**Single flashing:** **in color from S1 or S2:** S1 or S2 active **in white:** no (taught) position active
2	 every second: 2 x 25 ms ON	**Double flashing:** in color from S3: S3 active
3	 every second: 3 x 25 ms ON	**Triple flashing:** in color from S4: S4 active

Tab. 12: Flashing pattern for localisation function (only for IO-Link devices)

18.3 Signal priorities

18.3.1 When several statuses overlap for one valve

Different priorities apply to the different designs:

Priority for 24 V DC, AS-i, DeviceNet, 120 V AC	Priority for IO-Link	Signal
1.		**Internal fault** (error color: 450 ms ON, 50 ms OFF)
2.		**Manual operating mode** is active, e.g. by magnetic manual override - see chapter "19 Service mode / manual override" (error color: 50 ms ON, 450 ms OFF)
3.	4.	**Service / maintenance notification** or request (error color or for IO-Link devices in blue: 1 **s** ON, 3 **s** OFF
4.	3.	**Other faults**, e.g. position measuring system not taught, position measuring system signal fault (only for IO-Link design), bus error or other (see chapter "18.2 Flashing pattern / fault signalling")

18.3.2 When position feedback overlaps

The priorities as described in the following example tables apply.

Only the fields / colors highlighted in grey in the 3 examples below are reported back by the Top LED display, regardless of whether a signal is present (1) or no signal is present (0).

This means, **only the optical display** (Top LEDs) for the positions (S1 ... 4) is subject to the priority control, whereas the **electrical signals** are applied to the outlet (may also be several outlets simultaneously) according to the position of the process valve.

Example 1: Setting of the DIP switches (color combination): 0 0 0 0

S1	S2	S3	S4	Fault
Green	Yellow	**flashing green** (250 ms / 250 ms)	-	Red

S1	S2	S3	S4	Fault
0	0	0	-	
1	0	0	-	
0	1	0	-	
0	0	1	-	
1	0	1	-	
0	1	1	-	
1	1	0	-	
1	1	1	-	

Example 2: Setting of the DIP switches (color combination): 0 0 0 1

(The external initiator S4 monitors whether the upper valve plate has been closed,
the valve is only considered safely closed if S1 and S4 = 1; the “Cycle stroke color S3/S4 different” function is not active)

S1	S2	S3	S4	Fault
Green	Yellow	**flashing green** (250 ms / 250 ms)	**flashing green** (125 ms / 125 ms)	Red

S1	S2	S3	S4	Fault
0	0	0	1	
1	0	0	1	
0	1	0	1	
0	0	1	1	
0	0	0	0	
1	0	0	0	
1	0	1	1	
0	1	0	0	
0	1	1	0	
0	1	1	1	
1	1	0	1	
1	1	0	0	
1	0	1	0	
0	0	1	0	
1	1	1	1	
1	1	1	0	

Example 3: Setting of the DIP switches (color combination): 0 0 0 1
(Logic S4 -> Changeover via the Service interface required)

(The external initiator S4 monitors whether the upper valve plate has been closed, the “Cycle stroke color S3/S4 different” function is not active)

S1	S2	S3	S4	Fault
Green	Yellow	**flashing green** (250 ms / 250 ms)	**flashing green** (125 ms / 125 ms)	Red

S1	S2	S3	S4	Fault
0	0	0	0	
1	0	0	0	
0	1	0	0	
0	0	1	0	
0	0	0	1	
1	0	0	1	
1	0	1	0	
0	1	0	1	
0	1	1	1	
0	1	1	0	
1	1	0	0	
1	1	0	1	
1	0	1	1	
0	0	1	1	
1	1	1	0	
1	1	1	1	

19 SERVICE MODE / MANUAL OVERRIDE

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

- A **magnetic manual override** for solenoid valve V1 (2/A1) *) and
- A **mechanical manual override** accessible when the hood is open on each equipped solenoid valve (“19.2”).

19.1 Magnetic manual override

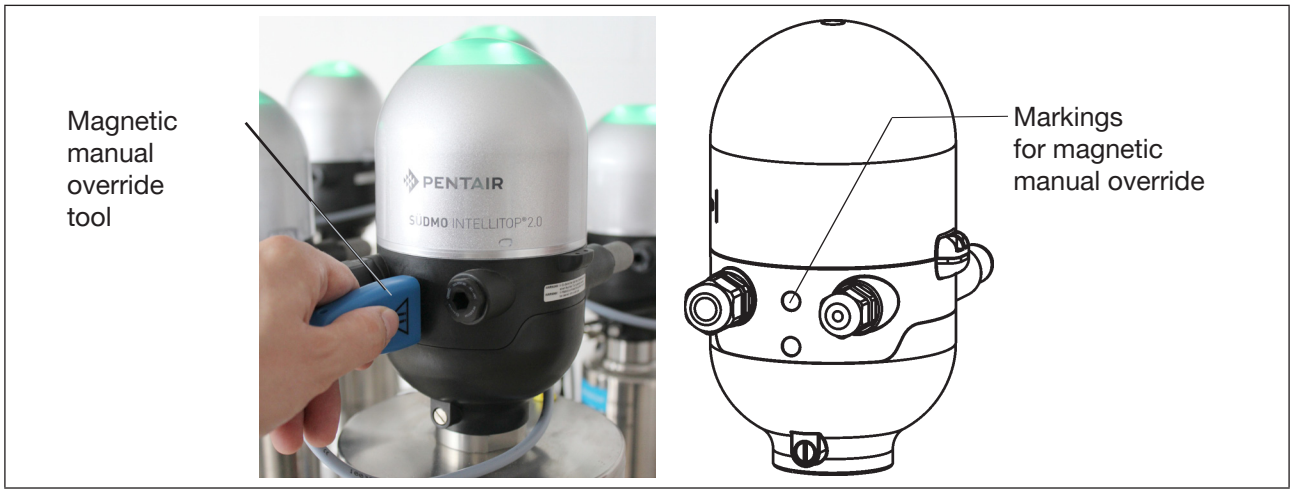


Fig. 40: Magnetic manual override (manual override tool) on the basis of encoded magnetic fields

Irrespective of the signal of the higher-level controller, in **automatic operating state**, the magnetic manual override sets the outlet of solenoid valve V1*) electrically to an ON signal and, if pilot pressure is present, switches the 2/A1 outlet*). **In manual operating state**, the magnetic manual override **cannot** be used.

However, if the outlet of solenoid valve V1*) is activated by the controller (ON signal), this switching state cannot be set to an OFF signal with the manual override!

Activation / deactivation of this function is possible using the PC software (for IO-Link devices also via acyclic data access (index 0x2C04sub0x1) or the “Bürkert Communicator” (“14.4”)). The **factory setting** is “magnetic manual override function active”, i.e. the function can be used, it is not disabled.

Connection to the PC is via the respective Service interface. Details are described in the “PC software manual” under the “SYSTEM/Start-up” menu option.

NOTE!

When the magnetic manual override (solenoid valve V1*)) is activated:

- the peripheral fault bit is set for the AS-Interface design.
- The mode is switched to “Manual override active” for the DeviceNet design and can be read out.
- The feedback signals (positions S1-3, external initiator) function as per normal operation.

Always observe the safety guidelines and the system statuses!

*) Both solenoid valves V1, V2 are actuated simultaneously for the design for double-acting actuators (see chapter “16 Design for double-acting actuators” on page 91)

The **activation of the manual override** or faults when using the manual override are signalled by the Top LED – see chapter “18.2 Flashing pattern / fault signalling”.

Procedure for activating / deactivating the manual override for valve location 2/A1:

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

→ Activating the magnetic manual override (only possible in automatic operating state)::
Hold the manual override tool on the identification points between the cable glands for 3 seconds (see “Fig. 40”) – feedback for activation by Top LED (chapter “18.2”).

→ Once the measure has been completed, deactivate the magnetic manual override:
Hold the manual override tool on the identification points between the cable glands for another 3 seconds (see “Fig. 40”).

After a power failure, the magnetic manual override is reset and the control head restarts in normal operating mode, i.e. the signal from the higher-level controller is accepted.

19.2 Mechanical manual override

If additional manual overrides 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 override of the solenoid valves V1 ... V3 after opening the housing.

DANGER!

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- Opening the hood or the housing in a potentially explosive atmosphere is only allowed in a not energized state!

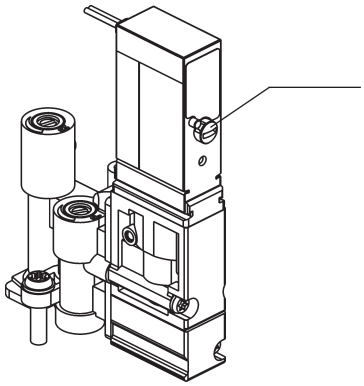


Fig. 41: Mechanical manual override of the solenoid valves

When the service measures have been completed, reset all manual overrides to “0” for controlled operation of the system!

20 MAINTENANCE, TROUBLESHOOTING

20.1 Safety instructions

DANGER!

Risk of injury from high pressure in the system!

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

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- Opening the hood or the housing in a potentially explosive atmosphere is only allowed in a not energized state!

WARNING!

Risk of injury from electric shock!

- Before reaching into the system (except for the teach procedure in a non-explosive atmosphere), switch off the power supply and secure it to prevent restarting!
- Observe the applicable accident prevention and safety regulations for electrical devices!

Risk of injury due to improper maintenance work!

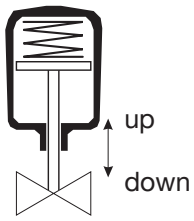
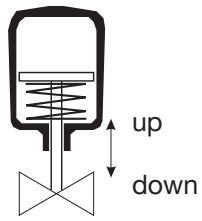
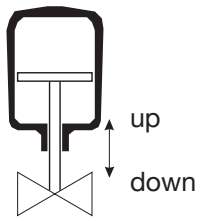
- Maintenance may be carried out by authorized technicians only and with the appropriate tools!

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

- Secure the system against unintentional activation.
- Ensure a controlled restart after maintenance has been completed.

20.2 Safety positions

Safety positions of the solenoid 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**
	single-acting Control function A • air opening • spring closing	down	down
	single-acting Control function B • air closing • spring opening	up	up
	double-acting Control function I • air opening • air closing	**not defined** for both solenoid valves NC, but **defined** for solenoid valve V1 NC + solenoid valve V2 NO	not defined

By default, the control head is equipped with solenoid valves with NC mode of operation, the design for double-acting actuators is equipped with 1 solenoid valve NC and 1 solenoid valve NO.

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

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

AS-Interface:	If the Watchdog is activated (default), behaviour is the same as in the case of a failure of the auxiliary power, i.e. all solenoid valve outlets are set to “0”.
DeviceNet:	See chapter “12.12.1 Configuration of the safety position of solenoid valves in case of a bus error” on page 69
IO-Link:	See chapter “14.7 Safety position if the bus fails” on page 88

20.3 Maintenance / service

When used properly, the control head IntelliTop 2.0 operates maintenance and trouble-free.

For service work, certain components or assemblies are offered as spare part sets (see chapter “22 Spare parts” on page 121). However, only the manufacturer may repair the control head for use in potentially explosive atmospheres.

If the service / maintenance notification function is active (see chapter “6.8 Factory settings in the firmware” on page 30), a maintenance request is issued - signalled by a “flashing pattern” in the error color (1 s ON, 3 s OFF) - see chapter “18.2 Flashing pattern / fault signalling” on page 102.

20.4 External cleaning of the control head

NOTE!

Aggressive cleaning agents may damage the material!

- In a potentially explosive atmosphere, only wipe the control head with a damp or anti-static cloth to avoid electrostatic charges.
- 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 control head 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!

20.5 Malfunctions

In the event of any malfunctions in spite of a correct installation, proceed according to the fault analysis described in the table below:

Fault description	Possible cause of the fault	Troubleshooting
No feedback signal	Setting of the position measuring system (teach procedure) not appropriate for the process valve spindle position	Perform / repeat the teach procedure (see chapter “17.1.2 Setting the position measuring system (manual teach procedure)”)
	Setting of the external initiators incorrect	Set the external initiator according to the respective operating instructions.
	No or faulty connected feedback signals or external initiator	Set the connections according to the pin and plug assignments described in these operating instructions (for the respective voltage and communication design).
	Target is not mounted on the process valve spindle or target faulty	Check the target for correct instal-lation and condition (see chapter (“6.7 Position measuring system data”).

Fault description	Possible cause of the fault	Troubleshooting
Feedback signal is “lost” in system operation	Position in the limit range of the feedback field	Repeat the teach procedure (see chapter “17.1.2 Setting the position measuring system (manual 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 outlet 2/A1 cannot be switched off with the controller	Magnetic manual override is still activated	Deactivate the manual override. See chapter “19.1 Magnetic manual override”
Valve outlets cannot be switched off by the controller	Mechanical manual override at the solenoid valve is still activated	Deactivate the mechanical manual overrides on the solenoid valves See chapter “19.2 Mechanical manual override” on page 110
Faults are signalled by the 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 chapter “18.2 Flashing pattern / fault signalling” on page 102)
No or faulty function of the process valves	No electrical power supply or communication for the control head	Check the power supply and the communication settings (also refer to the detailed descriptions of the respective versions in these operating instructions)
	No or insufficient pneumatic supply of the control head	Check the pressure supply and ensure that supply is sufficient
Incorrect function of the process valves	Swapped pneumatic connection lines	Check the correct pneumatic connection of the control head to the process valve (for fluid diagrams, see chapter “5.3.3 Fluid diagrams - examples” and the operating instructions of the corresponding process valves)
	Valves not correctly connected on electronic module	Check the correct electrical connection of the solenoid valves - see “Fig. 17: 24 V DC electronic module”

In the event of any undefined faults, be sure to contact the service department of Pentair Südmo GmbH!
Contact: E-mail: info@suedmo.de
Phone: +49 9081/803-0

21 REPLACEMENT OF COMPONENTS AND ASSEMBLIES

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

Devices that are used in a potentially explosive atmosphere may only be repaired by the manufacturer!

21.1 Safety instructions

DANGER!

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- Opening the hood or the housing in a potentially explosive atmosphere is only allowed in a not energized state!

WARNING!

Risk of injury due to electrical voltage!

- Before reaching into the system (except for the teach procedure in a non-explosive atmosphere), switch off the power supply and secure it to prevent restarting!
- Observe the applicable accident prevention and safety regulations for electrical devices!

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 maintenance work!

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

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

- Secure the system against unintentional activation.
- Ensure a controlled restart after maintenance has been completed.

NOTE!

IP65 / IP67 / IP69K protection

- During all work steps, make sure that P65 / IP67 / IP69K protection is once again ensured for the control head when used as intended!

Opening and closing the control head

- During all work which requires opening and closing the control head, also observe the notes and comments in chapter “8 Opening and closing the housing”!

21.2 Changing the electronic module

NOTE!

Electrostatically sensitive components / assemblies!

- The device contains electronic components that are susceptible to the effects of electrostatic discharging (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 minimise or avoid the possibility of damage caused by a sudden electrostatic discharge!
- Ensure that you do not touch the electronic components when the power supply voltage is applied!

Removal procedure:

→ Open the housing following the instructions in chapter “8 Opening and closing the housing”.

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

→ If necessary, note the position of the DIP switches for the set color code and, for the DeviceNet electronic module, of the DIP switches (8-switch block) for baud rate and address. For the AS-i electronic module, note the AS-Interface address and the jumper positions (AS-Interface power supply).

→ If required, read out and note special settings using the PC software.

→ 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 position measuring system are exposed.

→ Carefully lift the electronic module upwards.

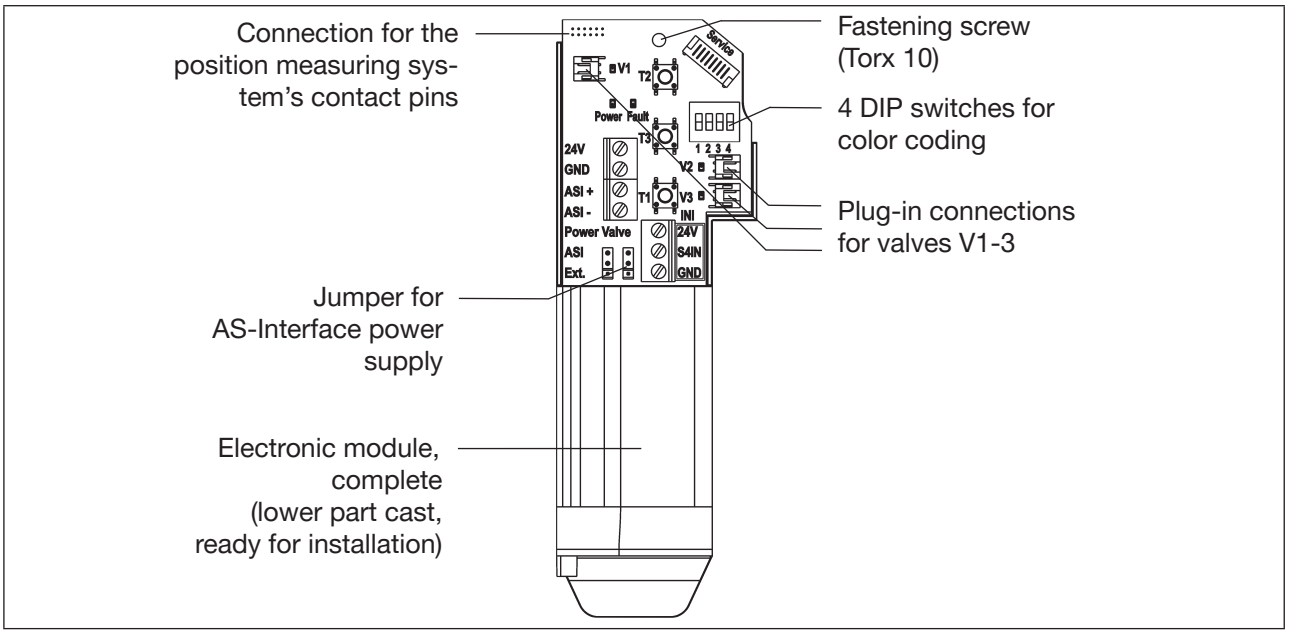


Fig. 42: Electronic module (here example of AS-Interface)

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 color coding, 8-switch block for 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, use the PC software to redo the settings read out via the PC software.

→ Perform teach procedure (see chapter"17.1.2 Setting the position measuring system (manual teach procedure)").

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

→ Close the housing following the instructions in chapter "8 Opening and closing the housing".

21.3 Changing the valves

Depending on the design, 0 to 3 solenoid valves (V1 ... V3) have been installed in the control head. The solenoid valves have been designed with the flow restriction equipment for intake and exhaust air and must be installed as a valve module.

Note:
Disassemble / assemble the valves in upright position, otherwise there is a risk that the non-return valve will fall out!

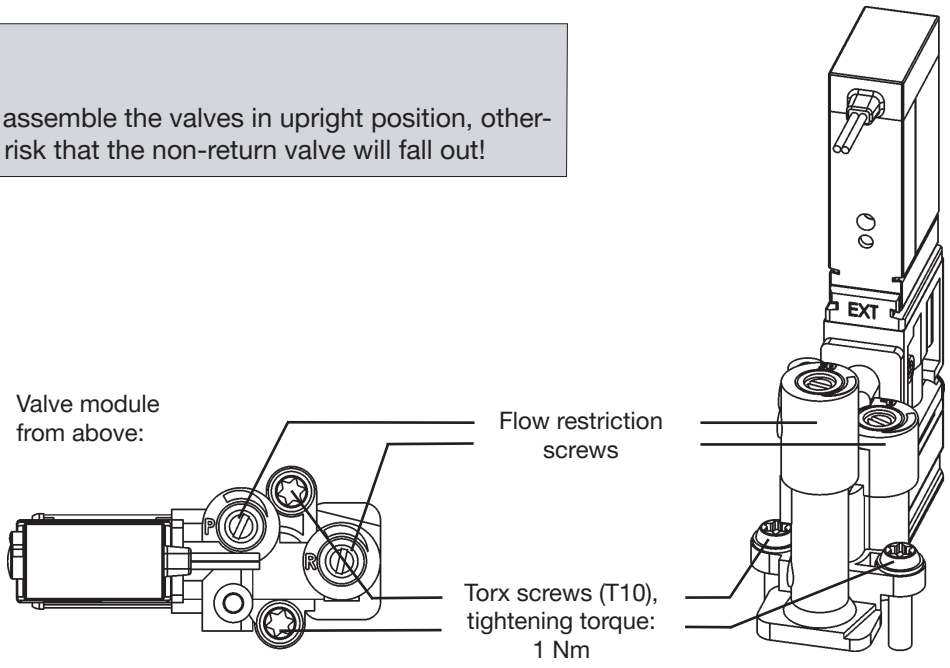


Fig. 43: Valve module

Procedure:

→ Open the housing following the instructions in chapter “8 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) of 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 valve flange!

→ To fix the valve module: 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 solenoid valve connections, have been removed, read the corresponding chapters on the electrical installation of the respective voltage / bus / connection design)

→ Close the housing following the instructions in chapter “8 Opening and closing the housing”.

21.4 Changing the position measuring system

The position measuring system consists of a housing, with a PCB mounted on top with LEDs and light guide. On the housing, there are 4 snap-fit hooks, which are snapped in place to fix the position measuring system in the bottom part of the housing.

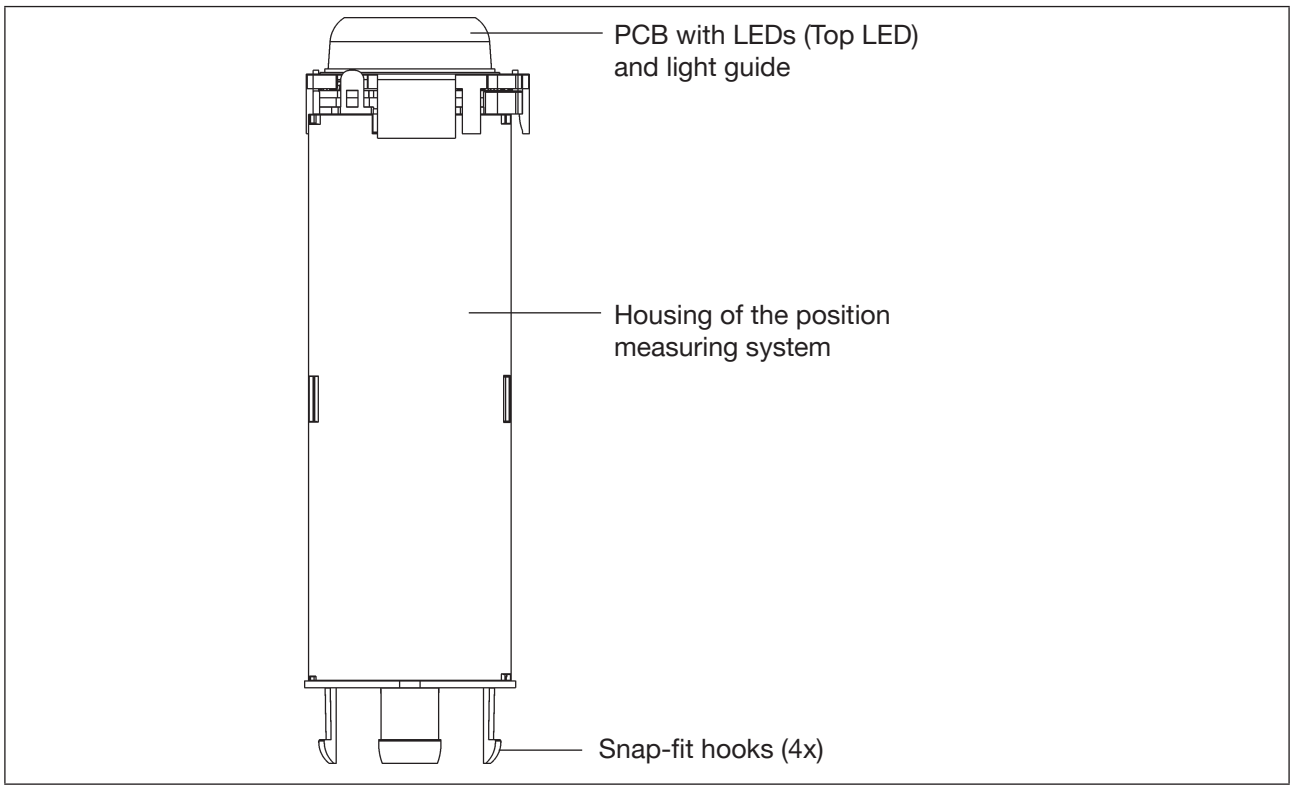


Fig. 44: Position measuring system

WARNING!

Risk of injury due to high pressure!

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

NOTE!

Electrostatically sensitive components / assemblies!

- Before changing the position measuring system, switch the electrical power for the control head off so that destruction of the PCB and electronic module is avoided.
- The device contains electronic components that are susceptible to the effects of electrostatic discharging (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 minimise or avoid the possibility of damage caused by a sudden electrostatic discharge!
- Ensure that you do not touch the electronic components when the power supply voltage is applied!

Deinstallation procedure:

→ Switch the electrical power to the control head off!

→ Loosen the control head from the process valve.

→ Open the housing following the instructions in chapter “8 Opening and closing the housing”.

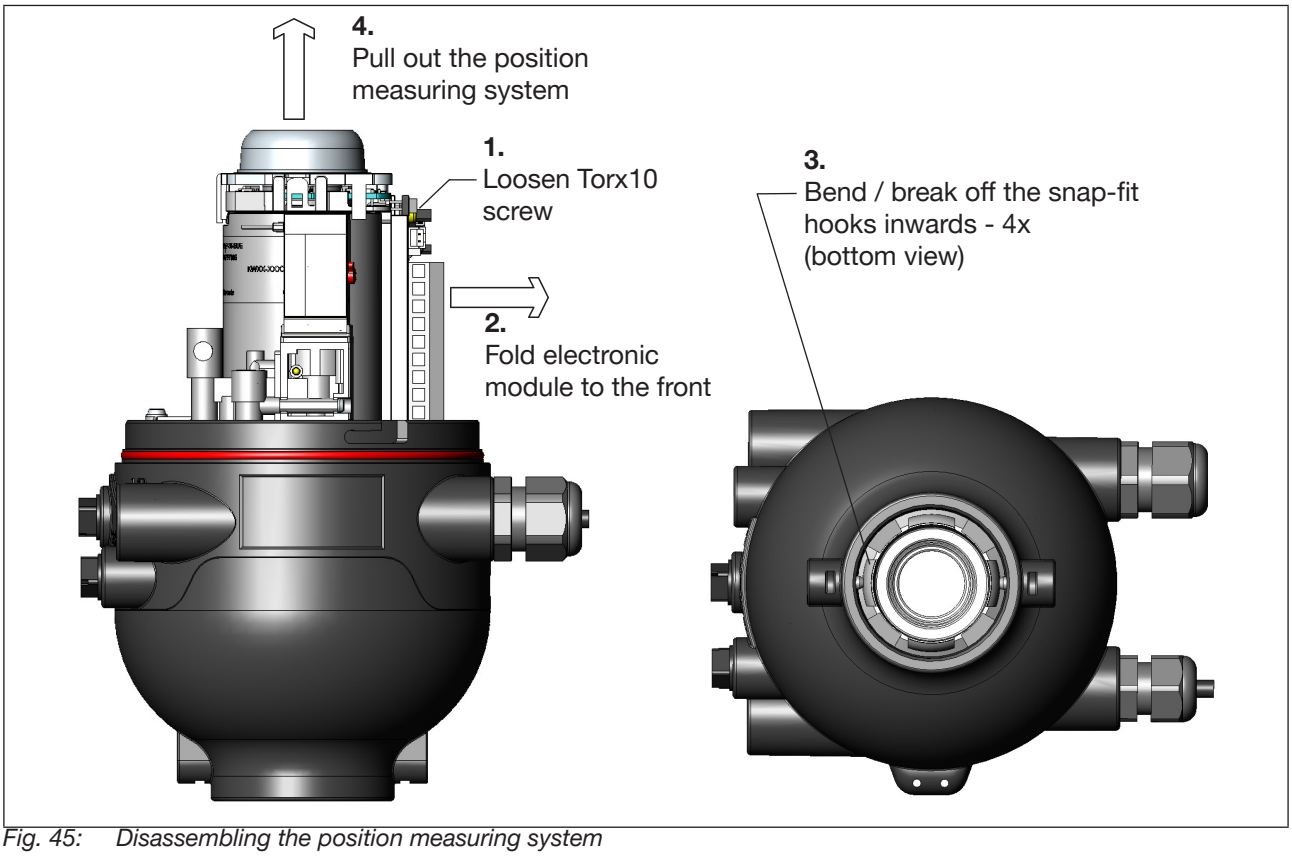


Fig. 45: Disassembling the position measuring system

→ Loosen the fastening screw (Torx 10) of the electronic module (see chapter “21.2 Changing the electronic module”).

→ Tilt the electronic module forwards to loosen the position measuring system’s contact pins from the electronic module.

→ Bend the snap-fit hooks on the bottom end of the position measuring system inwards or - in some cases - break them off.

→ Pull the position measuring system upwards out of the guide.

Installation procedure:

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

→ Carefully push the housing of the position measuring system 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.

→ Remount the control head on the process valve as described in chapter “7 Installation”.

→ Adjust the position measuring system to the process valve by teaching (see chapter”17.1.2 Setting the position measuring system (manual teach procedure)”).

→ Close the housing following the instructions in chapter “8 Opening and closing the housing”.

22 SPARE PARTS

CAUTION!

Risk of injury and/or damage to property due to incorrect parts!

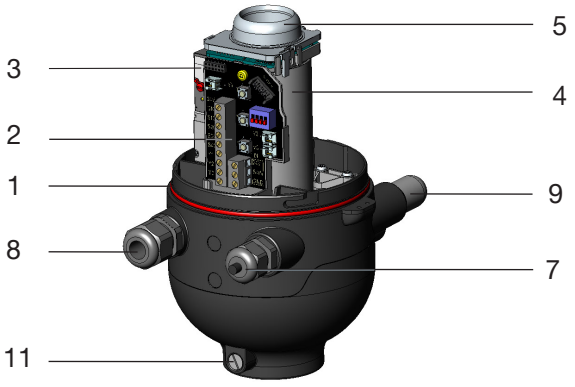
Incorrect accessories and unsuitable spare parts may cause injuries and damage to the device and the area around it.

- Use only original accessories and original spare parts from Pentair Südmo.

Item no.	Spare parts	ID no.
1	O-ring for hood (not for devices with FM approval*))	2307266
2	Electronic module, 24 V DC	2307255
2	Electronic module, AS-Interface / 2.11	2307256
2	Electronic module, DeviceNet	2307257
2	Electronic module, 120 V AC	2307258
2	Electronic module, IO-Link, Class A	2380096
2	Electronic module, IO-Link, Class B	2380097
3	Solenoid valve module, incl. flow restrictor module	2307252
4	Position measuring system with light guide	2307254
5	Light guide	2307253
(6)	Cable with 12-pole plug M12 (IEC 61076-2-101), approx. 10 cm (24 V DC)	2307261
(6)	Cable with 4-pole plug M12 (IEC 61076-2-101), approx. 10 cm (AS-Interface)	2307263
(6)	Cable with 4-pole plug M12 (IEC 61076-2-101), approx. 80 cm (AS-i)	2307262
(6)	Cable with 5-pole plug M12 (IEC 61076-2-101), approx. 80 cm (DeviceNet)	2307264
7	Cable gland M16 Ø 2-6 mm (possibly instead of dummy plug)	2307259
8	Cable gland M16 Ø 5-10 mm	2307260
9	Silencer	2307267
(10)	Hood, coated, with Pentair logo	2307265
11	Locking screw set (consisting of 2 x screws and 2 x nuts)	2307268
(12)	Flat cable terminal for AS-Interface cable	2024610
(13)	Paraliq GTE 703 - 2 g bag	2155156
	G1/8 angular quick fitting gland for 6 mm hose	2116513 **)
	G1/8 angular quick fitting gland for 6.35 mm hose (1/4")	2101513
	G1/4 angular quick fitting gland for 8 mm hose (5/16")	2344384 **)
	G1/4 angular quick fitting gland for 6.35 mm hose (1/4")	2125116
	G1/4 angular quick fitting gland for 6 mm hose	2116845

*) Available on request

**) Standard



23 SHUTDOWN

23.1 Safety instructions

DANGER!

Danger of explosion in a potentially explosive atmosphere (only in the event of a fault, as Zone 2)!

- Opening the hood or the housing in a potentially explosive atmosphere is only allowed in a not energized state!

WARNING!

Risk of injury due to electrical voltage!

- Before reaching into the system (except for the teach procedure in a non-explosive atmosphere), switch off the power supply and secure it to prevent restarting!
- Observe the applicable accident prevention and safety regulations for electrical devices!

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 authorized technicians only and with the appropriate tools!

23.2 Disassembling the control head IntelliTop 2.0

Prior to starting work, check the system status!

Procedure – cable gland designs:

→ Open the housing following the instructions in chapter “8 Opening and closing the housing”.

→ Uninstall the electrical connections at the terminal strip.

→ Close the housing following the instructions in chapter “8 Opening and closing the housing”.

→ Loosen the pneumatic connections (for a detailed description, see chapter “9 Pneumatic installation”).

→ Loosen the locking screws (shoulder screws M5).

→ Pull the control head upwards and off the adaptation.

Procedure – multi-pole connection designs:

→ Remove the multi-pole plugs.

→ Loosen the pneumatic connections (for a detailed description, see chapter “9 Pneumatic installation”).

→ Loosen the locking screws (shoulder screws M5).

 → Pull the control head upwards and off the adaptation.

24 PACKAGING AND TRANSPORT

NOTE!

Damage in transit!

Inadequately protected devices may be damaged during transport.

- Protect the device against moisture and dirt in shock-resistant packaging during transport.
- 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 control head. Preferably use this packaging.

If the control head is stored for further pre-assembly of a system, for example as part of a process valve assembly, please make sure:

→ that the control head has been secured sufficiently!

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

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

→ that the control head is not exposed to any mechanical stress!

25 STORAGE

NOTE!

Incorrect storage may damage the device.

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

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

26 DISPOSAL

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

NOTE!

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

- Observe the relevant disposal and environmental protection regulations.

Note:

Observe national waste disposal regulations.

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