

## Pendulum control & isolation valve with CC-Link interface

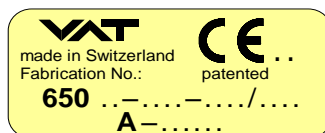
This manual is valid for the valve ordering number(s):

<b>650 . . . . GL</b> - . . . .	(1 sensor input)
<b>650 . . . . GN</b> - . . . .	(2 sensor inputs)
<b>650 . . . . AL</b> - . . . .	(1 sensor input / $\pm 15V$ SPS)
<b>650 . . . . AN</b> - . . . .	(2 sensor inputs / $\pm 15V$ SPS)
<b>650 . . . . HL</b> - . . . .	(1 sensor input / PFO)
<b>650 . . . . HN</b> - . . . .	(2 sensor inputs / PFO)
<b>650 . . . . CL</b> - . . . .	(1 sensor input / $\pm 15V$ SPS / PFO)
<b>650 . . . . CN</b> - . . . .	(2 sensor inputs / $\pm 15V$ SPS / PFO)

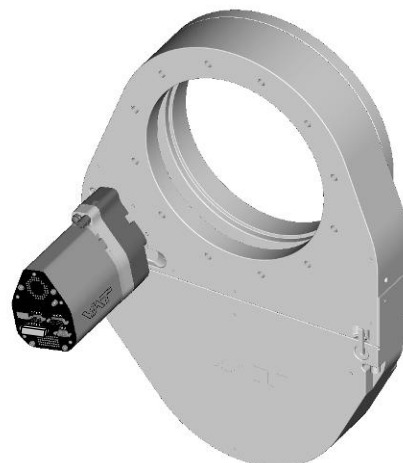
SPS = Sensor Power Supply      PFO = Power Failure Option

configured with firmware    **650C.1E.15**

The fabrication number is indicated on each product as per the label below (or similar):



← Fabrication number



sample picture

### Explanation of symbols:



Read declaration carefully before you start any other action!



Keep body parts and objects away from the valve opening!



Attention!



Hot surfaces; do not touch!



Product is in conformity with EC guidelines, if applicable!



Loaded springs and/or air cushions are potential hazards!



Disconnect electrical power and compressed air lines. Do not touch parts under voltage!



Wear gloves!



Read these «**Installation, Operating & Maintenance Instructions**» and the enclosed «**General Safety Instructions**» carefully before you start any other action!



## Imprint

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## 1 Use of product

This product is a throttling pendulum valve with isolation functionality. It is intended to use for downstream pressure control applications.

Use product for clean and dry indoor vacuum applications under the conditions indicated in chapter «Technical data» only! Other applications are only allowed with the written permission of VAT.

### 1.1 Technical data

Control and actuating unit	
Power input <sup>1)</sup> (α) [650 . . . . . A . . . . . / 650 . . . . . G . . . . .] [650 . . . . . C . . . . . / 650 . . . . . H . . . . .]	+24 VDC (±10%) @ 0.5 V pk-pk max. [connector: POWER] 50 W max. (operation of valve with max. load) without PFO <sup>4)</sup> 50 W plus 10 W for PFO <sup>4)</sup>
Sensor power supply <sup>2)</sup> (β) [650 . . . . . A . . . . . / 650 . . . . . C . . . . .] Input Output	+24 VDC / 1500 mA max. [connector: POWER] ±15 VDC (±5%) / 1000 mA max. [connector: SENSOR]
Sensor power supply <sup>2)</sup> (β) [650 . . . . . G . . . . . / 650 . . . . . H . . . . .] Input Output	+ 24 VDC resp. ± 15 VDC [connector: POWER] same as input but: [connector: SENSOR] 2.0 A max. at ± 15 VDC 1.5 A max. at + 24 VDC

Calculation of complete power consumption:

$$P_{\text{tot}} = \alpha + \beta$$

whereas β depends on sensor supply concept and sensor power consumption.



Control and actuating unit (continuation)				
Sensor input Signal input ADC resolution Sampling time	0-10 VDC / $R_i > 100 \text{ k}\Omega$ [connector: SENSOR] 0.23 mV 10 ms			
Digital outputs <sup>3)</sup> Input voltage Input current	70 VDC or 70 V peak max. [connector: LOGIC I/O] 0.1 ADC or 0.1 A peak max.			
PFO <sup>4)</sup> battery pack [650 . . . . C . . . . / 650 . . . . H . . . .] Charging time Durability	2 minutes max. up to 10 years @ 25°C ambient; refer to «Durability of power fail battery» for details			
Compressed air supply	4 - 7 bar / 55 - 100 psi (above ATM)			
Ambient temperature	0 °C to +50 °C max. (<35 °C recommended)			
Pressure control accuracy	0.1% of sensor full scale			
	<b>DN 100</b> <b>4"</b> (650 <b>40</b> - ....)	<b>DN 160</b> <b>6"</b> (650 <b>44</b> - ....)	<b>DN 200</b> <b>8"</b> (650 <b>46</b> - ....)	<b>DN 250</b> <b>10"</b> (650 <b>48</b> - ....)
Position resolution / position control capability	9155 steps (full stroke)	11111 steps (full stroke)	12266 steps (full stroke)	12533 steps (full stroke)
Closing time throttling only	0.7 s typ. (full stroke)	0.8 s typ. (full stroke)	0.9 s typ. (full stroke)	0.9 s typ. (full stroke)
Opening time throttling only	0.7 s typ. (full stroke)	0.8 s typ. (full stroke)	0.9 s typ. (full stroke)	0.9 s typ. (full stroke)
Closing time throttling & isolation	3 s typ. (full stroke)	3 s typ. (full stroke)	3 s typ. (full stroke)	3 s typ. (full stroke)
Opening time throttling & isolation	4 s typ. (full stroke)	4 s typ. (full stroke)	4 s typ. (full stroke)	4 s typ. (full stroke)

- 1) Internal overcurrent protection by a PTC device.
- 2) Refer to chapter «Sensor supply concepts» for details.
- 3) Refer to chapter «Schematics» for details.
- 4) PFO = Power Failure Option. Refer to «Behavior in case of power failure» for details.



Valve unit				
Pressure range at 20°C				
- Aluminum	(650 . . . . <b>A</b> . . . . .)	1 x 10E-8 mbar to 1.2 bar (abs)		
- Aluminum hard anodized	(650 . . . . <b>H</b> . . . . .)	1 x 10E-6 mbar to 1.2 bar (abs)		
- Aluminum nickel coated	(650 . . . . <b>I</b> . . . . .)	1 x 10E-8 mbar to 1.2 bar (abs)		
Leak rate to outside at 20°C				
- Aluminum	(650 . . . . <b>A</b> . . . . .)	1 x 10E-9 mbar l/s		
- Aluminum hard anodized	(650 . . . . <b>H</b> . . . . .)	1 x 10E-5 mbar l/s		
- Aluminum nickel coated	(650 . . . . <b>I</b> . . . . .)	1 x 10E-9 mbar l/s		
Leak rate valve seat at 20°C				
- Aluminum	(650 . . . . <b>A</b> . . . . .)	1 x 10E-9 mbar l/s		
- Aluminum hard anodized	(650 . . . . <b>H</b> . . . . .)	1 x 10E-4 mbar l/s		
- Aluminum nickel coated	(650 . . . . <b>I</b> . . . . .)	1 x 10E-9 mbar l/s		
Cycles until first service				
- Isolation cycles	(open - closed - open)	200'000 (unheated and under clean conditions)		
- Throttling cycles	(open - max. throttle - open)	1'000'000 (unheated and under clean conditions)		
Admissible operating temperature		10°C to +150°C		
Mounting position		any (valve seat on chamber side is recommended) (valve seat to face chamber is recommended)		
Wetted materials				
- Body	(650 . . . . <b>A</b> . . . . .)	Aluminum 3.2315 (AA6082)		
- Body	(650 . . . . <b>H</b> . . . . .)	Aluminum 3.2315 (AA6082) hard anodized		
- Body	(650 . . . . <b>I</b> . . . . .)	Aluminum 3.2315 (AA6082) nickel coated		
- Pendulum plate	(650 . . . . <b>A</b> . . . . .)	Aluminum 3.2315 (AA6082)		
- Pendulum plate	(650 . . . . <b>H</b> . . . . .)	Aluminum 3.2315 (AA6082) hard anodized		
- Pendulum plate	(650 . . . . <b>I</b> . . . . .)	Aluminum 3.2315 (AA6082) nickel coated		
- Sealing ring	(650 . . . . <b>A</b> . . . . .)	Aluminum 3.2315 (AA6082), 1.4306 (304L)		
- Sealing ring	(650 . . . . <b>H</b> . . . . .)	Aluminum 3.2315 (AA6082) hard anodized, 1.4306 (304L)		
- Sealing ring	(650 . . . . <b>I</b> . . . . .)	Aluminum 3.2315 (AA6082) nickel coated, 1.4306 (304L)		
- Other parts		Stainless steel 316L (1.4404 or 1.4435), 1.4122, 1.4310 (301), 1.4303 (304), 1.4571, A2 (304)		
- Seals		Viton® (standard). Other materials available. Seal materials are declared on dimensional drawing of specific valve ordering number.		
		<b>DN 100</b> <b>4"</b> (650 <b>40</b> - ....)	<b>DN 160</b> <b>6"</b> (650 <b>44</b> - ....)	<b>DN 200</b> <b>8"</b> (650 <b>46</b> - ....)
				<b>DN 250</b> <b>10"</b> (650 <b>48</b> - ....)
Max. differential pressure on plate during isolation		1200 mbar in either direction	1200 mbar in either direction	1200 mbar in either direction
Max. differential pressure on plate during opening and throttling		30 mbar	10 mbar	5 mbar
Min. controllable conductance (N <sub>2</sub> molecular flow)		3 l/s	5 l/s	10 l/s
Dimensions		Refer to dimensional drawing of specific valve ordering number (available on request)		

## 2 Installation

### 2.1 Unpacking



As this valve is a heavy component you should lift it with adequate equipment to prevent any injury to humans.

Valves DN200 (8") and larger are equipped with attachment points (tapped holes). Add eyebolts to these attachment points for lifting. The attachment points are indicated on the dimensional drawing of the specific valve part number (available on request).

Never lay the valve down with control and actuating unit downwards as it may be damaged.

### 2.2 Installation into the system



Fingers and objects must be kept out of the valve opening and away from moving parts. The valve plate starts to move just after power is supplied.

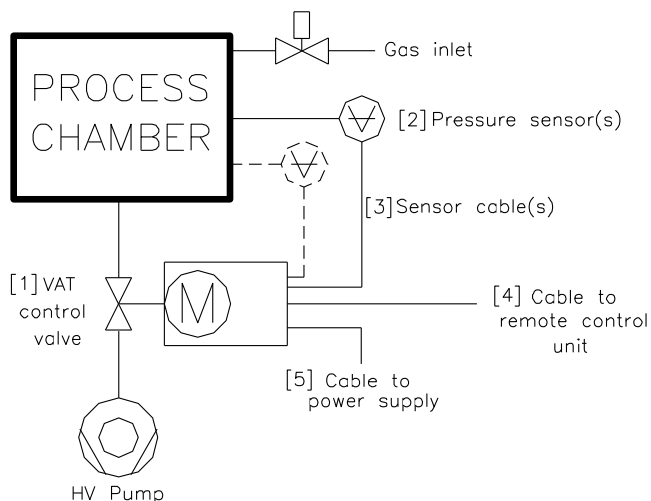


Do not connect or disconnect sensor cable when device is under power.

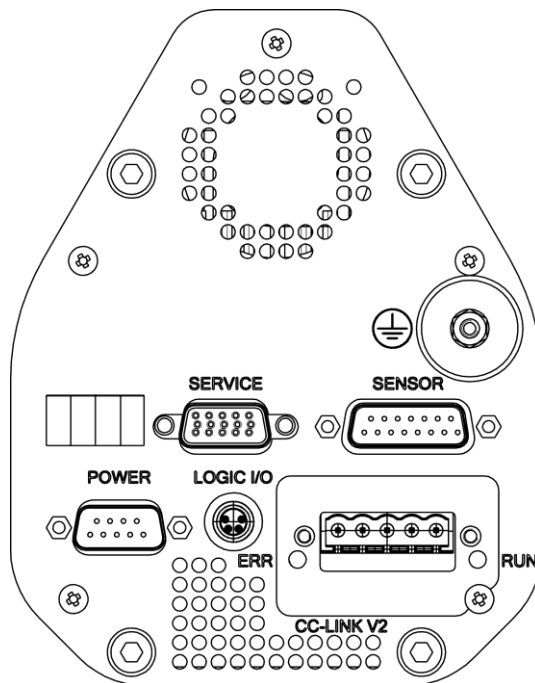


Do not disconnect air supply when device is under power. Compressed air pressure must be in the range of: 4 - 7 bar / 55 - 100 psi (above ATM). Use only clean, dry or slightly oiled air.

#### Connection overview:



#### Connectors at controller panel:



1. Install valve [1] into the vacuum system. Valve seat side should face process chamber. The valve seat side is indicated by the symbol "∇" on the valve flange.  
**Caution:** Do not tighten the flange screws stronger than indicated under «Tightening torque».  
**Caution:** Do not admit higher forces to the valve than indicated under «Admissible forces».  
**Note:** Make sure that enough space is kept free to do preventive maintenance work. The required space is indicated on the dimensional drawing.
2. Connect compressed air supply to connection labeled '**IN**' located at actuator, see Figure 1 below.  
 Connect compressed air return line connection labeled '**OUT**' located at actuator, see Figure 1 below.  
**Caution:** Compressed air pressure must be in the range of: **4 - 7 bar / 55 - 100 psi (above ATM)**.  
**Note:** Use only clean, dry or slightly oiled air. IN / OUT connections are 1/8" ISO/NPT internal threads.
3. Install the ground connection cable at controller. Refer to «Electrical connection»
4. Install pressure sensor(s) [2] according to the recommendations of the sensor manufacturer and directives given under «Requirements to sensor connection».
5. Connect sensor cable [3] to sensor(s) and then to valve (connector: SENSOR).  
 Refer to chapter «Electrical connection» for correct wiring.  
**Note:** Input for second sensor is available on 650 . . . - . . . **N** - . . . version only.
6. Connect valve to remote control unit [4] (connector: CC-LINK V2 and LOGIC I/O). Refer to «CC-Link schematics» for correct wiring.
7. Connect power supply [5] to valve (connector: POWER). Refer to chapter «Electrical connection» for correct wiring.  
**Note:** To provide power to the valve motor pins 4 and 8 must be bridged, otherwise motor interlock is active and the valve enters the safety mode and is not operative. Refer also to «Safety mode».
8. This valve has a double sealed rotary feedthrough and optionally an intermediate pumping port for the actuator shaft. This port (1/8" ISO/NPT) could be connected to the vacuum line, see Figure 2 below.
9. This valve may optionally be equipped with a heating device. Connect VAT heating device according to manual of respective heating device.
10. Perform «Setup procedure» to prepare valve for operation.  
**Note:** Without performing the setup procedure the valve will not be able to do pressure control.

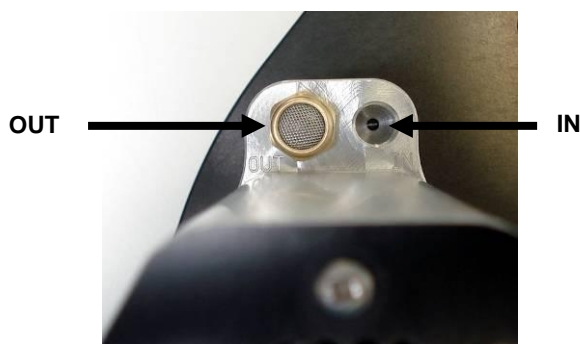


Fig. 1

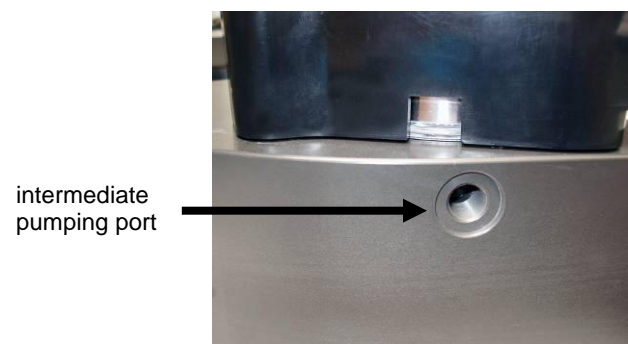


Fig. 2

## 2.3 Tightening torque

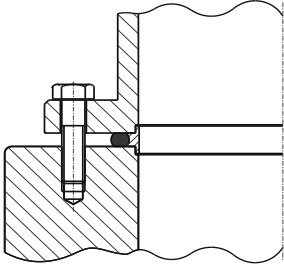
### Note:

The torque values below are dependent on many factors, such as materials involved, surface quality, surface treatment, and lubrication.

The torques below are valid if immersion depth of the mounting screws is at least once the thread diameter (min. 1d), and the friction coefficient of the screw-flange connection ( $\mu_{\text{total}} = (\mu_{\text{screw thread-helicoil}} + \mu_{\text{under screw head}})/2$ ) is bigger than 0.12. Lower friction coefficients may damage the valve, as the resulting preload force gets too high. Therefore for other friction coefficients the torque needs to be adapted. Please review design guidelines for Helicoil-Screw connections and make sure that screws in use are capable to withstand applied torques, are appropriate for the application and are not too long. Too long screws may damage the valve, the immersion depth should not exceed (hole depth – 1 mm).

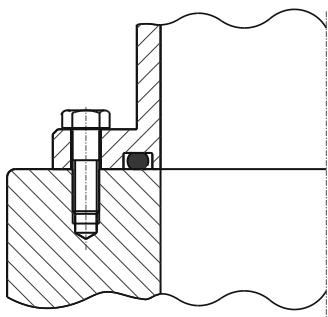
Tighten mounting screws of the flanges uniformly in crosswise order. Observe the maximum torque levels in the following tables.

### 2.3.1 Mounting with centering rings

Valve size	ISO-F	ISO-F	
	max. tightening torque (Nm)	max. tightening torque (lbs . ft)	
DN100 / 4" (65040 - . . . . - . . . .)	8-10	6-8	
DN160 / 6" (65044 - . . . . - . . . .)	13-15	9-11	
DN200 / 8" (65046 - . . . . - . . . .)	13-15	9-11	
DN250 / 10" (65048 - . . . . - . . . .)	17-20	13-15	
	hole depth (mm)	hole depth (inch)	
DN100 / 4" (65040 - . . . . - . . . .)	12	0.47	
DN160 / 6" (65044 - . . . . - . . . .)	14	0.55	
DN200 / 8" (65046 - . . . . - . . . .)	15	0.59	
DN250 / 10" (65048 - . . . . - . . . .)	16	0.63	

Refer to «Spare parts and accessories» for centering rings ordering numbers.

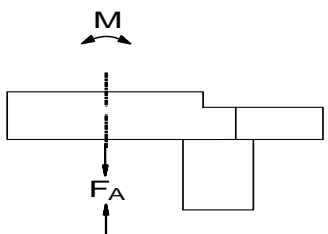
### 2.3.2 Mounting with O-ring in grooves

Valve size	ISO-F	JIS	ASA-LP	ISO-F	JIS	ASA-LP	
	max. tightening torque (Nm)			max. tightening torque (lbs . ft)			
DN100 / 4" (65040 - . . . . .)	20-23	35-40	35-40	15-17	26-30	26-30	
DN160 / 6" (65044 - . . . . .)	35-40	35-40	35-40	26-30	26-30	26-30	
DN200 / 8" (65046 - . . . . .)	35-40	35-40	80-90	26-30	26-30	59-67	
DN250 / 10" (65048 - . . . . .)	35-41	65-70	80-90	26-30	48-52	59-67	
	hole depth (mm)			hole depth (inch)			
DN100 / 4" (65040 - . . . . .)	12	12	12	0.47	0.47	0.47	
DN160 / 6" (65044 - . . . . .)	14	14	14	0.55	0.55	0.55	
DN200 / 8" (65046 - . . . . .)	15	15	14	0.59	0.59	0.59	
DN250 / 10" (65048 - . . . . .)	16	16	16	0.63	0.63	0.63	

### 2.4 Admissible forces

Forces from evacuating the system, from the weight of other components, and from baking can lead to deformation and malfunctioning of the valve. Stress has to be relieved by suitable means, e.g. bellows sections.

Valve size	Axial tensile or compressive force «F <sub>A</sub> »		Bending moment «M»	
	N	lb.	Nm	lbf.
DN100 / 4" (65040 - . . . . .)	1000	220	40	30
DN160 / 6" (65044 - . . . . .)	2000	440	80	60
DN200 / 8" (65046 - . . . . .)	2000	440	80	60
DN250 / 10" (65048 - . . . . .)	2500	550	100	75
For a combination of both forces (F <sub>A</sub> and M) the values are invalid. Verify that the depth of the mounting screws is min. 1 x thread diameter. Please contact VAT for more information.				



## 2.5 Requirements to sensor connection

To achieve fast and accurate pressure control a fast sensor response is required.

Sensor response time: < 50ms

The sensor is normally connected to the chamber by a pipe. To maintain that the response time is not degraded by this connection it needs to meet the following requirements:

Inner diameter of connection pipe:  $\geq 10 \text{ mm}$

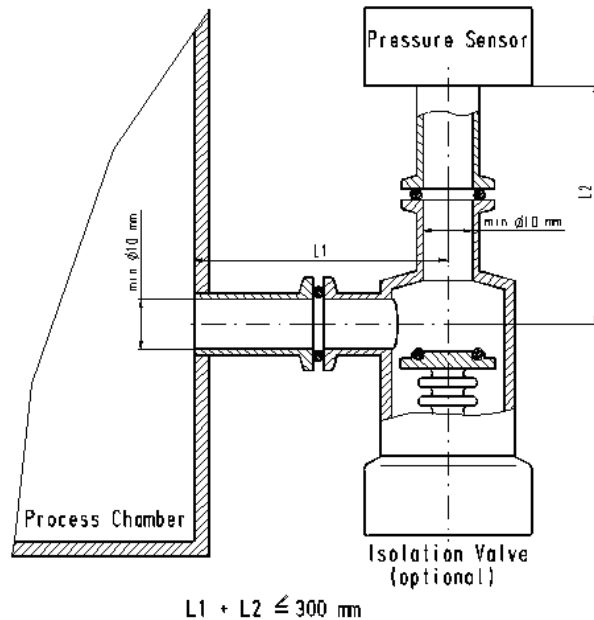
Length of connection pipe:  $\leq 300 \text{ mm}$

These conductance guidelines must include all valves and limiting orifices that may also be present.

Make also sure that there is no obstruction in front of sensor connection port inside the chamber.

The sensor should also be mounted free of mechanical shock and vibration.

Dynamic stray magnetic fields may introduce noise to sensor output and should be avoided or shielded.

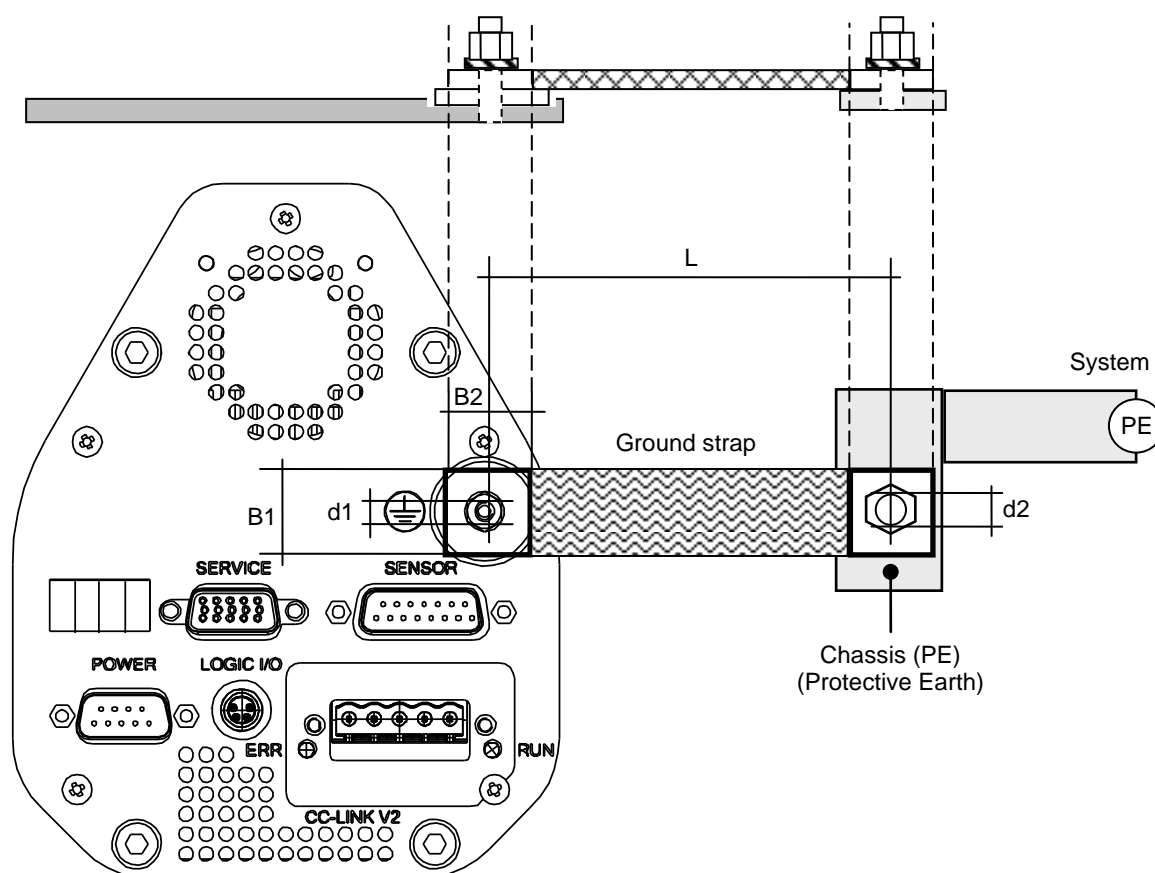


## 2.6 Electrical connection

### 2.6.1 Ground connection

Recommendation for ground strap between controller and system (chassis)

Material	L (Length max.)	B1 (min.)	B2 (min.)	d1 (Ø)	d2 (Ø)
copper tinned	200 mm	25 mm	25 mm	4.5 mm	customized



**Note:** Connection plates of ground strap must be total plane for a good electrical contact!

**Note:** The connection point at chassis (PE) must be blank metal (not coated).

It is also possible to connect the ground strap at system chamber if it is well connected to PE.

**Note:** Avoid low chassis cross section to the system PE connection. (Min. same cross section as ground strap)



### 2.6.2 Sensor supply concepts

This valve offers 3 alternative concepts to supply the sensor(s) with power. This depends on the sensor type and valve version that is used. This valve is available with an optional sensor power supply module (SPS) that converts  $\pm 15$  VDC from the 24 VDC.

Concepts:

- External + 24 VDC supplied to POWER connector is feed through to SENSOR connector to supply 24 VDC sensors. Refer to chapter «2.6.3 Power and sensor connection (+24 VDC sensors)» for schematic and correct wiring.
- External  $\pm 15$  VDC supplied to POWER connector is feed through to SENSOR connector to supply  $\pm 15$  VDC sensors. Refer to chapter «2.6.4 Power and sensor connection ( $\pm 15$  VDC sensors) without optional SPS module» for schematic and correct wiring.
- External + 24 VDC supplied to POWER connector is converted into  $\pm 15$  VDC by the valve internal SPS and supplied to SENSOR connector to supply  $\pm 15$  VDC sensors. Refer to chapter «2.6.5 Power and sensor connection ( $\pm 15$  VDC sensors) with optional SPS module» for schematic and correct wiring.

Valve versions:

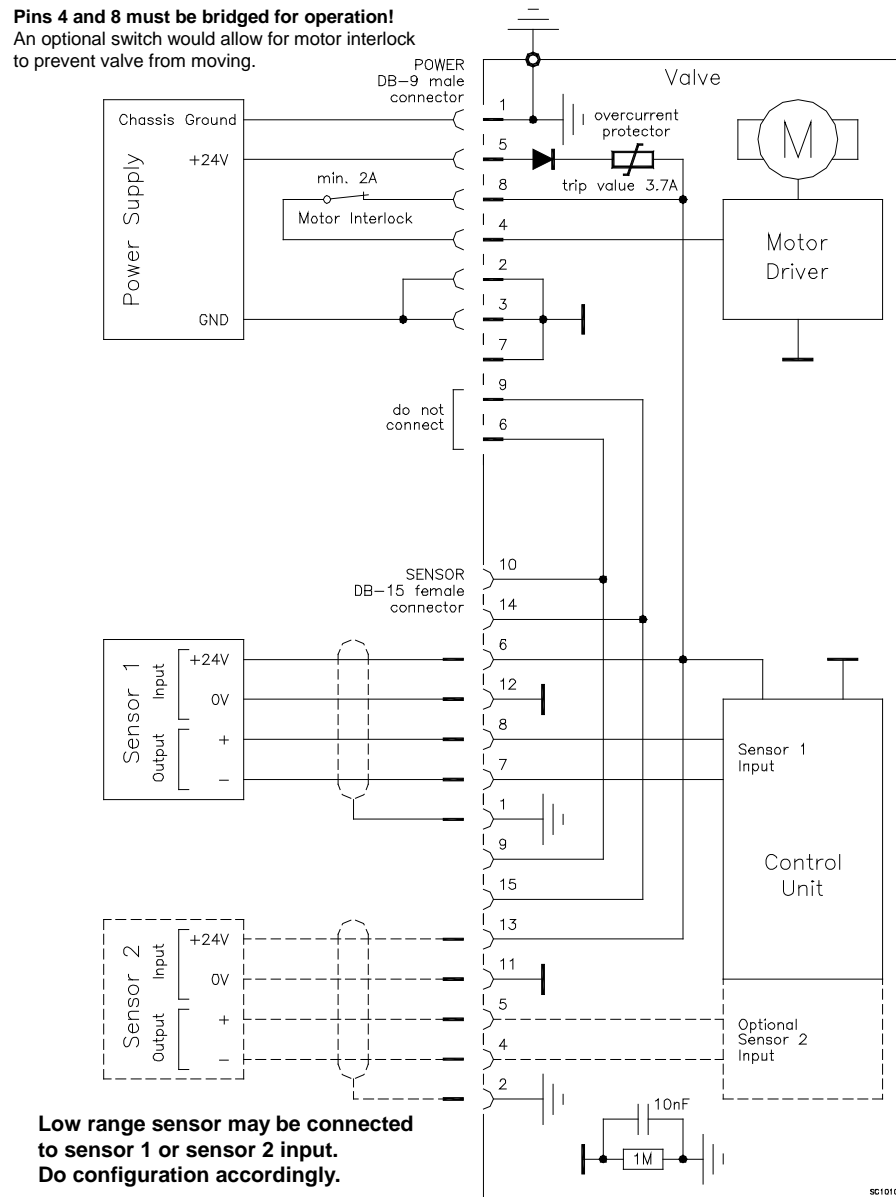
- 650 . . . . **G** . . . . . / 650 . . . . **H** . . . . . SPS module not included
- 650 . . . . **A** . . . . . / 650 . . . . **C** . . . . . SPS module included

**Note:** The SPS module can be retrofitted. Refer to chapter «Retrofit / replacement procedure» for instruction.

### 2.6.3 Power and sensor connection (+24 VDC sensors)

[650 . . - . . **G** . - . . . . / 650 . . - . . **H** . - . . . . versions recommended]

### 2.6.3.1 Sensor power wiring via controller

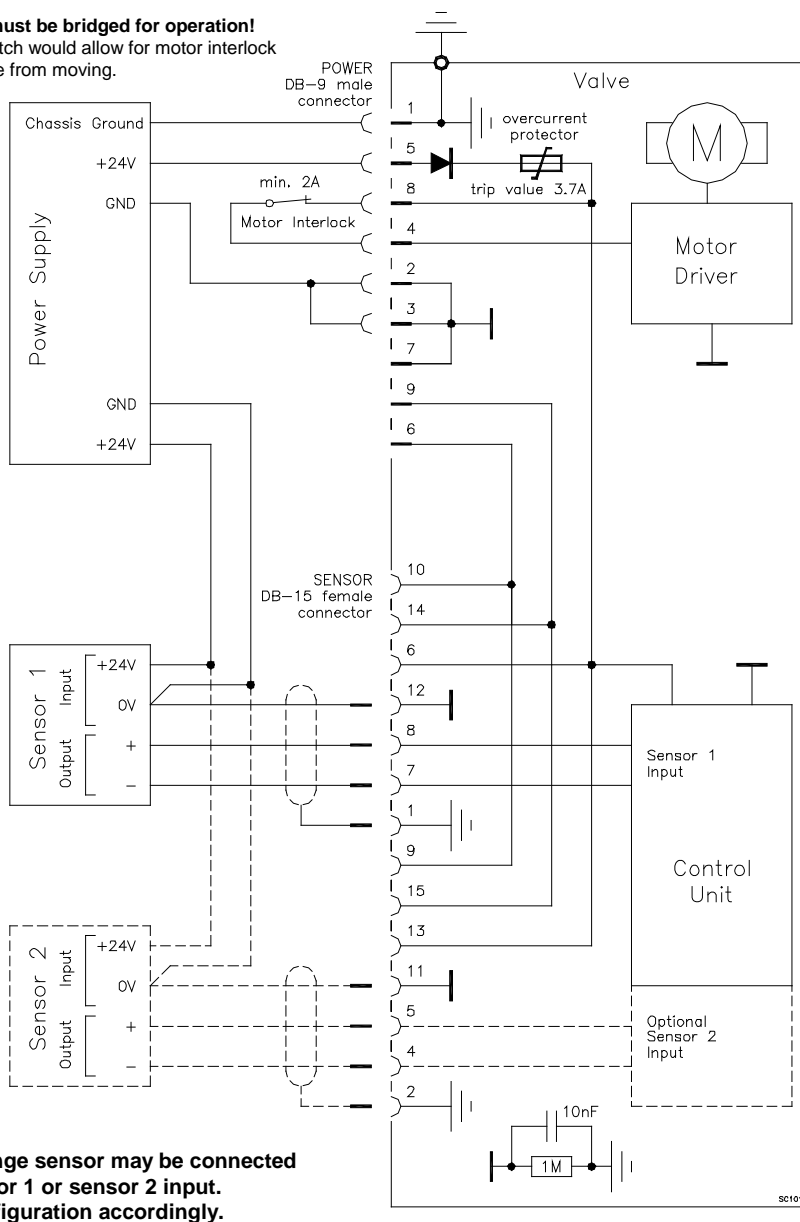


**Note:**

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect the +24 VDC sensors at DB-15 female sensor connector exactly as shown in the drawing above. Do not connect other pins, that may damage power supply or controller!
- Connector: Use only screws with 4-40UNC thread for fastening the connectors!

### 2.6.3.2 Sensor power wiring external

**Pins 4 and 8 must be bridged for operation!**  
An optional switch would allow for motor interlock to prevent valve from moving.



#### Note:

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect the +24 VDC sensors at DB-15 female sensor connector exactly as shown in the drawing above. Do not connect other pins, that may damage power supply or controller!
- Connector: Use only screws with 4-40UNC thread for fastening the connectors!

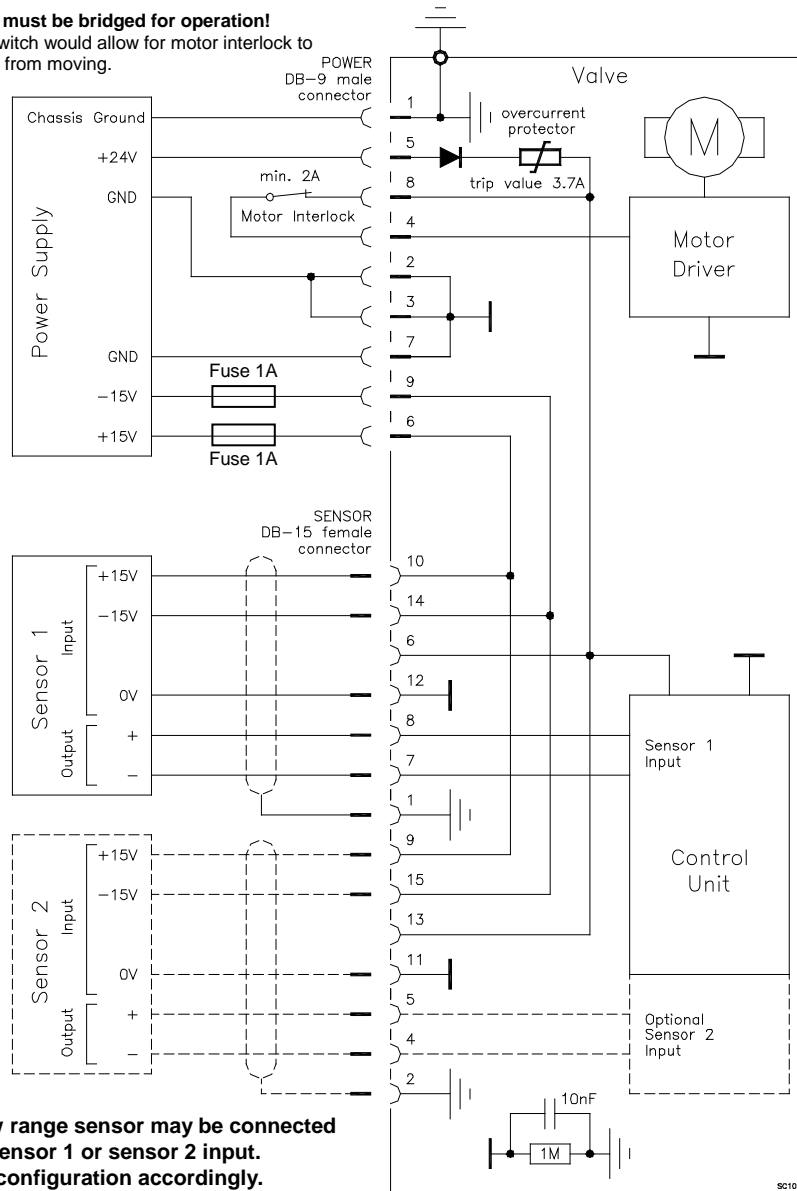
### 2.6.4 Power and sensor connection ( $\pm 15$ VDC sensors) without optional SPS module

[650 . . . . G . . . . / 650 . . . . H . . . . versions only]

#### 2.6.4.1 Sensor power wiring via controller

**Pins 4 and 8 must be bridged for operation!**

An optional switch would allow for motor interlock to prevent valve from moving.



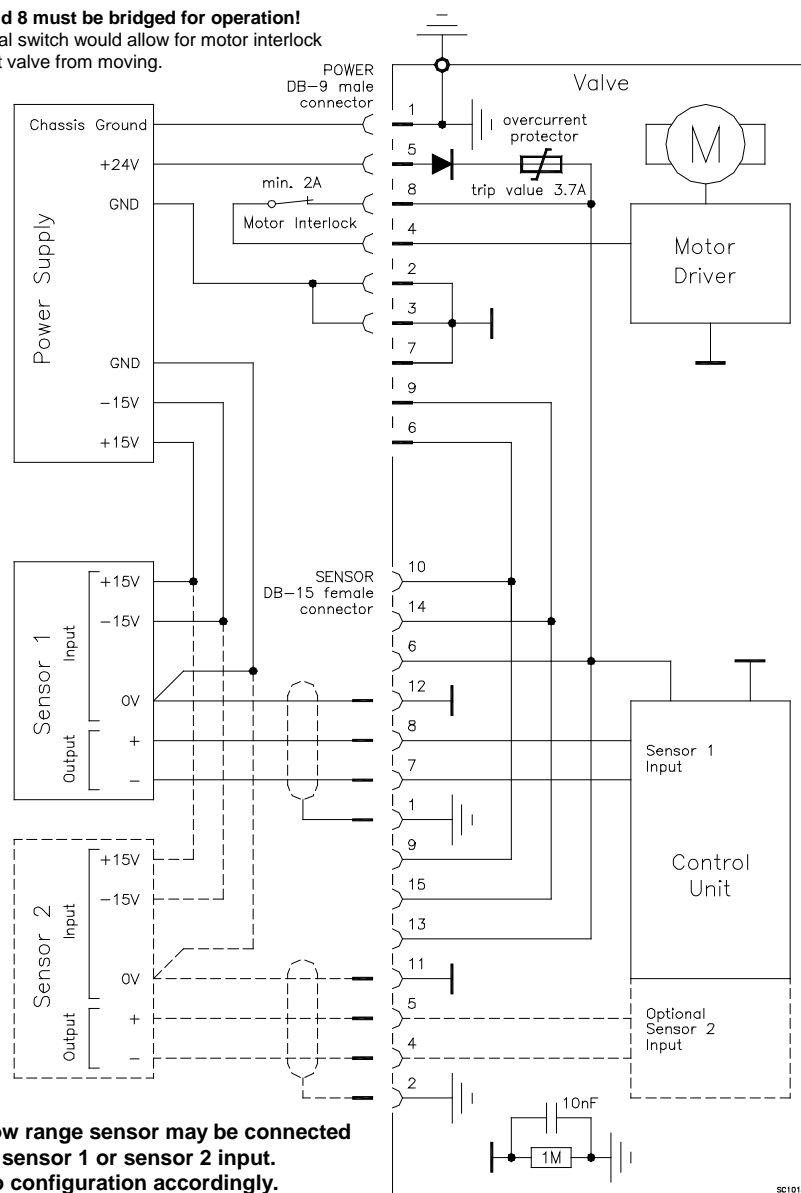
#### Note:

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect the  $\pm 15$  VDC sensors at DB-15 female sensor connector exactly as shown in the drawing above. Do not connect other pins, that may damage power supply or controller!
- Connector: Use only screws with 4-40UNC thread for fastening the connectors!

### 2.6.4.2 Sensor power wiring external

**Pins 4 and 8 must be bridged for operation!**

An optional switch would allow for motor interlock to prevent valve from moving.

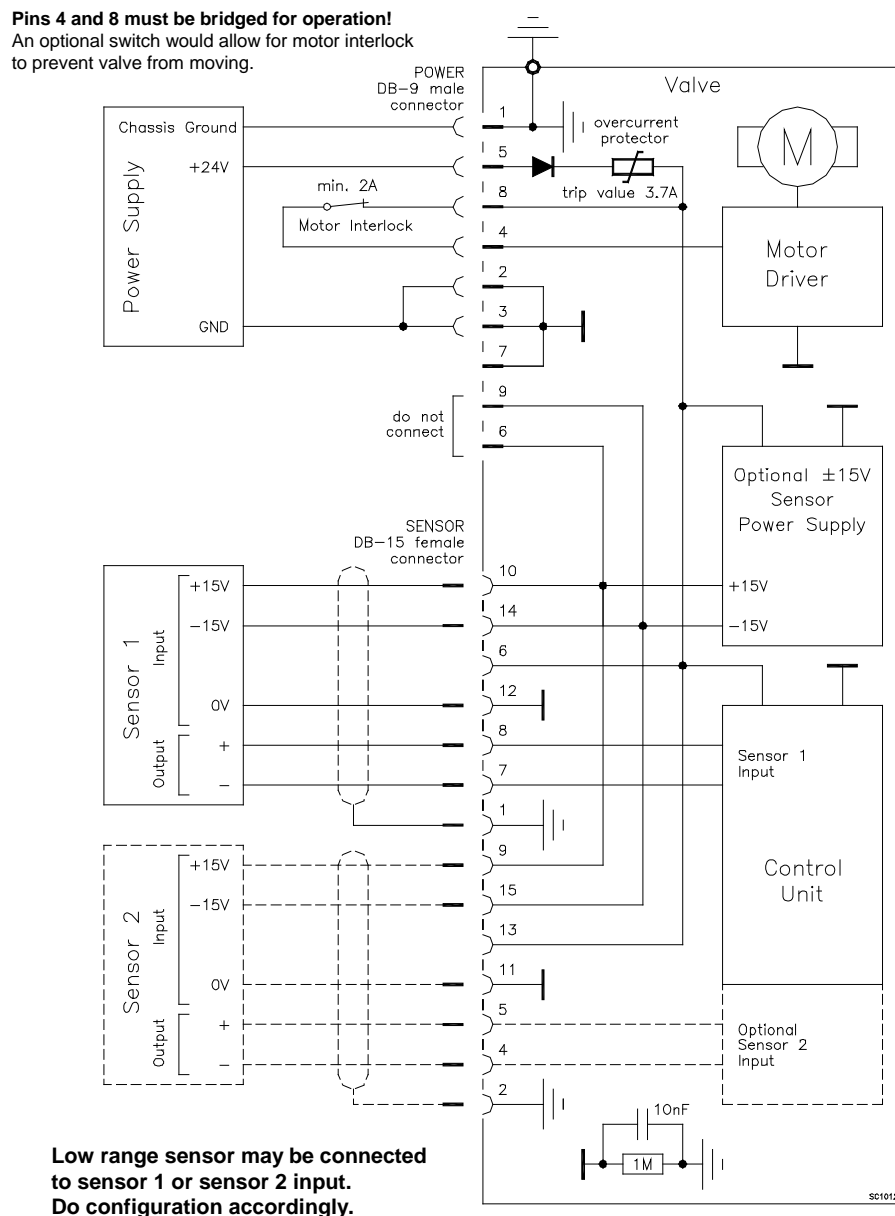


#### Note:

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect the  $\pm 15$  VDC sensors at DB-15 female sensor connector exactly as shown in the drawing above. Do not connect other pins, that may damage power supply or controller!
- Connector: Use only screws with 4-40UNC thread for fastening the connectors!

### 2.6.5 Power and sensor connection ( $\pm 15$ VDC sensors) with optional SPS module

[650 .. - .. **A** . - ..... / 650 .. - .. **C** . - ..... versions only]

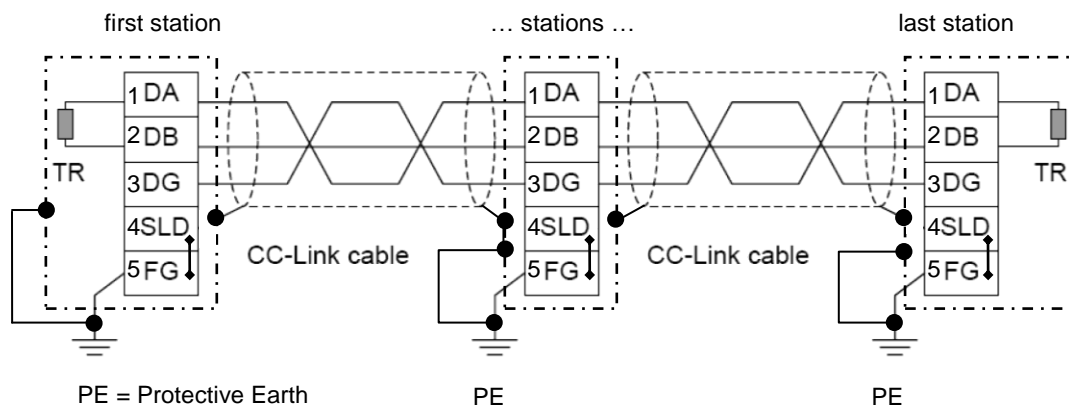


**Note:**

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect the  $\pm 15$  VDC sensors at DB-15 female sensor connector exactly as shown in the drawing above. Do not connect other pins, that may damage power supply or controller!
- Connector: Use only screws with 4-40UNC thread for fastening the connectors!

## 2.6.6 CC-Link interface connection

### 2.6.6.1 CC-Link cable installation (example)



--- = Connector housing



↕ = Internal connection between «SLD and FG»

TR = Terminal resistor (Must be compatible to used CC-Link cable version!)

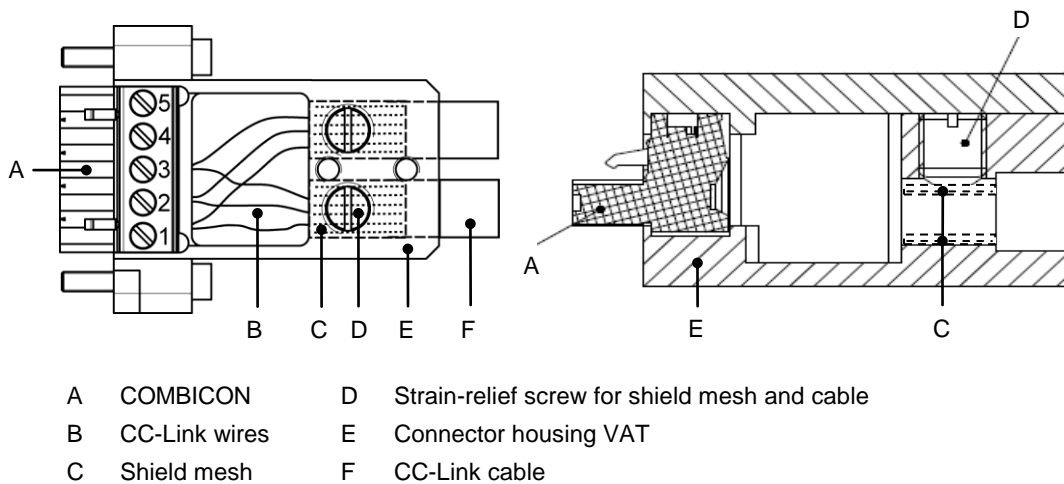
**Note:** The valve can be defined as «first station», «...stations...» between first and last, or «last station». If the valve at first or last station, «TR» must be installed between 1 (DA) and 2 (DB).

**Note:** The station type for VAT valves are: Version 2 Remote Device Station.

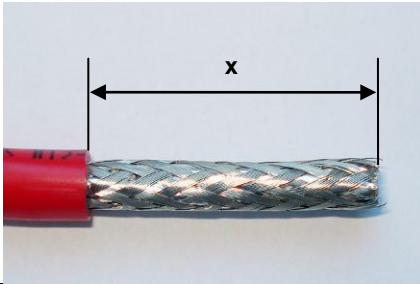


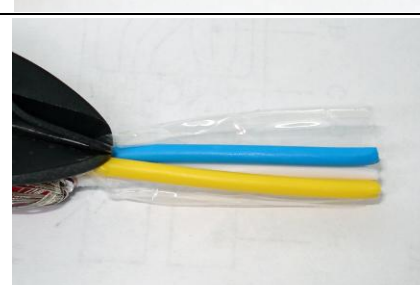
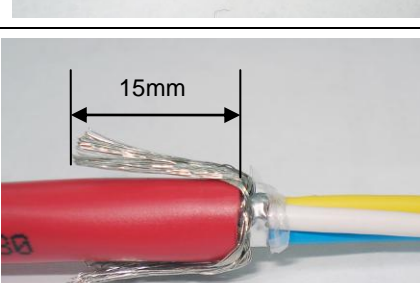
### 2.6.6.2 Preparing CC-Link connector

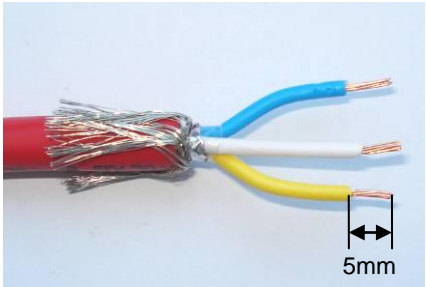
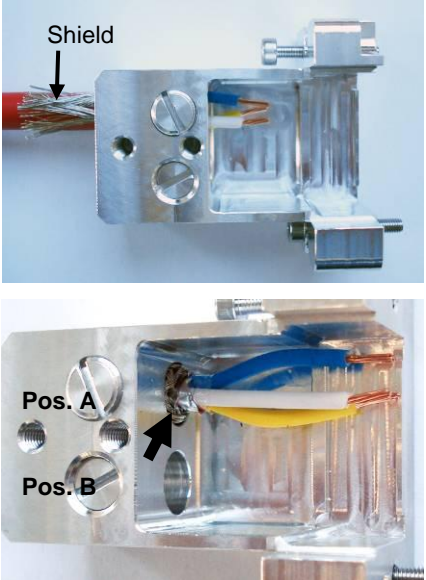
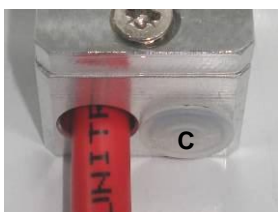

Description	Required tool
<p>1. Remove «COMBICOM» connector (A) at valve controller</p>	 <p>sample picture</p>
<p>2. Prepare all parts of connector for installation</p> <p><b>Note:</b> All parts of connector are supplemented in a plastic bag (407612), except «COMBICOM» connector from valve controller</p>	

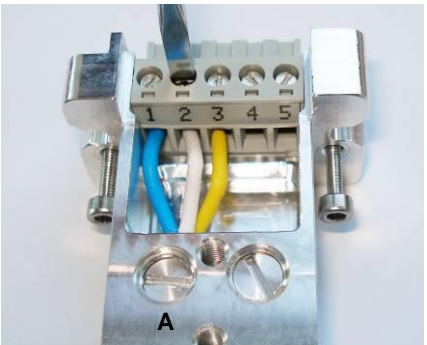
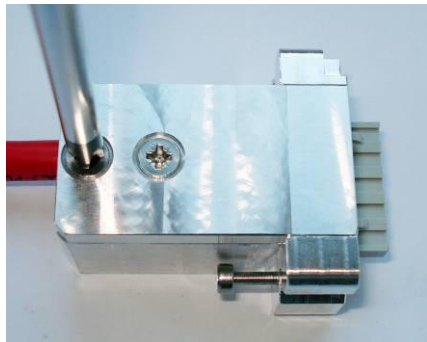
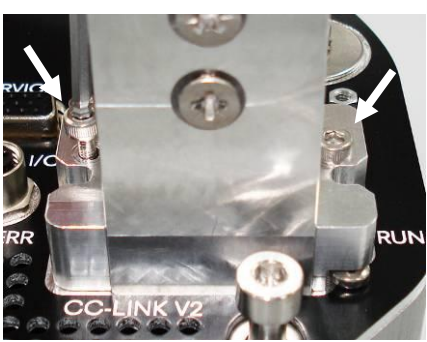
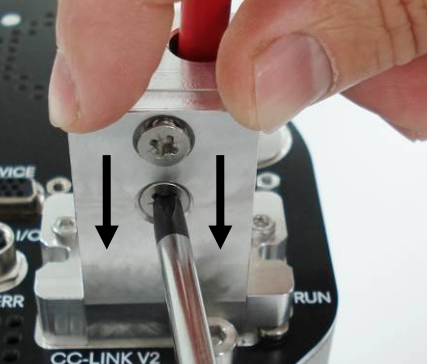
### 2.6.6.3 CC-Link connector overview



#### 2.6.6.4 Install CC-Link cable at valve controller

Description		Required tool
<p>3. Remove the cable coat carefully</p> <ul style="list-style-type: none"> <li>■ Cable Pos. A, <b>x</b> about 30mm</li> <li>■ Cable Pos. B, <b>x</b> about 40mm</li> </ul> <p><b>Note:</b> Pos. see step 8</p>		Knife
4. Cut off the shield wire		Side-cutting pliers
5. Cut off the aluminum shield and remove it		Side-cutting pliers
<p>6. Cut off the plastic and remove it</p> <p><b>Note:</b> Take care to the wires. Do not damage the isolation of wires!</p>		Side-cutting pliers
<p>7. Cut off the shield wires about 15mm</p> <p>8. Separate the shield wires in two equal quantum and place them 180° opposite</p>		Side-cutting pliers

Description		Required tool
<p>9. Remove the wire coat carefully about 5mm</p>		<p>Wire strippers</p>
<p>10. Insert the cable(s) at connector housing as shown in the pictures, see also chapter CC-Link connector</p> <p><b>Note:</b> If valve in CC-Link network is at «first or last station» install the CC-Link cable at position A and close B with blind plug C.</p> <p>If valve in CC-Link network at «...stations...» install the CC-Link cables at position A and B.</p>		
<p>11. Fasten the strain-relief screw until the cable can not pulled out by manual force</p>		<p>Screw driver size 4</p>

Description		Required tool
<p>12. Install the CC-Link wires, see also «Connector type» table below</p> <p><b>Note:</b>            If cable at pos. A (first or last station) install «TR» between 1 and 2            1 x blue to 1            1 x white to 2            1 x yellow to 3</p> <p>If cables at pos. A + B (...stations...) install            2 x blue to 1            2 x white to 2            2x yellow to 3</p>		<p>Screw driver size 1</p>
<p>13. Close the cover of connector and fasten the screws a little</p>		<p>Pozidriv screw driver size 2</p>
<p>14. Connect the connector and fasten it with the screws at controller (sample picture)</p>		<p>Allen Wrench 2.5 mm</p>
<p>15. Push the cover down to controller and fasten the cover screws (sample picture)</p>		<p>Pozidriv screw driver size 2</p>



**Connector type:** COMBICON 2.5 / 5 - ST – 5, 08 with special VAT housing

PIN interface connector	Signal	Color of isolator (CC-Link wires)	Comment
1	DA	Blue	Positive RS485 RxD/TxD
2	DB	White	Negative RS485 RxD/TxD
3	DG	Yellow	Signal Ground
4	SLD	-	Cable Shield
5	FG	-	Functional Ground

The CC-Link interface is galvanic isolated from control unit.

#### 2.6.6.5 CC-Link network and cable

**Note:**

For detail information about «**CC-Link cable, wiring and TR**» refer to CC-Link homepage:  
<http://www.cc-link.org> > «CC-Link Cable Wiring Manual»

## 2.6.7 LOGIC I/O

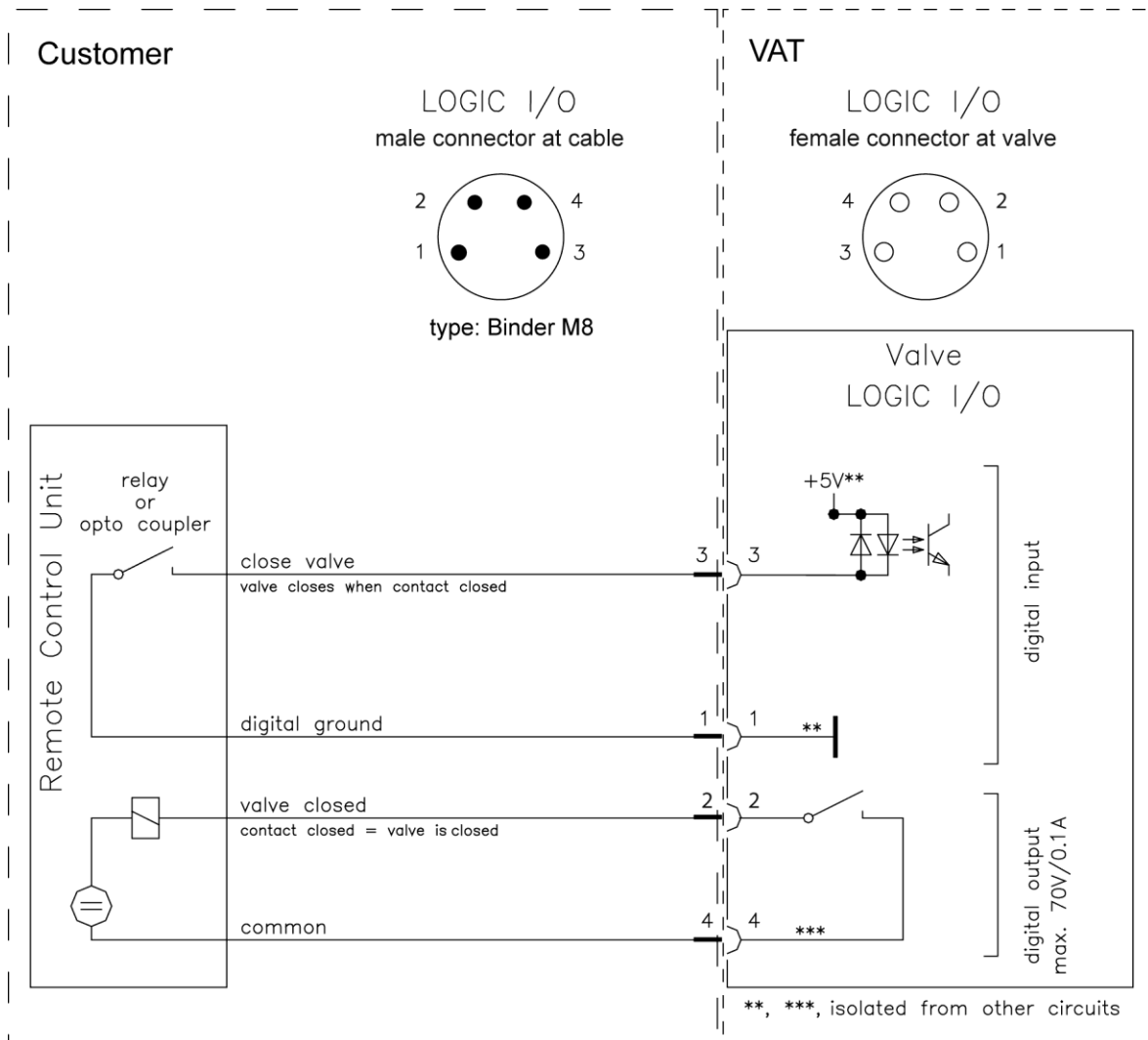
This interface allows for remote operation by means of a command set based on the CC-Link protocol. In addition there is a digital input and a digital output. Digital input may only be operated by a switch.

Active **digital input** has:



- **higher priority than CC-Link** commands
- **higher priority than Local** commands

**Configuration with switch for digital input:**



**Note:** Do not connect other pins than indicated in the schematics above! Connector type: Binder M8 (99-3363-00-04).



### 2.6.8 Digital input

Pin	Function	Signal type	Description	Priority
3	CLOSE VALVE	Digital input <sup>1)</sup>	<p>This function will close the valve. Valve will be in interlock mode as long as function is activated. After deactivation of function it will remain effective until</p> <ul style="list-style-type: none"><li>- converse CC-Link control command have been received</li></ul> <p>The function is activated when optocoupler is 'on' in <b>non inverted</b> configuration. The function is activated when optocoupler is 'off' in <b>inverted</b> configuration.</p> <p>Configuration can be adjusted in local operation via service port with CV, CPA or Hyper terminal. Refer to chapter: «LOGIC I/O configuration».</p>	1 <sup>2)</sup>
1	DIGITAL GROUND	Digital ground	<p>Ground for digital input. Connect switch to ground. See also «2.6.7 LOGIC I/O Fehler! Verweisquelle konnte nicht gefunden werden.».</p>	

- 1) The digital input is digitally filtered. Filter delay is 50ms. This means that digital signal must be applied for at least 50ms to be effective.  
Refer to «2.6.7 LOGIC I/O» for details about input circuit.
- 2) Highest priority is 1. Functions with lower priorities will not be effective as long as higher priority functions are active. The digital input has higher priority than all CC-Link and Local commands.

### 2.6.9 Digital output

Pin	Function	Signal type	Description	Priority
2	VALVE CLOSED	Digital output	This function will indicate that the valve is closed.	
4	DIGITAL COMMON	Digital common	<p>Common for all digital output. Connect + or – terminal of source with common. See also «2.6.7 LOGIC I/O».</p>	

### 2.6.10 Service port connection

The service port (connector: SERVICE) allows to connect the valve to a RS232 port of a computer. This requires a service cable and software from VAT. You can either use our freeware 'Control View', which can be downloaded from [www.vatvalve.com](http://www.vatvalve.com) or purchase our 'Control Performance Analyzer'. Alternatively the VAT Service Box 2 can be connected to the service port for setup and local operation. The service port is not galvanic isolated. Therefore we recommend using this only for setup, testing and maintenance and not for permanent control. Refer also to «Local Operation» for details and to «Spare parts / Accessories» for ordering numbers of service cable, software and Service Box 2.

**Connector:** Use only screws with 4-40UNC thread for fastening the service port connector!

### 3 Operation



Operation is allowed after completion of the installation procedure only.

#### 3.1 Introduction

This valve is designed for downstream pressure control in vacuum chambers. It can be employed in a pressure control mode or a position control mode.

In both cases local or remote operation is possible.

##### 3.1.1 Local operation

Local operation means that the valve is operated via the service port using a computer or the Service Box 2. When using a computer, a service cable and a software from VAT are required. You can either download our freeware 'Control View' from [www.vatvalve.com](http://www.vatvalve.com) or purchase our 'Control Performance Analyzer'.

These software are beneficial especially for setup, testing and maintenance.

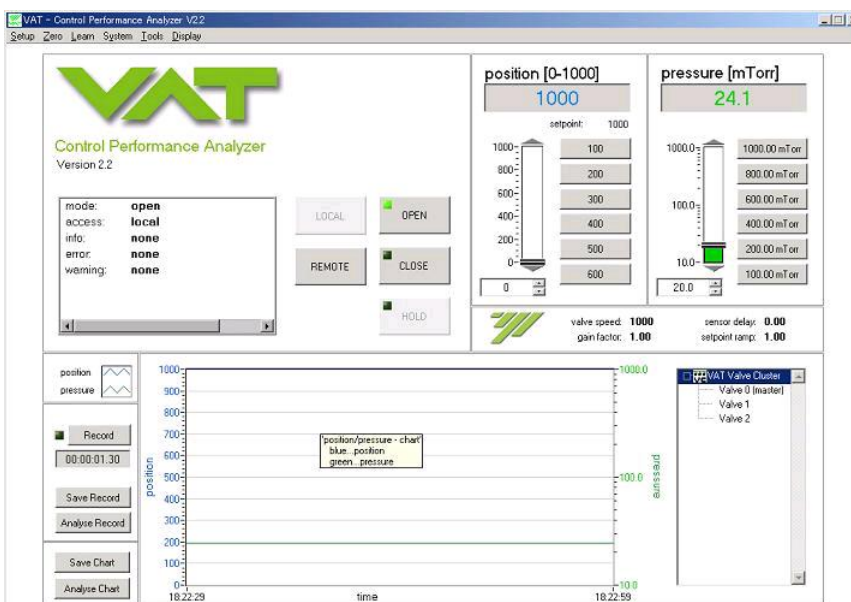
**How to start:** Connect service cable, start software and push button 'LOCAL' to enable for operation. Then enter menu Setup/Sensor and do sensor configuration according to your application to make sure that you get the correct pressure displayed.

'Control view' supports:

- parameter setup
- manual control
- numeric monitoring
- basic diagnostic

'Control Performance Analyzer' supports:

- parameter setup
- manual control
- sequence control
- numeric and graphical monitoring
- data recording
- data analysis
- advanced diagnostic



When communication to service port is interrupted the valve will change to remote operation. So when service cable will be disconnected or software will be shut down, the valve returns automatically to remote operation.

This may result in an immediate movement of the valve depending on remote control.

Refer to «Spare parts / Accessories» for ordering numbers of service cable, software and Service Box 2.



### 3.1.2 Remote operation

This product is equipped with a CC-Link interface to allow for remote operation. See section «CC-Link Interface» for details. 'Control View' software, 'Control Performance Analyzer' software or 'Service Box 2' may be used for monitoring during remote control.

**Note:** In case 'Control View' or 'Control Performance Analyzer' software is connected to valve make sure 'REMOTE' button is pushed to enable for remote operation. In case Service Box 2 is connected to valve make sure the LED on button 'LOCAL' is OFF for remote operation.

### 3.1.3 Safety mode

By means of an external switch (see connection diagrams «Electrical connection») the motor power supply can be interrupted. In this case the valve enters the 'safety mode'. This motor interlock prevents the valve from moving (e.g. maintenance work). Data reading from the control unit remains possible.

When motor interlock is active during power up the valve directly enters the 'safety mode' and is not able to synchronize. Display shows 'D C' or 'D999'. In this case synchronization cycle will be done when motor interlock is deactivated. Then Display shows 'INIT' for a moment followed by 'SYNC'.

When 'safety mode' is entered from operation (i.e. pressure control mode), the unit will automatically switch to position control mode and remain at current position. Once motor interlock is deactivated the unit remains in position control mode.

## 3.2 Operation under increased temperature

This valve may be operated in the temperature range mentioned in chapter «Technical data».

## 3.3 Behavior during power up

Valve position before power up:	Reaction of valve:	
	Valve power up configuration = closed (default)	Valve power up configuration = open
Closed (isolated)	Valve remains closed. Display shows alternately 'C C' and 'INIT'. Synchronization will be done when first movement command is received.	Valve runs to max. throttle position to detect the limit stops to synchronize. Display shows configuration of product resp. 'SYNC' until synchronization is done. Valve position after power up is open.
All other than closed (not isolated)	Valve runs to max. throttle position to detect limit stop for synchronization. Display shows configuration of product resp. 'SYNC' until synchronization is done. Valve position after power up is closed	Valve position after power up is open

Refer also to chapter «Display information».



### 3.4 Behavior in case of power failure

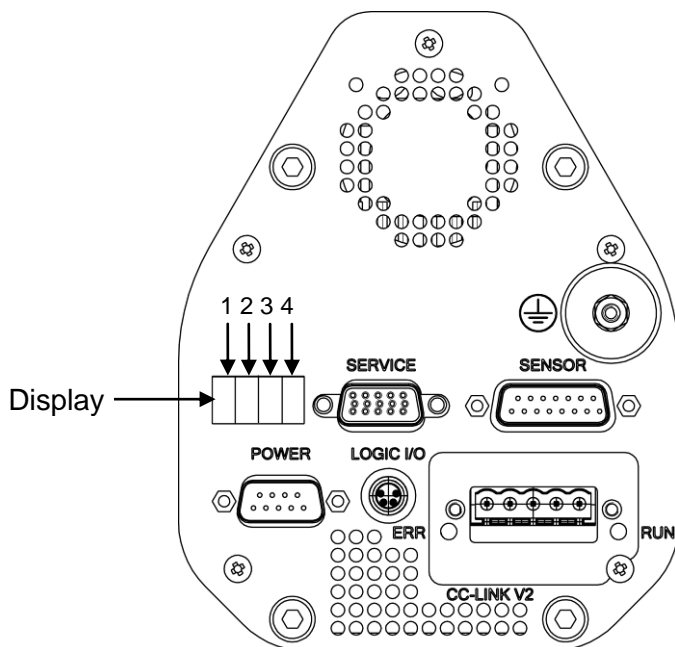
Valve position before power failure:	Reaction of valve:	
	Without Power Failure Option (PFO)	With Power Failure Option (PFO)
	650 . . . . <b>G</b> . . . . . 650 . . . . <b>A</b> . . . . . 650 . . . . <b>T</b> . . . . . 650 . . . . <b>V</b> . . . . .	650 . . . . <b>H</b> . . . . . 650 . . . . <b>C</b> . . . . . 650 . . . . <b>U</b> . . . . . 650 . . . . <b>W</b> . . . . .
Closed (isolated)	Valve remains closed.	Valve will close or open depending on valve configuration *).
Valve open or in any intermediate position	Sealing ring moves down and blocks the pendulum plate at the current position.	Default is not defined. Display indicates <b>F</b> .

\*) Provided that battery pack of the VAT controller is charged. Charging time after power up is 2 minutes max..

All parameters are stored in a power fail save memory.

### 3.5 Display information

There is a 4 digit display located on the panel. It displays configuration, status and position information. For details refer to following tables.



#### Power up:

Description	Digit 1	Digit 2	Digit 3	Digit 4
At first all dots are illuminated then configuration is displayed:	1	E	0	0
<ul style="list-style-type: none"> <li>Firmware version [e.g. 1E00] (1<sup>st</sup> information for about 2s)</li> <li>Controller configuration (2<sup>nd</sup> information for about 2s)</li> </ul>		A = No or unknown busmodule detected	0 = basic	
In case <b>D C</b> or <b>D999</b> is displayed, motor interlock is active. Refer to «Safety mode» for details.		I = CC-Link interface	1 = with SPS <sup>1)</sup>	1 = 1 sensor version
If valve is closed (isolated) display shows alternately <b>C C</b> and <b>INIT</b> . Synchronization will be done when first movement command is received.			2 = with PFO <sup>2)</sup>	2 = 2 sensor version
			3 = with SPS <sup>1)</sup> and PFO <sup>2)</sup>	
<b>SYNC</b> indicates that synchronization is running.	S	Y	N	C

1) SPS = optional ±15 VDC Sensor Power Supply module

2) PFO = optional Power Failure Option

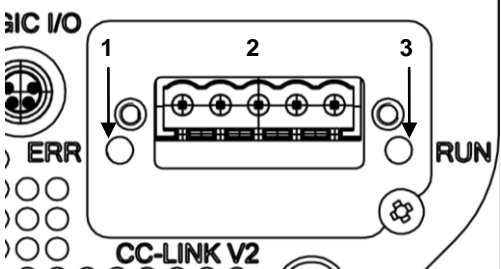
**Operation:**

Description / Mode	Digit 1	Digit 2	Digit 3	Digit 4
PRESSURE CONTROL mode	<b>P</b>	<b>0 . . . 100</b> = valve position (% , 0 = closed / 100 = open)		
POSITION CONTROL mode	<b>V</b>			
Valve closed	<b>C</b>			
Valve open	<b>O</b>			
Closed / open interlock (Valve closed / open by digital input)	<b>I</b>			
HOLD (position frozen) activated	<b>H</b>			
ZERO running	<b>Z</b>			
LEARN running	<b>L</b>			
Safety mode established. Refer to «Safety mode» for details.	<b>D</b>			
Power failure	<b>F</b>			

**Errors:**

Description	Digit 1	Digit 2	Digit 3	Digit 4
Compressed air failure (< 4 bar / 55 psi)	<b>A</b>	<b>I</b>	<b>R</b>	<b>f</b>
Compressed air on exhaust	<b>A</b>	<b>I</b>	<b>R</b>	<b>x</b>
Fatal error occurred	<b>E</b>	Error code. Refer to «Trouble shooting» for details		

### 3.5.1 CC-Link LEDs

#	Item	
1	Error LED	
2	CC-Link Interface connector	
3	Run LED	

#### Run LED (3)

State	Meaning
Off	No network participation, timeout status (no power)
Green	Participating, normal operation
Red	Major fault (FATAL error)

#### Error LED (1)

State	Meaning
Off	No error detected (no power)
Red	Major fault (Exception or FATAL event)
Red, flickering	CRC error (temporary flickering)
Red, flashing	Station Number or Baud rate has changed since startup (flashing)

### 3.6 Setup procedure



To enable this valve for **pressure control** setup **steps 1 to 5 must be performed**.  
In case position control is required only it's sufficient to perform steps 1 to 3.

Setup step		Description
1	<b>Power up</b>	Turn on external + 24VDC power supply (and external $\pm 15$ VDC for sensor power supply if required). Refer to chapter «Behavior during power up» for details.
2	<b>CC-Link configuration</b>	<ol style="list-style-type: none"> <li>1. Station Number</li> <li>2. Transmission rate</li> <li>3. Operational settings mode</li> </ol> Refer to chapter «CC-Link configuration» for details.
3	<b>Valve and sensor configuration</b>	Basic configurations of the valve must be adapted according to application needs. Refer to chapter «Valve and sensor configuration» for details.
4	<b>ZERO</b>	Compensation of the sensor offset voltage. Refer to chapter «ZERO» for details.
5	<b>LEARN</b>	Determination of the vacuum system characteristic to accommodate the PID controller. Refer to chapter «LEARN» for details. <b>Note:</b> Without LEARN the valve is not able to run pressure control



### 3.6.1 CC-Link configuration

**Note:** The station type for VAT valves are: Version 2 Remote Device Station.

#### 1. Station Number

The «station number» is used to distinguish between stations on the CC-Link network. Unique station numbers in consecutive order without duplication must be used, when assigning stations to the CC-Link network.

The «station number» can be configured by 'Control View', 'Control Performance Analyzer', 'Universal Hyper Terminal or 'Service Box 2'.

The «set-command» is: «s:25xxx00000». The xxx value is the «station number». Valid range is 001 to 064.

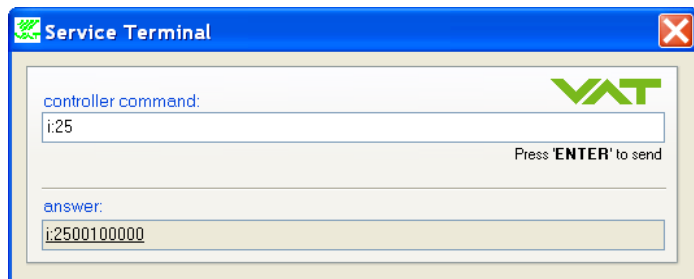
The «get-command» is: «i:25». The answer returns the node address → «i:25xxx00000». The xxx value is the current «station number».

Consider that the controller must be in local mode to accept the commands! After a «s:25» command is sent the module is reseted and starts up again.

«c:0100» → change into local mode

«c:0101» → change into remote mode

Example «get-command» with Terminal:





## 2. Transmission rate

Use the same «transmission rate» for all stations in the bus and also for master station. If any of the settings for at least one station is different, data link cannot be established normally.

The «transmission rate» can select from 156 kbps / 625 kbps / 2.5 Mbps / 5 Mbps / 10 Mbps

The «transmission rate» can be configured by 'Control View', 'Control Performance Analyzer', 'Universal Hyper Terminal' or 'Service Box 2'.

The «set-command» is: «s:21xxx00000». The xxx value is the «transmission rate» shown in the table below

The «get-command» is: «i:21». The answer returns the «transmission rate» → «i:21xxx00000». The xxx value is the current «transmission rate».

Consider that the controller must be in local mode to accept the commands! After a s:21 command is sent the module is reseted and starts up again.

«c:0100» → change into local mode

«c:0101» → change into remote mode

Value	Transmission rate
000	156 kbps
001	625 kbps
002	2.5 Mbps
003	5 Mbps
004	10 Mbps

## 3. Operational settings mode

The «operational settings mode» defines the following CC-Link parameters:

- **CC-Link version**
- **Number of occupied stations:** The number of stations (occupying one stations worth of memory area) used by a single slave station in a network.
- **Extended cyclic settings:** In the extended cyclic transmission (only Ver.2), the extended cyclic points can be set as 2 times, 4 times or 8 times of the normal cyclic transmission points.

The VAT slave supports two combinations of the CC-Link parameter settings.

Value	Operational settings
001	CC-Link Ver.2 / Occupies 1 station / Octuple expanded cyclic
004	CC-Link Ver.2 / Occupies 4 stations / Double expanded cyclic

The «operational settings mode» can be configured by 'Control View', 'Control Performance Analyzer', 'Universal Hyper Terminal' or 'Service Box 2'.

The «set-command» is: «s:22xxx00000». The xxx value is the operational settings mode!

The «get-command» is: «i:22». The answer returns the «operational settings mode» → «i:22xxx00000». The xxx value is the current operational settings mode.

Consider that the controller must be in local mode to accept the commands! After a s:22 command is sent the module is reseted and starts up again.

«c:0100» → change into local mode

«c:0101» → change into remote mode

#### 4. Data type of pressure and position values (optional)

The «data type of pressure and position» can be configured by 'Control View', 'Control Performance Analyzer', 'Universal Hyper Terminal' or 'Service Box 2'.

The «**set-command**» is: «**s:23xxy00000**». The xxy value is the data type of a pressure and position signal.

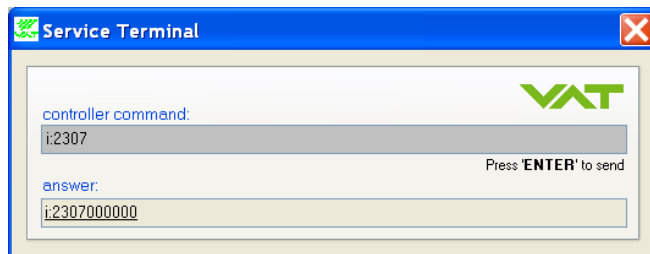
y: 0 = signed integer(32 bit), 1 = floating point (32 bit, IEEE-754 standard), default = 0

xx: signal number in the buffer

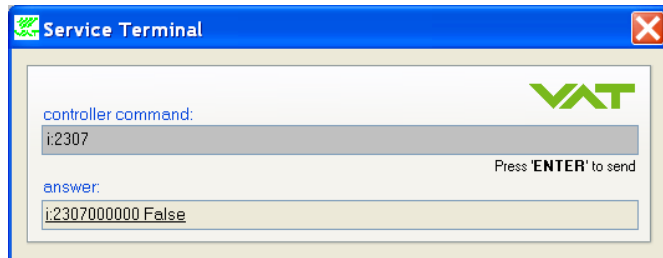
xx	Value
00	Pressure
01	Pressure sensor 1
02	Pressure sensor 2 (optional, only in case of 2 sensor version)
03	Position
04	<i>Not used – reserved</i>
05	<i>Not used – reserved</i>
06	Pressure setpoint
07	Position setpoint
08	<i>Not used – reserved</i>
09	<i>Not used – reserved</i>
10	<i>Not used – reserved</i>
11	<i>Not used – reserved</i>

The «**get-command**» is: «**i:23xx**». The answer returns the data type of a pressure and position signal → «i:23xxy00000». The y value is the current data type of buffer value xx.

Example «get-command» with Terminal: Get the data Type of Position setpoint:



**Note:** If at start up the data type value in the memory is out of range the default value is taken. In this case the data type is set to default value (0 = signed integer) and the get command i:23 add a string "False":



## 5. Range of pressure and position values (optional)

The «range of pressure and position values» can be adjusted. That means:

- For position values, the value for valve position “CLOSE” and the valve position “OPEN” can be set to a other ones then the default 0...100'000 is.
- For pressure values, the value for physical **0 Volt** and **10 Volt** of the sensor output can be set to other values then the default 0...1'000'000 is.

The range of pressure and position values can be configured by 'Control View', 'Control Performance Analyzer' or 'Universal Hyper Terminal'.

The «**set-command**» is: «**s:24xytoz**».

y: **lower scale value**, floating point, entry with a point '.' and '-' for negative values possible

z: **upper scale value**, floating point, entry with a point '.' and '-' for negative values possible

xx: signal number in the buffer

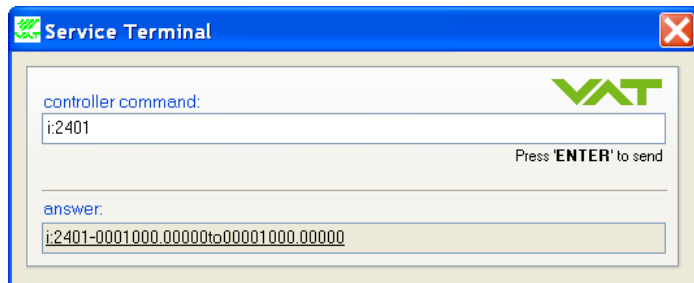
xx	Value	Default range		Min/Max range	
		Default lower scale value	Default upper scale value	Min lower scale vlaue	Max upper scale value
00	Pressure	0	1'000'000	-1'000'000	1'000'000
01	Not used – reserved	-	-	-	-
02	Not used – reserved	-	-	-	-
03	Position	0	100'000	-1'000'000	1'000'000
04	Not used – reserved	-	-	-	-
05	Not used – reserved	-	-	-	-
06	Pressure setpoint	0	1'000'000	-1'000'000	1'000'000
07	Position setpoint	0	100'000	-1'000'000	1'000'000
08	Not used – reserved	-	-	-	-
09	Not used – reserved	-	-	-	-
10	Not used – reserved	-	-	-	-
11	Not used – reserved	-	-	-	-

The «**get-command**» is: «**i:24xx**». The answer returns the range → «i:24xytoz». The xx is the value number, y value is the current lower scale value of buffer and value z the upper scale value.

The format of y and z has following syntax: \_ \_ \_ \_ \_ . \_ \_ \_ \_ \_

Examples: i:2400-0012345.12345to00123456.12345  
i:2401-0001000.00000to00001000.00000  
i:240200001000.00000to00001500.00000

Example «get-command» with Terminal: Get the range of Pressure Sensor 1:





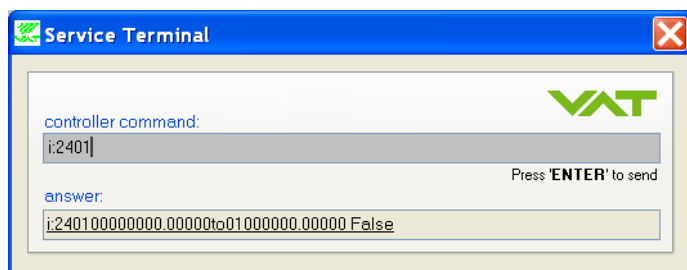
The «range of pressure and position values» is independent of the data type, equal for «signed integer» and «floating point».

**Note:** The internal accuracy of valve is for all positions 100'000 steps and for all pressures 1'000'000 steps. If the range of pressure and position values is rising, the accuracy of pressure and position will not rise. There is only the gain factor between the VAT valve and the CC-Link Master which will be adapted.

**Note:**

$$(\text{upper scale value} - \text{lower scale value}) \geq 1$$

**Note:** If at startup the scale values in the memory are out of range or the rule above is broken the default values are taken. In this case the get command i:24 add a string "False":



Example: s:24031234.56to7890 → set the range of position from 1234.56 (= closed position) to 7890 (= opened position)

Example: s:24000to100.75 → set the range of pressure from 0 (= 0 V) to 100.75 (= 10 V)

Example: s:2411-10.5to20.5 → set the range of cluster valve freeze position from -10.5 (=closed position) to 20.5 (=opened position)

### 3.6.2 LOGIC I/O configuration

The «logic digital input close valve» can adjusted. See also chapter «LOGIC I/O».

The «logic digital input close valve» can be configured by 'Control View', 'Control Performance Analyzer', 'Universal Hyper Terminal' or 'Service Box 2'.

The «set-command» is: «s:20000000a0».

The «get-command» is: «i:20». The answer returns the «operational settings mode» → «i:20000000a0».

Description:

code	description	data range
s:20	command header	
a	mode selection	0 = non inverted 1 = inverted 2 = disabled



### 3.6.3 Valve and sensor configuration

Basic valve configuration must be adapted according to application needs.

- Definition of valve plate position in case of:
  - **After power up**, default is 'close'.
  - **Power failure**, default is 'not defined'. Only for versions that have Power Fail Option equipped [650 . . . . **C** . . . . or 650 . . . . **H** . . . . ].
  - **Network failure**, default setting refer to individual product data sheet.
- ZERO function. This may be 'disabled' or 'enabled'. Default is 'enabled'. Refer also to «ZERO».
- Sensor configuration for 2 sensor version [650 . . . . . **F** . . . . ].  
Refer also to «Pressure control operation with 2 sensors».

Local operation: (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2’)	Remote operation:
1. Do power up configuration in menu ‘Setup / Valve’.	<b>Note:</b> It's not possible to do ‘Valve and sensor configuration’ via CC-Link.
2. Do power fail configuration in menu ‘Setup / Valve’.	
3. Do network failure configuration  Go to ‘Tools / Terminal’ menu and use the following commands  to change the configuration: s:04abcdefgh[CR] to read the configuration: i:04[CR]  <b>Note:</b> Each element is separated with square brackets for clarity. Square brackets are not part of command syntax. All elements are ASCII characters. There are no spaces between the elements necessary. Command is <u>case sensitive</u> .  abcd reserved; do not change e <b>0</b> = valve will close <b>1</b> = valve will open <b>2</b> = valve no change fgh reserved; do not change	
4. Enable or disable ZERO function in menu ‘Setup / Sensor’.	
5. Do 2 sensor configuration in menu ‘Setup / Sensor’.	

**Note:** Read first current configuration and do not change reserved bits when sending new configuration.



### 3.6.4 ZERO

ZERO allows for the compensation of the sensor offset voltage.

When ZERO is performed the current value at the sensor input is equated to pressure zero. In case of a 2 sensor system both sensor inputs will be adjusted. A max. offset voltage of +/- 1.4 V can be compensated. The offset value can be read via local and remote operation.

Local operation: (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2’)	Remote operation: (Refer to chapter «OUTPUT Buffer» > «GENERAL CONTROL SETPOINT» for details)
Go to menu ‘Zero / ZERO’ and follow instructions.	1. Wait until process chamber is evacuated and sensor signal is not shifting anymore.
	2. In «OUTPUT Buffer» > «GENERAL CONTROL SETPOINT» set [ZERO] (value = 1) only short impulse ca. 1sec.
	3. Wait until «ZERO EXECUTED» (value = 1) (see INPUT Buffer).

**Note:** Do not perform ZERO as long as pressure gauge voltage is shifting otherwise incorrect pressure reading is the result. Refer to manual of sensor manufacturer for warm up time.

**Note:** Do not perform ZERO, if the base pressure of your vacuum system is higher than 1‰ of sensor full scale. We recommend disabling ZERO function in this case; refer to «Valve and sensor configuration» of the setup procedure. Otherwise incorrect pressure reading is the result.



### 3.6.5 LEARN

LEARN adapts the PID controller of the valve to the vacuum system and its operating conditions. LEARN must be executed only once during system setup.

The LEARN routine determines the characteristic of the vacuum system. Based on this, the PID controller is able to run fast and accurate pressure control cycles.

This characteristic depends on various parameters such as chamber volume, conductance and flow regime. Therefore it must be performed with a specific gas flow according to instruction below.

The result of LEARN is a pressure versus valve position data table. This table is used to adapt the PID parameters. The data table is stored in the device memory which is power fail save. The data table can be up-/downloaded via 'Control Performance Analyzer' software or remote interface. Due to encoding the data may not be interpreted directly.

By an OPEN VALVE, CLOSE VALVE, POSITION CONTROL or PRESSURE CONTROL command the routine will be interrupted.

Local operation: (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2’)	Remote operation: (Refer to chapter: «OUTPUT Buffer» respective «INPUT Buffer» for details)
Go to ‘Learn / LEARN’ menu and follow instructions.  <b>Note:</b> Gasflow calculation according to recommendation below is done automatically based on inputs.	1. Set specific gas flow according to calculation below and wait until flow is stable. Autolearn does not need to be performed with the process gas. Instead N <sub>2</sub> or Ar may be used.
	2. Go to «OUTPUT Buffer» > «CONTROL MODE SETPOINT»
	3. Set «Learn» (value = 7)  <b>Note:</b> No pressure limit is settable. Learn is always done up to the maximum sensor value which equals to 10V sensor input signal.
	4. Wait until «LEARN PROCEDURE SUCCESSFULLY FINISHED» (value = 1) at «INPUT Buffer»

**Note:** Sensor signal must not shift during LEARN. Wait until sensor signal is stable before LEARN is performed.

**Note:** Learn may take several minutes. Do not interrupt the routine as **a single full run is required to ensure fast and accurate pressure control**. The PID controller covers 5% to 5000% of the gas flow which was used for learn. If learn finished the valve goes to position mode.

**Gasflow calculation for LEARN:**


Do not apply a different gasflow for learn than determined below. Otherwise pressure control performance may be insufficient.

Choose the applicable formula depending on units you are familiar with.

$$q_L = \frac{p_{SFS} \cdot C_{min}}{2000}$$

$q_L$  gasflow for learn [**Pa m<sup>3</sup>/s**]  
 $p_{SFS}$  sensor full scale pressure [**Pa**]  
 $C_{min}$  min. controllable conductance of valve [l/s], (refer to «Technical data»)

$$q_L = \frac{p_{SFS} \cdot C_{min}}{2}$$

$q_L$  gasflow for learn [**mbar l/s**]  
 $p_{SFS}$  sensor full scale pressure [**mbar**]  
 $C_{min}$  min. controllable conductance of valve [l/s], (refer to «Technical data»)

$$q_L = 39.4 \cdot p_{SFS} \cdot C_{min}$$

$q_L$  gasflow for learn [**sccm**]  
 $p_{SFS}$  sensor full scale pressure [**Torr**]  
 $C_{min}$  min. controllable conductance of valve [l/s], (refer to «Technical data»)

**3.7 Close valve**

Local operation: (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2’)	Remote operation: (Refer to chapter «OUTPUT Buffer» > «CONTROL MODE SETPOINT» for details)
Push CLOSE button	<ol style="list-style-type: none"> <li>1. In «OUTPUT Buffer» &gt; «CONTROL MODE SETPOINT»</li> <li>2. Select [Close] (value = 3)</li> </ol>

**3.8 Open valve**

Local operation: (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2’)	Remote operation: (Refer to chapter «OUTPUT Buffer» > «CONTROL MODE SETPOINT» for details)
Push OPEN button	<ol style="list-style-type: none"> <li>1. In «OUTUT Buffer» &gt; «CONTROL MODE SETPOINT»</li> <li>2. Select [Open] (value = 4)</li> </ol>

### 3.9 Position control

The valve position is directly controlled according to the position setpoint.

Local operation: (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2’)	Remote operation: (Refer to chapter «OUTPUT Buffer» for details)
Select or enter position setpoint	1. In «OUTPUT Buffer» > « POSITION SETPOINT» 2. Select a valid value
	3. In «OUTPUT Buffer» > «CONTROL MODE SETPOINT» 4. Select [Position] (value = 2)

### 3.10 Pressure control



To prepare valve for PRESSURE CONTROL perform complete «**Setup procedure**».

The valve has parameters that may be modified to tune pressure control performance.  
Refer to «**Tuning of control performance**».

The included PID controller controls the chamber pressure according to the pressure setpoint by means of the valve position. The PID controller works with an adaptive algorithm to achieve best results under altering conditions (gasflow, gas type).

Local operation: (‘Control View’ resp. ‘Control Performance Analyzer’)	Remote operation: (Refer to chapter «OUTPUT Buffer» for details)
Select or enter pressure setpoint	1. In «OUTPUT Buffer» > «PRESSURE SETPOINT» 2. Select valid value
	3. In «OUTPUT Buffer» > «CONTROL MODE SETPOINT» 4. Select [Pressure] (value = 5)



### **3.10.1 Pressure control operation with 2 sensors**

[applicable with 650 . . . . . N- . . . . version only]

If 2 sensor operation is enabled, changeover between the sensors is done automatically during pressure control. For configuration refer to chapter «Setup procedure». We recommend a ratio of 10:1 between the pressure gauges. Max. ratio is 100:1. High range respectively low range pressure gauge may be either connected to sensor 1 or sensor 2 input.

It's required to do correct sensor configuration.

Between 90 and 100% of the low range sensor full scale, the low range sensor is phased out while high range sensor is phased in during pressure rise. During pressure decrease the high range sensor is phased out while low range sensor is phased in. This maintains a functional response behavior in case of small calibration errors between the two sensors. The PRESSURE output in this range is a blend between both sensors.

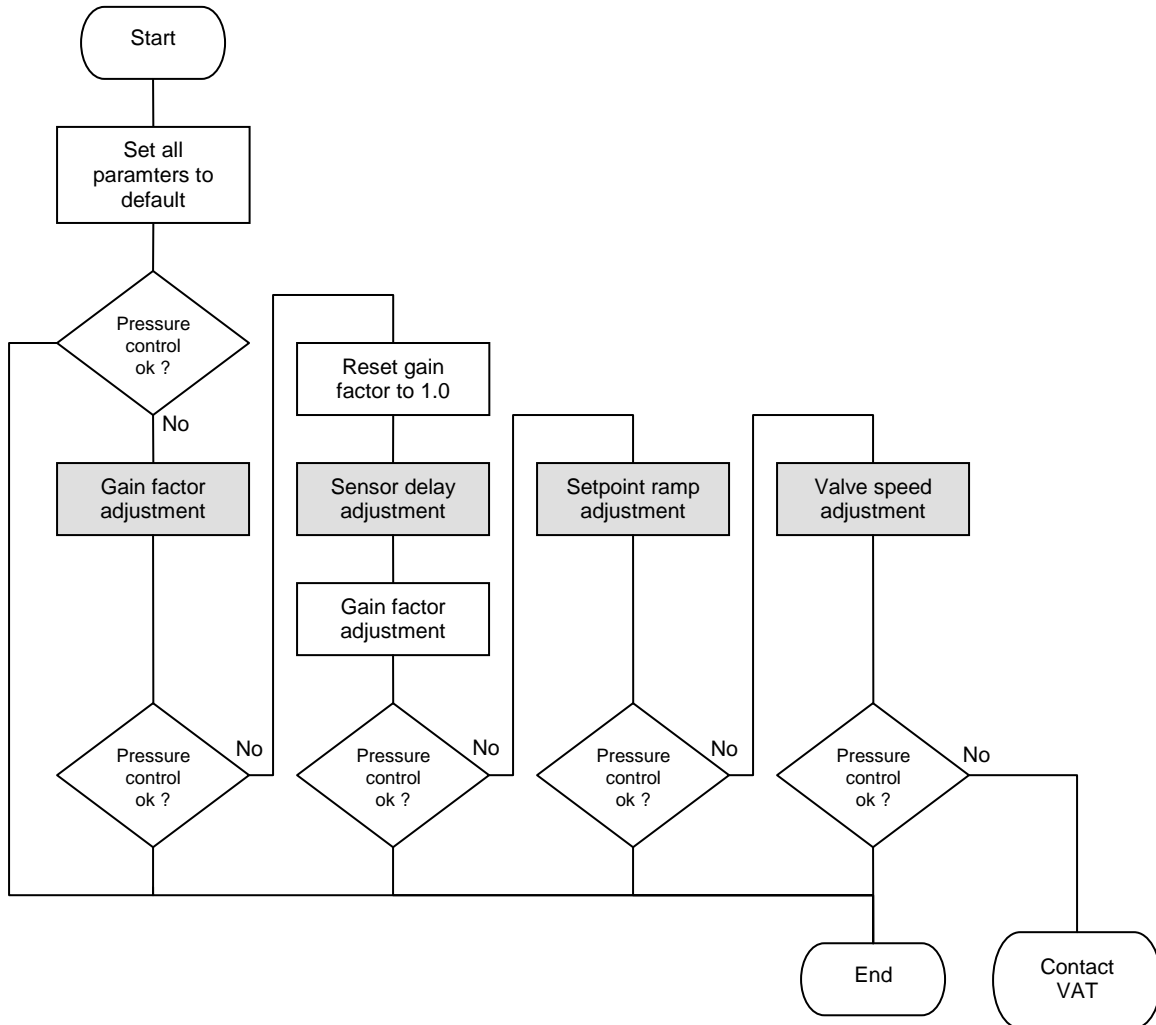
**Note:** Make sure that both sensors are calibrated.

**Note:** Do not close optional gauge isolation valves during the transition phase between the sensors.

### 3.10.2 Tuning of control performance

Normally the default settings will result in good pressure control performance. For some applications tuning may be required to improve performance.

The tuning procedures for each parameter (grey boxes) and its default values are described separately below. Strictly keep the procedure order.



Required information for support:

- Go to 'Tools / Create Diagnostic File' in 'Control View' resp. 'Control Performance Analyzer' and save file
- Pressure / flow / gas conditions to be controlled
- Chamber volume
- Pumping speed (l/s) and pump type (e.g. turbo pump)
- System description
- Problem description

Send diagnostic file with and all required information to [tuning-support@vat.ch](mailto:tuning-support@vat.ch)



### 3.10.2.1 Gain factor adjustment

The gain factor effects:

- **Stability**
- **Response time**

Default value is 1. Adjustment range is from 0.0001 to 7.5.

Higher gain results in:	faster response	higher over- / undershoot of pressure
Lower gain results in:	slower response	lower over- / undershoot of pressure

Adjustment procedure:

1. Start with gain factor 1.0
2. Open valve.
3. Control a typical pressure / flow situation.
4. Repeat from step 2 with lower (higher) gain factors until optimal pressure response is achieved and stability is ok.

**Note:** Normally adjustments down to gain factors of 0.42 should lead to good results. Otherwise you may need to improve sensor connection. Refer to «Requirements to sensor connection».

Local operation: (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2’)	Remote operation:
Set gain factor in menu ‘Setup / Control Parameter’	<b>Note:</b> It’s not possible to do ‘Gain factor adjustment’ via CC-Link.

### 3.10.2.2 Sensor delay adjustment

Sensor delay adjustment effects:

- **Stability**

Default value is 0. Adjustment range is from 0 to 1.0s.

Pipes and orifices for sensor attachment delay response time and so badly impact pressure control stability. By adapting this parameter to the approximate delay time stability problems can be reduced. But control response time will be slowed down by this measure.

**Note:** Whenever possible sensors should be attached to the chamber according to «Requirements to sensor connection». This is the most effective measure against stability issues. If your gauge attachment fulfills these criteria do not use this parameter.

Adjustment procedure:

1. Start with gain factor 1.0 and sensor delay 0s.
2. Open valve.
3. Control a typical pressure / flow situation.
4. Repeat from step 2 with higher sensor delays until best possible stability is achieved.
5. Adjustment gain factor again. Refer to «Gain factor adjustment».

Local operation: (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2’)	Remote operation:
Go to ‘Setup / Control Parameter’ menu. Select sensor delay.	<b>Note:</b> It’s not possible to do ‘Sensor delay adjustment’ via CC-Link.

### 3.10.2.3 Setpoint ramp adjustment

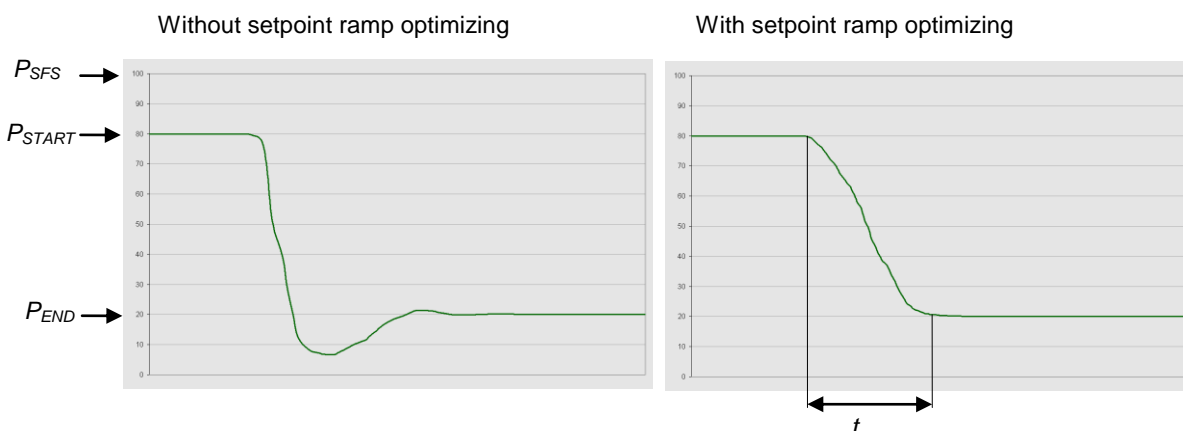
Setpoint ramp effects:

- Undershoot of pressure
- Response time

Default value for *Setpoint Ramp* is 1. Adjustment range for *Setpoint Ramp* is from 0 to 10 s.

This parameter defines the time that is used to decrease / raise pressure between 2 setpoints. Especially in pressure decrease situations at low flows pressure response can be improved much by adapting setpoint ramp time.

#### Pressure chart



Choose the applicable formula depending on units you are familiar with.

$$t = \text{Setpoint Ramp}$$

Adjustment procedure:

1. Start with optimal gain factor and sensor delay time according to preceding tuning steps.
2. Control a typical pressure / flow situation.
3. Control a lower pressure.
4. Repeat from step 2 with longer setpoint ramps until best response is achieved.
5. Verify pressure control response for a setpoint raise situation.

**Note:** In case a long ramp time is required to get optimal performance for pressure decrease situations it may be of advantage to apply different settings for decrease / raise control situations.

Local operation: (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2’)	Remote operation:
Go to ‘Setup / Control Parameter’ menu. Select setpoint ramp.	<b>Note:</b> It’s not possible to do ‘Setpoint ramp adjustment’ via CC-Link.



#### 3.10.2.4 Valve speed adjustment

Valve speed effects:

- **Response time**

Default value is 1000. Adjustment range is from 1 to 1000.

This parameter effects valve plate actuating speed.

Speed adjustment is effective for PRESSURE CONTROL and POSITION CONTROL.

**Note:** Normally best pressure control response is achieved with max. valve speed. In particular applications it may be of advantage to have a slower valve response.

**Note:** OPEN and CLOSE are always done with max. speed.

Adjustment procedure:

1. Use optimal gain factor, sensor delay time and setpoint ramp according to preceding tuning steps.
2. Open valve.
3. Control a typical pressure / flow situation.
4. Repeat from step 2 with slower valve speed until required response is achieved.

<b>Local operation:</b> (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2’)	<b>Remote operation:</b>
Go to ‘Setup / Control Parameter’ menu. Select valve speed.	<b>Note:</b> It’s not possible to do ‘Valve speed adjustment’ via CC-Link.

### 3.11 CC-Link interface connection setup

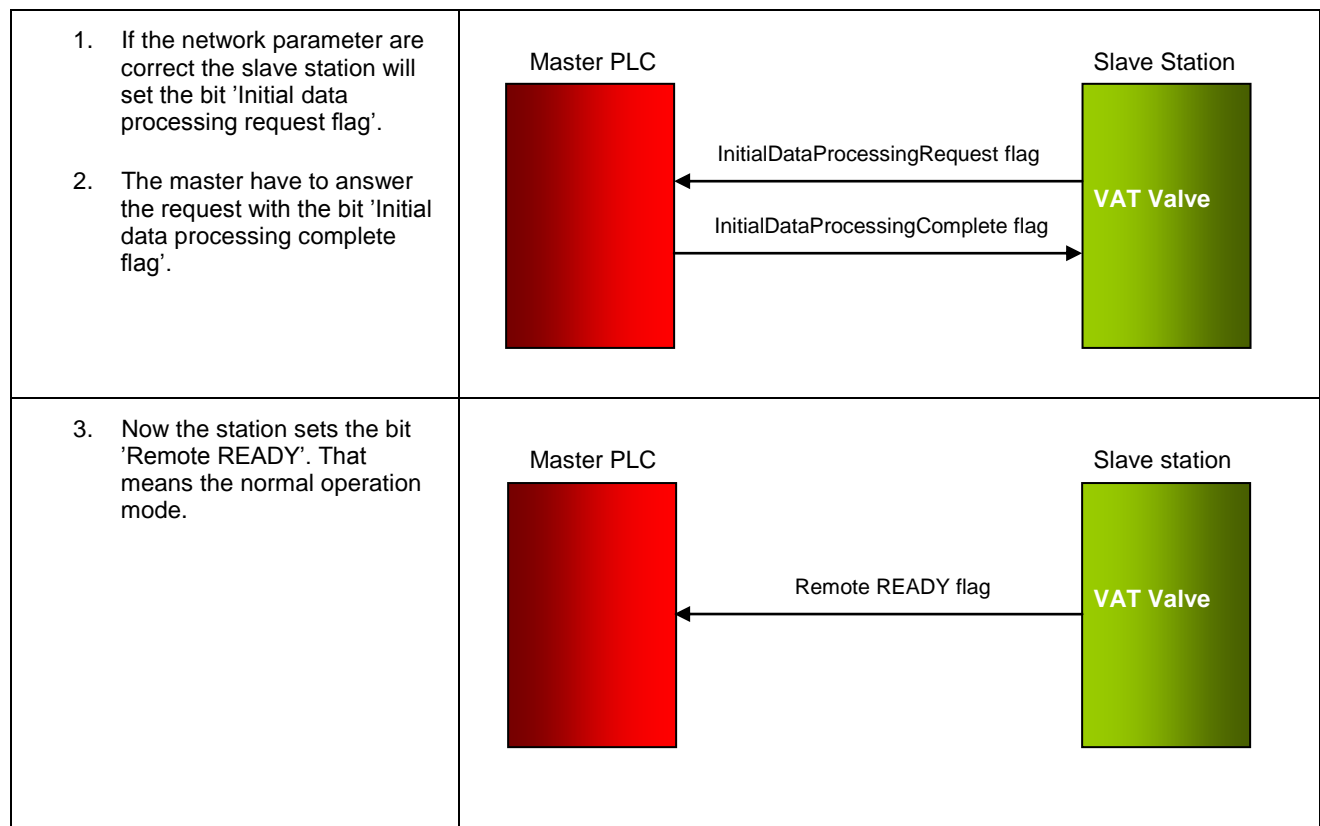
#### 3.11.1 CC-Link Handshaking

Before the CC-Link slave station (VAT valve) can be operated by the CC-Link Master (PLC), handshaking is necessary. If the handshake is not done, no data from the master will be transmitted to station.

An indication of a successful handshaking is the bit «FIELDBUS DATA VALID» (= 1) in the INPUT buffer > GENERAL STATUS.

The CC-Link "Network failure" is independent of the CC-Link handshaking. That means the "Network failure" is inactive if the handshaking is not done yet.

Procedure:



**Note:** The Flag 'Remote READY' from slave station must be set for normal operation.



## 3.11.2 Location of the handshaking bits

Slave → Master		Master → Slave	
Device	Signal name	Device No.	Signal name
RX m0	Not used	RY m0	Not used
RX m1		RY m1	
RX m2		RY m2	
RX m3		RY m3	
RX m4		RY m4	
RX m5		RY m5	
RX m6		RY m6	
RX m7		RY m7	
RX m8		RY m8	
RX m9		RY m9	
RX mA		RY mA	
RX mB		RY mB	
RX mC		RY mC	
RX mD		RY mD	
RX mE		RY mE	
RX mF		RY mF	
to	Reserved	to	Reserved
RX(m+n)0		RY(m+n)0	
RX(m+n)1		RY(m+n)1	
RX(m+n)2		RY(m+n)2	
RX(m+n)3		RY(m+n)3	
RX(m+n)4		RY(m+n)4	
RX(m+n)5		RY(m+n)5	
RX(m+n)6		RY(m+n)6	
RX(m+n)7		RY(m+n)7	
RX(m+n)8	Initial data processing request flag	RY(m+n)8	Initial data processing complete flag
RX(m+n)9	Initial data setting complete flag	RY(m+n)9	Initial data setting request flag
RX(m+n)A	Error status flag	RY(m+n)A	Error reset request flag
RX(m+n)B	Remote READY	RY(m+n)B	Reserved
RX(m+n)C	Reserved	RY(m+n)C	
RX(m+n)D		RY(m+n)D	
RX(m+n)E		RY(m+n)E	
RX(m+n)F		RY(m+n)F	

Table 1: Bit Memory Map Profile of VAT CC-Link slave

m : Address assigned to the master module by the station number setting. This means that the address range for this slave begins at address m of the master.

n : Dependent on the VAT Operational settings mode (number of occupied stations and number of extension cycles)

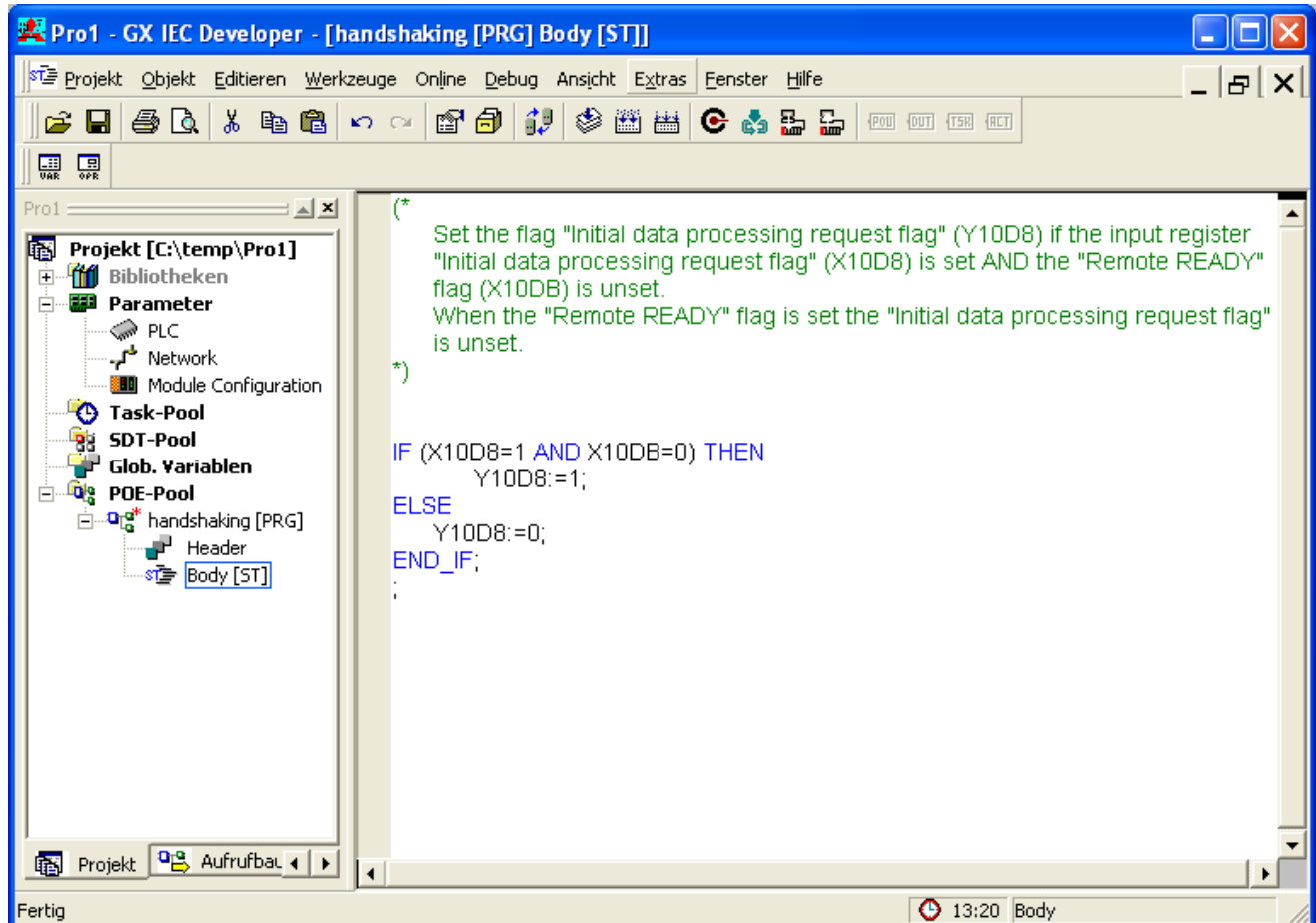
- Operational settings mode = 1 → n = 0x7 (hex)
- Operational settings mode = 4 → n = 0xD (hex)

Example see chapter: 3.11.3 Example of the handshaking by a PLC-program.

### 3.11.3 Example of the handshaking by a PLC-program

The following program sends an answer to the VAT CC-Link station which return a "Remote READY" flag. It is important to correct register address is used. In this example the address for this slave station (valve) starts at 1000 (hex). So m = 100 (see capture Location of the handshaking bits). The Operational setting mode of the slave is 4 – therefore n = D.

Table 1 said  $RX(m+n)8$  for the location of the 'Initial data processing request flag'. So the address X10D8 is used. For the 'Remote Ready' flag the address  $RX(m+n)B = X10DB$  is used.



### 3.12 CC-Link interface (Process data – cyclic communication)

- The buffer naming is in view from customer (master) PLC.
- Data format: All signals are transmitted and received in intel format (low byte first).
- All one-byte signals use the least significant byte (LSB).

#### 3.12.1 OUTPUT Buffer (Master PLC)

##### 3.12.1.1 Overview

Data model	Index	Buffer	
		Contents (MSB)	Contents (LSB)
16 bit (Word)	0	Pressure setpoint	
	1		
	2	Position setpoint	
	3		
	4	Not used – reserved	
	5		
	6		
	7		
	8		
	9		
	10	Not used – reserved	Control mode setpoint
	11	General control setpoint	
	12	Not used – reserved	
	13		
	14		
	15		
	16	Not used – reserved	
	17		
	18	Not used – reserved	Not used – reserved
	19	Not used – reserved	
	20	Not used – reserved	Not used – reserved

**Note:** For data consistency make sure your master PLC is supporting “block guarantee of cyclic data per station”.



## 3.12.1.2 Details

Signal Type	Name	Start Word	Byte Length	Data Type	Valid Range	Description
Signal	<b>PRESSURE SETPOINT</b>	0	4	signed integer (default) or floating point	0..1'000'000 (default), adjustable <sup>1)</sup>	In case of the valve is is pressure mode ( <b>CONTROL MODE</b> = Pressure (5)), the signal is used as setpoint value.
Signal	<b>POSITION SETPOINT</b>	2	4	signed integer (default) or floating point	0..100'000 (default), adjustable <sup>1)</sup>	<p>In case of the valve is is position mode (<b>CONTROL MODE</b> = Position (2)), the signal is used as setpoint value.</p> <p>min signal value (default 0) = "valve is closed"</p> <p>max signal value (default 100'000) = "valve is opened"</p> <p><b>Note:</b> If you want to close the valve completely, set bit <b>CONTROL MODE SETPOINT</b> = 3 (Close) (only 650)</p>
Signal	<b>CONTROL MODE SETPOINT</b>	10	1	unsigned integer	2...7	<p>2 = Position: Position control mode</p> <p>3 = Close: The valve is closed</p> <p>4 = Open: The valve is opened</p> <p>5 = Pressure: Pressure control mode</p> <p>6 = Hold: Valve is kept in current position; only valid in <b>CONTROL MODE</b> position and pressure</p> <p>7 = Learn: Valve starts the internal learn procedure</p>
Bitmap	<b>GENERAL CONTROL SETPOINT</b>	11	2	boolean array	-	See bitmap table below
-	<b>NOT USED (reserved)</b>	16	4	-	-	-
-	<b>NOT USED (reserved)</b>	18	1	-	-	-
-	<b>NOT USED (reserved)</b>	19	1	-	-	-
-	<b>NOT USED (reserved)</b>	20	1	-	-	-

1) To adjust range refer to chapter: «Range of pressure and position values»



GENERAL CONTROL SETPOINT bitmap table:

Bit		Description												
0	<b>ZERO</b>	<b>0</b> = No Operation <b>1</b> = ZERO adjust, the actual pressure signal is set to internal pressure 0. The valid range for adjustment is limited to -1.4V...+1.4! Otherwise the sensor must be adjusted!												
1	<b>NOT USED (reserved)</b>	-												
2	<b>PING PONG TX BIT</b>	PING PONG TX BIT transmitted from the master (PLC), is used to check the loop "master PLC - VAT station". See chapter: 3.11.9 Communication and timing control between Master (PLC) and Station (Valve)												
3	<b>NOT USED (reserved)</b>	-												
4	<b>ACCESS MODE LOCKED</b>	<table><tr><th>Start mode</th><th>Access mode locked bit</th><th>End mode</th></tr><tr><td>local</td><td>Set bit: 0→1</td><td>locked</td></tr><tr><td>locked</td><td>Reset bit: 1→0</td><td>remote</td></tr><tr><td>remote</td><td>Set bit: 0→1</td><td>locked</td></tr></table> <p>Example:</p> <ol style="list-style-type: none"><li>from local to locked<ul style="list-style-type: none"><li>1st step : set bit (0→1)</li></ul></li><li>from local to remote<ul style="list-style-type: none"><li>1st step : set bit (0→1)</li><li>2nd step: reset bit (1→0)</li></ul></li><li>from remote to locked<ul style="list-style-type: none"><li>1st step : set bit (0→1)</li></ul></li><li>from locked to remote<ul style="list-style-type: none"><li>1st step : reset bit (1→0)</li></ul></li></ol>	Start mode	Access mode locked bit	End mode	local	Set bit: 0→1	locked	locked	Reset bit: 1→0	remote	remote	Set bit: 0→1	locked
Start mode	Access mode locked bit	End mode												
local	Set bit: 0→1	locked												
locked	Reset bit: 1→0	remote												
remote	Set bit: 0→1	locked												
5-15	<b>NOT USED (reserved)</b>	-												

### 3.12.2 INPUT Buffer (Master PLC)

#### 3.12.2.1 Overview

Data model	Index	Buffer	
		Contents (MSB)	Contents (LSB)
<b>16-Bit (Word)</b>	0	Pressure	
	1		
	2	Pressure Sensor 1	
	3		
	4	Pressure Sensor 2 (optional, only in case of 2 sensor version)	
	5		
	6	Position	
	7		
	8	<i>Not used – reserved</i>	
	9		
	10	<i>Not used – reserved</i>	Control mode
	11	Fatal error	
	12	<i>Not used – reserved</i>	
	13		
	14		
	15		
	16	General status	
	17	General warnings	
	18	Extended warnings	
	19	<i>Not used – reserved</i>	<i>Not used – reserved</i>
	20	<i>Not used – reserved</i>	
	21		
	22	<i>Not used – reserved</i>	<i>Not used – reserved</i>
	23	<i>Not used – reserved</i>	
	24	<i>Not used – reserved</i>	



### 3.12.2.2 Details

Signal Type	Name	Start Word	Byte Length	Data Type	Valid Range	Description
Signal	<b>PRESSURE</b>	0	4	signed integer (default) or floating point	-270000.. 1'230'000 (default) (-2.7V..12.3V sensor signal), adjustable <sup>1)</sup>	<i>In case of default valid range:</i> Physical full scale value of the sensor (10 Volt) equals to 1'000'000. (In case of 2 sensor operation the full scale of high range sensor equals to 1'000'000.)
Signal	<b>PRESSURE SENSOR 1</b>	2	4	signed integer (default) or floating point	-270000.. 1'230'000 (default) (-2.7V..12.3V sensor signal), adjustable <sup>1)</sup>	<i>In case of default valid range:</i> Physical full scale value of the sensor (10 Volt) equals to 1'000'000.
Signal	<b>PRESSURE SENSOR 2</b>	4	4	signed integer (default) or floating point	-270000.. 1'230'000 (default) (-2.7V..12.3V sensor signal), adjustable <sup>1)</sup>	<i>Optional, only in case of 2 sensor version.</i> <i>In case of default valid range:</i> Physical full scale value of the sensor (10 Volt) equals to 1'000'000.
Signal	<b>POSITION</b>	6	4	signed integer (default) or floating point	0..100'000 (default), adjustable <sup>1)</sup>	min signal value = "valve is closed" max signal value = "valve is opened"  The position 9'999'999 (or 9'999'999.0 for floating point) show an unknown valve position – e.g. during synchronization at startup
Signal	<b>CONTROL MODE</b>	10	1	unsigned integer	0...14	<b>0</b> = init <b>1</b> = synch <b>2</b> = position <b>3</b> = close <b>4</b> = open <b>5</b> = pressure <b>6</b> = hold <b>7</b> = learn <b>8</b> = interlock open <b>9</b> = interlock close <b>10</b> = maintenance open <b>11</b> = maintenance close <b>12</b> = power failure <b>13</b> = safety <b>14</b> = fatal error
Signal	<b>FATAL ERROR</b>	11	2	unsigned integer	20,21,22,25,40	<b>20</b> = no stop detected during synch mode <b>21</b> = valve blocked during synch mode <b>22</b> = valve blocked <b>25</b> = step loss during synch mode <b>40</b> = motor driver fault



Signal Type	Name	Start Word	Byte Length	Data Type	Valid Range	Description
Bitmap	<b>GENERAL STATUS</b>	16	2	boolean array		See bitmap table below
Bitmap	<b>GENERAL WARNING</b>	17	2	boolean array		See bitmap table below
Bitmap	<b>EXTENDED WARNING</b>	18	2	boolean array		See bitmap table below
-	<b>NOT USED (reserved)</b>	19-22	1	-	-	-
-	<b>NOT USED (reserved)</b>	23-24	1	-	-	-

1) To adjust range refer to chapter: «Range of pressure and position values»

**GENERAL STATUS bitmap table:**

Bit		Description												
0	<b>FIELD BUS DATA VALID</b>	0 = Valve is not ready for communication (has not received the rising edge of "Initial Data Processing Complete") 1 = Valve is ready for communication (has received the rising edge of "Initial Data Processing Complete")												
1	<b>ZERO EXECUTED</b>	ZERO successful executed, active for 2 seconds												
2	<b>PING PONG RX-BIT</b>	PING PONG RX BIT, is inverted and transmitted back to the fieldbus master (PLC), See chapter: 3.12.3 Communication and timing control between Master (PLC) and Station (Valve)												
3	<b>PRESSURE SIMULATION</b>	0 = off 1 = on												
4	<b>PRESSURE SETPOINT REACHED</b>	0 = The actual pressure is not within 2% of the pressure setpoint 1 = The actual pressure is within 2% of the pressure setpoint												
5-6	<b>NOT USED (reserved)</b>	-												
7-8	<b>ACCESS MODE</b>	<table> <tr> <td>bit 8</td><td>bit 7</td><td></td></tr> <tr> <td>0</td><td>0</td><td>= LOCAL</td></tr> <tr> <td>0</td><td>1</td><td>= REMOTE</td></tr> <tr> <td>1</td><td>0</td><td>= LOCKED</td></tr> </table>	bit 8	bit 7		0	0	= LOCAL	0	1	= REMOTE	1	0	= LOCKED
bit 8	bit 7													
0	0	= LOCAL												
0	1	= REMOTE												
1	0	= LOCKED												
9	<b>WARNINGS ACTIVE</b>	0 = No WARNINGS 1 = At least one WARNING of the warning bitmaps is active (GENERAL WARNING bitmap and EXTENDED WARNING bitmap)												
10-15	<b>NOT USED (reserved)</b>	-												



GENERAL WARNING bitmap table:

Bit		Description
0	<b>SERVICE REQUEST</b>	Valve movement tight
1	<b>LEARN DATA SET</b>	Learn data not present. Learn required for adaptive pressure control.
2	<b>COMPRESSED AIR</b>	compressed air pressure < 4 bar (only for valves with compressed air)
3	<b>POWER FAILURE BATTERY</b>	Not ready, voltage too low
4	<b>SENSOR OVERLAPPING</b>	Sensor deviation between sensor 1 and sensor 2 $\geq \pm 10\%$
5	<b>NOT USED (reserved)</b>	-
6	<b>NOT USED (reserved)</b>	-
7-9	<b>NOT USED (reserved)</b>	-
10	<b>SENSOR MEASUREMENT UNIT FAULTY</b>	AD-converter of Sensor input 1 and/or 2 (optional, only in case of 2 sensor version) on the master board is faulty.
11-15	<b>NOT USED (reserved)</b>	-

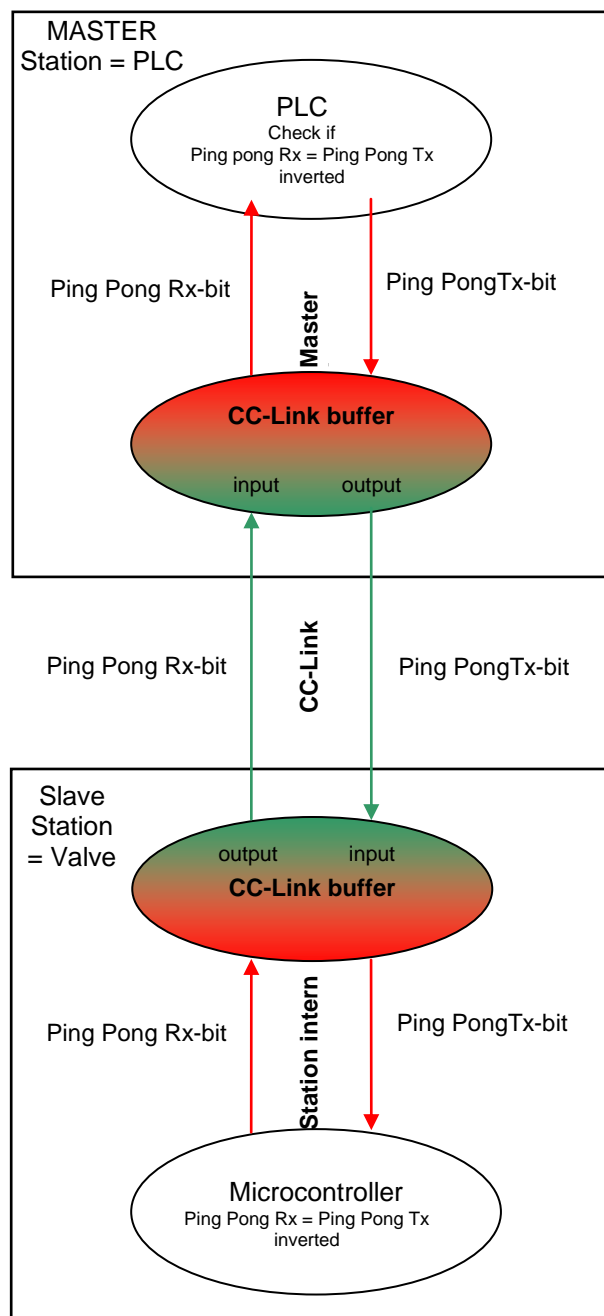


EXTENDED WARNING bitmap table:

Bit		Description
0	<b>REMOTE CONTROL NOT POSSIBLE</b>	Remote control not possible, access mode local is active, change to access mode remote or access mode locked
1	<b>ACTUAL CONTROL MODE SETPOINT NOT ALLOWED</b>	Not possible to switch the actual control mode to CONTROL MODE SETPOINT (for example control mode is interlock or fatal error)
2	<b>ZERO DISABLED</b>	Using zero function not possible
3	<b>PFO DEACTIVATED</b>	Power Failure Option is deactivated
4	<b>NOT USED (reserved)</b>	-
5	<b>OUT OF RANGE: PRESSURE SETPOINT</b>	Value of PRESSURE SETPOINT is out of range
6	<b>OUT OF RANGE: POSITION SETPOINT</b>	Value of POSITION SETPOINT is out of range
7-9	<b>NOT USED (reserved)</b>	-
10	<b>OUT OF RANGE: CONTROL MODE SETPOINT</b>	Value of CONTROL MODE SETPOINT is out of range
11	<b>OUT OF RANGE: GENERAL CONTROL SETPOINT</b>	Value of GENERAL CONTROL SETPOINT is out of range
12	<b>PROCESS DATA SETTING(S) NOT VALID</b>	Value of PROCESS DATA SETTING(S) not valid (DATA TYPE or RANGE of pressure and position signals)
13-15	<b>NOT USED (reserved)</b>	-

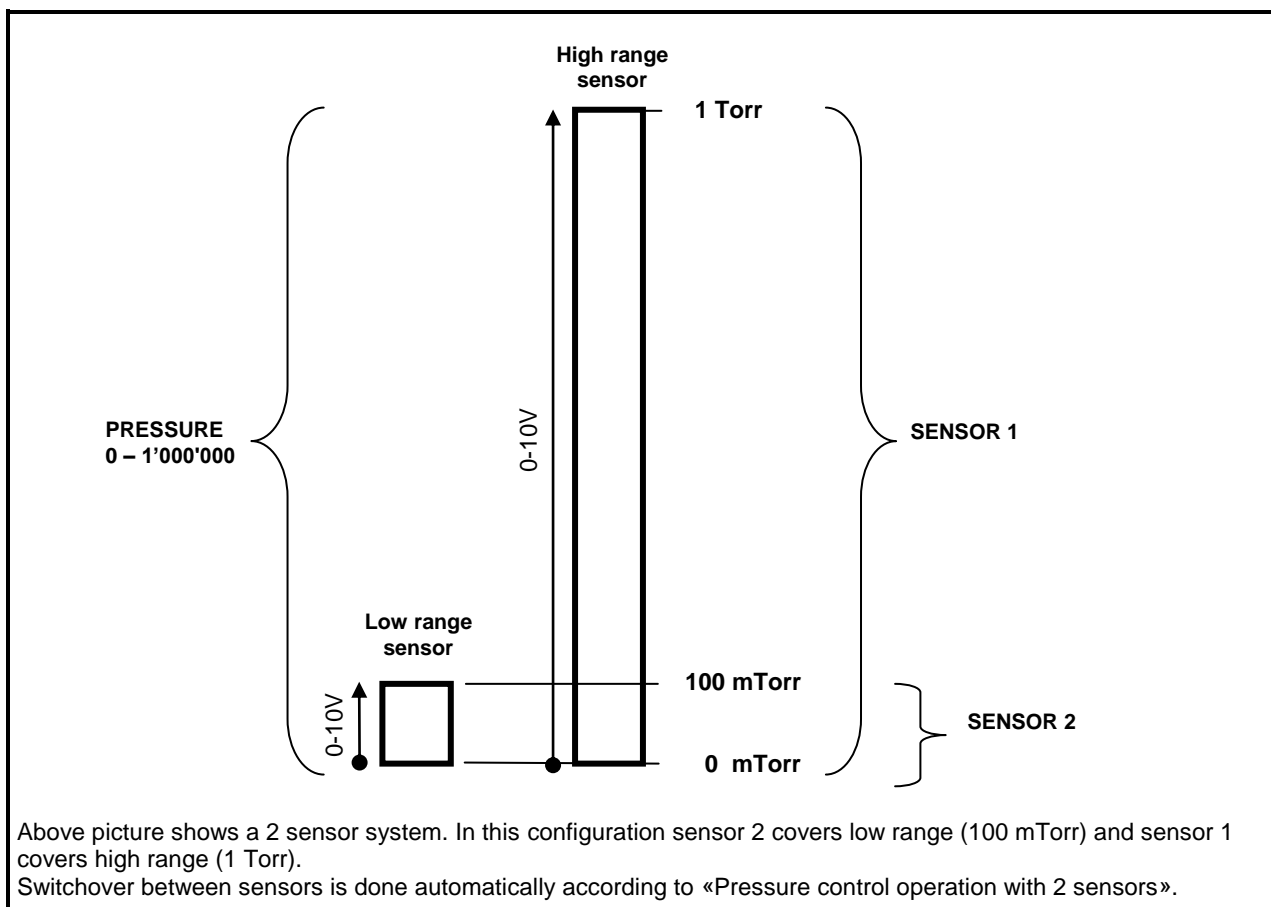
### 3.13 Communication and timing control between Master (PLC) and Station (Valve)

See chapter: «OUTPUT Buffer» > «PING PONG TX-BIT» and «INPUT Buffer» > «PING PONG RX-BIT». For visual overview see the diagram below.



### 3.14 PRESSURE and SENSOR READING allocation

Example of PRESSURE and SENSOR READING allocation:





## 4 Trouble shooting

Failure	Check	Action
No dots lighted on display	24 V power supply ok?	Connect valve to power supply according to «Electrical connection» and make sure that power supply is working.
Remote operation does not work	<ul style="list-style-type: none"><li>- Local operation via service port active</li><li>- Safety mode active, check for <b>D</b> on display?</li></ul>	<ul style="list-style-type: none"><li>- Switch to remote operation.</li><li>- Provide power to motor to allow for operation.</li><li>- Refer to «Electrical connection» for details.</li></ul>
Display shows « <b>E 20</b> » (fatal error - limit stop of valve unit not detected)		<ul style="list-style-type: none"><li>- Replace actuator according to «Maintenance procedures».</li></ul>
Display shows « <b>E 21</b> » (fatal error - rotation angle of valve plate limited during power up)	<ul style="list-style-type: none"><li>- Valve plate mechanically obstructed?</li></ul>	<ul style="list-style-type: none"><li>- Resolve obstruction.</li></ul>
Display shows « <b>E 22</b> » (fatal error - rotation angle of valve plate limited during operation)	<ul style="list-style-type: none"><li>- Valve plate mechanically obstructed?</li></ul>	<ul style="list-style-type: none"><li>- Resolve obstruction.</li></ul>
Display shows « <b>E 40</b> » (fatal error - motor driver failure detected)		<ul style="list-style-type: none"><li>- Replace control unit according to «Maintenance procedures».</li></ul>
Display shows « <b>D C</b> » or « <b>D999</b> » Motor Interlock is open	<ul style="list-style-type: none"><li>- Motor power supplied?</li></ul>	<ul style="list-style-type: none"><li>- Provide power to motor to allow for operation.</li><li>- Refer to «Electrical connection» for details.</li></ul>
Display shows « <b>SR</b> » (Service Request)	<ul style="list-style-type: none"><li>- Valve unit heavy contaminated or gate seal heavily sticking?</li></ul>	<ul style="list-style-type: none"><li>- Clean valve and/or replace gate seal according to «Maintenance procedures».</li></ul>
CLOSE VALVE does not work	<ul style="list-style-type: none"><li>- Safety mode active, check for <b>D</b> on display?</li><li>- Maintenance mode active</li></ul>	<ul style="list-style-type: none"><li>- Provide power to motor to allow for operation.</li><li>- Refer to «Electrical connection» for details.</li><li>- Refer to "Display shows «<b>M C</b>»" in this table</li></ul>
OPEN VALVE does not work	<ul style="list-style-type: none"><li>- Safety mode active, check for <b>D</b> on display?</li><li>- Maintenance mode active</li></ul>	<ul style="list-style-type: none"><li>- Provide power to motor to allow for operation.</li><li>- Refer to «Electrical connection» for details.</li><li>- Refer to "Display shows «<b>M100</b>»" in this table</li></ul>
Display shows « <b>M C</b> » Maintenance mode active		<ul style="list-style-type: none"><li>- Pin 14 of service connector is connected to ground. Plate will close. Further movement of plate is blocked. <sup>1)</sup></li></ul>
Display shows « <b>M100</b> » Maintenance mode active		<ul style="list-style-type: none"><li>- Pin 13 of service connector is connected to ground. Plate will open. Further movement of plate is blocked. <sup>1)</sup></li></ul>
POSITION CONTROL does not work	<ul style="list-style-type: none"><li>- Safety mode active, check for <b>D</b> on display?</li></ul>	<ul style="list-style-type: none"><li>- Provide power to motor to allow for operation.</li><li>- Refer to «Electrical connection» for details.</li></ul>
	<ul style="list-style-type: none"><li>- POSITION CONTROL selected, check for <b>V</b> on display?</li></ul>	<ul style="list-style-type: none"><li>- Select POSITION CONTROL mode. Refer to «Position control» for details.</li></ul>
COMPRESSED AIR FAILURE « <b>AIRf</b> »	<ul style="list-style-type: none"><li>- No or too less air pressure on air input of valve</li></ul>	<ul style="list-style-type: none"><li>- Connect air or increase air pressure. Make sure that the air pressure is more than 4 bar (55 psi).</li></ul>
COMPRESSED AIR FAILURE at Exhaust « <b>AIRx</b> »	<ul style="list-style-type: none"><li>- Wrong connection of compressed air input and output</li><li>- No compressed air at output exhaust</li></ul>	<ul style="list-style-type: none"><li>- Connect compressed air in accordance chapter installation.</li><li>- Contact your local VAT service centre for support.</li></ul>

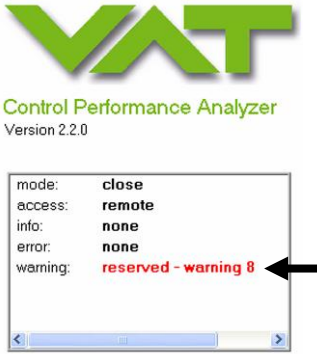
1) Priority of pin 14 is higher than pin 13. If pin 14 is connected to ground after pin 13 the valve will close.  
Ground of service connector is at pin 4 and 8.



Failure	Check	Action
Pressure reading is wrong or pressure reading is negative	<ul style="list-style-type: none"><li>- Sensor(s) connected?</li><li>- 2 sensor version present at valve controller?</li><li>- ZERO done?</li><li>- Does sensor power supply provide enough power for sensor(s)?</li></ul>	<ul style="list-style-type: none"><li>- Refer to «Electrical connection».</li><li>- Check valve version on page 1. Verify configuration. Refer to «Setup procedure».</li><li>- Refer to «Pressure control operation with 2 sensors».</li><li>- Perform ZERO when base pressure is reached. Refer to «ZERO» for details.</li><li>- Verify sensor supply voltage.</li></ul>
ZERO does not work	<ul style="list-style-type: none"><li>- Valve in open position, check for O on display?</li><li>- ZERO disabled?</li></ul>	<ul style="list-style-type: none"><li>- OPEN VALVE and bring chamber to base pressure before performing ZERO.</li><li>- Enable ZERO. Refer to «Valve and sensor configuration» for details.</li></ul>
Pressure is not '0' after ZERO  PRESSURE CONTROL does not work	<ul style="list-style-type: none"><li>- Sensor voltage shifting?</li><li>- System pumped to base pressure?</li><li>- Sensor offset voltage exceeds <math>\pm 1.4V</math></li><li>- Safety mode active, check for D on display?</li><li>- PRESSURE CONTROL selected, check for P on display?</li><li>- LEARN done?</li></ul>	<ul style="list-style-type: none"><li>- Wait until sensor does not shift any more before performing ZERO.</li><li>- OPEN VALVE and bring chamber to base pressure before performing ZERO.</li><li>- Replace pressure gauge.</li><li>- Provide power to motor to allow for operation. Refer to «Electrical connection» for details.</li><li>- Select PRESSURE CONTROL mode. Refer to «Pressure control» for details.</li><li>- Perform LEARN. Refer to «Setup procedure» for details.</li></ul>
PRESSURE CONTROL not optimal	<ul style="list-style-type: none"><li>- Setup done completely?</li><li>- LEARN done?</li><li>- ZERO performed before LEARN?</li><li>- LEARN interrupted?</li><li>- Was gas flow stable during LEARN?</li><li>- Tuning done?</li><li>- Is sensor range suited for application?</li><li>- Noise on sensor signal?</li></ul>	<ul style="list-style-type: none"><li>- Perform «Setup procedure» completely.</li><li>- Perform LEARN. Refer to «LEARN» for details.</li><li>- Perform ZERO then repeat LEARN. Refer to «Setup procedure» for details.</li><li>- Repeat LEARN. Refer to «LEARN» for details.</li><li>- Repeat LEARN with stable gas flow. Refer to «LEARN» for details.</li><li>- Tune valve for application. Refer to «Tuning of control performance» for details.</li><li>- Use a sensor with suitable range (controlled pressure should be <math>&gt;3\%</math> and <math>&lt;98\%</math> of sensor full scale).</li><li>- Make sure a shielded sensor cable is used.</li></ul>



#### 4.1 Additional CC-Link warning

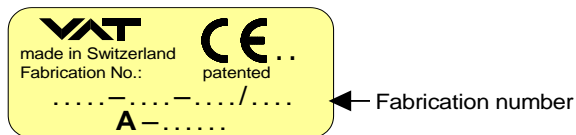
Failure detection with CPA or CV software	Check	Action
<p>Network failure: No CC-Link communication is active (warning 8)</p> 	<ul style="list-style-type: none"><li>- CC-Link cable ok?</li><li>- Connection to master ok?</li></ul>	<ul style="list-style-type: none"><li>- Check CC-Link cable.</li><li>- Check the CC-Link connection to master.</li></ul>

If you need any further information, please contact one of our service centers. You can find the addresses on our website: <http://www.vat.ch>

## 5 Maintenance & repairs

Under clean operating conditions, the valve does not require any maintenance during the specified cycle life. Contamination from the process may influence the function and requires more frequent maintenance.

Before carrying out any maintenance or repairs, please contact VAT. It has to be individually decided whether the maintenance/repair can be performed by the customer or has to be carried out by VAT. The fabrication number on the valve



has always to be specified.

All supplies (e. g. compressed air, electrical power) must be disconnected for removal/installation of the valve from/into the system.



Even with disconnected supply, loaded springs and/or air cushions in cylinders can be potential hazards.



Keep fingers and objects away from the valve opening!

Products returned to VAT must be free of harmful substances such as e.g. toxic, caustic or micro-biological ones. If products are radioactively contaminated, fill in the VAT form «Contamination and Radiation Report» and send it with the product. The form is available at VAT. The maximum values indicated in the form must not be exceeded.

## 5.1 Maintenance procedures



Keep fingers out of the valve during maintenance work.



Use cleanroom gloves during maintenance work.

Two preventive maintenance procedures are defined for this valve. These are:

- **Replacement of isolation seals** (gate and body seal of sealing ring) **and valve cleaning**
- **Replacement of actuator and actuator shaft seals**

Required frequency of cleaning and replacement of seals is depending on process conditions.



A critical factor influencing the maintenance period is the lifetime of the vacuum grease, being limited under increased temperature. In this case grease will separate to PTFE and oil. The oil may flow and contaminate the valve parts.

VAT can give the following **recommendations for preventive maintenance**:

	unheated *)	heated $\leq 80^{\circ}\text{C}$ *)	heated $> 80^{\circ}\text{C}$ *)
<b>isolation seals</b> (gate and body seal of sealing ring)	200'000 cycles	6 months but max. 200'000 cycles	3 months but max. 200'000 cycles
<b>actuator shaft seals</b>	1'000'000 cycles	6 months	3 months

\*) This figures are reference values for clean conditions under various temperatures. These values do not include any impact of the process. Therefore preventive maintenance schedule has finally to be checked for the actual process conditions.



Prevent gap between body and sealing ring from air gun cleaning. Otherwise vacuum grease may be distributed and contaminate the valve.

valve body



gap



sealing ring



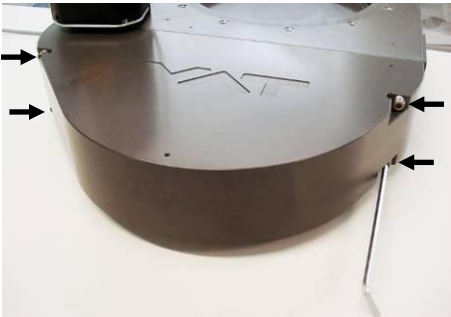


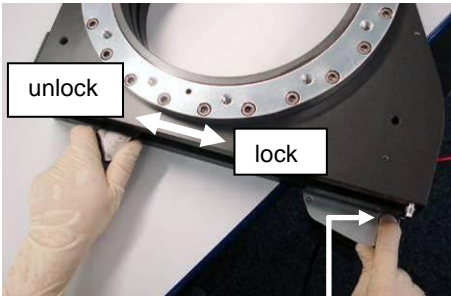
pendulum plate


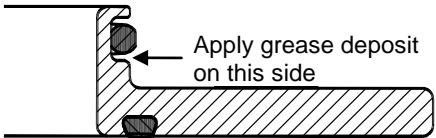



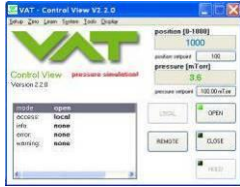


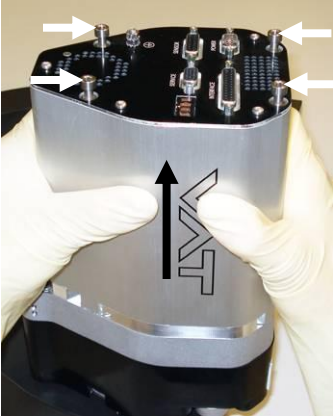
**Replacement of isolation seals** (gate and body seal of sealing ring) **and valve cleaning**

**Replacement of actuator and actuator shaft seals**

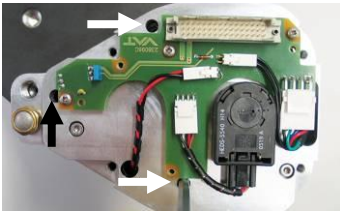
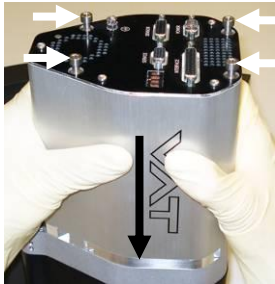
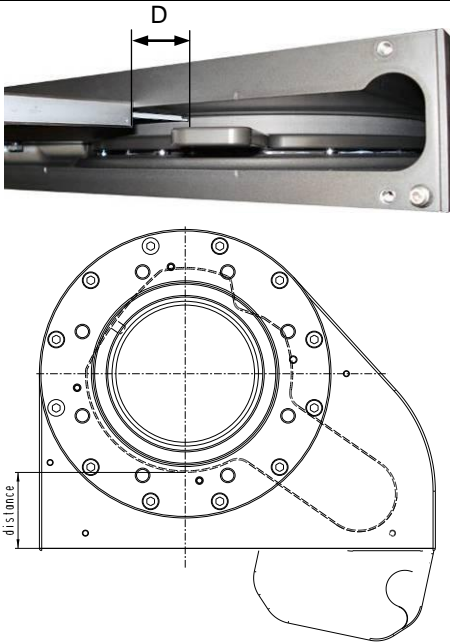
**Note:** Electrical power and compressed air is required to perform steps 2 to 9 during disassembly respectively 9 to 2 during assembly.


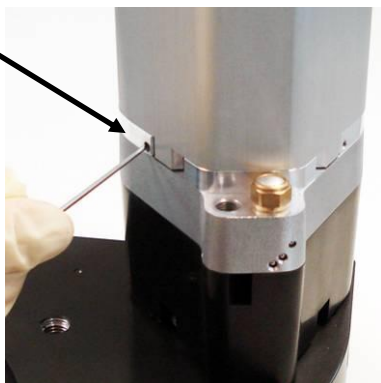
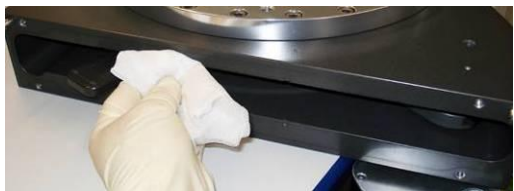

Description		Required tool		
<ol style="list-style-type: none"> <li>1. Vent both valve chambers.</li> <li>2. Open the 4 bonnet screws and remove valve bonnet.</li> </ol>		Allen wrench 5mm		
<ol style="list-style-type: none"> <li>3. Open valve <b>Caution:</b> Stand away from valve – pendulum plate moves out of the valve body.</li> <li>4. Unfasten mounting screw for pendulum plate. (For reinstall the pendulum plate, tighten the mounting screw to block.)</li> <li>5. Remove pendulum plate.</li> </ol>	 <p>mounting screw for pendulum plate</p> 	open end wrench 13mm		
<ol style="list-style-type: none"> <li>6. With one hand press the MAINTENANCE BUTTON to lower the sealing ring, with your second hand unlock the sealing ring by pressing the handle.</li> <li>7. Release MAINTENANCE BUTTON.</li> <li>8. Remove sealing ring.</li> <li>9. To prevent the shaft and retaining pins from moving during work, switch the valve to safety mode. Refer to «Safety mode» for details.</li> </ol> <p><b>Note:</b> Retaining pins will move up.</p>	 <p>unlock</p> <p>lock</p> <p>maintenance button</p>			

Description		Required tool	
<p>10. Remove gate and body seal from sealing ring carefully with a soft tool.</p> <p>11. Remove grease residues at sealing ring with lint-and dust-free towel a little soaked with isopropyl alcohol. Clean sealing ring and pendulum plate with lint-and dust-free towel little soaked with isopropyl alcohol or in an ultrasonic bath.</p> <p>12. Clean out valve body with alcohol. Use an appropriate non metal tool with a cloth to enter valve body. Do not enter valve body with hands! Then blow out valve body with clean air.</p> <p>Do not directly expose seals (actuator and retaining pin feedthroughs) to air stream!</p> <p>13. Clean or replace gate seal if necessary. Install gate seal to sealing ring without grease.</p>		<p>Soft tool (o-ring remover)</p> <p>VAT cleaning tool for valve body (Part No. see chapter spare parts / accessories)</p>	
<p>14. Clean or replace body seal if necessary. Lubricate body with the quantity of vacuum grease listed in the table to the right.</p>	Valve size	Quantity of grease [ml]	<ul style="list-style-type: none"> <li>Soft tool (o-ring remover)</li> <li>Vacuum grease</li> </ul>
	DN100 / 4" (65040 - . . . . - . . . .)	0.1	
	DN160 / 6" (65044 - . . . . - . . . .)	0.15	
	DN200 / 8" (65046 - . . . . - . . . .)	0.2	
	DN250 / 10" (65048 - . . . . - . . . .)	0.2	
15. Install body seal into sealing ring.			
<p>16. Deposit vacuum grease on the bottom side of the body seal according to drawing below. Pay attention that the quantity of vacuum grease listed in the table to the right is distributed constantly over the whole circumference.</p>	Valve size	Quantity of grease [ml]	Vacuum grease
	DN100 / 4" (65040 - . . . . - . . . .)	0.2	
	DN160 / 6" (65044 - . . . . - . . . .)	0.25	
	DN200 / 8" (65046 - . . . . - . . . .)	0.3	
	DN250 / 10" (65048 - . . . . - . . . .)	0.4	
 <p>Apply grease deposit on this side</p>			Vacuum grease

Description	Required tool	
<p><b>Note:</b> For Replacement of actuator or actuator shaft seals, proceed with step 19 otherwise go to step 17.</p> <p>17. Reassembly the valve in reverse order, step 9...3.</p> <p>18. Close the valve bonnet, see steps 40...42.</p>		
<p>19. Release the valve from safety mode. Refer to «Safety mode» for details</p> <p>20. Move the valve to position 50% (half opened) This is necessary, in order to dismount the actuator. See step 24.</p> <p>21. Disable PFO option feature via 'Power Fail Status' in menu 'System' of CV or CPA software, and turn off the power</p>	<div data-bbox="781 558 1019 743">  </div> <div data-bbox="748 758 1052 982">  </div> <div data-bbox="769 997 1031 1146">  </div> <ul style="list-style-type: none"> <li>• CV software</li> <li>• CPA software</li> <li>or</li> <li>• Service Box 2</li> </ul>	
<p>22. Disconnect 24VDC power. Wait for 60s, then disconnect cables and compressed air from valve actuator.</p> <p>23. Unfasten all 4 controller screws and lift controller carefully from actuator.</p>		<p>Allen Wrench 4 mm</p>

Description		Required tool		
24. Unfasten all 3 actuator screws and remove actuator.		Allen Wrench 5 mm		
25. Remove actuator shaft seals carefully with a soft tool. 26. Clean actuator feedthrough with alcohol. 27. Lubricate each o-ring groove with 0.1 ml vacuum grease. Pay attention that grease is distributed constantly over the whole circumference.		<ul style="list-style-type: none"> <li>• Soft tool (o-ring remover)</li> <li>• Vacuum grease</li> </ul>		
28. Clean or replace seals if necessary. Lubricate each o-ring with 0.05 ml vacuum grease. 29. Install o-rings. 30. Deposit 0.1 ml vacuum grease on each o-ring. Pay attention that grease is distributed constantly over the whole circumference.		Vacuum grease		
31. Remove fixation kit and mounting screw for pendulum plate. 32. Clean screw and slightly lubricate thread. Then reinstall fixation kit. 33. Clean actuator shaft and lubricate it with 0.1 ml vacuum grease.		Vacuum grease		

Description		Required tool		
34. Install actuator <ul style="list-style-type: none"> <li>Tighten actuator screws with 6 Nm.</li> <li>Remove vacuum grease from actuator shaft face after installation.</li> </ul>		Allen Wrench 5mm		
35. Install controller <ul style="list-style-type: none"> <li>Tighten the controller screws with 1 Nm.</li> <li>Connect cables at controller</li> <li>Connect compressed air at actuator</li> </ul>		Allen Wrench 4mm		
36. Turn on power of controller. <b>Note:</b> valve moves to close position.		open end wrench 13mm		
37. Open valve and install sealing ring and pendulum plate in reverse order as they had been disassembled (steps 8 to 3).				
<p><b>If actuator was replaced</b>, proceed with step 38, otherwise go to step 40.</p> <p>38. Close valve and check if pendulum plate is in center of flange. Check can be done either visual or by measurement. When the valve is mounted to a tool, the bonnet has to be removed and the center position can be measured by a depth gauge (see picture). If the centering (or distance D) is not correct, proceed with step 39.</p>		DN	Distance D [mm] between bonnet flange surface and pendulum plate.	
		100	51.5 ±0.5	
		160	45.0 ±0.5	
		200	40.0 ±0.5	
		250	50.0 ±0.5	

Description		Required tool		
<p>39. If necessary adjust pendulum plate:</p> <ol style="list-style-type: none"> <li>Move pendulum plate a little towards open (e.g. position 1% of full stroke)</li> <li>Use adjustment screw at flange side of actuator (1 turn clockwise adjusts pendulum plate by about 3mm towards open).</li> <li>Restart valve in menu 'System/Recovery'</li> <li>Check pendulum plate position according step 38 and redo adjustment procedure if necessary.</li> </ol>	<p>Adjusting screw mounted either in actuator position «B1 standard» or «B2 option»</p>  	<p>Allen wrench 2mm</p>		
40. Clean the valve sealing surface		<p>Lint-and dust-free towel a little soaked with isopropyl alcohol</p>		
41. Clean the valve bonnet o-ring		<p>Lint-and dust-free towel</p>		
<p>42. Mount valve bonnet.</p> <ul style="list-style-type: none"> <li>Tightening torques for bonnet screws, see in table to the right.</li> </ul>	<p><b>Max. torque 6 Nm</b></p>	<p>Allen wrench 5mm</p>		

## 5.2 Option board

The option board may or may not be equipped in your valve depending on the order. Refer to page 1 of this manual to check valve version. This board includes the optional modules for the valve which are:

- $\pm 15$ VDC sensor power supply (SPS)
- Power failure option (PFO)

It is available in 3 versions. These are:

- SPS module only
- PFO module only
- SPS and PFO module

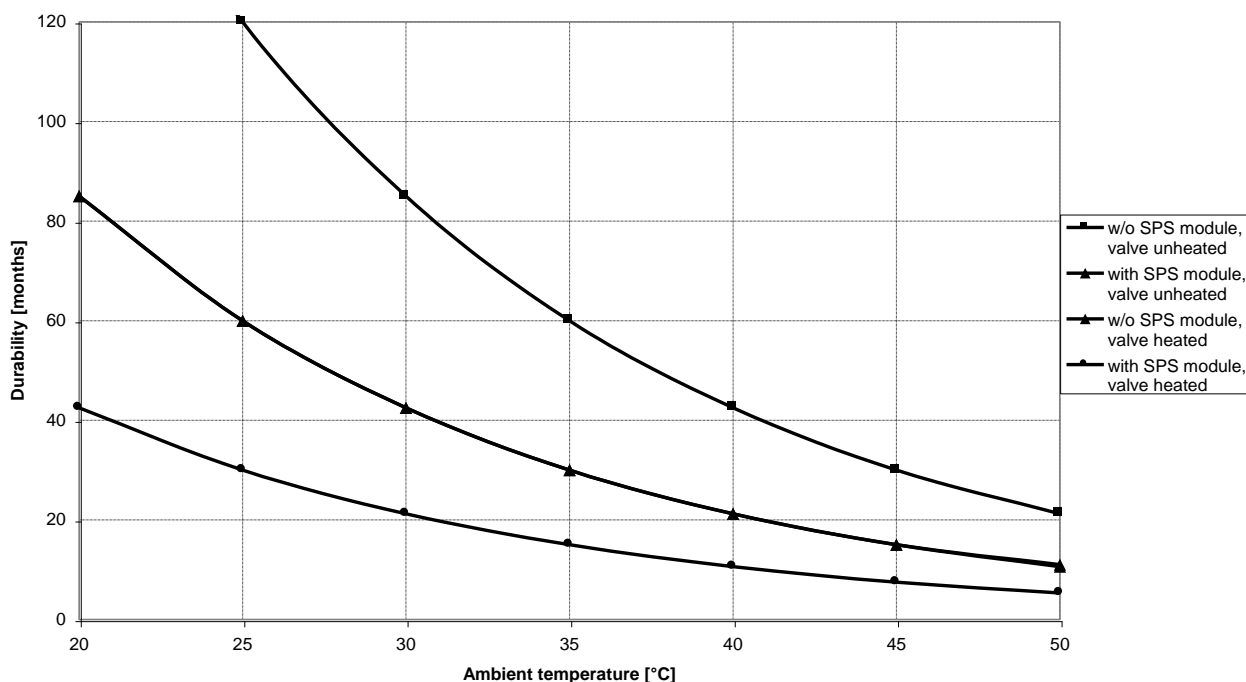
The modules may be retrofitted or replaced easily. The battery lifetime of the PFO module depends on the ambient temperature (see below). To assure PFO function the option board must be replaced after battery life has expired. For ordering number of the modules refer to «Spare parts and accessories».

### 5.2.1 Durability of power fail battery

The curves in the graph show the estimated life of UltraCap PFO in the worst condition (max. sensor load = 1 A, valve heating temperature = 150 degree C).

If the SPS is not fully loaded (< 1 A) or heating temperature of valve body is lower than 150 degree C, the corresponding life time curve will be somewhere in between the upper and the lower curve.

Therefore please determine the equivalent maintenance period for replacing the UltraCap battery (Option board).



**Note:** This graph shows estimated life of UltraCap PFO for reference and not as guaranteed value.

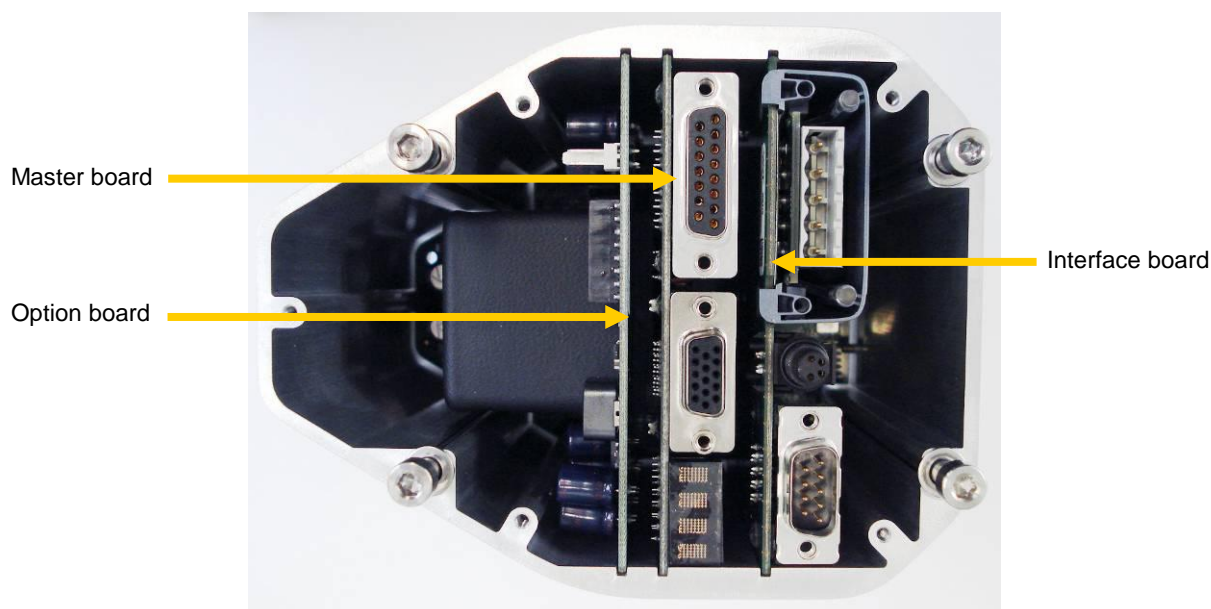
## 5.2.2 Retrofit / replacement procedure



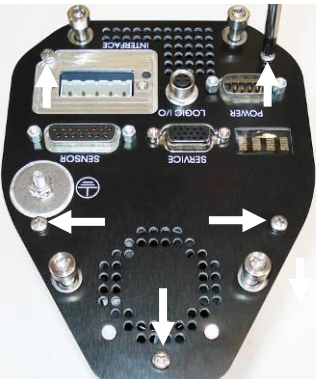
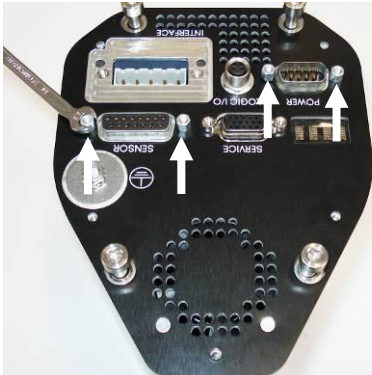
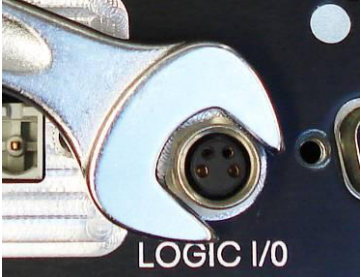
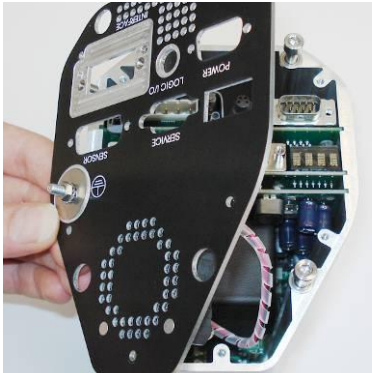
### ESD Precaution!

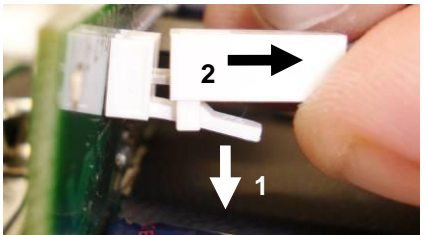
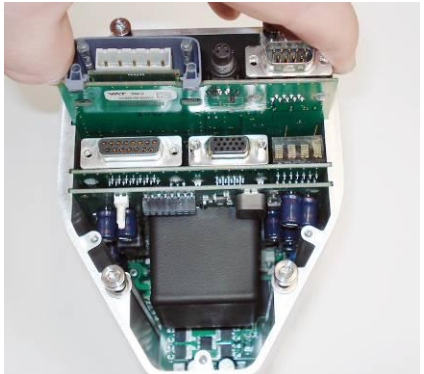
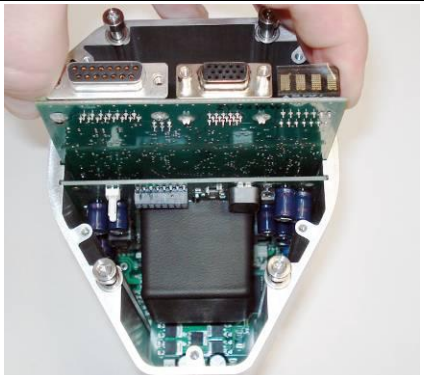
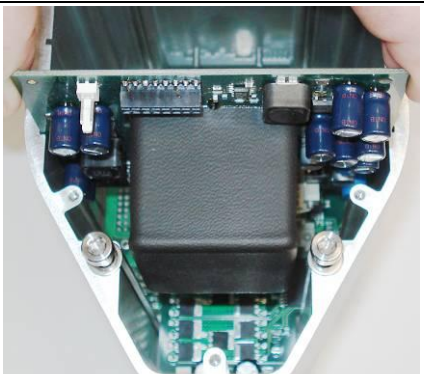
All work on the control and actuating unit has to be done under ESD protected environment to prevent electronic components from damage!

Top view on control and actuating unit with panel removed:



**Note:** All boards have a fixed position into control and actuating unit. It is not possible to fit a board in other position as shown in picture above. Do not try out other positions, that may be destroy the socket of boards!

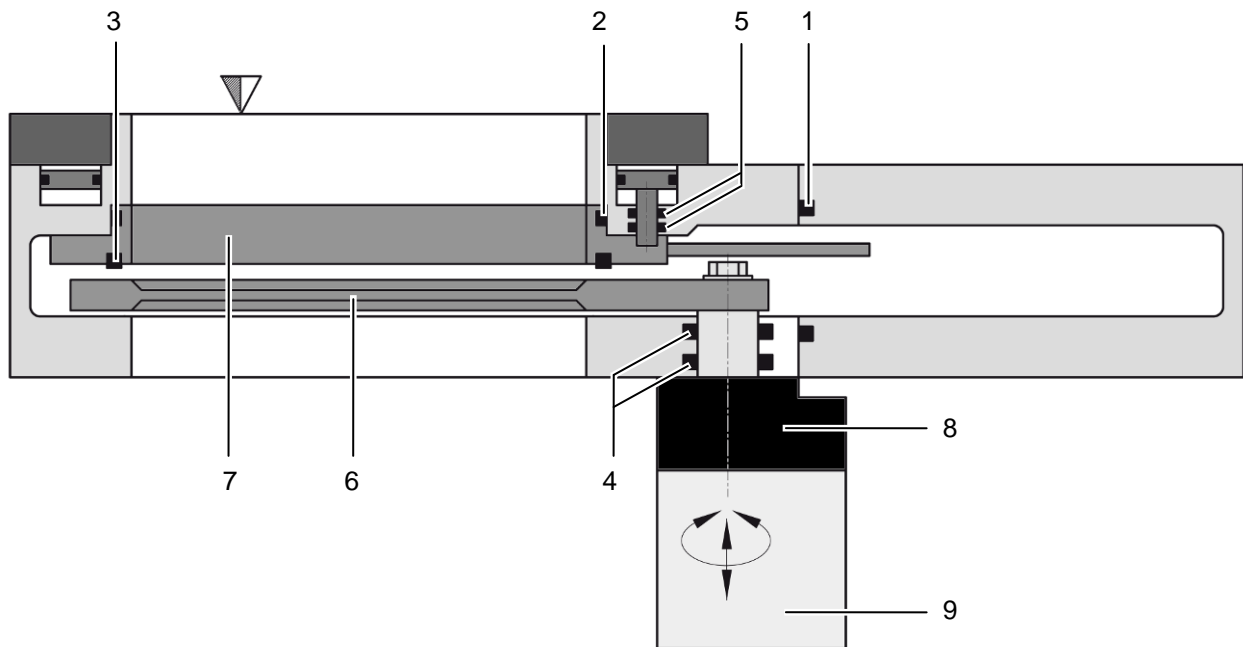
Description		Required tool
1. Remove the panel screws		Pozidriv screw driver size 1
2. Remove female screw locks from POWER and SENSOR connectors		Open end wrench 4.5 mm
3. Loosen and remove the LOCIC connector screw		Open end wrench 10mm
4. Lift the panel carefully		

Description		Required tool
<p>5. Pull out the option board a little</p> <p>6. Push the connector release (1) a little down and disconnect fan cable (2) from option board</p>		
<p>7. Remove the interface board or replace it, if existing master board is defect</p>		
<p>8. Remove the master board or replace it, if existing interface board is defect</p>		
<p>9. Remove the option board or replace it, if existing option board is defect</p>		
<p>10. Insert all boards in reverse order as they disassembled at correct positions (see steps 9...7)</p>		



Description		Required tool
1. Reassemble the controller panel (see steps 6...3).		Open end wrench 10mm
2. Tighten female screw locks from POWER and SENSOR connectors with 1.1 Nm (see step 2)		Open end wrench 4.5 mm
3. Tighten panel screws with 1.1 Nm (see step 1)		Pozidriv screw driver size 1

## 6 Drawing



- 1 Bonnet seal
- 2 Body seal
- 3 Plate seal
- 4 Rotary feedthrough seals
- 5 Shaft feedthrough seals
- 6 Pendulum plate
- 7 Sealing ring
- 8 Actuator
- 9 Control unit

## 7 Spare parts



Please specify the **fabrication number of the valve** (see yellow label on valve) when ordering spare parts. This is to ensure that the appropriate spare parts are supplied.

### 7.1 Control unit

Item	Description	
	Valve size Product ordering number	All sizes 650 . . . . .
9	Control unit	Too many to list. Depends on configuration, please contact VAT.
	Option board with SPS module (±15VDC sensor power supply)	371399
	Option board with PFO module (power failure option)	371397
	Option board with SPS and PFO module	326113
	Controller separation kit including 4.5m cable	264881



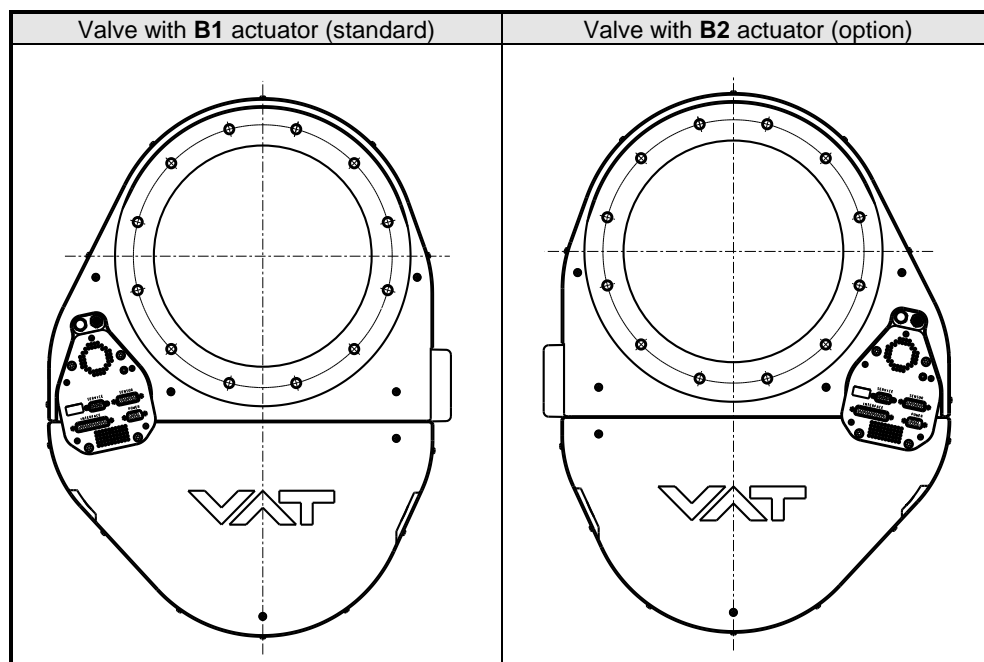
## 7.2 Valve unit

Item	Description				
	Valve size Valve part number	DN100 65040 - . . . . - . . . .	DN160 65044 - . . . . - . . . .	DN200 65046- . . . . - . . . .	DN250 65048 - . . . . - . . . .
1	Bonnet Viton seal other materials	N-5100-259 on request	N-5100-267 on request	N-5100-272 on request	N-5100-277 on request
2	Body seal (Viton) This includes a 2ml syringe of vacuum grease	204884	206527	200468	202592
3	Gate Viton seal other materials	N-5100-155 on request	N-5100-258 on request	N-5100-266 on request	N-5100-275 on request
	Seal kit vacuum (Viton). This consists of item 2 and 3.	204883	206526	204204	203883
	Syringe of vacuum grease	2ml 5ml	206792 206793		
4	Actuator shaft seals (Viton)	N-5111-329 (2 pcs required per valve)			
5	Sealing ring shaft seals (Viton)	N-5111-112 (12 pcs required per valve)	N-5111-112 (8 pcs required per valve)	N-5111-112 (12 pcs required per valve)	N-5111-112 (16 pcs required per valve)
6	Pendulum plate: - Blank B1 *) - Blank B2 *) - Hardanodized B1 *) - Hardanodized B2 *) - Nickel coated B1 *) - Nickel coated B2 *)	91048-01 on request 100741-01 on request on request on request on request	101570-01 231343 98371-01 98673-01 on request on request	201272 226661 200500 201437 211613 on request	94632-01 on request 92228-01 92229-01 on request on request
7	Sealing ring - Blank - Hardanodized - Nickel coated	216490 217050 on request	207518 204340 on request	204453 202046 211610	205874 203217 on request
8	Actuator B1 *) B2 *)	347193 347194	342943 346981		

**Note:** Use only spare parts manufactured by VAT to assure safe and reliable operation!

\*) Refer to figures on next page to check for actuator position options.

Actuator position options:



### 7.3 Accessories

Item	Description	Part number
	24 VDC power supply unit (input: 100 – 240 VAC)	249775
	'Control Performance Analyzer' package for Windows® consisting of software and cable	600SP-99LB-000
	'Control View' software for Windows®	248126 free download from <a href="http://www.vatvalve.com">www.vatvalve.com</a> or available on order against charge
	Service cable (PC to valve connection)	230327 free wiring information available for download from <a href="http://www.vatvalve.com">www.vatvalve.com</a>
	Connector kit consisting of: •DB-9 female POWER plug •DB-15 male SENSOR plug •DB-25 male INTERFACE plug	242411
	Service Box 2	601BS-29NN-000
	Control panel (rack-mount version of Service Box 2)	602BS-29LE-000

**7.3.1 Centering ring with Viton o-ring**

Description					
Valve size		DN 100 / 4"	DN 160 / 6"	DN 200 / 8"	DN 250 / 10"
Product ordering number		65040 - . . . .	65044 - . . . .	65046 - . . . .	65048 - . . . .
Centering ring with Viton o-ring (for ISO-F installation only)	Aluminum	32040-QAZV	32044-QAZV	32046-QAZV	32048-QAZV
	Stainless steel	32040-QEZV	32044-QEZV	32046-QEZV	32048-QEZV



## **8 Warranty**

Each product sold by VAT Vakuumventile AG (VAT) is warranted to be free from the manufacturing defects that adversely affect the normal functioning thereof during the warranty period stated in VAT's «Terms of Sale» immediately following delivery thereof by VAT, provided that the same is properly operated under conditions of normal use and that regular, periodic maintenance and service is performed or replacements made, in accordance with the instructions provided by VAT. The foregoing warranty shall not apply to any product or component that has been repaired or altered by anyone other than an authorized VAT representative or that has been subject to improper installation or abuse, misuse, negligence or accident. VAT shall not be liable for any damage, loss, or expense, whether consequential, special, incidental, direct or otherwise, caused by, arising out of or connected with the manufacture, delivery (including any delay in or failure to deliver), packaging, storage or use of any product sold or delivered by VAT shall fail to conform to the foregoing warranty or to the description thereof contained herein, the purchaser thereof, as its exclusive remedy, shall upon prompt notice to VAT of any such defect or failure and upon the return of the product, part or component in question to VAT at its factory, with transportation charges prepaid, and upon VAT's inspection confirming the existence of any defect inconsistent with said warranty or any such failure, be entitled to have such defect or failure cured at VAT's factory and at no charge therefor, by replacement or repair of said product, as VAT may elect. VAT MAKES NO WARRANTY OR REPRESENTATION OF ANY KIND, EXPRESS OR IMPLIED, (INCLUDING NO WARRANTY OR MERCHANTABILITY), EXCEPT FOR THE FOREGOING WARRANTY AND THE WARRANTY THAT EACH PRODUCT SHALL CONFORM TO THE DESCRIPTION THEREOF CONTAINED HEREIN, and no warranty shall be implied by law.

Furthermore, the «Terms of sale» at the back of the price list are applicable.