# Installation, Operating & Maintenance Instructions

# Butterfly Pressure Control Valve
**with RS232 interface**

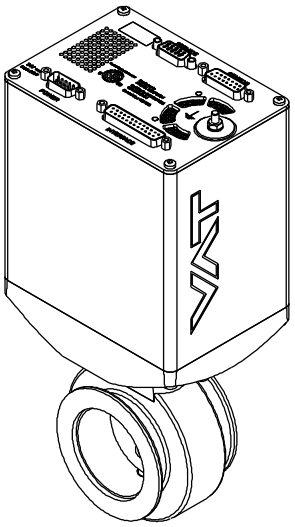
## Series 612
## DN 40-50 mm (I.D. 1.5“ - 2")

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

**612 . . - . .GG- . . . .** (1 sensor input)
**612 . . - . .GH- . . . .** (2 sensor inputs)
**612 . . - . .AG- . . . .** (1 sensor input / ±15V SPS)
**612 . . - . .AH- . . . .** (2 sensor inputs / ±15V SPS)
**612 . . - . .HG- . . . .** (1 sensor input / PFO)
**612 . . - . .HH- . . . .** (2 sensor inputs / PFO)
**612 . . - . .CG- . . . .** (1 sensor input / ±15V SPS / PFO)
**612 . . - . .CH- . . . .** (2 sensor inputs / ±15V SPS / PFO)
**612 . . - . .GV- . . . .** (1 sensor input / analog outputs)
**612 . . - . .GW- . . . .** (2 sensor inputs / analog outputs)
**612 . . - . .AV- . . . .** (1 sensor input / analog outputs / ±15V SPS)
**612 . . - . .AW- . . . .** (2 sensor inputs / analog outputs / ±15V SPS)
**612 . . - . .HV- . . . .** (1 sensor input / analog outputs / PFO)
**612 . . - . .HW- . . . .** (2 sensor inputs / analog outputs / PFO)
**612 . . - . .CV- . . . .** (1 sensor input / analog outputs / ±15V SPS / PFO)
**612 . . - . .CW- . . . .** (2 sensor inputs / analog outputs / ±15V SPS / PFO)

SPS = Sensor Power Supply  PFO = Power Failure Option

configured with firmware: **612P.1E.00**



Sample picture

## Imprint

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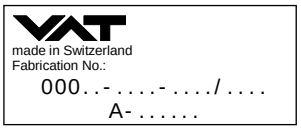
## Contents

# 1 Description of product

## 1.1 Identification of product

The fabrication number and order number are fixed on the product directly or by means of an identification plate.




← Fabrication number
← Order number

## 1.2 Use of product

This product is a Butterfly control valve for downstream pressure control in vacuum systems.
Use product for clean and dry vacuum applications only. Other applications are only allowed with the written permission of VAT.

## 1.3 Used abbreviations

| Abbreviation | Description |
|---|---|
| CPA | Control Performance Analyzer |
| CV | Control view |
| PFO | Power Failure Option |
| SFS | Sensor Full Scale |
| SPS | Sensor Power Supply |
| ADC | Analog-to-digital converter |

## 1.4 Related documents

- Product Data Sheet
- Dimensional Drawing
- IOMI Heating device (if valve with heater)

## 1.5 Important information

This symbol points to a very important statement that requires particular attention.

**Example:**

Refer to chapter: «Technical data» for detailed information.

## 1.6 Technical data

### 1.6.1 Control and actuating unit

| Control and actuating unit | |
|---|---|
| Power input [1] **(α)** | +24 VDC (±10%) @ 0.5 V pk-pk max. [connector: POWER] |
| [612 . . - . . **A** . - . . . . / 612 . . - . . **G** . - . . . . ]<br>[612 . . - . . **C** . - . . . . / 612 . . - . . **H** . - . . . . ] | 38 W max. (operation of valve with max. load) without PFO [4]<br>38 W plus 10 W for PFO [4] |
| Sensor power supply [2] **(β)**<br>[612 . . - . . **A** . - . . . . / 612 . . - . . **C** . - . . . . ]<br>Input<br>Output | <br><br>+24 VDC / 1500 mA max. [connector: POWER]<br>±15 VDC (±5%) / 1000 mA max. [connector: SENSOR] |
| Sensor power supply [2] **(β)**<br>[612 . . - . . **G** . - . . . . / 612 . . - . . **H** . - . . . . ]<br>Input<br>Output | <br><br>+ 24 VDC resp. ± 15 VDC [connector: POWER]<br>same as input but: [connector: SENSOR]<br>2.0 A max. at ± 15 VDC<br>1.5 A max. at + 24 VDC |

[1] Internal overcurrent protection by a PTC device.

[2] Refer to chapter «Sensor supply concepts» for details.

Calculation of complete power consumption:

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

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

| Control and actuating unit (continuation) | | |
|---|---|---|
| Sensor input<br>Signal input<br>ADC resolution<br>Sampling time | | <br>0-10 VDC / Ri>100 kΩ [connector: SENSOR]<br>0.23 mV<br>10 ms |
| Digital inputs [3] | | ±24 VDC max. |
| Digital outputs [3]<br>Input voltage<br>Input current<br>Breaking capacity | | <br>70 VDC or 70 V peak max.<br>0.5 ADC or 0.5 A peak max.<br>10 W max. |
| PFO [4] battery pack<br>[612 . . - . . **C** . - . . . . / 612 . . - . . **H** . - . . . . ]<br>Charging time<br>Durability | | <br><br>2 minutes max.<br>up to 10 years @ 25°C ambient;<br>refer to «Durability of power fail battery» for details |
| Ambient temperature | | 0 °C to +50 °C max. (<35 °C recommended) |
| Pressure control accuracy | | 5 mV or 0.1% of setpoint, whichever is greater |
| Position resolution / position control capability | | 20000 |
| Actuating time | closing | 0.3 s typ. |
| | opening | 0.3 s typ. |
| Utilizable valve torque | | 2.5 Nm |

[3] Refer to chapter «Schematics» for details.
[4] PFO = Power Failure Option. Refer to chapter «Behavior in case of power failure» for details

### 1.6.2 Valve unit

| Valve unit | | |
|---|---|---|
| Pressure range at 20°C | | |
| - Aluminum | (612 . . - . **A**. . - . . . . ) | 1 × 10E-8 mbar to 1.2 bar (abs) |
| - Aluminum hard anodized | (612 . . - . **H**. . - . . . . ) | 1 × 10E-6 mbar to 1.2 bar (abs) |
| - Aluminum nickel coated | (612 . . - . **I**. . - . . . . ) | 1 × 10E-8 mbar to 1.2 bar (abs) |
| - Stainless steel | (612 . . - . E. . - . . . . ) | 1 × 10E-8 mbar to 1.2 bar (abs) |
| Leak rate to outside at 20°C | | |
| - Aluminum | (612 . . - . **A**. . - . . . . ) | 1 × 10E-9 mbar l/s |
| - Aluminum hard anodized | (612 . . - . **H**. . - . . . . ) | 1 × 10E-5 mbar l/s |
| - Aluminum nickel coated | (612 . . - . **I**. . - . . . . ) | 1 × 10E-9 mbar l/s |
| - Stainless steel | (612 . . - . E. . - . . . . ) | 1 × 10E-9 mbar l/s |
| Cycles until first service | | 2'000'000 (unheated and under clean conditions) |
| Admissible operating temperature | | 10°C to +150°C |
| Mounting position | | Any<br>Control unit for ISO-KF version needs support when mounted on horizontal piping and control unit does not hang. |
| Wetted materials | | |
| - Body, plate | (612 . . - . A. . - . . . . ) | Aluminum 3.2315 (AA6082) |
| - Body, plate | (612 . . - . H. . - . . . . ) | Aluminum 3.2315 (AA6082) hard anodized |
| - Body, plate | (612 . . - . I. . - . . . . ) | Aluminum 3.2315 (AA6082) nickel coated |
| - Body, plate | (612 . . - . E. . - . . . . ) | Stainless steel 316L (1.4404 or 1.4435 ) |
| - Shaft | | Stainless steel 316L (1.4404 or 1.4435 ) |
| - Plate screws | | Stainless steel 316L (A4) |
| - Shaft seal | | Viton® (standard). Other materials available.<br>Seal materials are declared on dimensional drawing of specific valve ordering number. |
| - Slide bearing for shaft | | iglidur® X |
| | | **DN 40**<br>**1½"** |
| | | (612**32** - ....) |
| Max. differential pressure on plate | | 1000 mbar |
| Min. controllable conductance ($C_{min}$)<br>[N2 molecular flow] | | 0.25 l/s |
| Conductance in open position<br>[N2 molecular flow] | | 80 l/s |
| Dimensions | | Refer to dimensional drawing of specific valve ordering number (available on request) |

| | | |
|---|---|---|
| | | **DN 50**<br>**2"** |
| | | (612**34** - ....) |
| | | 1000 mbar |
| | | 0.3 l/s |
| | | 150 l/s |

# 2 Safety

## 2.1 Compulsory reading material

Read this chapter prior to performing any work with or on the product. It contains important information that is significant for your own personal safety. This chapter must have been read and understood by all persons who perform any kind of work with or on the product during any stage of its serviceable life.

**NOTICE**

**Lack of knowledge**

Failing to read this manual may result in property damage.

Firstly, read manual.

These Installation, Operating & Maintenance Instructions are an integral part of a comprehensive documentation belonging to a complete technical system. They must be stored together with the other documentation and accessible for anybody who is authorized to work with the system at any time.

## 2.2 Danger levels

**⚠ DANGER**

**High risk**

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

**⚠ WARNING**

**Medium risk**

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

**⚠ CAUTION**

**Low risk**

Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.

**NOTICE**

**Command**

Indicates a hazardous situation which, if not avoided, may result in property damage.

## 2.3 Personnel qualifications

**⚠ WARNING**

**Unqualified personnel**

Inappropriate handling may cause serious injury or property damage.

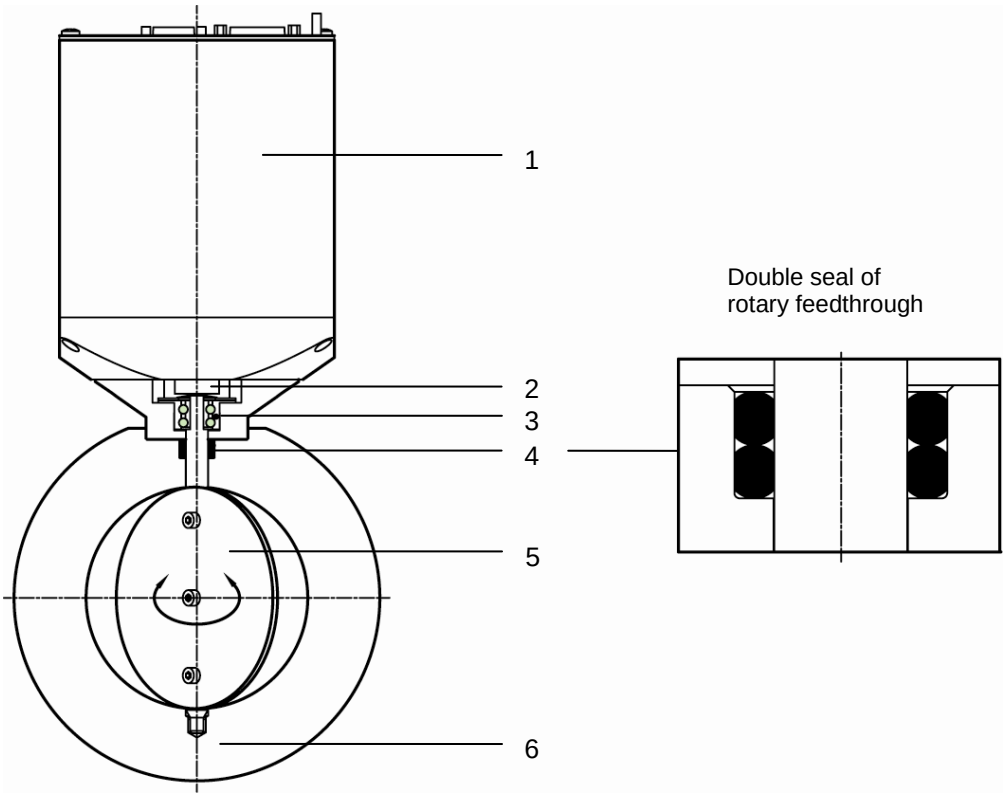
Only qualified personnel are allowed to carry out the described work.

## 2.4 Safety labels

| Label | Part No. | Location on valve |
|---|---|---|
|  | T-9001-156 | On protective foil covering of valve opening |

# 3 Design and Function

## 3.1 Design



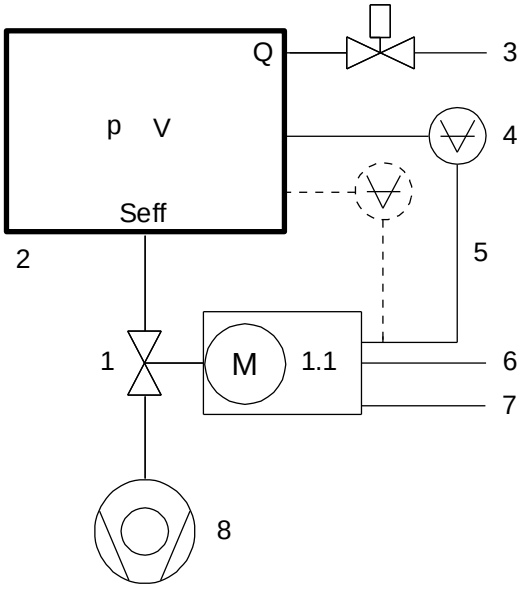

| | | | |
|---|---|---|---|
| 1 | Integrated controller | 4 | Double seal |
| 2 | Coupling | 5 | Plate |
| 3 | Bearing | 6 | Valve body |

## 3.2 Function

The valve plate (5) acts as a throttling element and varies the conductance of the valve opening.
The integrated controller (1) calculates the required plate position to achieve the setpoint pressure.
See also principle drawing on chapter: «Connection Overview».
Actuation is performed by a stepper motor. An encoder monitors the position. This principle ensures very fast and accurate process pressure control even in demanding contaminating processes.

### 3.2.1 Pressure control system overview and function

Vacuum pressures are always absolute pressures unless explicitly specified as pressure differences.




Example: Downstream control

1 Valve
1.1 Controller and actuator
2 Process chamber
3 Gas inlet
4 Pressure sensor(s)
5 Sensor cable
6 Cable to remote control unit
7 Cable to power supply
8 HV Pump

$S_{eff}$ Q / p
$S_{eff}$ effective pump speed ($ls^{-1}$)
Q Gas flow (mbar)
p Pressure (mbar)

or units used in USA
$S_{eff}$ = 12.7 • Q / p
$S_{eff}$ effective pump speed ($ls^{-1}$)
Q Gas flow (sccm)
p Pressure (mTorr)

#### 3.2.1.1 Way of operation

The controller compares the actual pressure in the process chamber given by the pressure sensor with the preset pressure. The controller uses the difference between actual and set pressure to calculate the correct position of the control valve. The controller drives the control valve into the correct position and the actual pressure again equals the set pressure.
This control operation is performed continuously. Pressure changes in the process chamber due to leaks, desorption, gas flow, reaction products, variations in pumping speed etc. are always corrected at once.

#### 3.2.1.2 Pressure control

In a vacuum system which is pumped and into which gas is admitted at the same time, the pressure can be controlled in two ways:

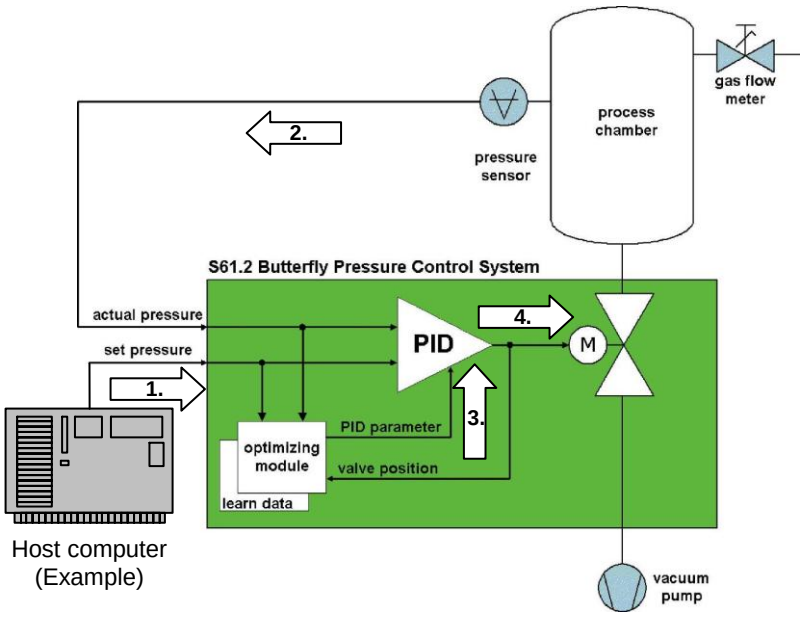
1. Downstream control (standard):
   The pressure is controlled by changing the conductance of a control valve between pump and process chamber. This changes the effective pumping speed at the process chamber. Pressure and gas flow can be independently controlled over a wide range.

2. Upstream control:
   The pressure is controlled by changing the gas flow into the process chamber, while the pumping speed remains constant.

#### 3.2.1.3 Adaptive controller (standard)

A controller adapting itself to changes in pressure, gas flow and pumping speed without any manual adjustments. This allows for a completely automatic operation of the system.

### 3.2.2 Principle of a pressure control system




1. Host computer sends pressure set point
2. Controller reads actual pressure from sensor
3. Optimizing module sends new PID parameters
4. Actuator sets new valve position

# 4 Installation

**⚠ WARNING**

**Unqualified personnel**

Inappropriate handling may cause serious injury or property damage.

Only qualified personnel are allowed to carry out the described work.

## 4.1 Unpacking

***NOTICE***

**Physical overstraining at controller**

Inappropriate handling with the valve may cause in damage of controller.

Do not place the valve on the controller.

- Make sure that the supplied products are in accordance with your order.
- Inspect the quality of the supplied products visually. If it does not meet your requirements, please contact VAT immediately.
- Store the original packaging material. It may be useful if products must be returned to VAT.

1. Open the transport case and remove inside packing material as far as necessary.
2. Lift the valve carefully and place it on a clean place.

Do not remove protective foils from valve opening

## 4.2 Installation into the system

**⚠ WARNING**

**Valve opening**

Risk of serious injury.

Human body parts must be kept out of the valve opening and away from moving parts. Do not connect the controller to power before the valve is installed complete into the system.

***NOTICE***

**Sealing surfaces**

Sealing surfaces of valve and vacuum system could be damage in case of incorrect handling.

Only qualified personal are allowed to install the valve into the vacuum system.

***NOTICE***

**Wrong connection**

Wrong connection may result in damage of controller or power supply.

Connect all cables exactly as shown in the following descriptions and schematics.

***NOTICE***

**Burned connector pins (spark)**

Connector pins or electronic parts could damage, if plugged and unplugged under power.

Do not plug or unplug connectors under power.

***NOTICE***

**Contamination**

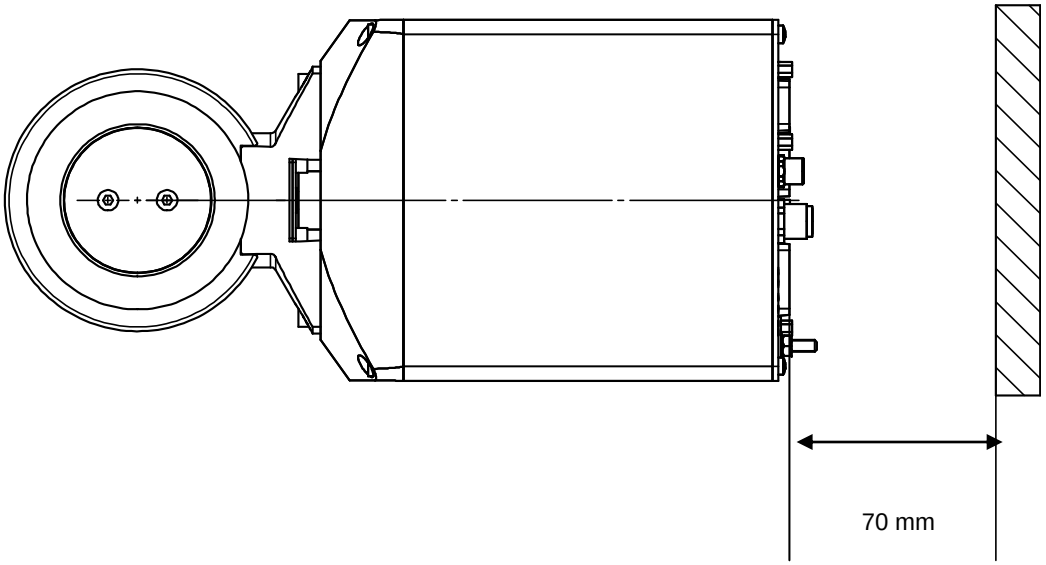
Gate and other parts of the valve must be protected from contamination.

Always wear clean room gloves when handling the valve.

Mount valve to a clean system only.

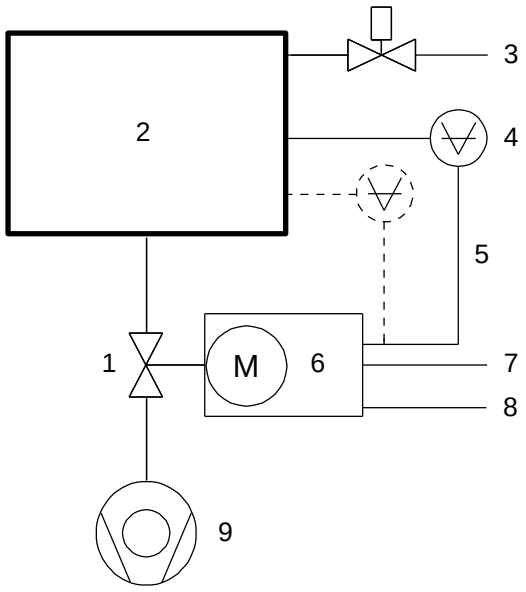
### 4.2.1 Installation space condition

Install the valve with integrated controller with space for dismantling and air circulation as shown in figure below.



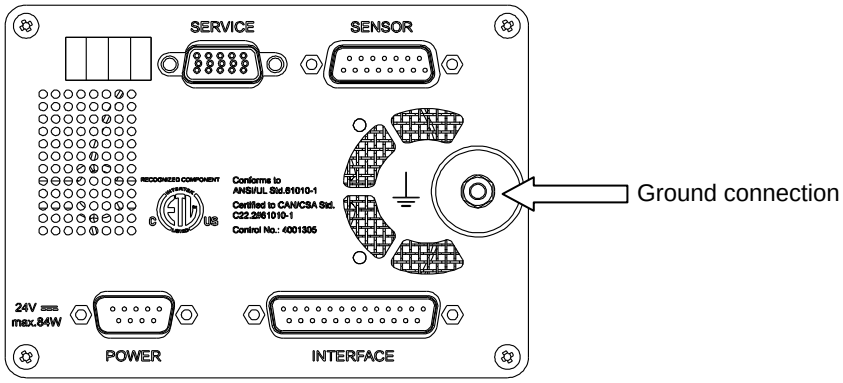
### 4.2.2 Connection overview

System:




1 Valve
2 Process chamber
3 Gas inlet
4 Pressure sensor(s)
5 Sensor cable(s)
6 Controller and actuator
7 Cable to remote control unit
8 Cable to power supply
9 Pump

Controller:



### 4.2.3 Installation procedure

All numbers in brackets refer to chapter: «Connection overview».

3. Remove protective covers from body flanges.

4. Install [1] valve into the vacuum system. Valve seat side must face process chamber.

- Do not tighten the flange screws stronger than indicated under chapter «Tightening torque».
- Do not admit higher forces to the valve than indicated under chapter «Admissible forces».
- Make sure that enough space is kept free to do preventive maintenance work. The required space is indicated on the dimensional drawing.
- Control unit of valves with ISO-KF (612 . . – **K** . . .) needs support when mounted on horizontal piping and control unit does not hang.

5. Install the ground connection cable at controller. Refer to chapter «Electrical connection».

6. Install sensor(s) [4] according to the recommendations of the sensor manufacturer and directives given under chapter «Requirements to sensor connection».

7. Connect sensor cable [5] to sensor(s) and then to valve (connector: SENSOR). Refer to chapter «Electrical connection» for correct wiring.

Input for second sensor is available on 612 . . - . . . **H** - . . . . , 612 . . - . . . **W** - . . . . , 612 . . - . . . **F** - . . . . and 612 . . - . . . **Z** - . . . . versions only.

8. Connect valve with cable [7] to remote control unit (connector: INTERFACE). Refer to chapter «RS232 connection» for correct wiring.

9. Connect power supply cable [8] to valve (connector: POWER). Refer to chapter «Electrical connection» for correct wiring.

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 chapter «Safety mode».

10. This valve may optionally be equipped with a heating device. Connect VAT heating device according to manual of respective heating device.

11. Perform chapter «Setup procedure» to prepare valve for operation.

Without performing the setup procedure the valve will not be able to do pressure Control.

## 4.3 Tightening torque

### 4.3.1 Mounting with ISO-KF flanges

Tightening torques for ISO-KF flange connections depend on the type of seal which is used. Follow recommendations of seal manufacturer.

## 4.4 Admissible forces

**NOTICE**

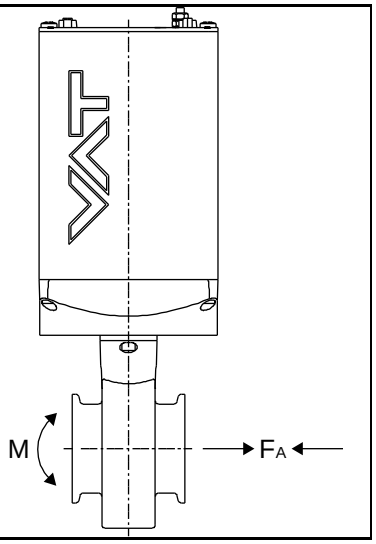
**Force at valve body**

Forces from the weight of other components can lead to deformation of the valve body and to malfunction of the valve.

Do not higher force the valve body as specified.

The following forces are admissible.

| Valve size | | Axial tensile or compressive force «$F_A$» | | Bending moment «M» | |
|---|---|---|---|---|---|
| mm | inch | N | lb. | Nm | Lbf. |
| 40 | 1½ | 100 | 22 | 6 | 4.5 |
| 50 | 2 | 150 | 34 | 11 | 8 |



### 4.4.1 Admissible forces at controller

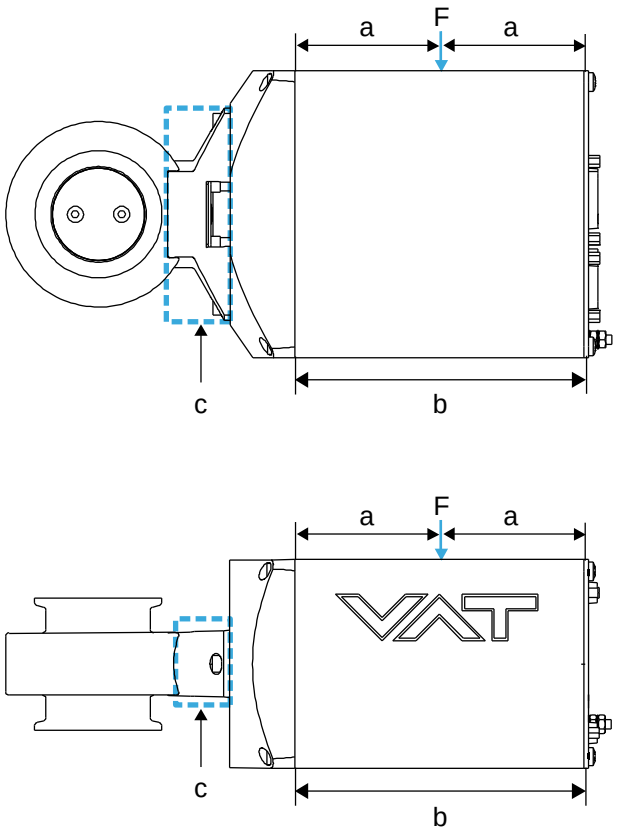
**NOTICE**

**Force at pedestal**

In case higher force is applied, the pedestal could be permanently damaged.

– Do not pushing, shocking load, or stressing the valve controller
– Do not deposit anything at valve controller

The admissible force at valve controller in regards to the pedestal is shown in table below.

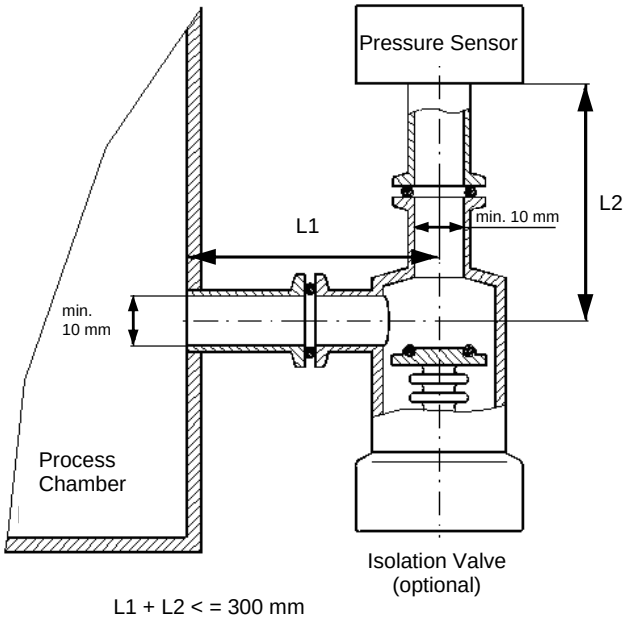
| Admissible force «F» | Overview<br>**F** = Force<br>a = middle of aluminium part of controller (b / 2) |
|---|---|
| **400 N** |  |

## 4.5 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: **> = 10 mm**
- Length of connection pipe: **< = 300 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.




## 4.6 Electrical connection

**NOTICE**

**Wrong connection**

Wrong connection may result in damage of controller or power supply.

Connect all cables exactly as shown in the following descriptions and schematics.

**NOTICE**

**Burned connector pins (spark)**

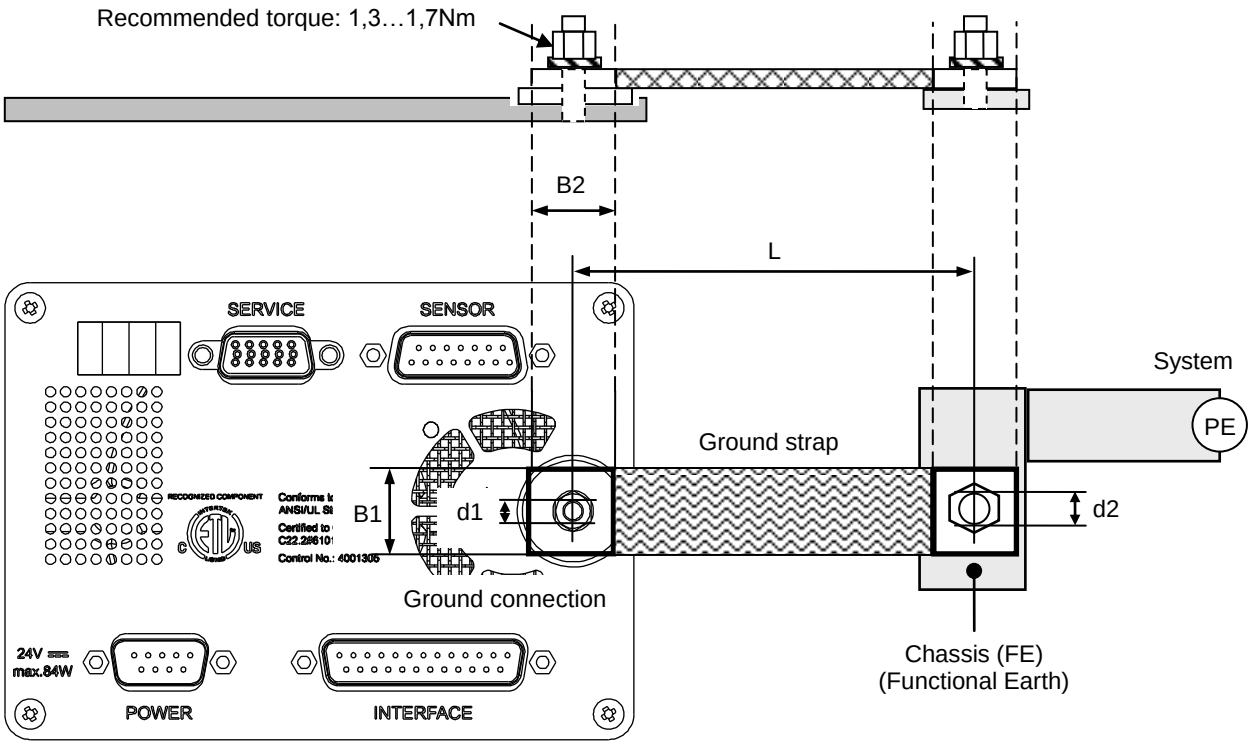
Connector pins or electronic parts could damage, if plugged and unplugged under power.

Do not plug or unplug connectors under power.

### 4.6.1 Ground connection

Recommendation for ground strap between controller and system (chassis)

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




- Connection plates of ground strap must be total plane for a good electrical contact!
- The connection point at chassis (FE) 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.
- Avoid low chassis cross section to the system PE connection. (min. same cross section as ground strap)

### 4.6.2 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 ±15 VDC from the 24 VDC.

Concepts:

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

This concept is only possible when SPS retrofit is installed.

Valve versions:

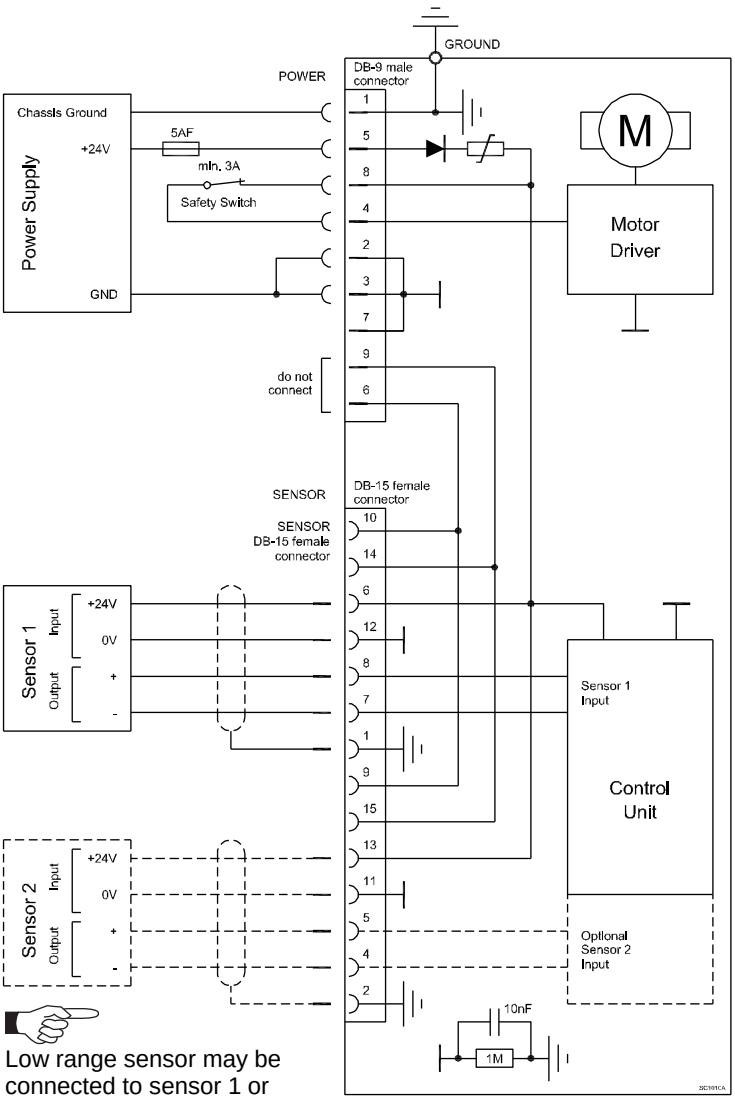
- 612. . - . . **G** . - . . . . and 612 . . - . . **H** . - . . . . SPS module not included
- 612 . . - . . **A** . - . . . . and 612 . . - . . **C** . - . . . . SPS module included

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

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

[612 . . - . . **G** . - . . . . / 612 . . - . . **H** . - . . . . versions recommended]

#### 4.6.3.1 Sensor power wiring via controller

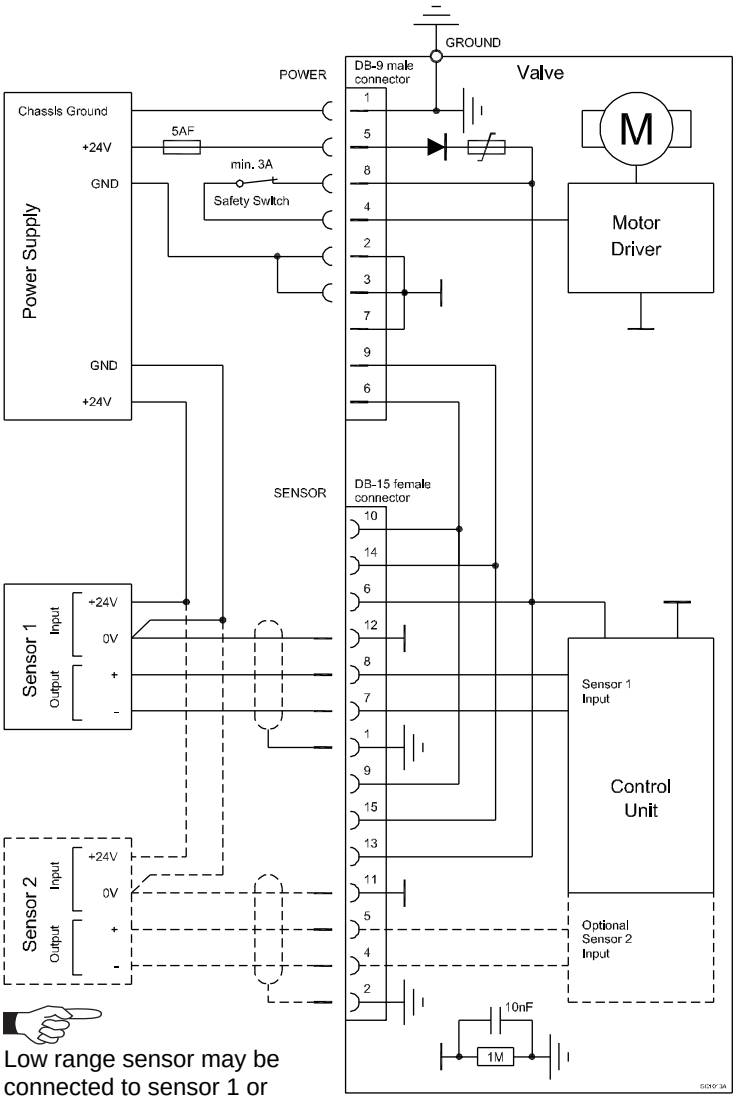



Pins 4 and 8 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

Low range sensor may be connected to sensor 1 or sensor 2 input. Do configuration accordingly.

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND) at DB–9 male power connector and Sensors (+24V / 0V / + / -) at DB–15 female sensor connector exactly as shown in the drawing above!
- Connector: Use only screws with 4–40 UNC thread for fastening the connectors!

### 4.6.3.2 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.

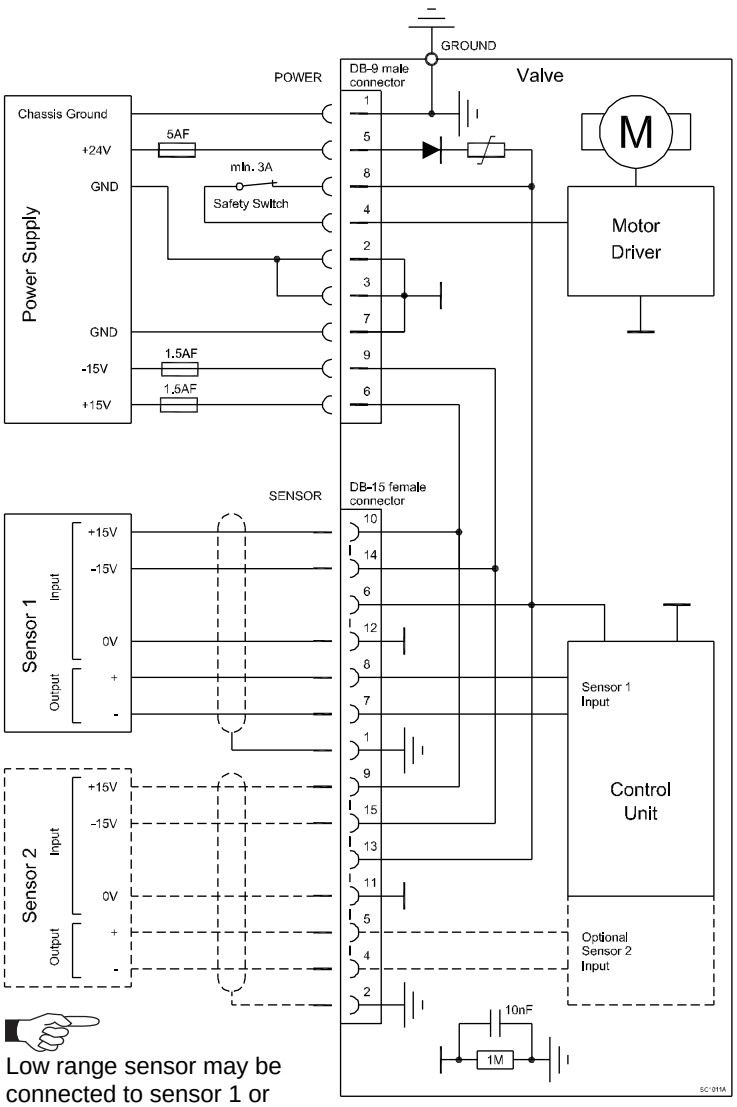
Low range sensor may be connected to sensor 1 or sensor 2 input. Do configuration accordingly.

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND) at DB–9 male power connector and Sensors (+24V / 0V / + / -) at DB–15 female sensor connector exactly as shown in the drawing above!
- Connector: Use only screws with 4–40 UNC thread for fastening the connectors!

### 4.6.4 Power and sensor connection (±15 VDC sensors) without opt. SPS module

[612 . . - . . G . - . . . . / 612 . . - . . H . - . . . . versions only]

#### 4.6.4.1 Sensor power wiring via controller

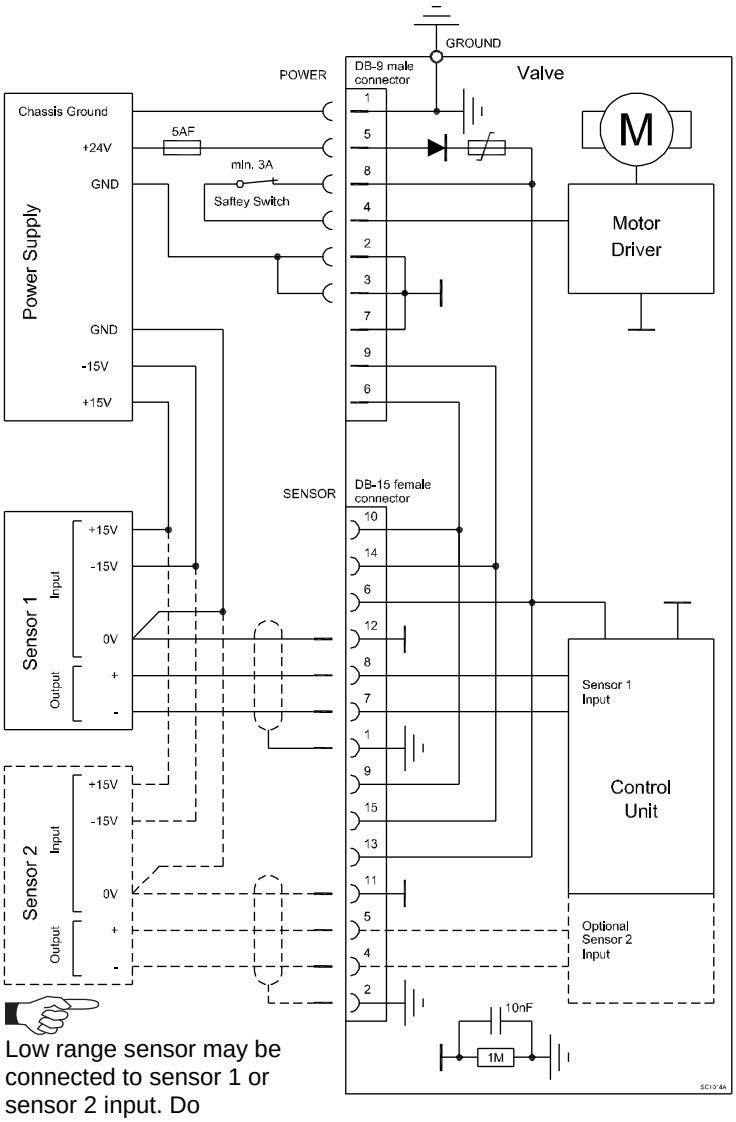



Pins 4 and 8 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

Low range sensor may be connected to sensor 1 or sensor 2 input. Do configuration accordingly.

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND and GND / -15V / +15V) at DB–9 male power connector and Sensors (+15V / -15V / 0V / + / -) at DB–15 female sensor connector exactly as shown in the drawing above!
- Connector: Use only screws with 4–40 UNC thread for fastening the connectors!

### 4.6.4.2 Sensor power wiring external



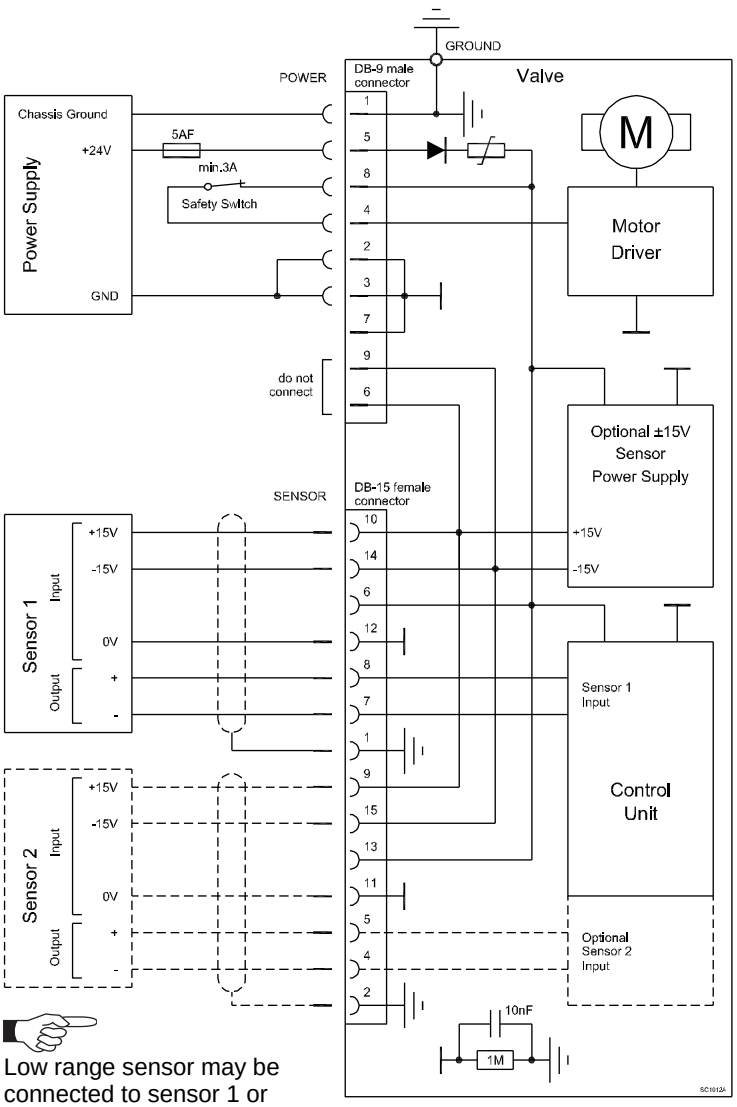

Pins 4 and 8 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

Low range sensor may be connected to sensor 1 or sensor 2 input. Do configuration accordingly.

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND and GND / -15V / +15V) at DB–9 male power connector and Sensors (+15V / -15V / 0V / + / -) at DB–15 female sensor connector exactly as shown in the drawing above!
- Connector: Use only screws with 4–40 UNC thread for fastening the connectors!

### 4.6.5 Power and sensor connection (±15 VDC sensors) with optional SPS module

[612 . . - . . **A** . - . . . . / 612 . . - . . **C** . - . . . . versions only]




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

Low range sensor may be connected to sensor 1 or sensor 2 input. Do configuration accordingly.

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND and GND / -15V / +15V) at DB–9 male power connector and Sensors (+15V / -15V / 0V / + / -) at DB–15 female sensor connector exactly as shown in the drawing above!
- Connector: Use only screws with 4–40 UNC thread for fastening the connectors!

### 4.6.6 RS232 interface connection

Refer to chapter: «Schematics» for wiring information.

### 4.6.7 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 or purchase our 'Control Performance Analyzer'. Alternatively the VAT Service Box2 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 chapter: «Local Operation» for details and to chapter «Spare parts / Accessories» for ordering numbers of service cable, software and Service Box 2.

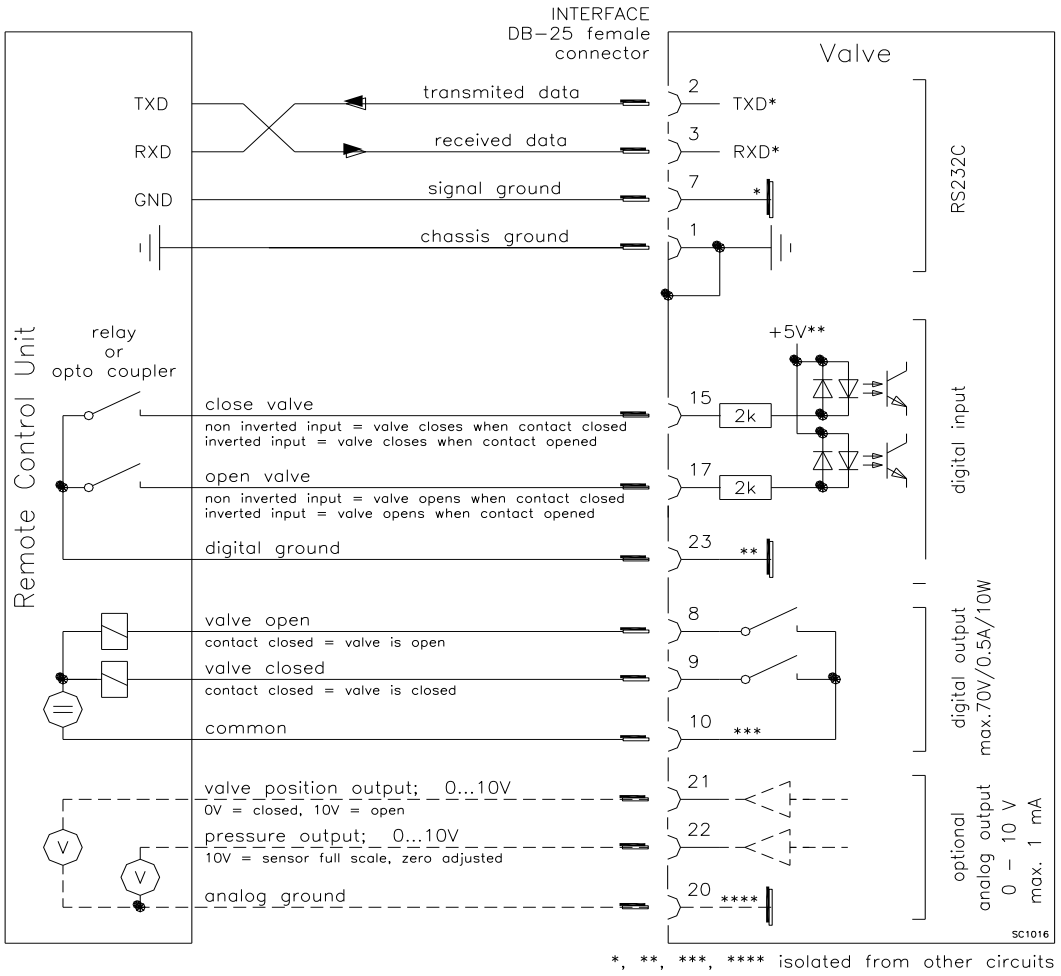
Use only screws with 4–40 UNC thread for fastening the service port connector.

### 4.6.8 Schematics

This interface allows for remote operation by means of a command set based on the RS232 protocol. In addition there are 2 digital inputs and 2 digital outputs. Digital inputs may be operated either by switches or by voltage sources.

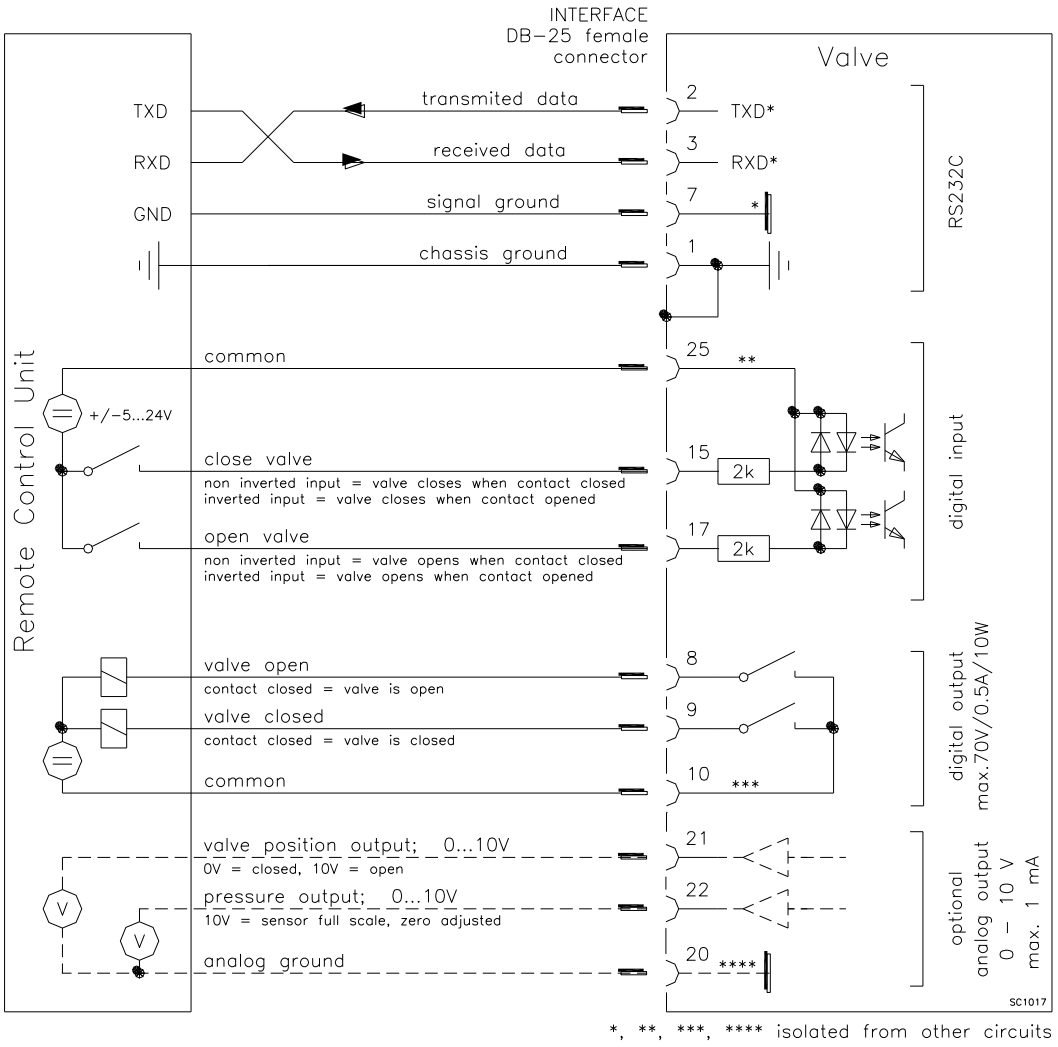
Optional analog outputs are available on 612 . . - . . . **V** - . . . .
and 612 . . - . . . **W** - . . . . versions only.
Active **digital inputs** have **higher priority than RS232** commands.

**a) Configuration with switches for digital inputs:**




Do not connect other pins than indicated in the schematics above! Use only screws with 4-40UNC thread for fastening the DB-25 connector!

**b) Configuration with voltage source for digital inputs:**




Do not connect other pins than indicated in the schematics above! Use only screws with 4-40UNC thread for fastening the DB-25 connector!

#### 4.6.8.1 Digital inputs

| Pin | Function | Signal type | Description | Priority |
|---|---|---|---|---|
| 15 | **CLOSE VALVE** | Digital input [1)] | This function will close the valve.<br>Valve will be in interlock mode as long as function is activated. After deactivation of function it will remain effective until<br>- OPEN valve digital input is active<br>- converse RS232 control command have been received<br>The function is activated when optocoupler is 'on' in **non inverted** configuration.<br>The function is activated when optocoupler is 'off' in **inverted** configuration.<br>Configuration can be done in local operation via service port or in remote operation. | 1 [2)] |
| 17 | **OPEN VALVE** | Digital input [1)] | This function will open the valve.<br>Valve will be in interlock mode as long as function is activated. After deactivation of function it will remain effective until converse RS232 control command have been received.<br>The function is activated when optocoupler is 'on' in **non inverted** configuration.<br>The function is activated when optocoupler is 'off' in **inverted** configuration.<br>Configuration can be done in local operation via service port or in remote operation. | 2 [2)] |
| 23 | **DIGITAL GROUND** | Digital ground | Ground for all digital inputs. Ground is used when digital inputs are operated by switches. Connect switches to ground.<br>See also in chapter «Schematics» configuration a). | |
| 25 | **DIGITAL COMMON** | Digital common | Common for all digital inputs. Common is used when digital inputs are driven by voltage sources. Connect + or – terminal of source with common (optocoupler inputs are capable of bidirectional operation).<br>See also in chapter «Schematics» configuration b). | |

1) All digital inputs are digitally filtered. Filter delay is 50ms. This means that digital signals must be applied for at least 50ms to be effective. Refer to chapter «Schematics» 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. These digital inputs have higher priority than all RS232 commands. RS232 commands will not be accepted while digital inputs are active.

## 4.7 Initial operation

### 4.7.1 Setup procedure

To enable the valve for **pressure control** setup **steps 1 to 6 must be performed**.
In case position control is required only it's sufficient to perform steps 1 to 3.

| Setup step | | Description |
|---|---|---|
| 1 | **Power up** | Turn on external + 24VDC power supply of valve (and external ±15 VDC for sensor power supply if required).<br>Refer to chapter «Behavior during power up» for details. |
| 2 | **Interface configuration** | RS232 with analog output parameters and digital inputs for valve may be changed from the default values.<br>Refer to chapter «RS232 with analog output interface» for details. |
| 3 | **Valve configuration** | Basic configurations of valve must be adapted according to application needs. Refer to chapter «Valve configuration» for details. |
| 4 | **Sensor configuration** | Basic configurations of sensor(s) must be adapted according to application needs. Refer to chapter «Sensor configuration» for details. |
| 5 | **ZERO** | Compensation of the sensor offset voltage.<br>Refer to chapter «ZERO» for details. |
| 6 | **LEARN** | Determination of the vacuum system characteristic to accommodate the PID controller. Refer to chapter «LEARN» for details. |

Without LEARN the valve is not able to run pressure control.

### 4.7.2 RS232 Interface configuration

The factory default configuration of the RS232 interface might be changed to fit the application by using the Control View software, the Control Performance Analyzer software or the Service Box 2.

RS232 interface configuration must be adapted according to application needs. The factory default configuration of the RS232 interface is shown in the table below.

| Baud rate | Data bits | Stop bits | Parity | Digital input OPEN | Digital input CLOSE |
|---|---|---|---|---|---|
| 9600 | 7 | 1 | even | not inverted | not inverted |

- Functionality of digital interlock inputs CLOSE VALVE and OPEN VALVE. These may be configured as 'not inverted', 'inverted' or 'disabled'. Default is 'not inverted'. Refer also to «Digital inputs».
- Pressure and position range for RS232 communication must be selected.
  Default for pressure is 0 - 1'000'000. Default for position is 0 - 100'000.

| **Local operation**:<br>('Control View', 'Control Performance Analyzer' or 'Service Box 2') | **Remote operation**:<br>(Refer to chapter «Setup commands» for details) |
|---|---|
| Do configuration in menu 'Setup / Interface'. | 1. Send INTERFACE CONFIGURATION |
| | 2. Send RANGE CONFIGURATION |

### 4.7.3 Valve 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 [612 . . - . . C . - . . . . or 612 . . - . . H . - . . . . ].
- **Network failure**, for default settings refer to individual product data sheet.

| **Local operation**:<br>(‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2‘) | **Remote operation**:<br>(Refer to chapter «Setup commands» for details) |
|---|---|
| 1. Do power up configuration in menu ‘Setup / Valve’. | 1. Send VALVE CONFIGURATION |
| 2. Do power fail configuration in menu ‘Setup / Valve’. | |

### 4.7.4 Sensor configuration

Basic sensor configuration must be adapted according to application needs.

- ZERO function: This may be ‘disabled’ or ‘enabled’. Default is ‘enabled‘. Refer also to chapter «ZERO».
- Sensor configuration for 2 sensor version [612 . . - . . . **H** - . . . .]. Refer also to chapter: «Pressure control operation with 2 sensors».

| **Local operation**:<br>(‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2‘) | **Remote operation**:<br>(Refer to chapter «RS232setup commands» for details) |
|---|---|
| 1. Enable or disable ZERO function in menu ‘Setup / Sensor’. | Send SENSOR CONFIGURATION |
| 2. Do 2 sensor configuration in menu ‘Setup / Sensor’. | |

### 4.7.5 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**:<br>(‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2‘) | **Remote operation**:<br>(Refer to chapter «RS232 with analog output control commands» resp. «RS232 with analog output setup commands» for details) |
|---|---|
| Go to menu ‘Zero / ZERO’ and follow instructions. | 1. Send OPEN VALVE |
| | 2. Wait until process chamber is evacuated and sensor signal is not shifting anymore. |

| | |
|---|---|
| | 3. Send ZERO |

- 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.
- 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.

### 4.7.6 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**:<br>('Control View', 'Control Performance Analyzer' or 'Service Box 2') | **Remote operation**:<br>(Refer to chapter «Control commands» resp. «Setup commands» for details) |
|---|---|
| Go to 'Learn / LEARN' menu and follow instructions.<br><br>Gasflow calculation according to recommendation below is done automatically based on inputs. | 1. Send OPEN VALVE |
| | 2. Set specific gas flow according to calculation below and wait until flow is stable.<br>LEARN does not need to be performed with the process gas. Instead $N_2$ or Ar may be used. |
| | 3. Send LEARN<br>(with pressure limit set to full scale) |

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

**Gasflow calculation for LEARN:**

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

Required pressure / flow regime must be known to calculate the most suitable learn gas flow for a specific application.

1. At first it is necessary to find out about the required control range respectively its conductance values. Each working point (pressure / flow) must be calculated with one following formulas. Choose the applicable formula depending on units you are familiar with.

$$C_{WP} = \frac{1000 \bullet q_{WP}}{p_{WP}}$$

$C_{WP}$ required conductance of working point [l/s]
$q_{WP}$ **gasflow** of working point [**Pa m3/s**]
$p_{WP}$ **pressure** of working point [**Pa**]

$$C_{WP} = \frac{q_{WP}}{p_{WP}}$$

$C_{WP}$ required conductance of working point [l/s]
$q_{WP}$ **gasflow** of working point [**mbar l/s**]
$p_{WP}$ **pressure** of working point [**mbar**]

$$C_{WP} = \frac{q_{WP}}{78.7 \bullet p_{WP}}$$

$C_{WP}$ required conductance of working point [l/s]
$q_{WP}$ **gasflow** of working point [**sccm**]
$p_{WP}$ **pressure** of working point [**Torr**]

2. Out of these calculated conductance values choose the lowest.

$$C_R = \min(C_{WP1}, C_{WP2}, \ldots, C_{WPn})$$

$C_R$ required lower conductance [l/s]
$C_{WPx}$ required conductance of working points [l/s]

To make sure that the valve is capable to control the most extreme working point verify that $C_R \geq C_{min}$ of the valve (refer to «Technical data»).

3. Calculate gasflow for learn. Choose the applicable formula depending on units you are familiar with.

$$q_L = \frac{p_{max} \bullet C_R}{2000}$$

$q_L$ gasflow for learn [**Pa m3/s**]
$p_{max}$ max. pressure to control [**Pa**]
$C_R$ required lower conductance [l/s]

$$q_L = \frac{p_{max} \bullet C_R}{2}$$

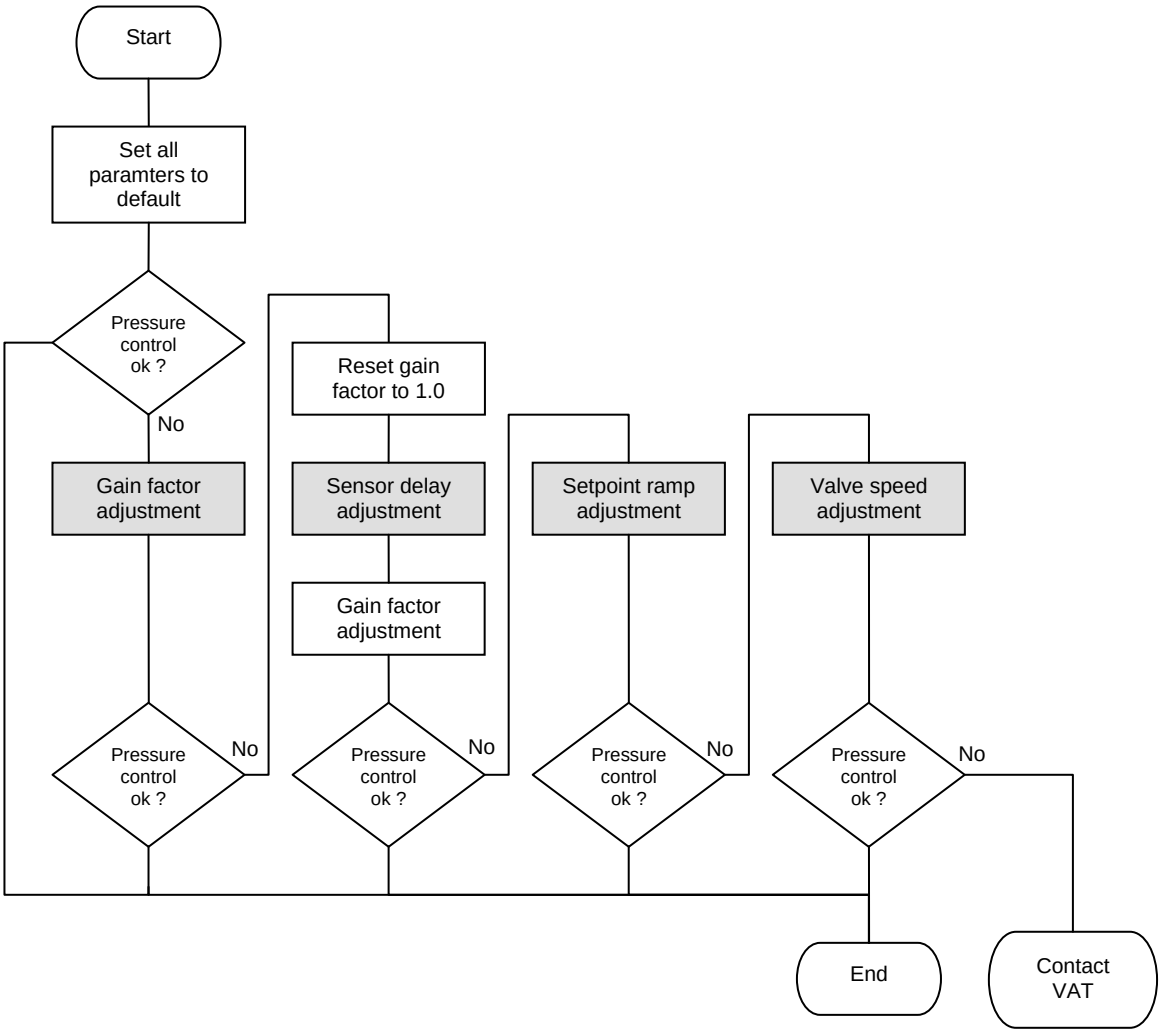
$q_L$ gasflow for learn [**mbar l/s**]
$p_{max}$ max. pressure to control [**mbar**]
$C_R$ required lower conductance [l/s]

$$q_L = 39.4 \bullet p_{max} \bullet C_R$$

$q_L$ gasflow for learn [**sccm**]
$p_{max}$ max. pressure to control [**Torr**]
$C_R$ required lower conductance [l/s]

### 4.7.7 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

#### 4.7.7.1 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.

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**:<br>(‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2‘) | **Remote operation**:<br>(Refer to chapter «RS232 setup commands» for details) |
|---|---|
| Set gain factor in menu ‘Setup / Control Parameter’ | Send<br>PID CONTROLLER CONFIGURATION |

#### 4.7.7.2 Sensor delay adjustment

Sensor delay adjustment effects: **Stability**

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

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.

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 0 s.
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:**<br>('Control View', 'Control Performance Analyzer' or 'Service Box 2') | **Remote operation**:<br>(Refer to chapter «RS232 setup commands» for details) |
|---|---|
| Go to 'Setup / Control Parameter' menu.<br>Select sensor delay. | Send<br>PID CONTROLLER CONFIGURATION |

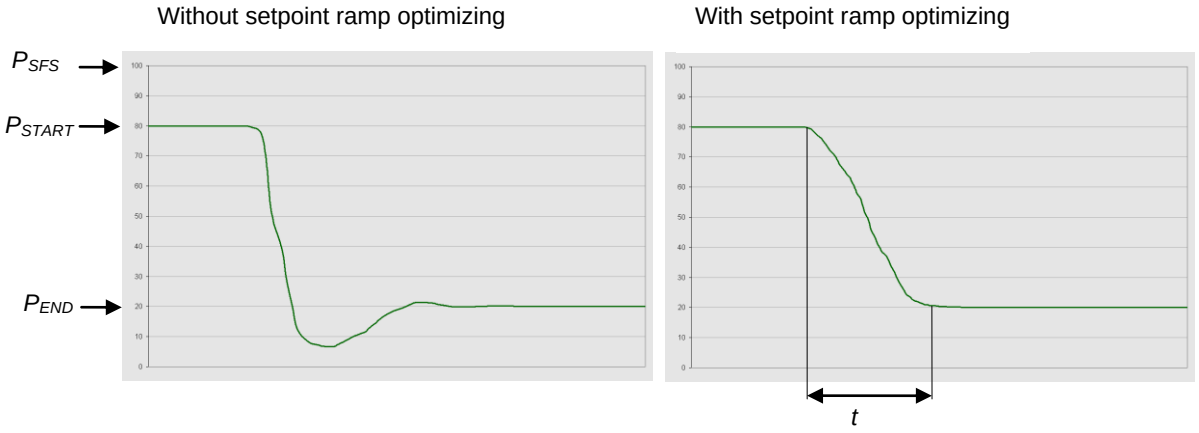
#### 4.7.7.3 Setpoint ramp adjustment

Setpoint ramp effects: **Undershoot of pressure, Response time**

Default value for Setpoint Ramp is 0. 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 = 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.

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:**<br>('Control View', 'Control Performance Analyzer' or 'Service Box 2') | **Remote operation:**<br>(Refer to chapter «RS232 setup commands» for details) |
|---|---|
| Go to 'Setup / Control Parameter' menu.<br>Select setpoint ramp. | Send<br>PID CONTROLLER CONFIGURATION |

#### 4.7.7.4 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.

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. OPEN and CLOSE are always done with maximum 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.

| **Local operation**:<br>('Control View', 'Control Performance Analyzer' or 'Service Box 2') | **Remote operation**:<br>(Refer to chapter «RS232 setup commands» for details) |
|---|---|
| Go to 'Setup / Control Parameter' menu. Select valve speed. | Send VALVE SPEED |

## 4.8 RS232 interface commands

### 4.8.1 Command syntax

[function][value][CR][LF]

Each element is separated with square brackets for clarity. Square brackets are not part of command syntax. Unless otherwise specified all elements are ASCII characters. There are no spaces between the elements necessary. Commands and values are case sensitive.
Data length of value depends on command. Number of characters is specified in the description. Some commands do not require the value element.
[CR] is Carriage Return (0D hexadecimal).
[LF] is Linefeed

### 4.8.2 RS232 Control commands

| Control function | Command | | Acknowledgement (within 10ms after reception of command) |
|---|---|---|---|
| | **Description** | | |
| **POSITION CONTROL** | Set | [R:][xxxxxx][CR][LF] | [R:][CR][LF] |
| | Get | [i:38][CR][LF] | [i:38][00xxxxxx][CR][LF] |
| | data length 6 characters for writing<br>8 characters starting with double zero for reading<br>xxxxxx position SETPOINT, value depends on configuration,<br>refer to «RS232 with analog output setup commands, RANGE CONFIGURATION»<br>for details<br><br>Change to POSITION CONTROL mode and transfer of position SETPOINT value resp. reading of position SETPOINT.<br>**Note:** Reading returns position setpoint only in case pressure control is not selected. | | |
| **HOLD** | Set | [H:][CR][LF] | [H:][CR][LF] |
| | This function stops the valve at the current position. It is effective in PRESSURE CONTROL and POSITION CONTROL. The function can be revoked by a POSITION CONTROL, PRESSURE CONTROL, OPEN VALVE or CLOSE VALVE command. | | |
| **CLOSE VALVE** | Set | [C:][CR][LF] | [C:][CR][LF] |
| | Valve will close. | | |
| **OPEN VALVE** | Set | [O:][CR][LF] | [O:][CR][LF] |
| | Valve will open. | | |
| **PRESSURE CONTROL** | Set | [S:][0xxxxxxx][CR][LF] | [S:][CR][LF] |
| | Get | [i:38][CR][LF] | [i:38][0xxxxxxx][CR][LF] |
| | data length 8 characters starting with a zero<br>xxxxxxx pressure SETPOINT, value depends on configuration,<br>refer to «RS232 with analog output setup commands, RANGE CONFIGURATION»<br>for details<br><br>Change to PRESSURE CONTROL mode and transfer of pressure SETPOINT resp. reading of pressure SETPOINT.<br>**Note:** Reading returns pressure setpoint only in case pressure control is selected, otherwise position setpoint is returned. | | |

### 4.8.3 RS232 Inquiry commands

| Inquiry function | Command | | Acknowledgement (within 10ms after reception of command) |
|---|---|---|---|
| | Description | | |
| **ASSEMBLY** | Get | [i:76][CR][LF] | [i:76][xxxxxxsyyyyyyyabc][CR][LF] |
| | data length 17 characters<br>xxxxxx position, return value depends on configuration, refer to «RS232 setup commands, RANGE CONFIGURATION» for details<br>s sign, 0 for positive pressure readings, - for negative pressure readings<br>yyyyyyy pressure, return value depends on configuration, refer to «RS232 setup commands, RANGE CONFIGURATION» for details<br>a **0** = local operation, **1** = remote operation, **2** = locked remote operation<br>b **0** = Initialization (Refer to chapter: «Behavior during power up»<br>**1** = synchronization, **2** = POSITION CONTROL, **3** = CLOSED<br>**4** = OPEN, **5** = PRESSURE CONTROL, **6** = HOLD , **7** = LEARN<br>**8** = INTERLOCK (OPEN by digital input)<br>**9** = INTERLOCK (CLOSED by digital input)<br>**C** = power failure, **D** = safety mode<br>**E** = fatal error (read «FATAL ERROR STATUS» for details)<br>c **0** = no warning, **1** = warning present (read «WARNINGS» and «ERROR STATUS» for details)<br>This function returns an assembly consisting of POSITION, PRESSURE and main status information for the valve. | | |
| **POSITION** | Get | [A:][CR][LF] | [A:][xxxxxx][CR][LF] |
| | data length 6 characters<br>xxxxxx position, return value depends on configuration, refer to «RS232 setup commands, RANGE CONFIGURATION» for details<br>This function returns the current valve position.<br>**Note:** When motor interlock is active during power up the valve enters the ‘safety mode’ and is not able to recognize position. In this case position 999’999 is returned. | | |
| **PRESSURE** | Get | [P:][CR][LF] | [P:][sxxxxxxx][CR][LF] |
| | data length 8 characters<br>s sign, 0 for positive readings, - for negative readings<br>xxxxxxx pressure, return value depends on configuration, refer to «RS232 setup commands, RANGE CONFIGURATION» for details<br>This function returns the actual pressure. | | |

| Inquiry function | Command | Acknowledgement (within 10ms after reception of command) |
|---|---|---|
| | **Description** | |
| **SENSOR 1 READING** | Get [i:64][CR][LF] | [i:64][sxxxxxxx][CR][LF] |
| | data length 8 characters<br>s sign, 0 for positive readings, - for negative readings<br>xxxxxxx sensor 1 reading, return value depends on configuration, refer to «RS232 setup commands, RANGE CONFIGURATION» for details<br>This function returns direct reading from sensor 1 input. | |
| **SENSOR 2 READING** | Get [i:65][CR][LF] | [i:65][sxxxxxxx][CR][LF] |
| | data length 8 characters<br>s sign, 0 for positive readings, - for negative readings<br>xxxxxxx sensor 2 reading, return value depends on configuration, refer to «RS232 setup commands, RANGE CONFIGURATION» for details<br>This function returns direct reading from sensor 2 input. | |
| **PRESSURE CONTROL STATUS** | Get [i:36][CR][LF] | [i:36][abcdefgh][CR][LF] |
| | data length 8 characters<br>a **0** = no pressure control (e.g. if position control is selected)<br>**1** = wide range control (PD control)<br>**2** = close up control (PID control)<br>cdefgh reserved, do not use<br>The controller distinguishes 2 control ranges and acts accordingly. | |
| **DEVICE STATUS** | Get [i:30][CR][LF] | [i:30][abcdefgh][CR][LF] |
| | data length 8 characters<br>a **0** = local operation, **1** = remote operation, **2** = locked remote operation<br>b **0** = Initialization (Refer to chapter: «Behavior during power up»<br>**1** = synchronization, **2** = POSITION CONTROL, **3** = CLOSED<br>**4** = OPEN, **5** = PRESSURE CONTROL, **6** = HOLD , **7** = LEARN<br>**8** = INTERLOCK (OPEN by digital input)<br>**9** = INTERLOCK (CLOSED by digital input)<br>**C** = power failure, **D** = safety mode<br>**E** = fatal error (read «FATAL ERROR STATUS» for details)<br>c **0** = Power Failure Option (PFO) disabled<br>**1** = Power Failure Option (PFO) enabled<br>d **0** = no warning, **1** = warning present (read «WARNINGS» and «ERROR STATUS» for details)<br>efg reserved, do not use<br>h **0** = normal operation, **1** = simulation running<br>This function returns status information about the valve.<br>**Note:** In simulation mode the valve can demonstrate pressure control capability independent of other equipment such as vacuum chamber, flow controller and gauge. Normal operation is not possible when simulation is running. | |

| Inquiry function | Command | Acknowledgement (within 10ms after reception of command) |
|---|---|---|
| | **Description** | |
| **WARNINGS** | Get [i:51][CR][LF] | [i:51][abcdefgh][CR][LF] |
| | data length 8 characters<br>a **0** = no service required<br>**1** = service request, it is indicated when the control unit detects that motor steps are apparently not effective. This may happen when the valve is heavily contaminated or the gate seal is heavily sticking. These ‚lost' steps are recognized and will be repeated to attempt target position in the short term. But in the medium term the valve requires cleaning or inspection.<br>b **0** = LEARN data set present, **1** = LEARN data set not present<br>c **0** = power failure battery ready<br>**1** = power failure battery not ready<br>defgh reserved, do not use<br>This function returns warning information about the valve. If a warning is present countermeasure should be taken. Use RESET command to delete service request bit.<br>**Note:** Without LEARN the valve is not able to run pressure control | |
| **SENSOR OFFSET** | Get [i:62][CR][LF] | [i:62][aaaabbbb][CR][LF] |
| | data length 8 characters<br>aaaa offset sensor 1 (-140 ... 0140 = -1.40V ... +1.40V)<br>bbbb offset sensor 2 (-140 ... 0140 = -1.40V ... +1.40V)<br>This function returns the sensor offset voltages for both sensors (adjusted by ZERO). | |
| **SENSOR 1 OFFSET** | Get [i:60][CR][LF] | [i:60][xxxxxxxx][CR][LF] |
| | data length 8 characters<br>xxxxxxxx offset sensor 1 (-1400000 ... 01400000 = -1.400000V ... +1.400000V)<br>This function returns the sensor 1 offset voltage (adjusted by ZERO). | |
| **SENSOR 2 OFFSET** | Get [i:61][CR][LF] | [i:61][xxxxxxxx][CR][LF] |
| | data length: 8 characters<br>xxxxxxxx offset sensor 2 (-1400000 ... 01400000 = -1.400000V ... +1.400000V)<br>This function returns the sensor 2 offset voltage (adjusted by ZERO). | |

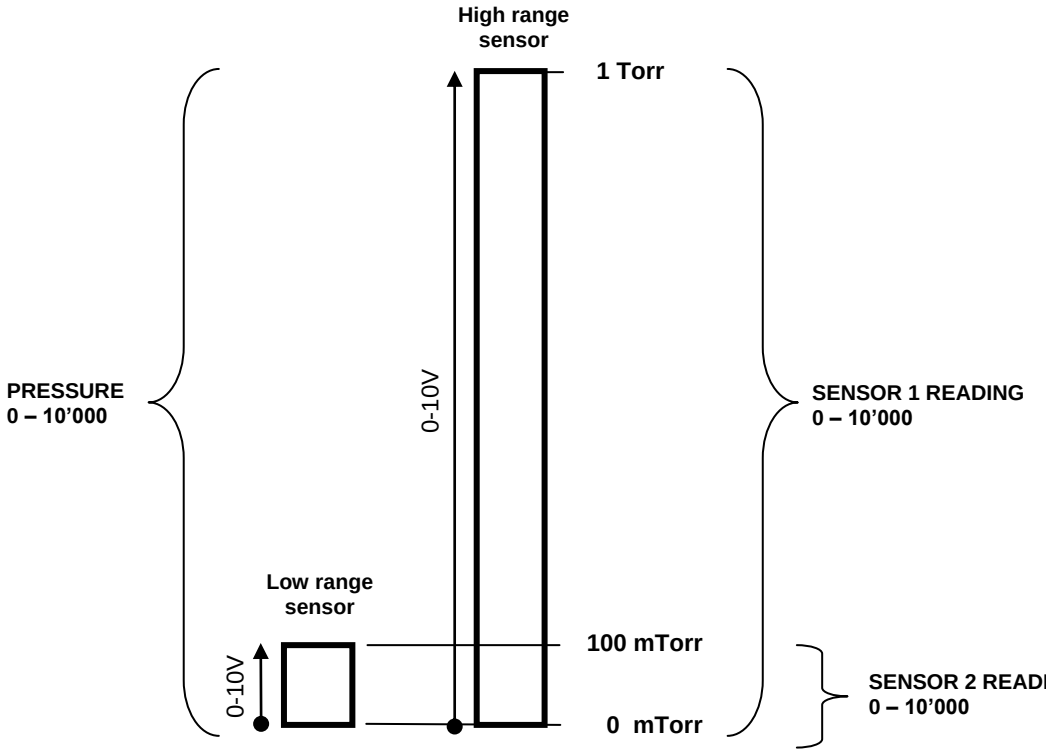
| Inquiry function | Command | | Acknowledgement (within 10ms after reception of command) |
|---|---|---|---|
| | Description | | |
| **LEARN STATUS** | Get | [i:32][CR][LF] | [i:32][abcdefgh][CR][LF] |
| | data length 8 characters<br>a **0** = LEARN not running, **1** = LEARN running<br>b **0** = LEARN data set present, **1** = LEARN data set not present<br>c **0** = ok<br>**1** = last LEARN interrupted by user (control command)<br>**2** = last LEARN interrupted by control unit (valve open pressure > sensor full scale)<br>d **0** = ok<br>**1** = valve open pressure > 50% sensor full scale (gasflow too high)<br>**2** = valve open pressure < 0 (sensor offset present)<br>e **0** = ok<br>**1** = valve max. throttle pressure < 10% sensor full scale (gasflow too low)<br>f **0** = ok<br>**1** = pressure not raising during LEARN (gasflow missing)<br>g **0** = ok<br>**1** = sensor unstability during LEARN<br>h reserved, do not use<br>This function checks the status of LEARN and indicates if the conditions during LEARN were ok. | | |
| **LEARN PRESSURE LIMIT** | Get | [i:34][CR][LF] | [i:34][0xxxxxxx][CR][LF] |
| | data length 8 characters starting with a zero<br>xxxxxxx pressure limit for LEARN, return value depends on configuration, refer to «RS232 setup commands, RANGE CONFIGURATION» for details<br>This function returns the pressure limit applied for LEARN. | | |
| **ERROR STATUS** | Get | [i:52][CR][LF] | [i:52][abcdefgh][CR][LF] |
| | data length 8 characters<br>a reserved, do not use<br>b **1** = sensor 1 signal converter failure<br>c reserved, do not use<br>d **1** = firmware memory failure<br>efgh reserved, do not use<br>This function returns an error code in case of any malfunction of the device otherwise 0 is returned. | | |
| **FATAL ERROR STATUS** | Get | [i:50][CR][LF] | [i:50][abc][CR][LF] |
| | data length 3 characters<br>abc error code = 000 (no error) or 020 (E·20) or 022 (E·22) or 040 (E·40)<br>See in chapter «Trouble shooting» for details.<br>This function returns an error code in case of any malfunction of the device. | | |

| Inquiry function | Command | | Acknowledgement (within 10ms after reception of command) |
|---|---|---|---|
| | Description | | |
| **THROTTLE CYCLE COUNTER** | Get | [i:70][CR][LF] | [i:70][xxxxxxxxxx][CR][LF] |
| | data length 10 characters<br>xxxxxxxxxx number of throttle cycles<br>This function returns the number of throttle cycles. A movement from max. throttle position to open back to max. throttle position counts as one cycle. Partial movements will be added up until equivalent movement is achieved. | | |
| **POWER UP COUNTER** | Get | [i:72][CR][LF] | [i:72][xxxxxxxxxx][CR][LF] |
| | data length 10 characters<br>xxxxxxxxxx number of power ups<br>This function returns the number of control unit power ups. | | |
| **HARDWARE CONFIGURATION** | Get | [i:80][CR][LF] | [i:80][abcdefgh][CR][LF] |
| | data length 8 characters<br>a **0** = Power Failure Option (PFO) not equipped<br>**1** = Power Failure Option (PFO) equipped<br>b **0** = ±15V sensor power supply (SPS) not equipped<br>**1** = ±15V sensor power supply (SPS) equipped<br>c **2** = RS232 Interface without analog outputs<br>**3** = RS232 Interface with analog outputs<br>d **1** = 1 sensor version, **2** = 2 sensor version<br>efgh reserved, do not use<br>This function returns the hardware configuration of the device. | | |
| **FIRMWARE CONFIGURATION** | Get | [i:82][CR][LF] | [i:82][xxxxxxxx][CR][LF] |
| | data length 8 characters<br>xxxxxxxx firmware version, e.g. 612P1E00<br>This function returns firmware version of the device. | | |
| **IDENTIFICATION** | Get | [i:83][CR][LF] | [i:83][xxxxxxxxxxxxxxxxxxxx][CR][LF] |
| | data length 20 characters<br>xxx...xxx identification code, e.g. 612..-..G-....<br>612..-..H-..../0001/, unused digits are filled up with spaces (20 hexadecimal)<br>This function returns controller's individual serial number. This code is unique for each valve and allows tracing. | | |

### 4.8.4 RS232 Setup commands

| Setup function | Command | | Acknowledgement (within 10ms after reception of command) |
|---|---|---|---|
| | Description | | |
| **ACCESS MODE** | Set | [c:01][xx][CR][LF] | [c:01][CR][LF] |
| | data length: 2 characters<br>xx **00** = local operation (service port)<br>**01** = remote operation, change to local enabled<br>**02** = locked remote operation, change to local not possible via service port<br>This function selects the access authorization to the valve. To read access mode use inquiry command DEVICE STATUS.<br>**Note:** Local operation is only possible when either 'Control View' or 'Control Performance Analyzer' software is running. When communication to service port is interrupted the valve will automatically change to remote operation. | | |
| **INTERFACE CONFIGURATION** | Set | [s:20][abcdefgh][CR][LF] | [s:20][CR][LF] |
| | Get | [i:20][CR][LF] | [i:20][abcdefgh][CR][LF] |
| | data length 8 characters<br>a baud rate:<br>**0** = 600, **1** = 1200k, **2** = 2400, **3** = 4800, **4** = 9600<br>**5** = 19.2k, **6** = 38.4k, **7** = 57.6k, **8** = 115.2k<br>b parity bit: **0** = even, **1** = odd, **2** = mark, **3** = space, **4** = no<br>c data length: **0** = 7 bit, **1** = 8 bit<br>d number of stop bits: **0** = 1, **1** = 2<br>e **0** (reserved, do not change)<br>f digital input OPEN VALVE: **0** = not inverted, **1** = inverted, **2** = disabled<br>g digital input CLOSE VALVE: **0** = not inverted, **1** = inverted, **2** = disabled<br>h **0** (reserved, do not change)<br>This function does the RS232 and digital input configuration.<br>**Note:** Digital outputs are always enabled. | | |
| **VALVE CONFIGURATION** | Set | [s:04][abcdefgh][CR][LF] | [s:04][CR][LF] |
| | Get | [i:04][CR][LF] | [i:04][abcdefgh][CR][LF] |
| | data length 3 characters<br>a valve position after power up: **0** = closed, **1** = open<br>b valve position after power failure: **0** = closed, **1** = open<br>c **0** (reserved, do not change)<br>d **0** (reserved, do not change)<br>e **0** (reserved, do not change)<br>f **0** (reserved, do not change)<br>g **0** (reserved, do not change)<br>h **0** (reserved, do not change)<br>This function does the valve configuration. | | |

| Setup function | Command | | Acknowledgement (within 10ms after reception of command) |
|---|---|---|---|
| | Description | | |
| **SENSOR CONFIGURATION** | Set | [s:01][abcdefgh][CR][LF] | [s:01][CR][LF] |
| | Get | [i:01][CR][LF] | [i:01][abcdefgh][CR][LF] |
| | data length | 8 characters | |
| | a | **0** = no sensor<br>**1** = 1 sensor operation (sensor 1 input)<br>**2** = 2 sensor operation with automatic changeover<br>(low range = sensor 2 input, high range = sensor 1 input)<br>**3** = 1 sensor operation (sensor 2 input)<br>**4** = 2 sensor operation with automatic changeover<br>(low range = sensor 1 input, high range = sensor 2 input)<br>**Note:** Sensor operation modes 2, 3 and 4 are possible with 2 sensor hardware<br>(612 . . - . . . **H** - . . . . and 612 . . - . . . **W** - . . . .) only.<br>**Note:** For applications where the high range sensor is used for for monitoring purpose only, select sensor operation modes 1 or 3 for pressure control with low range sensor and read high range sensor from «SENSOR 2 READING» resp. «SENSOR 1 READING». | |
| | b | **1** = ZERO enabled, **0** = ZERO disabled | |
| | cdefgh | High range / Low range sensor full scale ratio * 1'000 (**1000** … **100000**).<br>In case of a 1 sensor valve use any value within the valid range. | |
| | This function does the sensor configuration for pressure control. | | |

<table>
<tr><th rowspan="2">Setup function</th><th colspan="2">Command</th><th>Acknowledgement<br>(within 10ms after reception of command)</th></tr>
<tr><th colspan="3">Description</th></tr>
<tr><td rowspan="4">RANGE CONFIGURATION</td><td>Set</td><td>[s:21][abcdefgh][CR][LF]</td><td>[s:21][CR][LF]</td></tr>
<tr><td>Get</td><td>[i:21][CR][LF]</td><td>[i:21][abcdefgh][CR][LF]</td></tr>
<tr><td colspan="3">data length 8 characters<br>a range for POSITION: 0 = 0 – 1’000, 1 = 0 – 10’000, 2 = 0 – 100’000<br>bcdefgh upper value for PRESSURE and SENSOR READING: 1000 ... 1000000<br>e.g. 0010000 -> pressure range 0 – 10’000<br><br>This function defines the communication range between the valve and the host computer for POSITION, PRESSURE and SENSOR READING.<br>Note: In case ZERO has been performed, gauge offset for PRESSURE and SENSOR READING is compensated.<br>Note: In case 2 sensor operation for pressure control is selected, PRESSURE covers high range gauge because switchover between sensors is done automatically.<br>SENSOR 1 READING and SENSOR 2 READING always return full scale values according to selected range.</td></tr>
<tr><td colspan="4"> 

Above picture shows a 2 sensor system. In this configuration sensor 2 covers low range (100 mTorr) and sensor 1 covers high range (1 Torr). RANGE CONFIGURATION for PRESSURE resp. SENSOR READING is set to 10’000. Switchover between sensors is done automatically.</td></tr>
</table>

| Setup function | Command | | Acknowledgement (within 10ms after reception of command) |
|---|---|---|---|
| | Description | | |
| **ZERO** | Set | [Z:][CR][LF] | [Z:][CR][LF] |
| | This command initiates ZERO to compensate for offset of gauge(s).<br>**Note:** Refer to «ZERO» for correct zero procedure. | | |
| **PRESSURE ALIGNMENT** | Set | [c:6002][xxxxxxxx][CR][LF] | [c:60][CR][LF] |
| | data length: 8 characters<br>xxxxxxxx System base pressure, value depends on configuration, refer to «RS232 setup commands, RANGE CONFIGURATION» for details. Alignment range is equivalent to max. +/-1.4V sensor signal.<br>This command aligns PRESSURE to a certain value. Also SENSOR READING will be aligned accordingly. It might be used instead of ZERO in case base pressure is not low enough. | | |
| **LEARN** | Set | [L:][0xxxxxxx][CR][LF] | [L:][CR][LF] |
| | data length 8 characters starting with a zero<br>xxxxxxx Pressure limit for LEARN, value depends on configuration, refer to «RS232 setup commands, RANGE CONFIGURATION» for details<br>This command starts LEARN.<br>By OPEN VALVE, CLOSE VALVE or POSITION CONTROL commands the routine may be interrupted.<br>**Note:** Without LEARN the PID controller is not able to perform pressure control. Refer to «LEARN» for correct learn gas flow and procedure. | | |
| **DOWNLOAD LEARN DATA** | Set | [d:][pppdddddddd][CR][LF] | [d:][ppp][CR][LF] |
| | data length 3 + 8 characters<br>ppp pointer, **000** ... **103**<br>dddddddd single data set<br>This command downloads the LEARN data sets from the host computer to the valve. There are a total number of 104 data sets. Each data set consists of 8 data bytes and needs to be uploaded separately.<br>**Note:** Make sure that all 104 data sets will be downloaded. | | |
| **UPLOAD LEARN DATA** | Get | [u:][ppp][CR][LF] | [u:][pppdddddddd][CR][LF] |
| | data length 3 + 8 characters<br>ppp pointer, **000** ... **103**<br>dddddddd single data set<br>This command uploads the LEARN data sets from the valve up to the host. There are a total number of 104 data sets. Each data set consists of 8 data bytes and needs to be uploaded separately.<br>**Note:** Make sure that all 104 data sets will be uploaded. | | |

<table>
<tr><th rowspan="2">Setup function</th><th colspan="2">Command</th><th>Acknowledgement<br>(within 10ms after reception of command)</th></tr>
<tr><th colspan="3">Description</th></tr>
<tr><td rowspan="4">PID CONTROLLER CONFIGURATION</td><td>Set</td><td>[s:02][abcdefgh][CR][LF]</td><td>[s:02][CR][LF]</td></tr>
<tr><td>Get</td><td>[i:02][CR][LF]</td><td>[i:02][abcdefgh][CR][LF]</td></tr>
<tr><td colspan="3">data length 8 characters<br>a 0 (reserved, do not change)<br>b gain factor:<br>0 = 0.10, 1 = 0.13, 2 = 0.18, 3 = 0.23, 4 = 0.32, 5 = 0.42, 6 = 0.56<br>7 = 0.75, 8 = 1.00, 9 = 1.33, A = 1.78, B = 2.37, C = 3.16, D = 4.22<br>E = 5.62, F = 7.50, G = 0.0001, H = 0.0003, I = 0.001, J = 0.003,<br>K = 0.01, L = 0.02, M = 0.05<br>c sensor delay:<br>0 = 0.00, 1 = 0.02, 2 = 0.04, 3 = 0.06, 4 = 0.08, 5 = 0.10, 6 = 0.15,<br>7 = 0.20, 8 = 0.25, 9 = 0.30, A = 0.35, B = 0.4, C = 0.50, D = 0.60,<br>E = 0.80, F = 1.00<br>d setpoint ramp:<br>0 = 0.0, 1 = 0.5, 2 = 1.0, 3 = 1.5, 4 = 2.0, 5 = 2.5, 6 = 3.0, 7 = 3.5,<br>8 = 4.0 , 9 = 4.5, A = 5.0, B = 5.5, C = 6.0, D = 6.5, E = 7.0, F = 7.5,<br>G = 8.0, H = 8.5, I = 9.0, J = 9.5, K = 10.0<br>efgh 0000 (reserved, do not change)<br>This command selects gain factor, sensor response time and setpoint ramp for the PID controller.<br>Note: Refer to «Tuning of control performance» for details.</td></tr>
<tr><td rowspan="3">VALVE SPEED</td><td>Set</td><td>[V:][00xxxx][CR][LF]</td><td>[V:][CR][LF]</td></tr>
<tr><td>Get</td><td>[i:68][CR][LF]</td><td>[i:68][0000xxxx][CR][LF]</td></tr>
<tr><td colspan="3">data length 6 characters starting with double zero for writing<br>8 characters starting with quadruple zero for reading<br>xxxx valve speed, 1 ... 1000 (1 = min. speed, 1000 = max. speed)<br>This command allows changing the actuating speed of the valve plate. Speed selection is effective for pressure control and position control. Open valve and close valve are always done with max. speed.<br>Note: Refer to «Valve speed adjustment» for details.</td></tr>
<tr><td rowspan="2">RESET</td><td>Set</td><td>[c:82][xx][CR][LF]</td><td>[c:82][CR][LF]</td></tr>
<tr><td colspan="3">data length 2 characters<br>xx 00 = reset service request bit from WARNINGS<br>01 = reset FATAL ERROR (restart control unit)<br>This function resets warnings and errors.</td></tr>
</table>

### 4.8.5 Error messages

| Description | Error message |
|---|---|
| **Protocol** | |
| Parity error | [E:][000001][CR][LF] |
| Framing error (data length, number of stop bits) | [E:][000003][CR][LF] |
| Input buffer overflow (to many characters) | [E:][000002][CR][LF] |
| | |
| **Commands** | |
| <CR> or <LF> missing | [E:][000010][CR][LF] |
| **:** missing | [E:][000011][CR][LF] |
| Unknown command | [E:][000020][CR][LF]<br>[E:][000021][CR][LF] |
| Invalid value | [E:][000022][CR][LF]<br>[E:][000023][CR][LF] |
| Value out of range | [E:][000030][CR][LF] |
| Invalid number of characters (between **:** and [CR][LF]) | [E:][000012][CR][LF] |
| | |
| **Setup** | |
| ZERO disabled | [E:][000060][CR][LF] |
| | |
| **Device Status** | |
| Command not accepted due to local operation | [E:][000080][CR][LF] |
| Command not accepted due to synchronization, CLOSED or OPEN by digital input, safety mode or fatal error | [E:][000082][CR][LF] |
| | |
| **Hardware** | |
| Command not applicable for hardware configuration | [E:][000041][CR][LF] |

# 5 Operation

**⚠ WARNING**

**Unqualified personnel**

Inappropriate handling may cause serious injury or property damage.

Only qualified personnel are allowed to carry out the described work.

**⚠ WARNING**

**Valve opening**

Risk of serious injury.

Human body parts must be kept out of the valve opening and away from moving parts. Do not connect the controller to power before the valve is installed complete into the system.

## 5.1 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.

### 5.1.1 Local operation

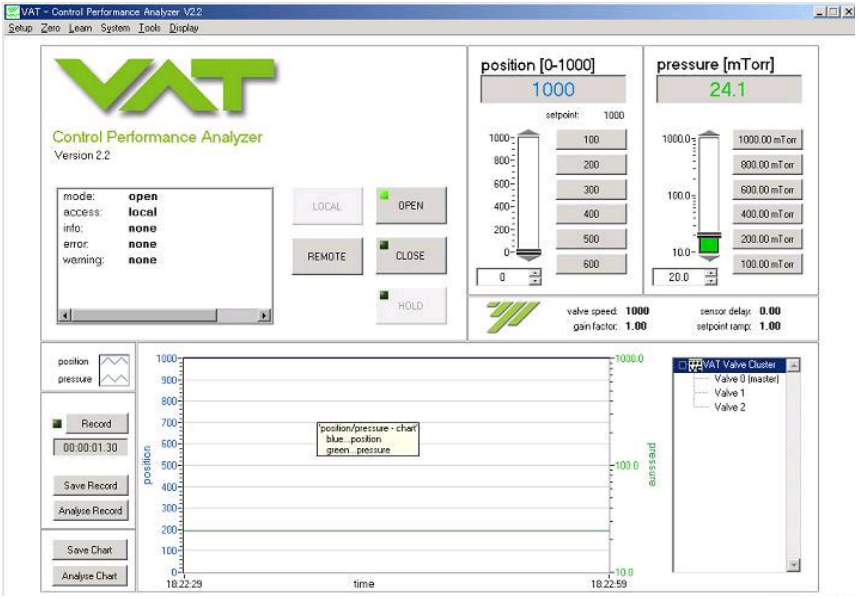
Local operation means that the valve is operated via the service port using a computer or the Service Box 2. When using a computer, a service cable and a software from VAT are required. You can either download our freeware 'Control View' from www.vatvalve.comor purchase our 'Control Performance Analyzer'.

These softwares 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 «Accessories» for ordering numbers of service cable, software and Service Box 2.

### 5.1.2 Remote operation

This product is equipped with a RS232 with analog output interface to allow for remote operation. See section «RS232 with analog output Interface» for details. ‘Control View’ software, 'Control Performance Analyzer' software or 'Service Box 2' may be used for monitoring during remote control.

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.

### 5.1.3 Close valve

| **Local operation**:<br>('Control View', 'Control Performance Analyzer' or 'Service Box 2') | **Remote operation**:<br>(Refer to chapter «RS232 control commands» for details) |
|---|---|
| Push CLOSE button | Send CLOSE VALVE |

### 5.1.4 Open valve

| **Local operation**:<br>('Control View', 'Control Performance Analyzer' or 'Service Box 2') | **Remote operation**:<br>(Refer to chapter «RS232 control commands» for details) |
|---|---|
| Push OPEN button | Send OPEN VALVE |

### 5.1.5 Position control

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

| **Local operation**:<br>('Control View', 'Control Performance Analyzer' or 'Service Box 2') | **Remote operation**:<br>(Refer to chapter «RS232 control commands» for details) |
|---|---|
| Select or enter position setpoint | Send POSITION CONTROL |

### 5.1.6 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).

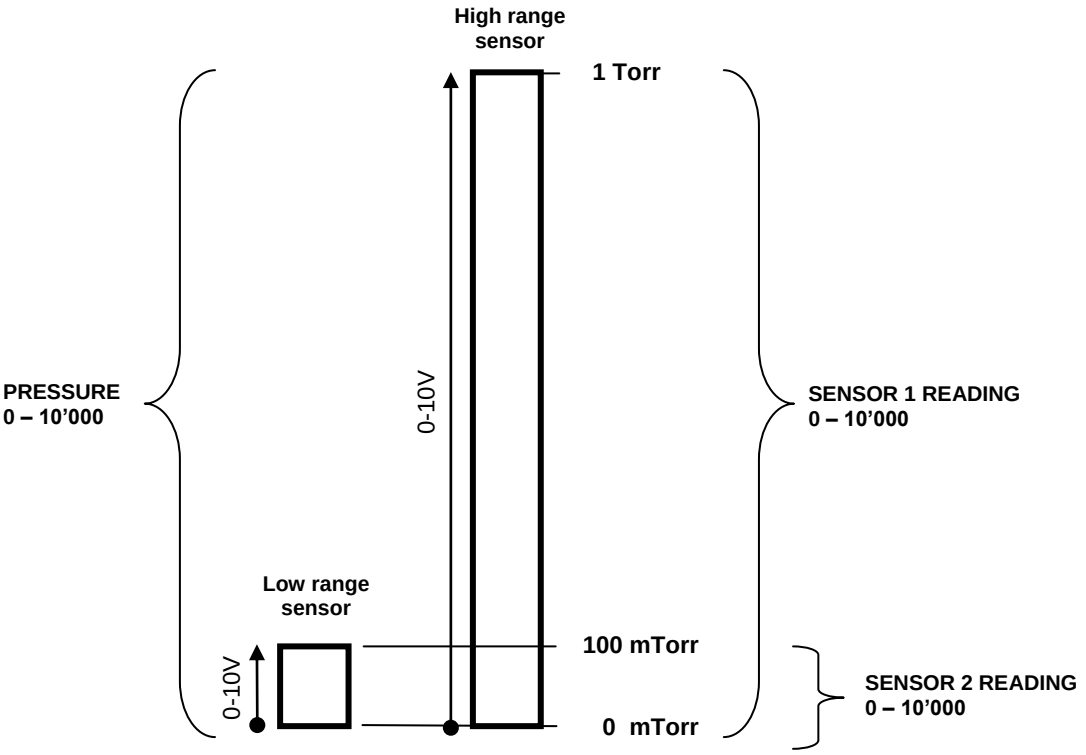
| **Local operation**:<br>('Control View', 'Control Performance Analyzer' or 'Service Box 2') | **Remote operation**:<br>(Refer to chapter «RS232 control commands» for details) |
|---|---|
| Select or enter pressure setpoint | Send PRESSURE CONTROL |

### 5.1.6.1 Pressure control operation with 2 sensors

[applicable with 612 . . - . . . **W** - . . . . 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.
For monitoring purpose each sensor signal may be read out individually. Refer to «inquiry commands SENSOR 1 READING and SENSOR 2 READING»

- Make sure that both sensors are calibrated.
- Do not close optional gauge isolation valves during the transition phase between the sensors.



### 5.1.7 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.

### 5.1.8 Service indication

This product is able to indicate that the valve unit needs to be cleaned, or an obstruction is present.
A service request is indicated when the control unit detects that motor steps are apparently not effective. This may happen when the valve unit is heavily contaminated. These ‚lost‘ steps are recognized and will be repeated to attempt target position in the short term. But in the medium term the valve unit requires cleaning or inspection. ‘Service request’ (SR) would be indicated on the display or could be read via remote operation. Refer to «Display information» for details.

### 5.1.9 Operation under increased temperature

**⚠ CAUTION**

**Hot valve**

Heated valve may result in minor or moderate injury.

Do not touch valve and heating device during operation. Once heating is switched off (valve and system) await until the valve is cooled down complete before doing any work.

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

## 5.2 Behaviour during power up

| **Valve position before power up:** | **Reaction of valve:** | |
|---|---|---|
| | Valve power up configuration = closed (defaullt) | Valve power up configuration = open |
| Any | Valve runs a synchronization cycle (close-open-close) to detect the limit stops. This cycle is performed with reduced torque (2Nm). Display shows configuration of product until synchronization cycle is done. Refer also to chapter «Display information». | |
| | Valve position after power up is closed | Valve position after power up is open |

## 5.3 Behavior in case of power failure

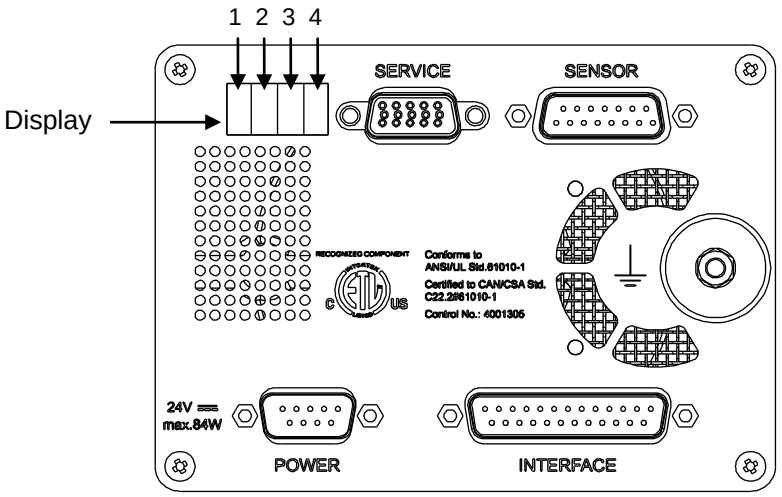
| **Valve position before power failure:** | **Reaction of valve:** | |
|---|---|---|
| | Without Power Failure Option (PFO)<br>612 . . - . . **G** . - . . . .<br>612 . . - . . **A** . - . . . .<br>612 . . - . . **T** . - . . . .<br>612 . . - . . **V** . - . . . . | With Power Failure Option (PFO)<br>612 . . - . . **H** . - . . . .<br>612 . . - . . **C** . - . . . .<br>612 . . - . . **U** . - . . . .<br>612 . . - . . **W** . - . . . . |
| Any | Valve remains at current position. | Valve will close or open depending on valve configuration [1].<br>Default is not defined.<br>Display indicates **F**. |

[1] 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.

## 5.4 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.




### 5.4.1 Power up:

| Description | Digit 1 | Digit 2 | Digit 3 | Digit 4 |
|---|---|---|---|---|
| At first all dots are illuminated then configuration is displayed:<br>• Firmware version [e.g. 1E00] (1st information for about 3s)<br>• Controller configuration (2nd information for about 3s)<br><br>In case **D999** is displayed, motor interlock is active. Refer to «Safety mode» for details. | **1** | **E** | **0** | **0** |
| | | **2**<br>= RS232 interface<br><br>**3**<br>= RS232 interface with analog outputs | **0**<br>= basic<br>**1**<br>= with SPS[1)]<br>**2**<br>= with PFO[2)]<br>**3**<br>= with SPS[1)] and PFO[2)] | **1**<br>= 1 sensor version<br><br>**2**<br>= 2 sensor version |
| **SYNC** indicates that powerup synchronization is running. | **S** | **Y** | **N** | **C** |

[1)] SPS = optional ±15 VDC Sensor Power Supply module, [2)] PFO = Power Failure Option

### 5.4.2 Operation:

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

[1)] If SR is blinking alternatively with the actual mode display (e.g. P.11 ⇔ ..SR) the valve requires cleaning.

RxD / TxD activity of RS232 communication is displayed by 2 blinking dots in digit 2. The lower dot indicates RxD activity where the upper dot indicates TxD activity. The indication is not real time.

### 5.4.3 Fatal error:

| Description | Digit 1 | Digit 2 | Digit 3 | Digit 4 |
|---|---|---|---|---|
| Fatal error occurred | **E** | Error code. Refer to «Trouble shooting» for details | | |

# 6 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 | - Local operation via service port active<br>- Safety mode active, check for D on display? | - Switch to remote operation.<br>- Provide power to motor to allow for operation.<br>- Refer to «Electrical connection» for details. |
| Display shows «**E 20**»and position is 009999<br>(**fatal error** - limit stop of valve unit not detected) | Clamp coupling screw not fastened? | Tighten clamp coupling screw. Refer to chapter «Maintenance» for details.<br>RESET or restart of valve is necessary. |
| Display shows «**E 21**»and position is 009999<br>(**fatal error** - rotation angle of valve plate limited during power up) | - Valve plate centric adjusted?<br>- Valve unit heavy contaminated?<br>- Valve plate mechanically obstructed? | - Adjust valve plate according to «Maintenance procedure».<br>- Clean valve unit according to «Maintenance procedure».<br>- Resolve obstruction.<br>- Reset control unit. Cycle power (OFFàON)<br>or<br>- Send reset command: local via service port with CV/CPA/Service Box2 |
| Display shows «**E 22**»and position is 009999<br>(**fatal error** - rotation angle of valve plate limited during operation) | - Valve unit heavy contaminated?<br>- Valve plate mechanically obstructed? | - Clean valve unit according to «Maintenance procedure».<br>- Resolve obstruction.<br>- Reset control unit. Cycle power (OFFàON)<br>or<br>- Send reset command: local via service port with CV/CPA/Service Box2 |
| Display shows «**E 40**»and position is 009999<br>(**fatal error** - motor driver failure detected) | | Replace control and actuating unit according to «Maintenance procedure». |
| Display shows «**D 0**»<br>Motor Interlock is open | Motor power supplied? | - Provide power to motor to allow for operation.<br>- Refer to «Electrical connection» for details. |
| Display shows «**SR**»<br>(Service Request) | Valve unit heavy contaminated? Or gate seal is sticking. | - Clean valve unit according to «Maintenance procedures».<br>- Reset control unit. Cycle power (OFFàON)<br>or<br>- Send reset command: local via service port with CV/CPA/Service Box2 |

| Failure | Check | Action |
|---|---|---|
| CLOSE VALVE does not work | - Safety mode active, check for D on display?<br>- Maintenance mode active | - Provide power to motor to allow for operation.<br>- Refer to «Electrical connection» for details.<br>- Refer to “Display shows «**M C**»” in this table |
| OPEN VALVE does not work | - Safety mode active, check for D on display?<br>- Maintenance mode active | - Provide power to motor to allow for operation. Refer to «Electrical connection» for details.<br>- Refer to “Display shows «**M100**»” in this table |
| Display shows «**M C**»<br>Maintenance mode active | | Pin 14 of service connector is connected to ground. Plate will close. Further movement of plate is blocked.<br>**Note:** Priority of pin 14 is higher than pin 13. If pin 14 is connected to ground after pin 13 the valve will close.<br>Ground of service connector is at pin 4 and 8. |
| Display shows «**M100**»<br>Maintenance mode active | | Pin 13 of service connector is connected to ground. Plate will open. Further movement of plate is blocked. |
| Pressure reading is wrong<br>or<br>pressure reading is negative | - Sensor(s) connected?<br>- 2 sensor version present at valve controller?<br>- ZERO done?<br>- Does sensor power supply provide enough power for sensor(s)? | - Refer to «Electrical connection».<br>- Check valve version on page 1. Verify configuration. Refer to «Setup procedure».<br>- Perform ZERO when base pressure is reached. Refer to «ZERO» for details.<br>- Verify sensor supply voltage. |
| ZERO does not work | - Valve in open position, check for O on display?<br>- ZERO disabled? | - OPEN VALVE and bring chamber to base pressure before performing ZERO.<br>- Enable ZERO. Refer to «Valve configuration» for details. |
| Pressure is not ‘0’ after ZERO | - Sensor voltage shifting?<br>- System pumped to base pressure?<br>- Sensor offset voltage exceeds ±1.4V | - Wait until sensor does not shift any more before performing ZERO.<br>- OPEN VALVE and bring chamber to base pressure before performing ZERO.<br>- Replace pressure gauge. |
| PRESSURE CONTROL does not work | - Safety mode active, check for D on display?<br>- PRESSURE CONTROL selected, check for P on display?<br>- LEARN done? | - Provide power to motor to allow for operation. Refer to «Electrical connection» for details.<br>- Select PRESSURE CONTROL mode. Refer to «Pressure control» for details.<br>- Perform LEARN. Refer to «Setup procedure» for details. |

| Failure | Check | Action |
|---|---|---|
| PRESSURE CONTROL not optimal | - Setup done completely? | - Perform «Setup procedure» completely. |
| | - LEARN done? | - Perform LEARN. Refer to «LEARN» for details. |
| | - ZERO performed before LEARN? | - Perform ZERO then repeat LEARN. Refer to «Setup procedure» for details. |
| | - LEARN interrupted? | - Repeat LEARN. Refer to «LEARN» for details. |
| | - Was gas flow stable during LEARN? | - Repeat LEARN with stable gas flow. Refer to «LEARN» for details. |
| | - Tuning done? | - Tune valve for application. Refer to «Tuning of control performance» for details. |
| | - Is sensor range suited for application? | - Use a sensor with suitable range (controlled pressure should be >3% and < 98% of sensor full scale). |
| | - Noise on sensor signal? | - Make sure a shielded sensor cable is used. |

If you need any further information, please contact one of our service centers. You will find the addresses on our website: www.vatvalve.com.

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

# 7 Maintenance

**⚠ WARNING**

**Unqualified personnel**

Inappropriate handling may cause serious injury or property damage.

Only qualified personnel are allowed to carry out the described work.

**⚠ WARNING**

**Valve opening**

Risk of serious injury.

Human body parts must be kept out of the valve opening and away from moving parts. Disconnect power on controller before doing any work.

**⚠ CAUTION**

**Hot valve**

Heated valve may result in minor or moderate injury.

Do not touch valve and heating device during operation. Once heating is switched off (valve and system) await until the valve is cooled down complete before doing any work.

***NOTICE***

**Contamination**

Gate and other parts of the valve must be protected from contamination.

Always wear clean room gloves when handling the valve.

## 7.1 Maintenance intervals

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, please contact VAT. It has to be individually decided whether the maintenance can be performed by the customer or has to be carried out by VAT. Please write down the fabrication number of the valve before contact VAT. Refer to chapter: «Identification of product» for fabrication number.

## 7.2 Maintenance procedures

Two maintenance procedures are defined for this valve. This are:

- Replacement of shaft feedthrough seals and valve cleaning. Refer to chapter: «Replacement of rotary feedthrough».
- Replacement of Option board. Refer to chapter: «Replacement of Option board»

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

VAT can give the following recommendations for preventive maintenance:

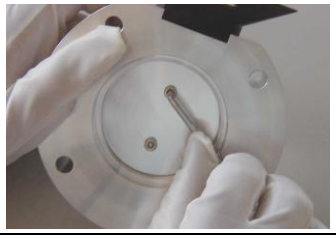
| Replacement of | unheated [1)] | heated ≤ 80 °C [1)] | heated > 80 °C [1)] |
|---|---|---|---|
| **Rotary feedthrough seals** | 2'000'000 cycles | 6 months but max. 2'000'000 cycles | 3 months but max. 2'000'000 cycles |

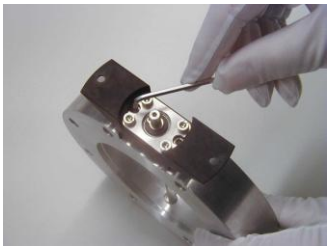
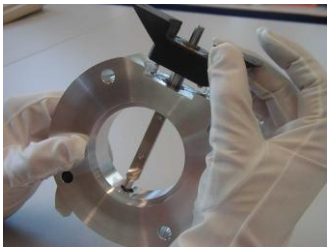
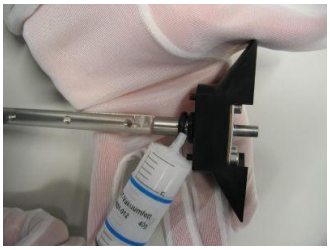
[1)] Those figures are reference values for clean conditions under various temperatures. These values do not include any impact of the process. Therefore preventive maintenance schedule has finally to be checked for the actual process conditions.

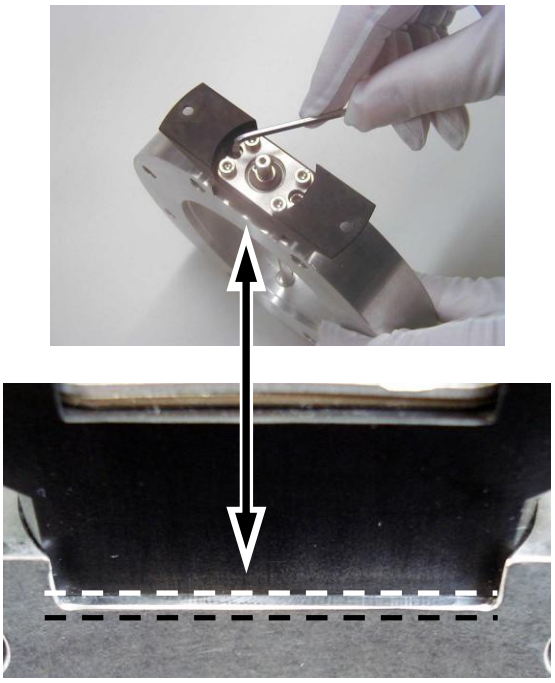
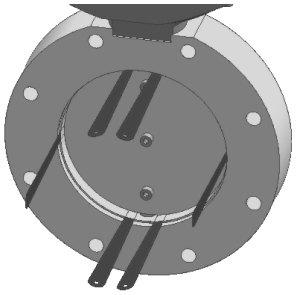
## 7.2.1 Replacement of shaft feedthrough seals and valve cleaning

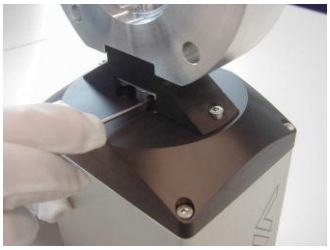
### 7.2.1.1 Needed tools

- Allen Wrench 2mm
- Allen Wrench 3mm
- feeler gauge
- Clean room wipes, isopropyl alcohol

| Description | | Required tool |
|---|---|---|
| Make sure that the valve is in closed position<br>1. Vent vacuum system, disconnect electrical connections and remove valve from vacuum system. If you only replace control and actuating unit, the valve can remain in the system.<br>Take care not to damage sealing surface! Do not move the plate by hands when control an actuating unit is installed. | | Depending on flange screws |
| 2. Unfasten clamp coupling |  | Allen Wrench 2mm |
| 3. Unfasten the 2 connection bolts and separate both parts.<br>Valve size DN 160 (6”) and bigger require a shortened wrench. For ordering number refer to «Spare parts and accessories».<br>12 mm  |  | Allen Wrench 3mm |
| 4. Unfasten screws and remove plate from shaft. |  | Allen Wrench 3mm |

| Description | | Required tool |
|---|---|---|
| 5. Unfasten alternately the 2 mounting screws little by little.<br><br>If only one screw is fasten / unfasten, the mechanical unit will be damaged. Max. difference should be less than 1 turn or 0.5 turn of the screws. |  <br>  | Allen Wrench 3mm |
| 6. Remove mechanical unit and clean shaft. |  | |
| 7. Remove o-rings.<br>8. Clean shaft feedthrough and valve body. |  | Clean room wipes a little soaked with isopropyl alcohol |
| 9. Lubricate seal contact surface of valve body with a slight film of vacuum grease (0.025 ml).<br>10. Lubricate each o-ring with a slight film of vacuum grease (0.0125 ml). |  | |
| 11. Lubricate seal contact surface of shaft with a slight film of vacuum grease (0.0125 ml).<br>12. Slide both o-rings onto shaft till the end.<br>13. Deposit 0.0375 ml vacuum grease between the o-rings<br>14. Clean shaft from vacuum grease. |  | Vacuum grease<br><br>Clean room wipes |

<table>
<tr><th>Description</th><th>Required tool</th></tr>
<tr><td>15. Assemble mechanical unit in reverse order as disassembled (steps 6 to 5).<br><br>16. Align pedestal parallel to valve body and tighten the 2 mounting screws with 2.5 Nm.</td><td>Allen Wrench 3mm<br>  </td></tr>
<tr><td>17. Center plate.<table><tr><td>Size</td><td>Feeler gauge mm</td></tr><tr><td>40</td><td>0.04</td></tr><tr><td>50</td><td>0.04</td></tr></table><br>18. Tighten plate screws with 2.5 Nm.</td><td>Actuator side<br>  </td><td>Allen Wrench 3mm<br><br>Adequate feeler gauge</td></tr>
<tr><td>19. Assemble control and actuating unit to valve unit. Tighten mounting screws adequately.</td><td>  </td><td>Allen Wrench 3mm</td></tr>
</table>

| Description | | Required tool |
|---|---|---|
| 20. Tighten clamp coupling with 1.1 Nm. |  | Allen Wrench 2mm |
| 21. Reinstall valve into vacuum system according to chapter «Installation». | | |

### 7.2.2 Replacement of Option board

**NOTICE**

**Electrostatic discharge**

Electronic components could be damage.

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

**NOTICE**

**Burned connector pins (spark)**

Connector pins or electronic parts could damage, if plugged and unplugged under power.

Do not plug or unplug connectors under power.

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:

- ±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

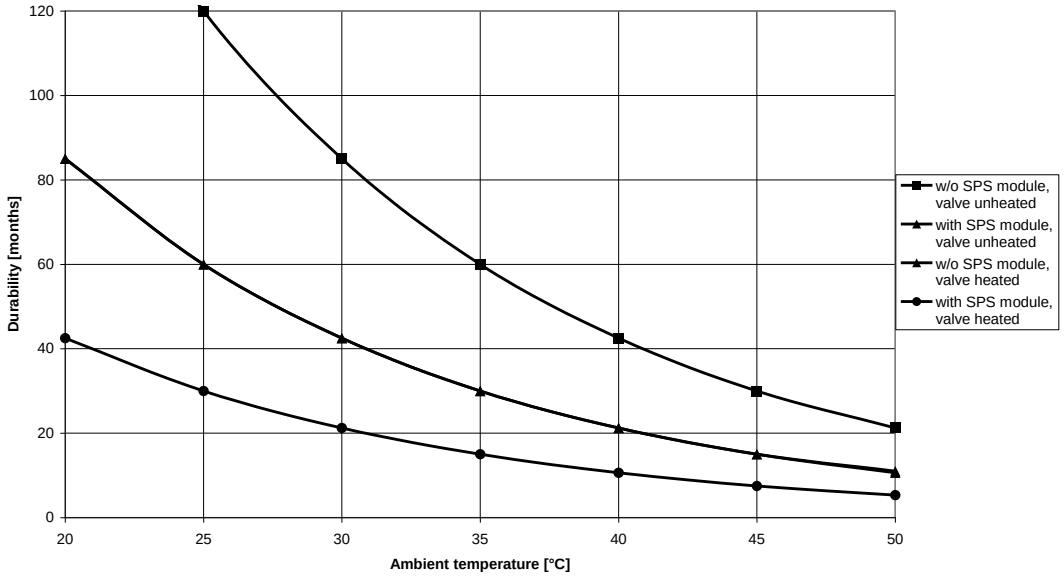
The modules may be retrofitted or replaced easily. The battery lifetime of the PFO module depends on the ambient temperature (see below). To assure PFO function the option board must be replaced after battery life has expired. For ordering number of the modules refer to chapter «Spare parts».

### 7.2.2.1 Durability of power fail battery

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

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

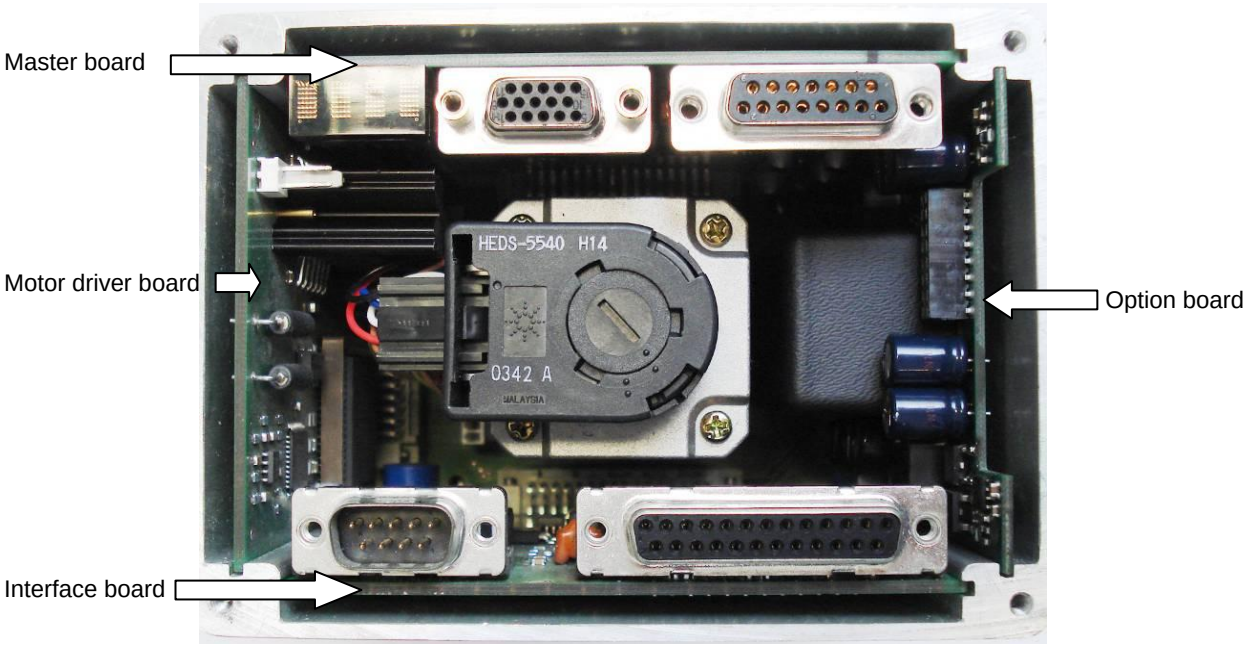
Therefore please determine the equivalent maintenance period for replacing the Ultra Cap battery (Option board).




This graph shows estimated life of Ultra Cap PFO for reference and not as guaranteed value.

### 7.2.2.2 Retrofit / replacement procedure

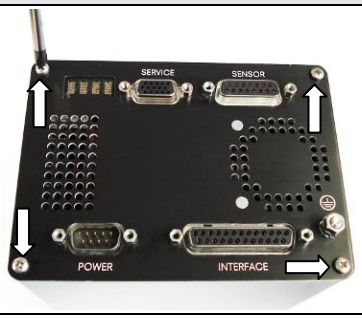
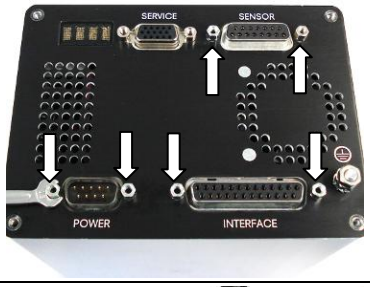
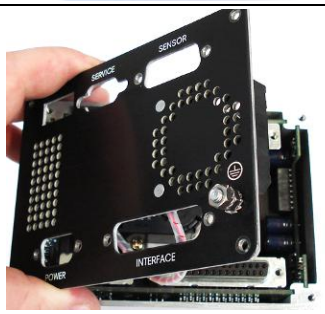
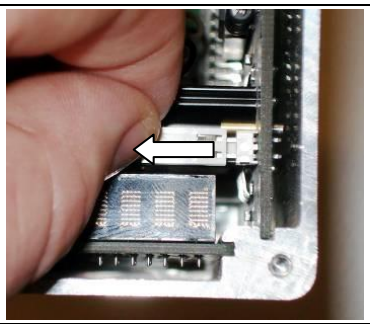
Top view on control and actuating unit with panel removed:

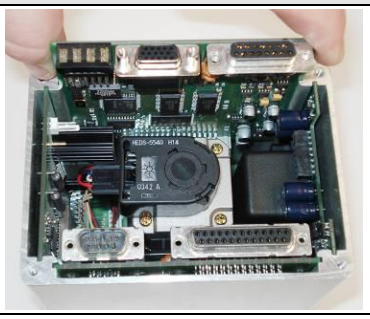
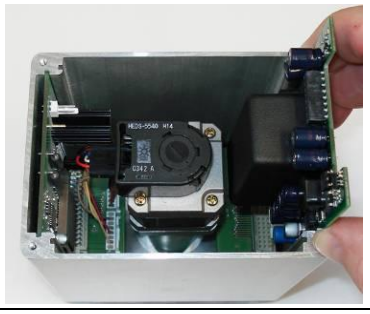



All boards have a fixed position into control and actuating unit. It is not possible to fit a board in other position as shown in picture above! Do not try out other positions, which maybe destroy the socket of boards!

### 7.2.2.3 Needed tools

- Pozidriv screw driver size 1
- Open end wrench 4.5mm

| Description | | Required tool |
|---|---|---|
| 1. Remove the panel screws. |  | Pozidriv screw driver size 1 |
| 2. Remove female screw locks from POWER, SENSOR and INTERFACE connectors. |  | Open end wrench 4.5 mm |
| 3. Lift the panel carefully. |  | |
| 4. Disconnect fan cable from board. |  | |

| Description | | Required tool |
|---|---|---|
| 5. Remove the master board. |  | |
| 6. Remove the interface board. |  | |
| 7. Replace option board. |  | |
| 8. Insert master board and interface board in reverse order as disassembled at correct positions (see steps 6 to 5). | | |
| 9. Insert option board at correct position (see step 7) | | |
| 10. Reconnect fan cable (see step 4) | | |
| 11. Place the panel and tighten screws with 1.1 Nm (see steps 3 to 2) | | Pozidriv screw driver size 1 |
| 12. Tighten female screw locks from POWER, SENSOR and INTERFACE connectors with 1.1 Nm (see step 1) | | Open end wrench 4.5 mm |

If you need any further information, please contact one of our service centers. You can find the addresses on our website: www.vatvalve.com.

# 8 Repairs

Repairs may only be carried out by the VAT service staff. In exceptional cases, the customer is allowed to carry out the repairs, but only with the prior consent of VAT.

Please contact one of our service centers. You will find the addresses on our website www.vatvalve.com.

# 9 Dismounting and Storage

**⚠ WARNING**

**Unqualified personnel**

Inappropriate handling may cause serious injury or property damage.

Only qualified personnel are allowed to carry out the described work.

**⚠ WARNING**

**Harmful substances**

Risk of injury in case of contact with harmful substances.

Remove harmful substances (e. g. toxic, caustic or microbiological) from the valve before dismounting.

## 9.1 Dismounting

***NOTICE***

**Contamination**

Gate and other parts of the valve must be protected from contamination.

Always wear clean room gloves when handling the valve.

***NOTICE***

**Valve in open position**

Valve body may become damaged if valve gate is in open position.

Move valve gate to the closed position before dismounting the valve.

1. Close the valve
2. For dismounting the valve please follow the instructions of chapter: «Installation», however in reverse order.

## 9.2 Storage

**NOTICE**

**Wrong storage**

Inappropriate temperatures and humidity may cause damage to the product.

Valve must be stored at:
– relative humidity between 10% and 70%
– temperature between +10 °C and +60 °C
– non-condensing environment

**NOTICE**

**Inappropriate packaging**

Product may get damaged if inappropriate packaging material is used.

Always use the original packaging material and handle product with care.

1. Clean / decontaminate valve.
2. Cover all valve openings with a protective foil.
3. Pack valve appropriately, by using the original packaging material.

# 10 Packaging and Transport

**⚠ WARNING**

**Unqualified personnel**

Inappropriate handling may cause serious injury or property damage.

Only qualified personnel are allowed to carry out the described work.

**⚠ WARNING**

**Harmful substances**

Risk of injury in case of contact with harmful substances.

Remove harmful substances (e. g. toxic, caustic or microbiological ones) from valve before you return the valve to VAT.

***NOTICE***

**Inappropriate packaging**

Product may get damaged if inappropriate packaging material is used.

Always use the original packaging material and handle product with care.

- When returning products to VAT, please fill out the VAT form «Declaration of Chemical Contamination of Vacuum Valves and Components» and send it to VAT in advance. The form can be downloaded from our website www.vatvalve.com (Section: Services – Aftersales).
- If products are radioactively contaminated, the VAT form «Contamination and Radiation Report» must be filled out. Please contact VAT in advance.
- If products are sent to VAT in contaminated condition, VAT will carry out the decontaminating procedure at the customer's expense.

## 10.1 Packaging

***NOTICE***

**Valve in open position**

Valve mechanism may get damaged if valve is in open position.

Make sure that the valve is closed.

1. Cover all valve openings with a protective foil.
2. Pack valve appropriately, by using the original packaging material.

VAT disclaims any liability for damages resulting from inappropriate packaging.

## 10.2 Transport

**NOTICE**

**Inappropriate packaging**

Product may get damaged if inappropriate packaging material is used.

Always use the original packaging material and handle product with care.

VAT disclaims any liability for damages resulting from inappropriate packaging.

# 11 Disposal

**⚠ WARNING**

**Unqualified personnel**

Inappropriate handling may cause serious injury or property damage.

Only qualified personnel are allowed to carry out the described work.

# 12 Spare parts

**NOTICE**

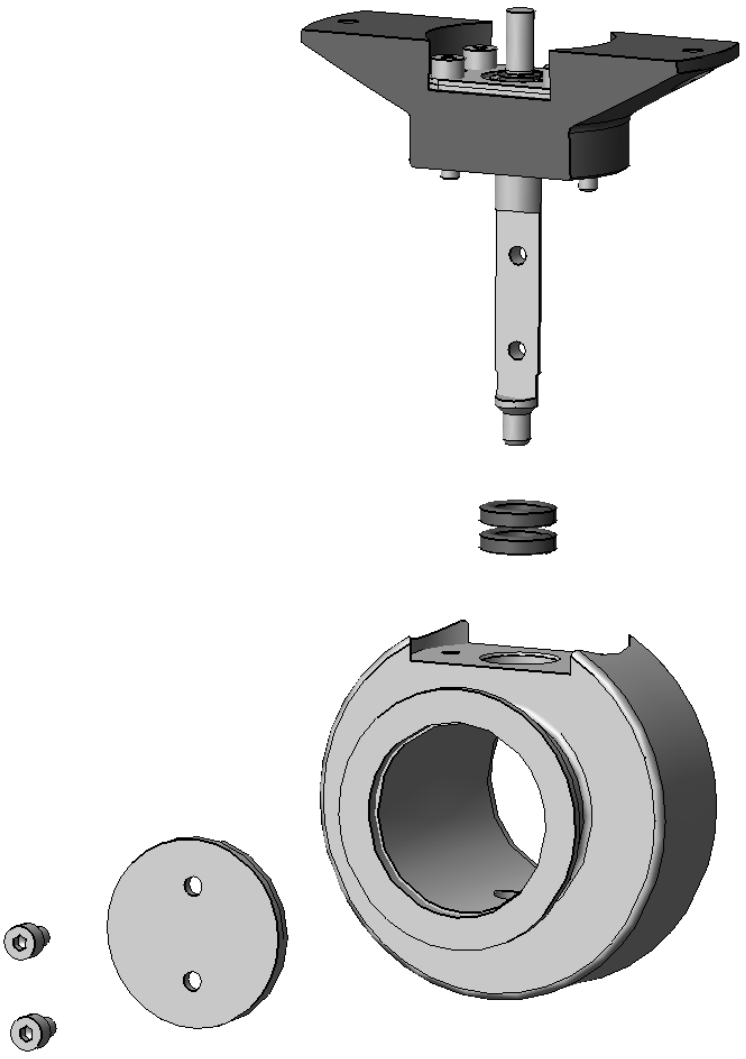
**Non-original spare parts**

Non-original spare parts may cause damage to the product.

Use original spare parts from VAT only.

- Please specify the fabrication number of the product when you place an order for spare parts; see chapter: «Identification of product». This is to ensure that the appropriate spare parts are supplied.
- VAT makes a difference between spare parts that may be replaced by the customer and those that need to be replaced by the VAT service staff.
- The following tables contain spare parts that may be replaced by the customer. If you need any other spare parts, please contact one of our service centers. You will find the addresses on our website www.vatvalve.com.

## 12.1 Drawing



Sample picture

All “Item“ refer to chapter «Drawing»

### 12.1.1 ISO-KF valve unit - aluminum blank, without heating

| Item | Description | | |
|---|---|---|---|
| | **Valve size<br>Product ordering number** | **DN 40 / 1½”<br>61232 - KA . .<br>ISO-KF** | **DN 50 / 2”<br>61234 - KA . .<br>ISO-KF** |
| 1 | Spare parts kit valve unit | 485726 | 485723 |
| 2 | Spare parts kit mechanical unit | 471287 | 471292 |
| 3 | Spare parts kit valve body | 232271 | 232272 |
| 4 | Spare parts kit plate | 232276 | 239549 |
| | Plate screws | 353386<br>(2 pcs required) | 353386<br>(2 pcs required) |

### 12.1.2 ISO-KF valve unit – stainless steel, without heating

| Item | Description | | |
|---|---|---|---|
| | **Valve size<br>Product ordering number** | **DN 40 / 1½”<br>61232 - KE . .<br>ISO-KF** | **DN 50 / 2”<br>61234 - KE . .<br>ISO-KF** |
| 1 | Spare parts kit valve unit | 486772 | 486056 |
| 2 | Spare parts kit mechanical unit | 471287 | 471292 |
| 3 | Spare parts kit valve body | 243089 | 444568 |
| 4 | Spare parts kit plate | 243090 | 444594 |
| | Plate screws | 353386<br>(2 pcs required) | 353386<br>(2 pcs required) |

For versions such as:

- other valve sizes
- heated valves
- valves made of hard anodized aluminum
- valves made of nickel coated aluminum
- valves with JIS, ASA or CF-F flanges

spare parts ordering numbers are available on request.

### 12.1.3 Control and actuating unit

| Item | Description | Part number |
|---|---|---|
| | **Valve size**<br>**Product ordering number** | **All sizes**<br>**612 . . - . . . .** |
| | Control and actuating unit | Too many to list. Please contact VAT. |
| | Option board with SPS module<br>(±15 VDC sensor power supply) | 378000 |
| | Option board with PFO module<br>(power failure option) | 378002 |
| | Option board<br>with SPS and PFO module | 376837 |

## 12.2 Accessories

| Item | Description | Part number |
|---|---|---|
| | 24 VDC power supply unit<br>(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<br>free download from www.vatvalve.com<br>or<br>available on order against charge |
| | Service cable<br>(PC to valve connection) | 230327<br>free wiring information available for download from www.vatvalve.com |
| | Connector kit consisting of:<br>•DB-9 female POWER plug<br>•DB-15 male SENSOR plug<br>•DB-25 male INTERFACE plug | 242411 |
| | Service Box 2 | 601BS-29NN-000 |
| | Control panel (rack-mount version of Service Box 2) | 602BS-29LE-000 |
| | Special Allen wrench (SW3) for disassembly and assembly | 244873 |
| | Special tool kit for disassembly and assembly:<br>• Special Allen wrench (SW3)<br>• Allen wrench (SW2)<br>• Feeler gauges: 0.04, 0.06 and 0.08mm each 6 pcs. | 257820 |

### 12.2.1 Centering ring with Viton o-ring

| **Description** | | | |
|---|---|---|---|
| **Valve size**<br>**Product ordering number** | | **DN 40 / 1½”**<br>**61232 - . . . .** | **DN 50 / 2”**<br>**61234 - . . . .** |
| Centering ring with Viton o-ring (for ISO-KF and ISO-F installation only) | Aluminum | 31032-KAZV | 32034-KAZV |
| | Stainless steel | 31032-KEZV | 32034-KEZV |

# 13 Appendix

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