Installation, Operating & Maintenance Instructions

Control gate valve
with DeviceNet interface

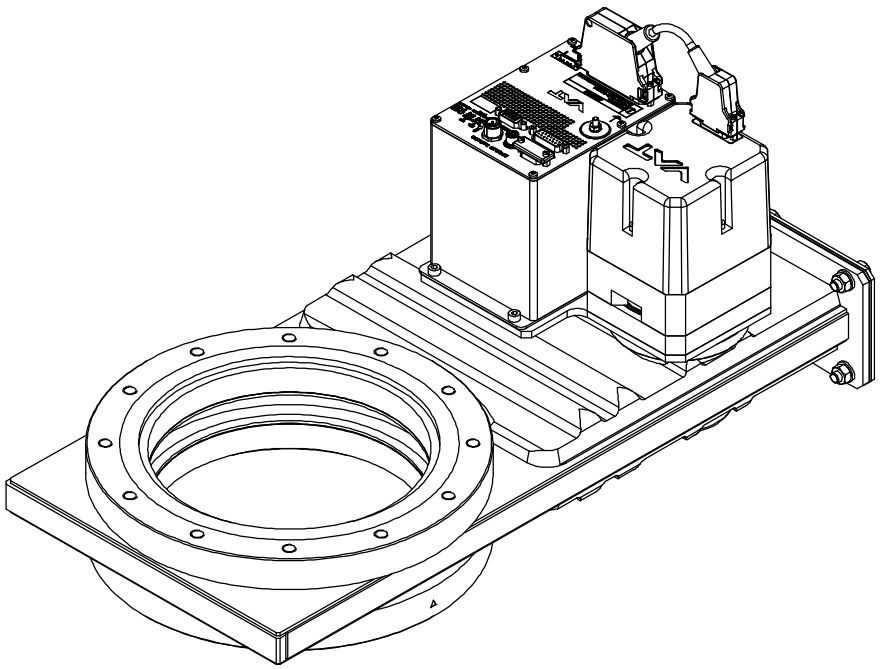
Series 642
DN 63- 400 mm (I.D. 2.5” - 16")

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

642 . . - . .GP-	(1 sensor input)
642 . . - . .GQ-	(2 sensor inputs)
642 . . - . .AP-	(1 sensor input / ±15V SPS)
642 . . - . .AQ-	(2 sensor inputs / ±15V SPS)
642 . . - . .HP-	(1 sensor input / PFO)
642 . . - . .HQ-	(2 sensor inputs / PFO)
642 . . - . .CP-	(1 sensor input / ±15V SPS / PFO)
642 . . - . .CQ-	(2 sensor inputs / ±15V SPS / PFO)

SPS = Sensor Power Supply PFO = Power Failure Option

configured with firmware **600P.1G.00.08** and **375487** (DeviceNet®)



Sample picture

Imprint

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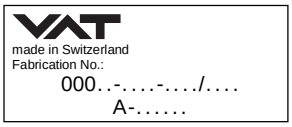
Contents

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 control gate valve with isolation functionality. It is intended to use for downstream pressure control applications.
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
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

Description	
Power input [1] **(α)** [642 . . - . . **A** . - . . . . / 642 . . - . . **G** . - . . . .] [642 . . - . . **C** . - . . . . / 642 . . - . . **H** . - . . . .]	+24 VDC (±10%) @ 0.5 V pk-pk max. [connector: POWER] 50 W max. (operation of valve with max. load) without PFO [4] 50 W plus 10 W for PFO [4]
Power input (DeviceNet®) **(β)**	3 W max. (from DeviceNet®) [connector: DeviceNet®]
Sensor power supply [2] **(β)** [642 . . - . . **A** . - . . . . / 642 . . - . . **C** . - . . . .] Input Output	 +24 VDC / 1500 mA max. [connector: POWER] ±15 VDC (±5%) / 1000 mA max. [connector: SENSOR]
Sensor power supply [2] **(β)** [642 . . - . . **G** . - . . . . / 642 . . - . . **H** . - . . . .] Input Output	 + 24 VDC resp. ± 15 VDC [connector: POWER] same as input but: [connector: SENSOR] 2.0 A max. at ± 15 VDC 1.5 A max. at + 24 VDC
Sensor input Signal input voltage ADC resolution Sampling time	 0-10 VDC / Ri>100 kΩ [connector: SENSOR] 0.23 mV 10 ms
LOGIC I/O[3] (configurable)	1 digital input [connector: LOGIC I/O] 1 digital output
PFO [4] battery pack [642 . . - . . **C** . - . . . . / 642 . . - . . **H** . - . . . .] Charging time Durability	 2 minutes max. up to 10 years @ 25°C ambient; 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

[1] Internal overcurrent protection by a PTC device.
[2] Refer to chapter: «Sensor supply concepts» for details.
[3] Refer to chapter: «LOGIC I/O» for details.
[4] PFO = Power Failure Option. Refer to «Behavior in case of power failure» for details.

Calculation of complete power consumption:
$P_{tot} = \alpha + \beta$
whereas β depends on sensor supply concept and sensor power consumption.

1.6.2 Valve unit

Description									
Pressure range at 20°C (unheated on delivery) • DN63…200 • DN250…400					1 × 10E-8 mbar to 2.0 bar (abs) 1 × 10E-8 mbar to 1.2 bar (abs)				
Leak rate to outside / seat at 20°C (unheated on delivery)					1 × 10E-9 mbar ls^{-1}				
Differential pressure on the gate • Valve closed - DN63…200 - DN250…400 • During closing / opening					≤ 2.0 bar ≤ 1.2 bar ≤ 30 mbar				
Cycles until first service (unheated and under clean conditions) • Pressure control • Isolation cycles					1'000'000 200'000				
Admissible operating temperature • Valve body • Ambient					≤ 150°C ≤ 50°C				
Mounting position (valve seat to face chamber is recommended) • DN63…350 • DN400					Any Horizontal only (optional in vertical position with extended closing time, fewer cycles)				
Process side materials	body / plate				Stainless steel: 304 (1.4301)				
	other parts				Stainless steel: 301 (1.4310), 304 (1.4301), 420 (1.4034), 420D (1.4037), 430 (1.4016)				
Seals	plate				FKM (e.g. Viton®)				
	rotary feed through				FKM (e.g. Viton®)				
	bonnet				FKM (e.g. Viton®) (DN63…200 vulcanized)				
Operating time (s) for:	**DN 63 2½"**	**DN 80 3"**	**DN 100 4"**	**DN 160 6"**	**DN 200 8"**	**DN 250 10"**	**DN 320 12"**	**DN 350 14"**	**DN 400 16"**
Open / close	4	4	6	6	6	10	10	10	10
Pressure control (throttling)	3	3	3	5	5	9	9	9	9
Min. controllable conductance (ls^{-1}) [N_2 molecular flow]	0.65	0.8	1	1.6	2	2.5	3.2	3.5	4
Max. Conductance (ls^{-1}) [N_2 molecular flow]	440	800	1700	5000	12000	22000	30000	40000	50000
Weight (approx.) kg	14	14	17	28	34	62	112	120	155
Weight (approx.) lbs	31	31	37	62	75	136	246	264	340
Valve position indication					Visual (mechanical and on controller)				
Dimensions					Refer to dimensional drawing of specific valve ordering number (available on request)				

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.

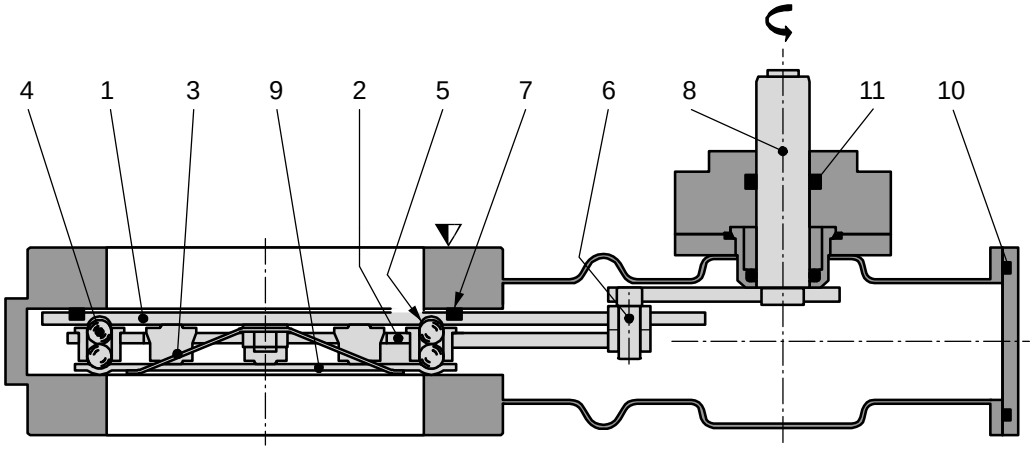
Only qualified personnel are allowed to carry out the described work.

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



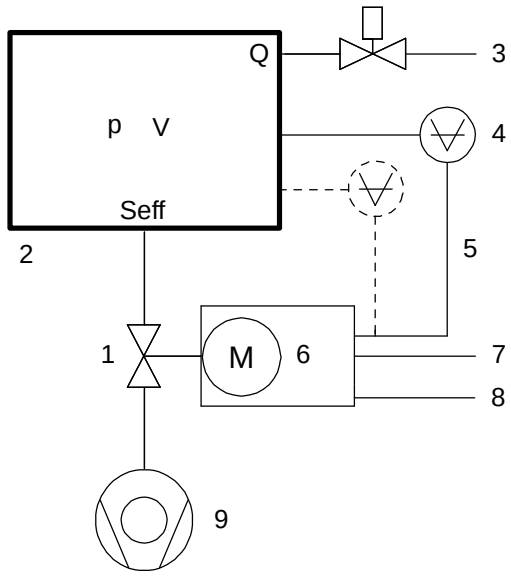
1	Valve gate	7	Gate seal
2	Ball guidance	8	Actuator shaft
3	Leaf spring	9	Counter plate
4	Ball pairs	10	Bonnet seal
5	Detents	11	Rotary feed through seals
6	Crank bolt		

3.2 Function

The valve gate (1) acts as a throttling element and varies the conductance of the valve opening. Actuation is performed with a stepper motor and controller. The stepper motor/controller version ensures accurate pressure control due to exact gate positioning. For leak tight closing the VATLOCK principle is applied. For details refer to VAT catalog.

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

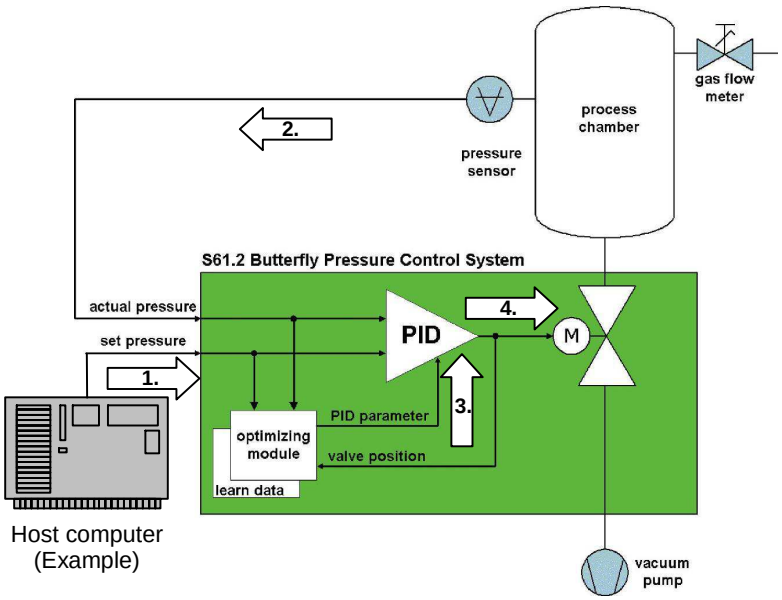
1. Downstream control (standard):
   The pressure is controlled by changing the conductance of a control valve between pump and process chamber. This changes the effective pumping speed at the process chamber. Pressure and gas flow can be independently controlled over a wide range.

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.

⚠ CAUTION

Valve is a heavy component

Physical overstraining.

Use a crane to lift valves DN 200 (8”) and larger.

- 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. Attach lifting device for valves DN 200 (8”) and larger. For attachment refer to dimensional drawing of valve.
3. 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

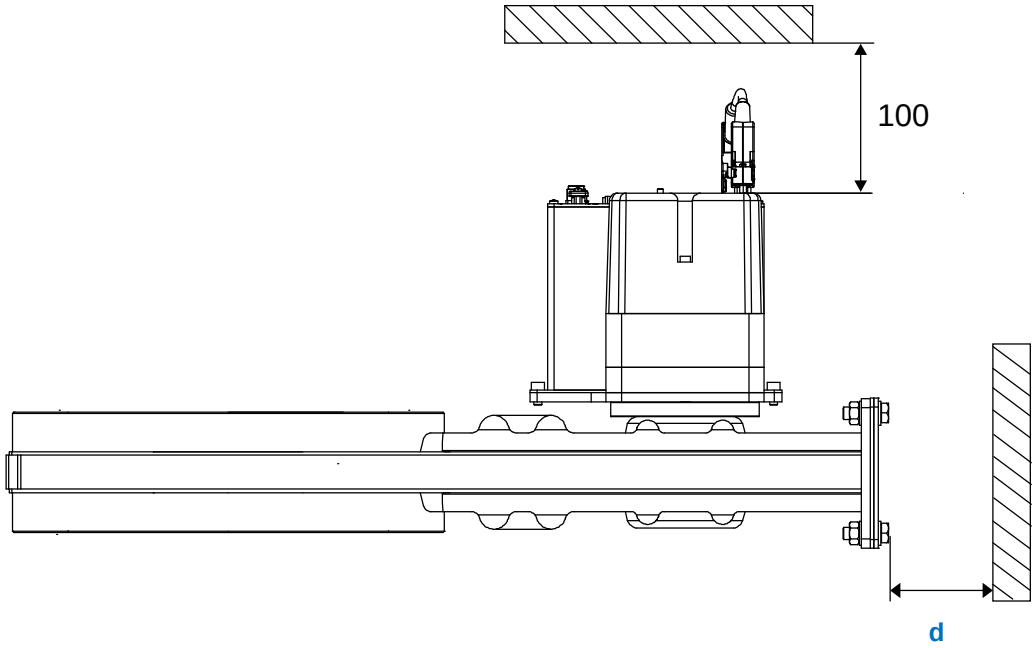
Gate and other parts of the valve must be protected from contamination.

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. (sample picture)

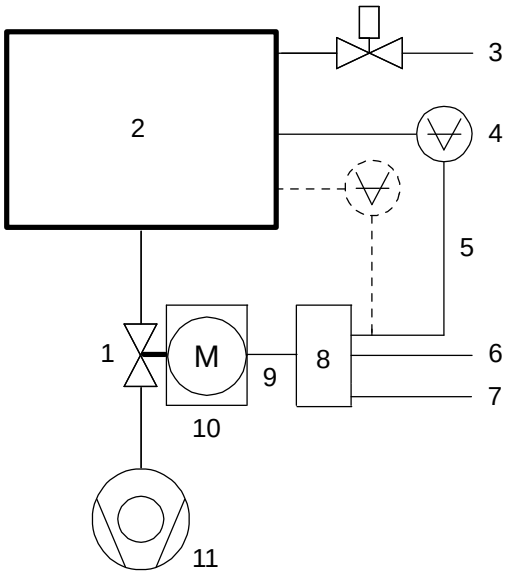


Overview table: DN to required distance (d) for maintenance.

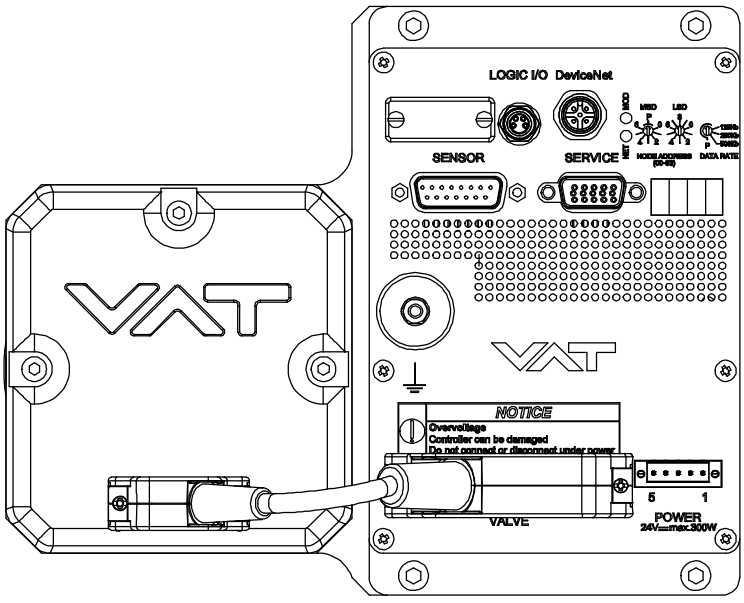
DN	63	80 / 100	160	200	250	320 / 350	400
d	180	220	300	350	450	550	600

4.2.2 Connection overview

System:



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



Actuator Controller

4.2.3 Installation procedure

1. Install valve [1] into the vacuum system, with valve seat side to process chamber. The valve seat side is indicated by the symbol "Δ" on the valve flange.

- Do not tighten the flange screws stronger than indicated under «Tightening torque».
- Do not admit higher forces to the valve than indicated under «Admissible forces».
- Make sure that enough space is kept free to do preventive maintenance work. The required space is indicated on the dimensional drawing.

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

3. Install connection cable between actuator (connector) and controller (connector: VALVE)

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

5. Connect pressure 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 642 . . - . . . **Q** - . . . . version only.

6. Connect valve to DeviceNet [6] (DeviceNet connector). Refer to «DeviceNet interface connection» for correct wiring.

7. Connect power supply [7] to valve (connector: POWER). Refer to chapter «Electrical connection» for correct wiring.

To provide power to the valve motor pins 2 and 3 must be bridged, otherwise motor interlock is active and the valve enters the safety mode and is not operative. Refer also to «Safety mode».

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

9. Perform «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 of CF-F flanges

Tightening torques for CF-F flange connections depends on the type of seal which is used. Follow recommendations of seal manufacturer.

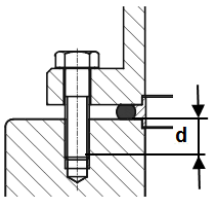
The torque values below are dependent on many factors, such as materials involved, surface quality, surface treatment, and lubrication.

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

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

4.3.2 Mounting with centering rings

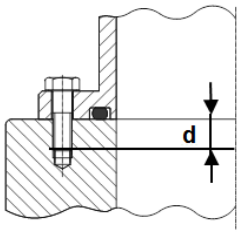
DN		max. torque (Nm)			max. torque (lbs . ft)			Max. hole depth [d] (mm)		
mm	inch	ISO-F	JIS	ASA-LP	ISO-F	JIS	ASA-LP	ISO-F	JIS	ASA-LP
63	2 1/2	8 – 10	8 – 10	8 – 10	6 – 8	6 – 8	6 – 8	13	13	15
80	3	8 – 10	8 – 10	8 – 10	6 – 8	6 – 8	6 – 8	13	13	15
100	4	8 – 10	8 – 10	8 – 10	6 – 8	6 – 8	6 – 8	13	13	15
160	6	13 – 15	13 – 15	20 - 30	9 - 11	9 - 11	15 – 22	14	14	15
200	8	13 – 15	13 – 15	20 - 30	9 - 11	9 - 11	15 – 22	16	16	20
250	10	17 – 20	17 – 20	40 – 60	13 – 15	13–15	30 – 44	16	16	20
320	12	17 - 20	17 – 20	40 - 60	13 – 15	13–15	30 - 44	16	16	20
350	12	17 - 20	17 – 20	40 - 60	13 – 15	13–15	30 - 44	16	16	20
400	16	17 – 20	30 – 35	55 – 80	13 – 15	22 – 26	41 – 59	25	25	NA



Refer to «Spare parts / Accessories» for centering rings ordering numbers.

4.3.3 Mounting with O-ring in grooves

DN		max. torque t (Nm)			max. torque (lbs . ft)			Max. hole depth [d] (mm)		
mm	inch	ISO-F	JIS	ASA-LP	ISO-F	JIS	ASA-LP	ISO-F	JIS	ASA-LP
63	4	N/A	N/A	N/A	N/A	N/A	N/A	13	13	15
80	4	N/A	N/A	N/A	N/A	N/A	N/A	13	13	15
100	4	N/A	N/A	N/A	N/A	N/A	N/A	13	13	15
160	6	N/A	N/A	N/A	N/A	N/A	N/A	14	14	15
200	8	N/A	N/A	N/A	N/A	N/A	N/A	16	16	20
250	10	N/A	N/A	N/A	N/A	N/A	N/A	16	16	20
320	12	N/A	N/A	N/A	N/A	N/A	N/A	16	16	20
350	12	NA	N/A	N/A	N/A	N/A	N/A	16	16	20
400	16	NA	N/A	N/A	N/A	N/A	N/A	25	25	N/A



4.4 Admissible forces

NOTICE

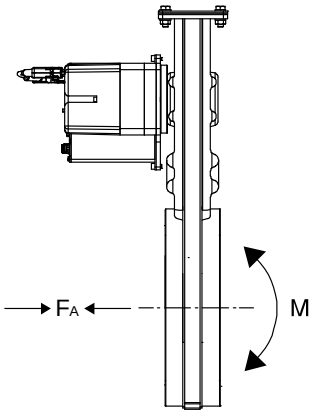
Force at flange and valve body

Forces from evacuating the system, from the weight of other components, and from baking can lead to deformation and malfunctioning of the valve.

Do not higher force the valve body as specified.

The following forces are admissible.

DN (nom. I.D.)		Axial traction or pressure force «F_A»		Bending moment «M»	
mm	inch	N	lbf	Nm	lbf · ft
63	2½	1960	440	78	58
80	3	1960	440	78	58
100	4	2450	560	98	72
160	6	2940	660	147	108
200	8	2940	660	147	108
250	10	3430	770	196	145
320	12	3920	880	294	217
350	14	3920	880	294	217
400	16	7840	1760	980	722
In case of both kind of forces are occurring («FA» und «M»), the above shown values are invalid. Please contact VAT in this case.					

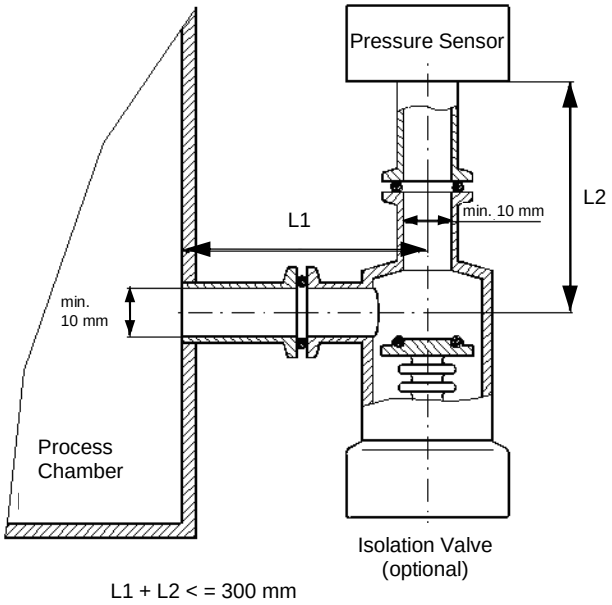


4.4.1 Requirements to sensor connection

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.



L1 + L2 < = 300 mm

4.5 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)

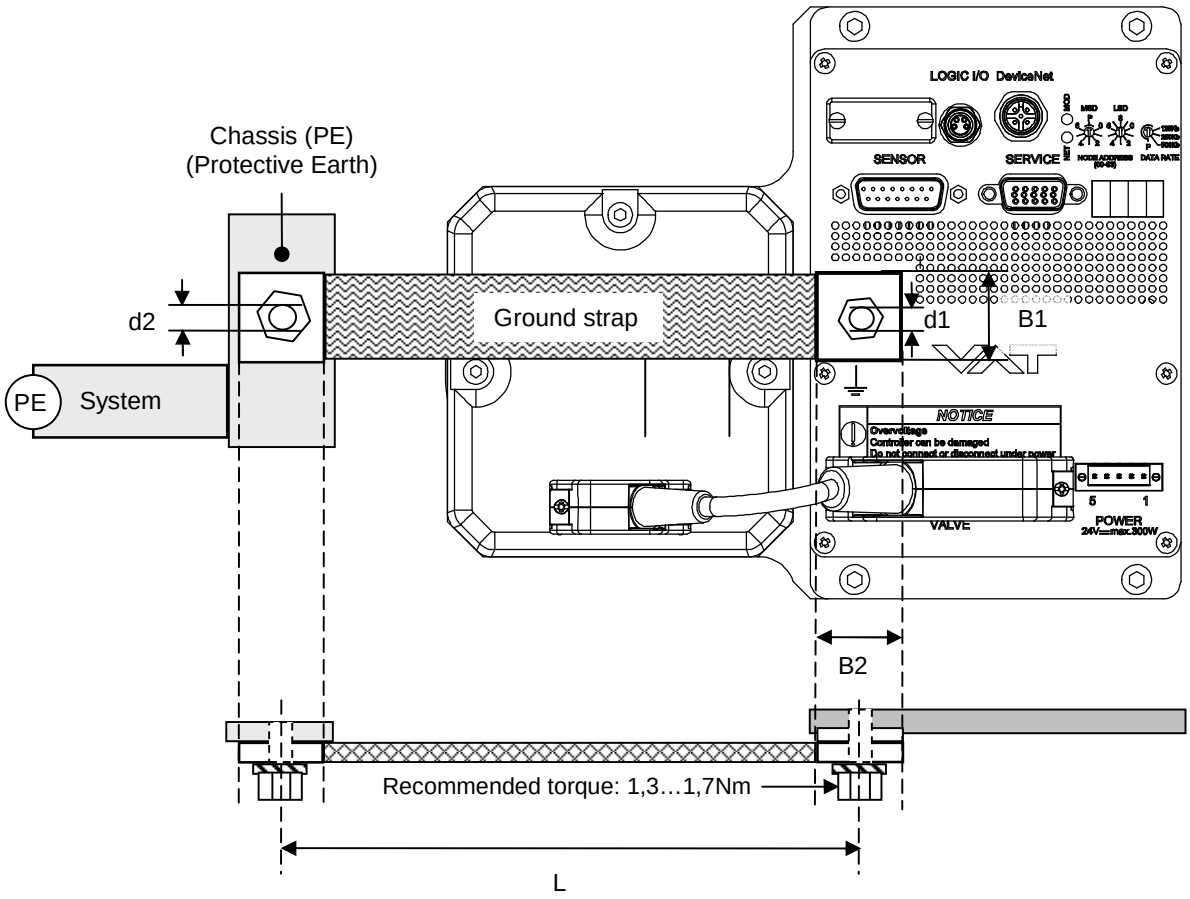
Connector pins or electronic parts could damage, if plugged and unplugged under power.

Do not plug or unplug connectors under power.

4.5.1 Ground connection

Recommendation for ground strap between controller ground 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)

4.5.2 Sensor supply concepts

Those valves offer 4 alternative concepts to supply the sensor(s) with power. This depends on the sensor type and valve version that is used.
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.
    - o +24 VDC power to supply +24 VDC sensors via controller
    - o +24 VDC power to supply +24 VDC sensors externally

- 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 opt. SPS module» for schematic and correct wiring.

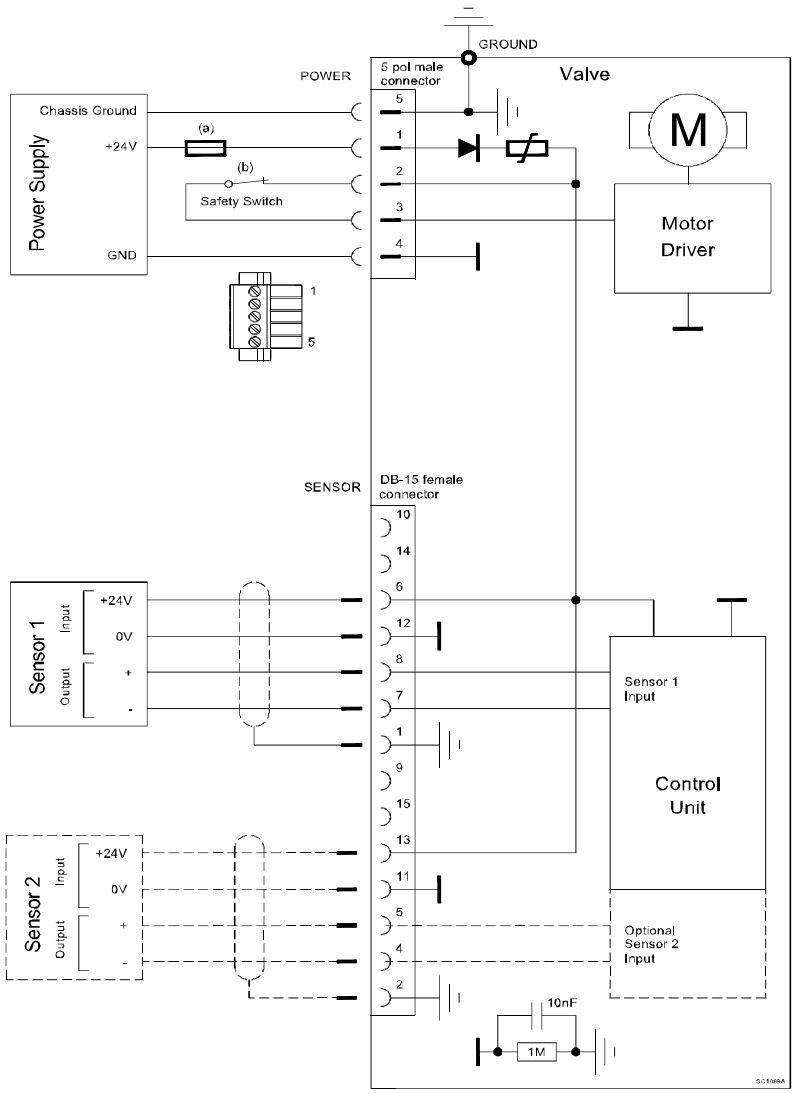
- External ±15 VDC power to supply ±15 VDC sensors without SPS option externally. Refer to chapter «Power and sensor connection (±15 VDC sensors) without SPS module» for schematic and correct wiring.

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

4.5.3 Power and sensor connection (+24 VDC sensors)

[642 . . - . . **G** . - . . . . / 642 . . - . . **H** . - . . . . versions recommended]

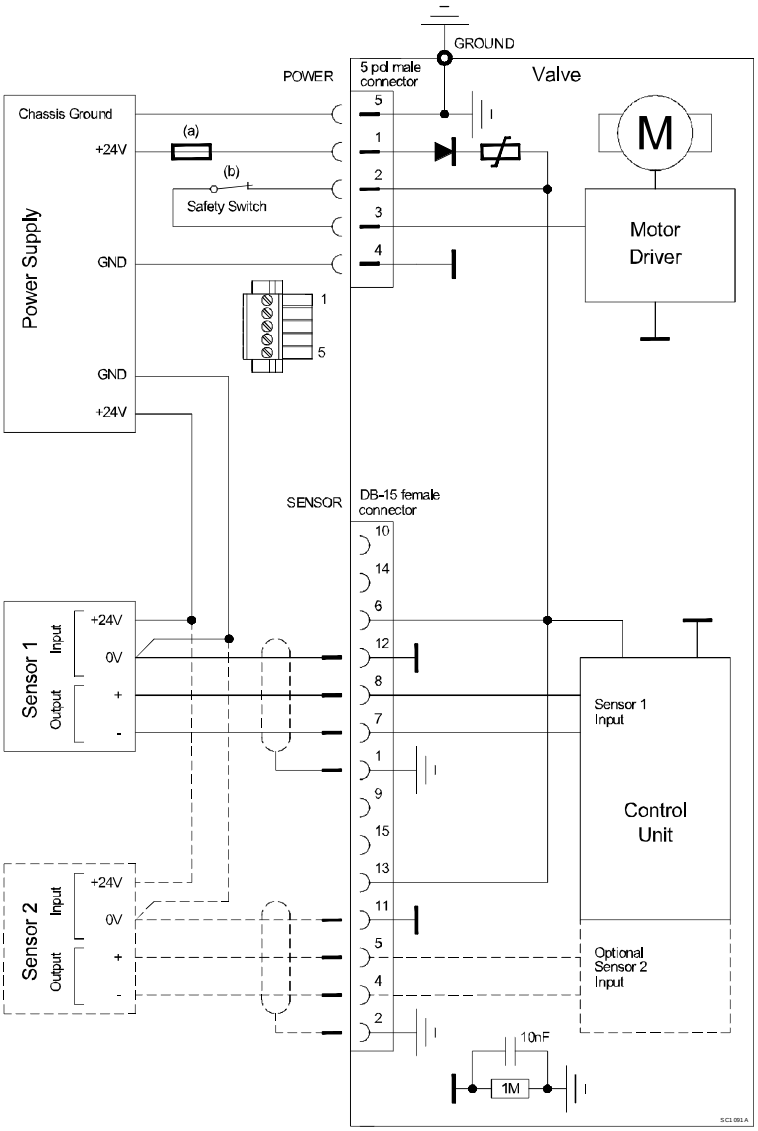
4.5.3.1 +24 VDC power to supply +24 VDC sensors via controller



Pins 2 and 3 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

- **VAT fuse recommendation: (a) 5AF / (b) Safety switch 3A min.**
- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND) at power 5 pol. male connector and Sensors (+24V / 0V / + / -) at DB–15 female sensor connector exactly as shown in the drawing above!

4.5.3.2 +24 VDC power to supply +24 VDC sensors externally

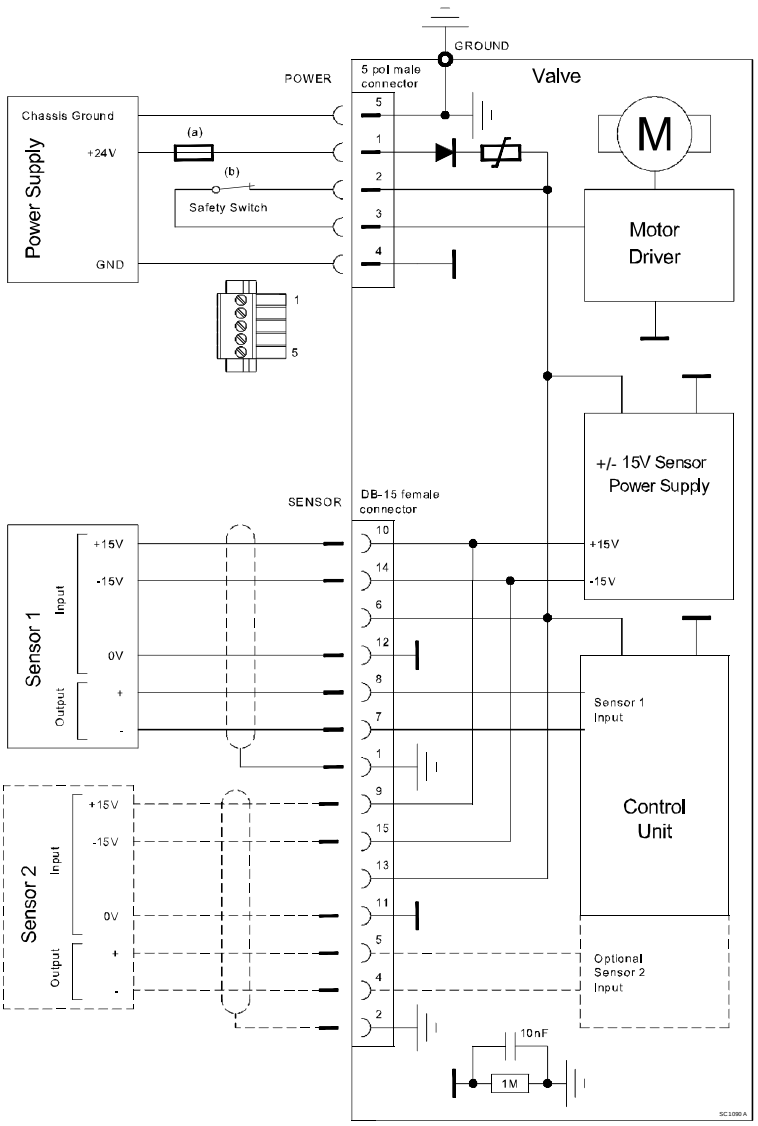


Pins 2 and 3 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

- **VAT fuse recommendation: (a) 5AF, / (b) Safety switch 3A min.**
- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND) at power 5 pol. male connector and Sensors (0V / + / -) at DB–15 female sensor connector exactly as shown in the drawing above!

4.5.4 Power (+24 VDC) and sensor connection (±15 VDC sensors) with SPS module

[642 . . - . . **A** . - . . . . / 642 . . - . . **C** . - . . . . versions only]

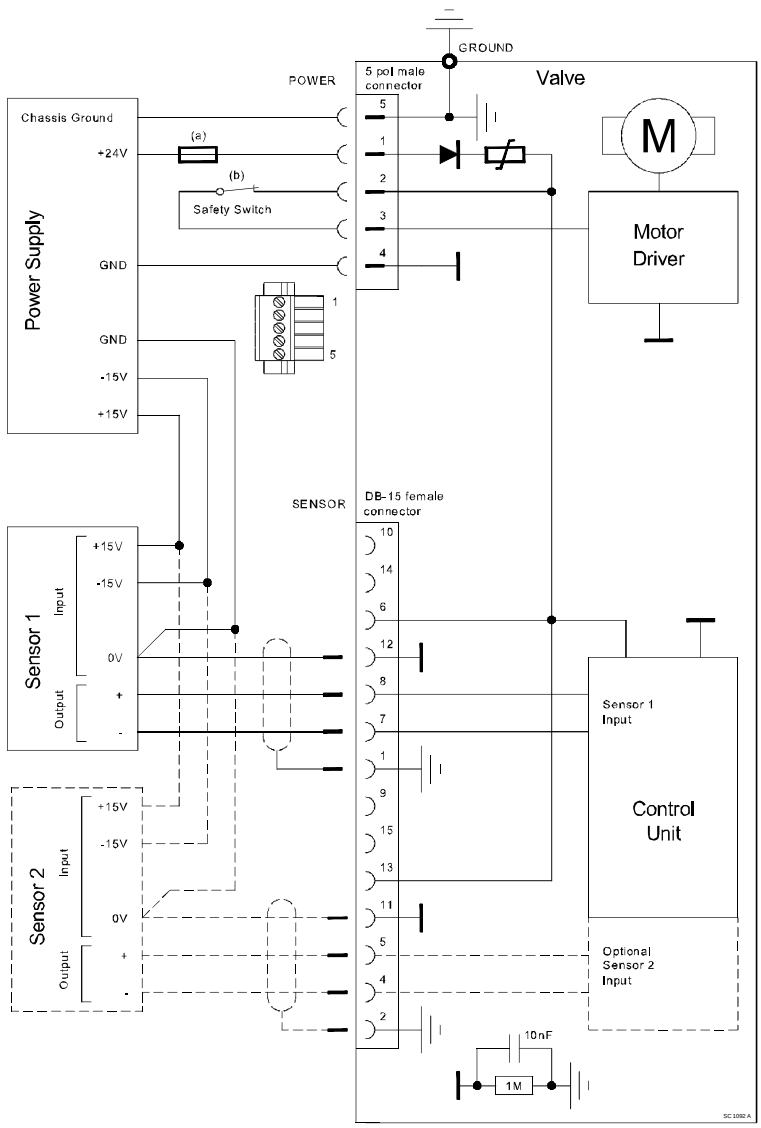


Pins 2 and 3 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

- **VAT fuse recommendation: (a) 5AF, / (b) Safety switch 3A min.**
- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND) at power 5 pol. male connector and Sensors (0V / + / - / ±15 VDC) at DB–15 female sensor connector exactly as shown in the drawing above!

4.5.4.1 External sensor power wiring without SPS module

[642 . . - . . **G** . - . . . . / 642 . . - . . **H** . - . . . . versions only]



Pins 2 and 3 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

- **VAT fuse recommendation: (a) 5AF, / (b) Safety switch 3A min.**
- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND) at power 5 pol. male connector and Sensors (0V / + / -) at DB–15 female sensor connector exactly as shown in the drawing above!

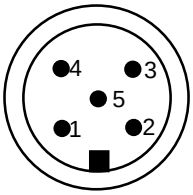
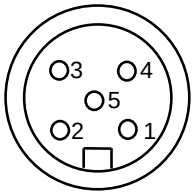
4.5.5 DeviceNet® interface connection

Connector type: Micro-style male (5 pin), connector is shown on panel refer to chapter «Installation into the system».

At valve controller	DeviceNet® cable		
PIN	Name	Wire color	Description
1 ⟷	Drain	Bare	Shield
2 ⟷	V+	Red	DeviceNet® power supply +
3 ⟷	V-	Black	DeviceNet® power supply -
4 ⟷	CAN_H	White	DeviceNet® signal
5 ⟷	CAN_L	Blue	DeviceNet® signal

The DeviceNet® interface is galvanic isolated from control unit.

4.5.5.1 Micro Connector Pinout

Male (pins) at valve controller	Female (sockets) at DeviceNet® cable
	

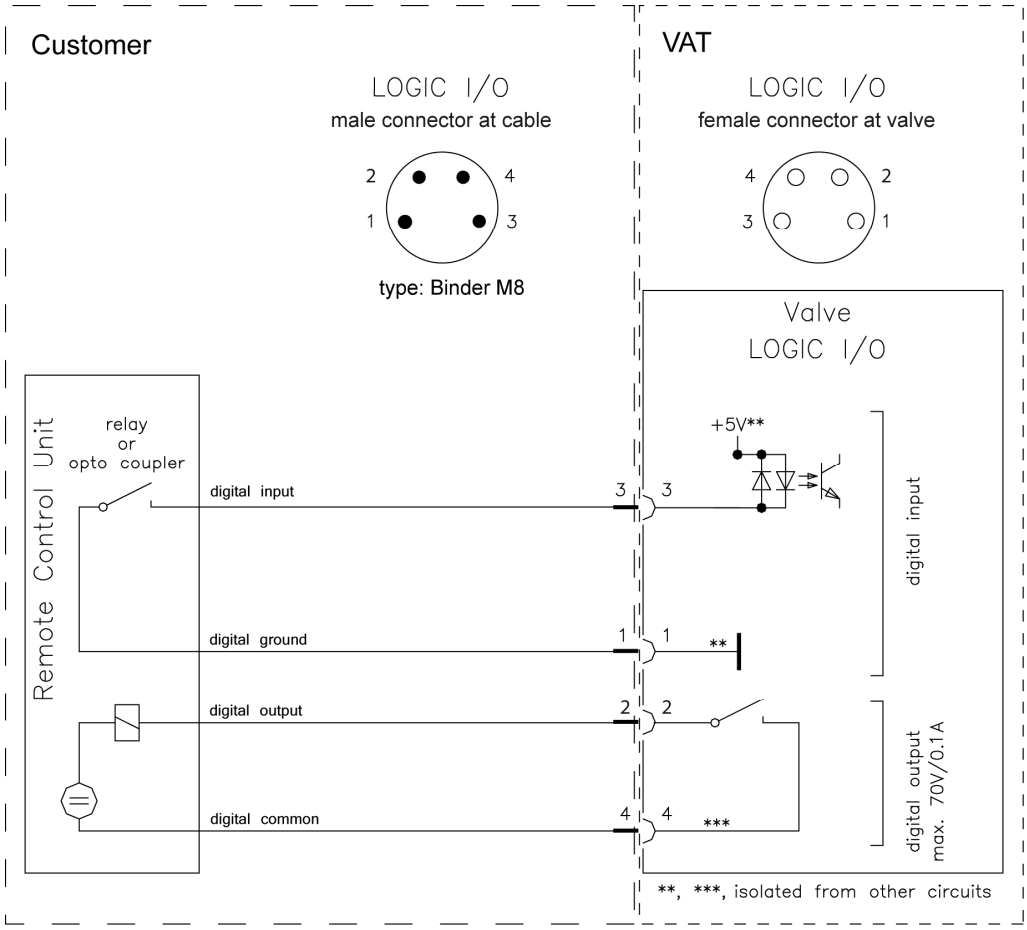
4.5.6 LOGIC I/O

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

Active **digital input** has:

- **higher priority than DeviceNet** commands
- **higher priority than Local** commands

Configuration with switch for digital input:



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

4.5.6.1 Digital input

Pin	Signal type	Description
3	Digital input	This function will close the valve. Valve will be in interlock mode as long as function is activated. After deactivation of function it will remain effective until - converse DeviceNet control command have been received The function is activated when optocoupler is 'on' in **non inverted** configuration. The function is activated when optocoupler is 'off' in **inverted** configuration. Configuration can be adjusted in local operation via service port with CV, CPA or Hyper terminal. Refer to chapter: «LOGIC I/O configuration».
1	Digital ground	Ground for digital input. Connect switch to ground. See also chapter: «LOGIC I/O».

The digital input is digitally filtered. Filter delay is 50ms. This means that digital signal must be applied for at least 50ms to be effective. Refer to chapter: «LOGIC I/O » for details about input circuit.

4.5.6.2 Digital output

Pin	Signal type	Description
2	Digital output	This function will indicate that the valve is closed. If the function "ON" is configured the output is continous on. Configuration can be changed in local operation via service port with CV, CPA or Hyper terminal. Refer to chapter: «LOGIC I/O configuration».
4	Digital common	Common for all digital output. Connect + or – terminal of source with common. See also chapter: «LOGIC I/O ».

4.5.7 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 use our Software (freeware) 'Control Performance Analyzer' which can be downloaded from:
http://www.vatvalve.com/customer-service/informations-and-downloads/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 Initial operation

4.6.1 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 5.

Setup step		Description
1	**Power up**	Turn on external + 24VDC power supply (and external ±15 VDC for sensor power supply if required). Refer to chapter «Behavior during power up» for details.
2	**DeviceNet® configuration**	DeviceNet® node number and baudrate for valve must be selected. DeviceNet® parameters must be adapted according to application needs. Refer to chapter «DeviceNet® configuration» for details.
3	**Valve configuration**	Basic configurations of the valve must be adapted according to application needs. Refer to chapter «Valve configuration» for details.
4	**Sensor configuration**	Basic configurations of the valve must be adapted according to application needs. Refer to chapter «Sensor configuration» for details.
5	**ZERO**	Compensation of the sensor offset voltage. Refer to chapter «ZERO» for details.
6a	**LEARN**	Determination of the vacuum system characteristic to accommodate the PID controller. Refer to chapter «LEARN adaptive» for details.
6b	**PRESSURE CONTROL COFIGURATION**	Accommodation of PID controller to the vacuum system characteristic. Refer to chapter: «Pressure control configuration» for details.

- Without «LEARN adaptive» or «Pressure Control configuration» the valve is not able to run pressure control.
- For ease setup (in Local mode) of 'Interface', 'Valve', 'Sensor', 'Senor ZERO', 'LEARN' and 'PRESSURE CONTROL COFIGURATION' it is possible to use the CPA 3.0, The free download is available on the VAT homepage: http://www.vatvalve.com/customer-service/informations-and-downloads/control-performance-analyzer

4.6.2 DeviceNet® configuration

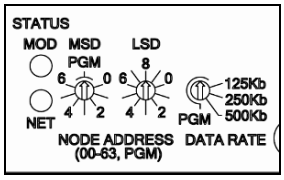
MSD and LSD switches are arranged in unusal order. Make sure to select the correct node number.

DeviceNet® node number and baudrate for valve must be selected. DeviceNet® parameters must be adapted according to application needs.

It's not the goal of this manual to describe the configuration of all parameters.

Several tools and interfaces from different vendors are on the market. For communication structure and way of commanding with these tools and interfaces you need to consult the vendor.
Operation via DeviceNet® is sophisticated and requires specific knowledge and training about it and its tools.
VAT offers valve-related but not general DeviceNet® support. Contact us under: devicenet-support@vat.ch

1. The **node number** is the device address and can be selected by two rotary switches which are on the valve controller panel. For example, to set the address to 13, set the MSD (most significant digit) to 1 and the LSD (least significant digit) to 3. (Factory default is 00).



Sample picture

In case a valid node number (0-63) is selected the number will be used at start of system as MAC-Id of the device and stored in the device memory. In this case node number is not selectable by DeviceNet® service.
If an invalid node number is selected (> 63) node number will be read from the device memory and node number is settable by DeviceNet®.

2. The **baudrate** can be selected by a rotary switch (DATA RATE) which is also on the valve controller panel.

If a valid baudrate is selected (125kBaud, 250kBaud, 500kBaud), the rate will be used and stored in the device memory as actual baudrate (Factory default is 500kb). In this case baudrate is not selectable by DeviceNet® service.
If an invalid baudrate is selected, the baudrate will be read from the device memory and the rate is settable by DeviceNet®.

3. **DeviceNet®** offers many **parameters** that may be set. Many of them are not directly used to operate the valve but are part of the DeviceNet® profile. You may set all parameters via electronic data sheet (EDS) or via explicit messaging. Setup steps 3 to 5 describe all valve specific parameters that require a setup to enable for valve operation.

The Electronic Data Sheet (EDS) allows the configuration of DeviceNet® components with a general configuration tool. The EDS contains general data regarding device, selection of operation mode, assignment of I/O data to the corresponding I/O message connections (Polling, Bit Strobe, Change of State) and description of device parameters. The parameters of a device are described in a form which is defined by DeviceNet® and visualized by a configuration tool.

EDS can be downloaded on our website: http://www.vatvalve.com/customer-service/informations-and-downloads/electronic-support-files > EDS Files

4. If **Poll** or **Change of State / Cycling** connection is used for remote operation it's required to preset the correct assemblies.
   Refer to chapter «DeviceNet interface» > «Assembly objects» for default values.

Assembly object change procedure:

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Explicit messaging setup commands» for details)
It's not possible to make assembly object configuration in local operation.	1. Select POLL CONNECTION OUTPUT assembly
	2. Select POLL CONNECTION INPUT assembly
	3. Select CHANGE OF STATE / CYCLING INPUT assembly
	4. Reestablish poll I/O connection

4.6.3 LOGIC I/O configuration

Default configuration for LOGIC I/O is:

#	Function	Mode	Input
Digital input	close valve	non inverted	enabled

#	Function	Mode	Output
Digital output	close	non inverted	enabled

The «LOGIC I/O» Digital input and Digital output can be adjusted.

Local operation: ('Control View', 'Control Performance Analyzer' or Hyper terminal)	**Remote operation**:
1. Open CV or CPA 2. Switch to [LOCAL] 3. Go to «Tools» > «Terminal» and send setup command according to application needs. (possibility of adjustment see below) **For Digital input:** to change the configuration: s:2601abcdef[CR] to read the configuration: i:2601[CR] Each element is separated with square brackets for clarity. Square brackets are not part of command syntax. All elements are ASCII characters. There are no spaces between the elements necessary. Command is case sensitive. data length 6 characters a **0** = close valve **1** = open valve b **0** = non inverted **1** = inverted c **0** = enabled **1** = disabled def **000** (reserved) **For Digital output:** to change the configuration: s:2611abcdef[CR] to read the configuration: i:2611[CR] data length 6 characters a **0** = close **1** = open **2** = On b **0** = non inverted **1** = inverted c **0** = enabled **1** = disabled def **000** (reserved) For LOGIC I/O connector schematics see also chapter «LOGIC I/O».	It's not possible to configuration in remote operation.

4.6.4 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 [642 . . - . . **C** . - . . . . or 642 . . - . . **H** . - . . . .].
- **Network failure**, for default settings refer to individual product data sheet.

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Explicit messaging setup commands» for details)
With CPA: • Do valve configuration in menu 'Valve / Setup'. With SB2: • Do power up configuration in menu 'Setup / Valve'. • Do power fail configuration in menu 'Setup / Valve'.	1. Select POWER UP CONFIGURATION 2. Select POWER FAIL CONFIGURATION

4.6.5 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 sensors versions [642 . . - . . . **Q** - . . . .]. Refer also to chapter: «Pressure control operation with 2 sensors».

Local operation: ('Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Explicit messaging setup commands» for details)
With CPA: • Do 2 sensor configuration in menu 'Sensor / Setup'. With SB2: • Enable or disable ZERO function in menu 'Setup / Sensor'. • Do 2 sensor configuration in menu 'Setup / Sensor'.	1. Select ZERO CONTROL 2. Select SENSOR MODE 3. Select SENSOR RATIO

4.6.6 ZERO

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

Local operation: ('Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Explicit messaging control commands» resp. «Explicit messaging setup commands» for details)
With CPA: • Do the ZERO in menu 'Sensor / Zero'. With SB2: • Go to menu 'Zero / ZERO' and follow instructions.	1. Send EXECUTING (if not yet selected)
	2. Select SETPOINT TYPE = position control
	3. Select CONTROL MODE for position = open valve
	4. Wait until process chamber is evacuated and sensor signal is not shifting anymore.
	5. 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.

4.6.7 **LEARN** (adaptive)

LEARN adapts the PID controller of the valve to the vacuum system and its operating conditions. LEARN must be executed only once during system setup. The LEARN routine determines the characteristic of the vacuum system. Based on this, the PID controller is able to run fast and accurate pressure control cycles.
This characteristic depends on various parameters such as chamber volume, conductance and flow regime. Therefore it must be performed with a specific gas flow according to instruction below.
The result of LEARN is a pressure versus valve position data table. This table is used to adapt the PID parameters. The data table is stored in the device memory which is power fail save. The data table can be up-/downloaded via 'Control Performance Analyzer' software or remote interface. Due to encoding the data may not be interpreted directly.
By an OPEN VALVE, CLOSE VALVE, POSITION CONTROL or PRESSURE CONTROL command the routine will be interrupted.

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Explicit messaging control commands» resp. «Explicit messaging setup commands» for details)
Go to 'Learn / LEARN' menu and follow instructions. 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. LEARN does not need to be performed with the process gas. Instead N_2 or Ar may be used.
	3. Set SETPOINT (= pressure limit for learn) to p_{max} (max. pressure to control during process)
	4. Set LEARN Alarm (VALVE STATUS) is set as long learn is performed, if alarm is off, learn is finished.
	5. Reset LEARN
	6. Reset OPEN VALVE

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.

$$q_L = \frac{p_{SFS} \bullet C_{min}}{1100}$$

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

$$q_L = \frac{p_{SFS} \bullet C_{min}}{1.1}$$

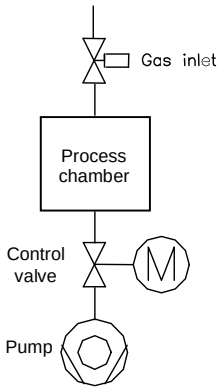
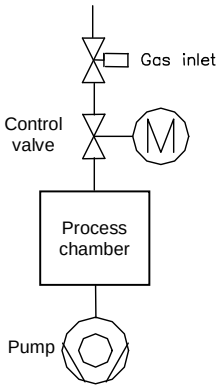
q_L gasflow for learn [**mbar l/s**]
p_{SFS} sensor full scale pressure [**mbar**]
C_{min} min. controllable conductance of valve [l/s], (refer to «Technical data»)

$$q_L = 71 \bullet p_{SFS} \bullet C_{min}$$

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

4.6.8 Pressure control configuration

Select the configuration what your application needs.

<table>
<tr><th rowspan="2">System Configuration</th><th colspan="2">Constant gas flow available</th><th rowspan="2">Constant gas flow not available</th></tr>
<tr><th>Tv*<= 500 sec</th><th>Tv* > 500 sec</th></tr>
<tr><td>Downstream
 
</td><td>Adaptive pressure controller
(Refer to chapter: Pressure controller)</td><td colspan="2">Fixed pressure controller
(Refer to chapter: Pressure controller)</td></tr>
<tr><td>Upstream
 
</td><td colspan="3">Fixed pressure controller
(Refer to chapter: Pressure controller)</td></tr>
<tr><td>Soft Pump</td><td colspan="3">Soft Pump (Refer to chapter: Pressure controller)</td></tr>
</table>

Use the formula below to define the applicable pressure control algorithm.

$$Tv = \frac{P_{SFS} \bullet CV}{q_L}$$

q_L	gasflow for learn [mbarl/s]
p_{SFS}	sensor full scale pressure [mbar]
Tv*	Vacuum time constant [sec]
CV	Chamber Volume [l]

4.6.8.1 Pressure controller

Configuration of three possible pressure controller.

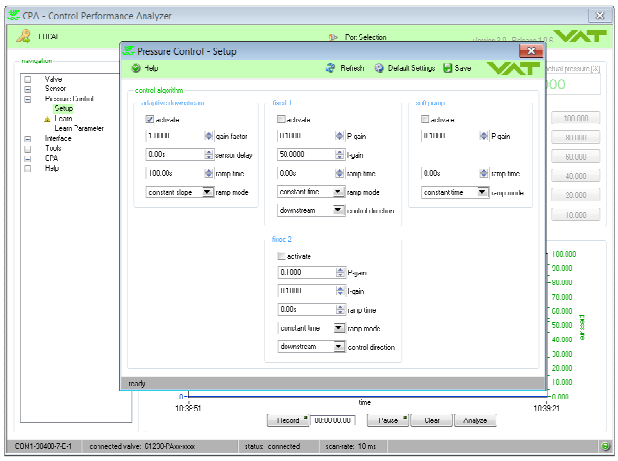
<table>
<tr><th colspan="2">Local operation:
(‘Control View’ or ‘Control Performance Analyzer’)</th><th>Remote operation:</th></tr>
<tr><td colspan="2">4. Open CV or CPA
5. Go to «Tools» > «Terminal» and send setup command s:02 according to application needs. (possibility of adjustment see below)
<table><tr><th rowspan="2"></th><th>Command</th><th>Acknowledgement
(within 10ms after reception of command)</th></tr><tr><th colspan="2">Describtion</th></tr><tr><td>Set</td><td>s:02Z00a
configure pressure controller a</td><td>s:02</td></tr><tr><td>Get</td><td>i:02Z00
get the actual pressure controller a</td><td>i:02Z00a</td></tr></table>This command selects pressure controller.
a Pressure controller
0 = Adaptive downstream
1 = Fixed 1
2 = Fixed 2
3 = Soft pump</td><td>It’s not possible to do ‘Pressure controller configuration‘ via remote operation.</td></tr>
</table>

For easy setup (Local operation) of ‘Pressure controller’ and ‘Pressure control parameter’ please use the VAT “Control Performance Analyzer” CPA 3.0.

There is a free download on the VAT home page, refer to: http://www.vatvalve.com/customer-service/informations-and-downloads/control-performance-analyzer

4.6.8.2 With CPA 3.0 direct setup (standard)

Open the CPA. In menu ‘Pressure Control’ / ‘Setup’, select the ‘Pressure controller’ and do the setup for pressure control algorithm (parameter).



4.6.8.3 Pressure control parameter

<table>
<tr><th>Local operation:
(‘Control View’ or ‘Control Performance Analyzer’)</th><th>Remote operation:</th></tr>
<tr><td>
• Open CPA
• Go to «Tools» > «Terminal» and send setup command s:02 according to application needs. (possibility of adjustment see below)
<table>
<tr><th></th><th>Command</th><th>Acknowledgement
(within 10ms after reception of command)</th></tr>
<tr><th></th><th colspan="2">Describtion</th></tr>
<tr><td>Set</td><td>s:02abbc
configure pressure control parameters</td><td></td></tr>
<tr><td>Get</td><td>i:02abbc
get pressure control parameters</td><td>i:02abbc</td></tr>
</table>
This command selects pressure control parameter.

a pressure controller (one digit) see table:

bb parameter number (two digits) see table: “Overview parameter number”

c parameter value using data type “unsigned integer” or “floating point” (dependend on the corresponding data type)

For details (commands etc.), see next tables.
Note: Each pressure control algorithm has its own parameters. That means the adjustment of a e.g. adaptive downstream parameter (e.g. Ramp Time “Adaptive downstream”) doesn’t influence one of the other Ramp time parameter of other pressure control algorithms and vice versa.
</td><td>

It’s not possible to do ‘Pressure control parameter‘ configuration‘ via remote operation.
</td></tr>
</table>

4.6.8.4 Overview parameter number

	bb Parameter number	a = A (adaptive pressure controller)	a = B (fixed 1 pressure controller)	a = C (fixed 2 pressure controller)	a = D (soft pump pressure controller)
SENSOR DELAY	00	✓	×	×	×
RAMP TIME	01	✓	✓	✓	✓
RAMP MODE	02	✓	✓	✓	✓
CONTROL DIRECTION	03	×	✓	✓	×
P-GAIN (for A = GAIN FACTOR)	04	✓	✓	✓	✓
I-GAIN	05	×	✓	✓	×

✓ existent for this pressure controller
× not used for this pressure controller

4.6.9 Pressure control algorithem

- Local operation:
  - o With CPA direct setup, see chapter: With CPA 3.0 direct setup (standard).
  - o With CV or CPA, go to «Tools» > «Terminal» and send setup commands according to application needs. See next tables.

4.6.9.1 Adaptive control algorithm (downstream)

Parameter	Command		Request	Data Type	Values
SENSOR DELAY	Set	s:02A00**c**	s:02	FLOAT	**c** = 0.00…1.00 Default is: 0.00 s
	Get	i:02A00	i:02A00**c**		
RAMP TIME	Set	s:02A01**c**	s:02	FLOAT	**c** = 0.00…1'000'000.0 Default is: 0.00 s
	Get	i:02A01	i:02A01**c**		
RAMP MODE	Set	s:02A02**c**	s:02	UINT	**c** = 0 or 1 **0** = constant time **1** = constant slope Default is: 0
	Get	i:02A02	i:02A02c		
GAIN FACTOR	Set	s:02A04**c**	s:02	FLOAT	**c** = 0.0001…7.5 Default is: 1.0
	Get	i:02A04	i:02A04**c**		

Explanation:

SENSOR DELAY
Sensor response time [s]
The SENSOR DELAY is a control parameter to compensate delays during the pressure detection. Pipes and orifices for sensor attachment can cause delays in response time and could impact badly the 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.

RAMP TIME
Pressure setpoint ramp time [s]

RAMP MODE

Mode = 0 Cocnstant Time	The RAMP TIME is dependent on the adjusted parameter ramp time and is always the same independent of the control deviation. That means the ramp time from the actual value to the setpoint value is the adjusted parameter ramp time value.
Mode = 1 Constant Slope	The RAMP TIME is dependent on the adjusted parameter ramp time and is different depending on the control deviation. The RAMP TIME is calculated corresponding to the sensor full scale value (10V). Ramp time = 10 sec.; ramp time slope is SFS (10V) in 10 Seconds.

In the adaptive pressure controller mode, the RAMP TIME parameter also can be a value to minimize over- / undershooting. The ramp could be used to harmonize the adaptive control algorithm.

GAIN FACTOR
The GAIN FACOTR is a control parameter to adapt the performance of the pressure control algorithm. A higher gain results in faster response, higher over- / undershoot of pressure. A lower gain results in slower response, lower over- / undershoot of pressure.

Example:
Set SENSOR DELAY of the adaptive pressure controller to the value 0.75

Command	Pressure controller	Parameter selection variable	Parameter value (seconds)
s:02	**A** (a)	**00** (bb)	**0.75** (c)

→ s:02A000.75

To optimize adaptive control algorithm, refer to chapter «Tuning of control performance».

4.6.9.2 Fixed 1 control algorithm

Parameter	Command		Request	Data Type	Values
RAMP TIME	Set	s:02B01**c**	s:02	FLOAT	**c** = 0.00…1'000'000.0 Default is: 0.00
	Get	i:02B01	i:02B01**c**		
RAMP MODE	Set	s:02B02**c**	s:02	UINT	**c** = 0 or 1 **0** = constant time **1** = constant slope Default is: 0
	Get	i:02B02	i:02B02**c**		
CONTROL DIRECTION	Set	s:02B03**c**	s:02	UINT	**c** = 0 or 1 **0** = downstream **1** = upstream Default is: 0
	Get	i:02B03	i:02B03**c**		
P-GAIN	Set	s:02B04**c**	s:02	FLOAT	**c** = 0.001…100 Default is: 0.1
	Get	i:02B04	i:02B04**c**		
I-GAIN	Set	s:02B05**c**	s:02	FLOAT	**c** = 0…100.0 Default is: 0.1
	Get	i:02B05	i:02B05**c**		

Explanation:

RAMP TIME
Pressure setpoint ramp time [s]

RAMP MODE

Mode = 0 Constant Time	The RAMP TIME is dependent on the adjusted parameter ramp time and is always the same independent of the control deviation. That means the ramp time from the actual value to the setpoint value is the adjusted parameter ramp time value.
Mode = 1 Constant Slope	The RAMP TIME is dependent on the adjusted parameter ramp time and is different depending on the control deviation. The RAMP TIME is calculated corresponding to the sensor full scale value (10V). Ramp time = 10 sec.; ramp time slope is SFS (10V) in 10 Seconds.

CONTROL DIRECTION
The CONTROL DIRECTION defines the type of application, if the valve is mounted in downstream or upstream. Downstream means the valve is after the chamber and before the pump. Upstream, valve is mounted before chamber and pump.

P-GAIN / I-GAIN
The P-GAIN is the proportional factor of the fixed control algorithm. The I-GAIN is the integral factor.

Example:

Set RAMP MODE of the Fixed 1 pressure controller to the value 0 (fixed time)

Command	Pressure controller	Parameter selection variable	Parameter value
s:02	**B** (a)	**02** (bb)	**0** (c)

→ s:02B020

To optimize Fixed 1 algorithm, refer to chapter «Tuning of control performance».

4.6.9.3 Fixed 2 control algorithm

Parameter	Command		Request	Data Type	Values
RAMP TIME Pressure setpoint ramp time [s]	Set	s:02C01**c**	s:02	FLOAT	**c** = 0.00…1'000'000.0 Default is: 0.00
	Get	i:02C01	i:02C01**c**		
RAMP MODE	Set	s:02C02**c**	s:02	UINT	**c** = 0 or 1 **0** = constant time **1** = constant slope Default is: 0
	Get	i:02C02	i:02C02**c**		
CONTROL DIRECTION	Set	s:02C03**c**	s:02	UINT	**c** = 0 or 1 **0** = downstream **1** = upstream Default is: 0
	Get	i:02C03	i:02C03**c**		
P-GAIN	Set	s:02C04**c**	s:02	FLOAT	**c** = 0.001…100 Default is: 0.1
	Get	i:02C04	i:02C04**c**		
I-GAIN	Set	s:02C05**c**	s:02	FLOAT	**c** = 0…100.0 Default is: 0.1
	Get	i:02C05	i:02C05**c**		

Explanation: Refer to: «Fixed 1 control algorithm»

4.6.9.4 Soft pump control algorithm

Parameter	Command		Request	Data Type	Values
RAMP TIME	Set	s:02D01**c**	s:02	FLOAT	**c** = 0.00…1'000'000.0 Default is: 0.00
	Get	i:02D01	i:02D01**c**		
RAMP MODE	Set	s:02D02**c**	s:02	UINT	**c** = 0…1 **0** = constant time **1** = constant slope Default is: 0
	Get	i:02D02	i:02D02**c**		
P-GAIN	Set	s:02D04**c**	s:02	FLOAT	**c** = 0.001…100 Default is: 0.1
	Get	i:02D04	i:02D04**c**		

Explanation:

RAMP TIME
Pressure setpoint ramp time [s]

RAMP MODE

Mode = 0 Constant Time	The RAMP TIME is dependent on the adjusted parameter ramp time and is always the same independent of the control deviation. That means the ramp time from the actual value to the setpoint value is the adjusted parameter ramp time value.
Mode = 1 Constant Slope	The RAMP TIME is dependent on the adjusted parameter ramp time and is different depending on the control deviation. The RAMP TIME is calculated corresponding to the sensor full scale value (10V). Ramp time = 10 sec ; ramp time slope is SFS (10V) in 10 Seconds.

P-GAIN
The P-GAIN is the proportional factor of the soft pump control algorithm.

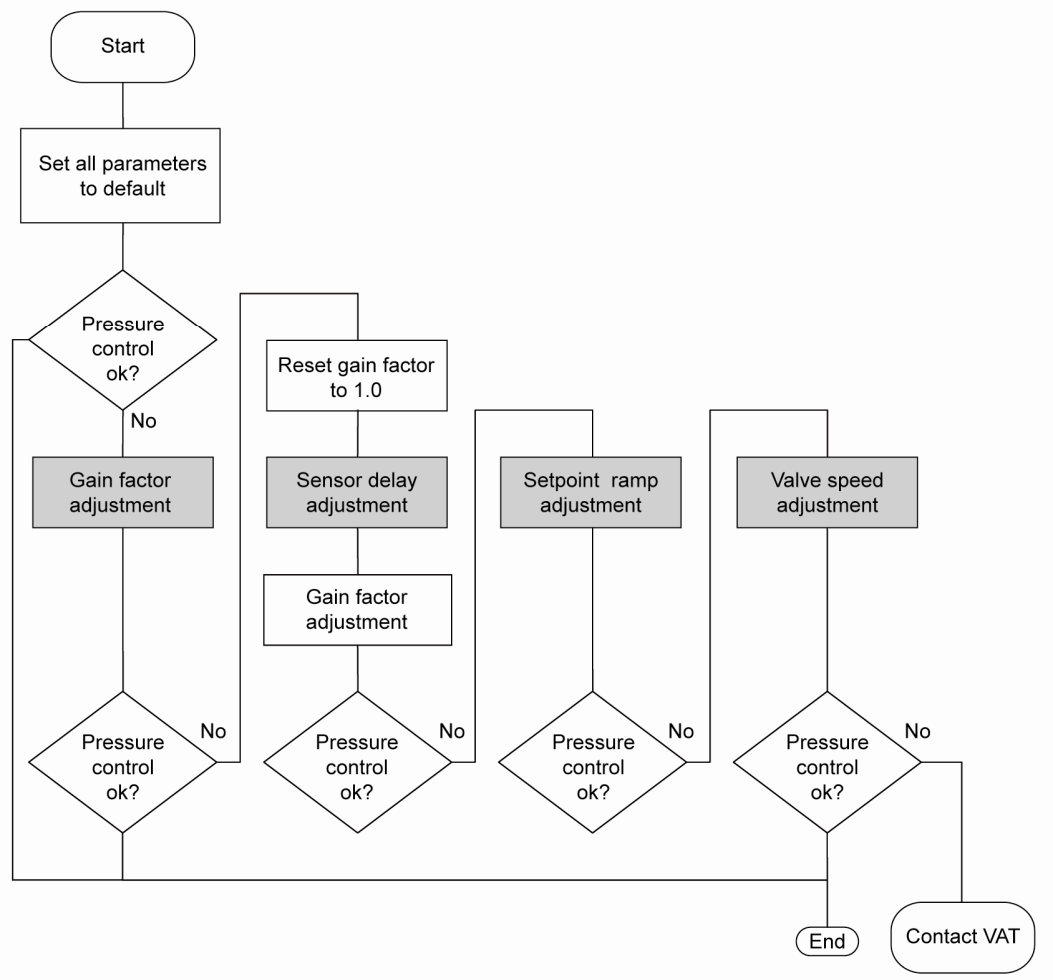
To optimize soft pump algorithm, refer to chapter «Tuning of control performance».

4.7 Tuning of control performance

- Tuning of control performance with adaptive algorithm, refer to chapter: 4.7.1 Tuning of control performance with adaptive algorithm
- Tuning of control performance with fixed PI algorithm, refer to chapter: 4.7.2 Tuning of control performance with fixed PI algorithm
- Tuning of control performance with Soft pump algorithm, refer to chapter: 4.7.4 Tuning of control performance with soft pump algorithm

4.7.1 Tuning of control performance with adaptive algorithm

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.



4.7.1.1 Gain factor adjustment

The gain factor effects: Stability, Response time

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: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Explicit messaging setup commands» for details)
Set gain factor in menu 'Setup / Control Parameter'	Send PID CONTROLLER CONFIGURATION GAIN FACTOR

4.7.1.2 Sensor delay adjustment

Sensor delay adjustment effects: Stability

Adjustment range is from 0 to 1.0s.

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

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

Adjustment procedure:

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

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Explicit messaging setup commands» for details)
Go to 'Setup / Control Parameter' menu. Select sensor delay.	Send PID CONTROLLER CONFIGURATION SENSOR DELAY

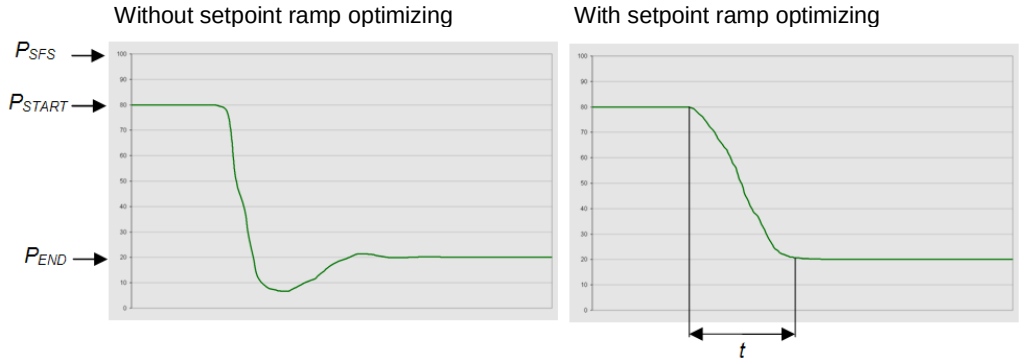
4.7.1.3 Setpoint ramp adjustment

Setpoint ramp effects: Undershoot of pressure, Response time

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



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: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation:** (Refer to chapter «Explicit messaging setup commands» for details)
Go to 'Setup / Control Parameter' menu. Select setpoint ramp.	Send PID CONTROLLER CONFIGURATION RAMP TIME

4.7.1.4 Valve speed adjustment

Valve speed effects: Response time

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

4.7.2 Tuning of control performance with fixed PI algorithm

This valve may be used for downstream or upstream pressure control depending on configuration. The PI parameters of the pressure controller require correct adjustment. These parameters must be set once during system setup and are stored in the device memory which is power fail save. Based on the PI controller configuration, the valve is able to run fast and accurate pressure control cycles. The PI parameters can be evaluated using below instruction.

In downstream control mode valve will move towards open when current pressure is higher than set point. In upstream control mode valve will move towards close when current pressure is higher than set point.

Local operation: ('Control View' resp. 'Control Performance Analyzer')	**Remote operation**:
Go to 'Tools / Terminal' menu and do the: ■ Pressure control cofiguration → Controller mode + PI-Parameters Refer to chapter «Pressure control configuration» for details.	It's not possible to optimize P-gain and I-Gain via DeviceNet®

Introduction

PI controller mode is used if for any reason (e.g. too long system time constant) the adaptive control mode does not provide satisfying control performance.
In PI controller mode the parameters P gain and I gain have to be set according to the systems characteristics. The best set of parameters can be found by using the empiric method below.

1. Pressure and gas flow for optimization

A PI controller delivers the best results for a certain working point (pressure/gas flow). If there is only one working point, this pressure and gas flow has to be used for optimizing P and I gain. If there are several working points that have to be covered, the pressure for optimizing is the medium pressure between highest and lowest pressure to be controlled, the gas flow for optimizing is the highest flow out of all working points.

Two different pressure set points are necessary for optimization. Set point 1 (SP1) is the pressure for optimizing as determined above. Set point 2 (SP2) is about 10 - 20% lower than SP1.

Example: pressure range: 4 – 10 Torr
Flow range: 2 – 4 slm

Pressure set points and gas flow for optimization:

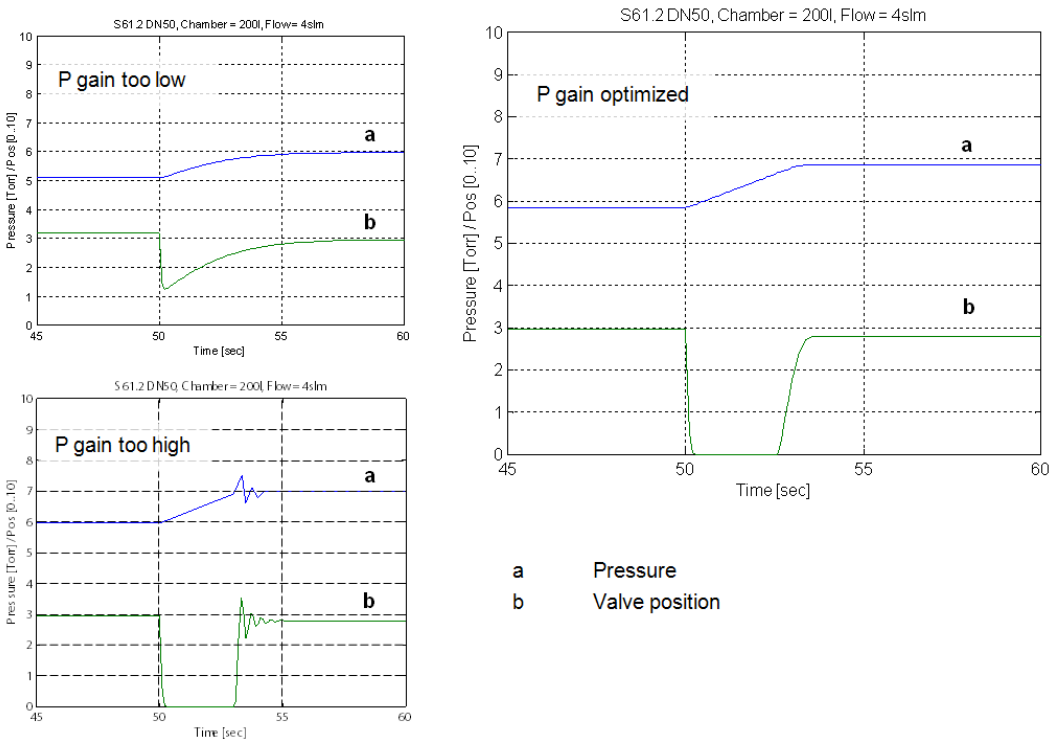
SP1	=	7 Torr
SP2	=	6 Torr
Gas flow	=	4slm

2. Optimizing P gain

While optimizing P gain, the gas flow determined above has to be constant all the time.

Start optimization with P gain set to 1.0 and I gain set to 0.0.
Set chamber pressure to SP2, wait until the pressure is stable. Set pressure to SP1. If the transition from SP2 to SP1 results in a significant pressure over shoot or even does not stabilize at all, the P gain is too high. If there is no over shoot and the pressure reaches SP1 asymptotically and very slow, P gain is too low.
The optimal P gain value is found if the transition from SP2 to SP1 results in a slight pressure over shoot. It does not matter if there is still a deviation between SP1 and actual pressure.

Example:



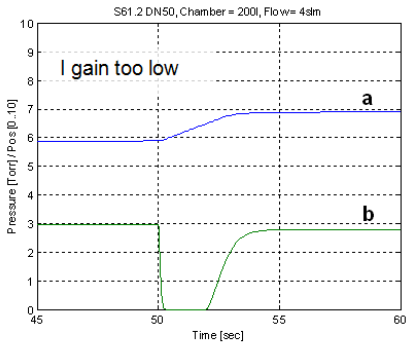
Check control performance over the whole control range with parameters above.

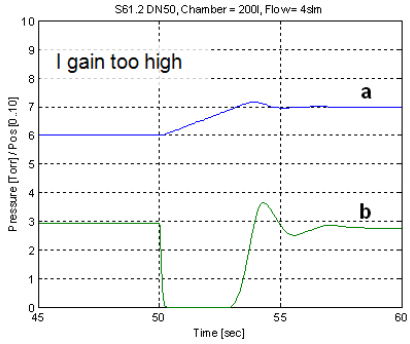
3. Optimizing I gain

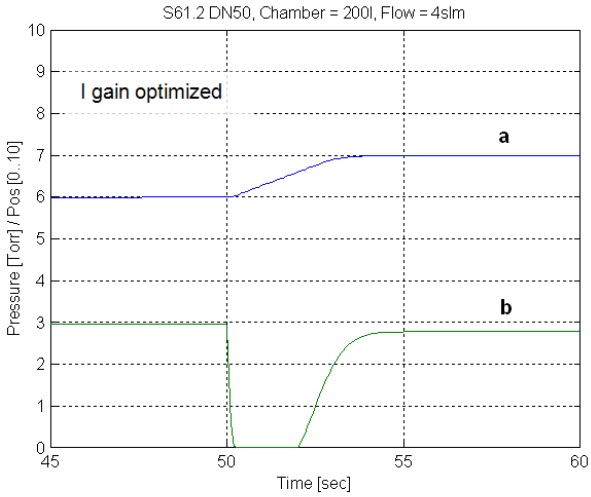
While optimizing I gain, the gas flow determined above has to be constant all the time.

Start with P gain set to half of the value found when optimizing P gain and set I gain to 1.0.
Keep the P gain constant.
Set chamber pressure to SP2, wait until the pressure is stable. Set pressure to SP1. If the transition from SP2 to SP1 results in a significant pressure over shoot or if the valve position does not stabilize, I gain is to high. If the transition results in a slow asymptotical pressure rise and there is still a constant deviation to SP2, the I gain is too low.
The optimal value for I gain is found if the transition from SP2 to SP1 result in just a slight pressure over shoot, a stable valve position and the actual pressure matches SP2 exactly.

Example:







a Pressure
b Valve position

Check control performance over the whole control range with parameters above.

4.7.2.1 Required information for support (in case of unsuccessful tuning procedure):

- 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

4.7.3 Tuning of control performance with soft pump algorithm

This valve may be used to control pressure ramps during pump down. The P parameter of the pressure controller requires correct adjustment. This parameter must be set once during system setup and is stored in the device memory which is power fail save. Based on the soft pump controller configuration, the valve is able to run fast and accurate pressure control cycles. The P parameter can be evaluated using below instruction.

Local operation: ('Control View' resp. 'Control Performance Analyzer')	**Remote operation**:
Go to 'Tools / Terminal' menu and do the: ■ Pressure control cofiguration → Controller mode + P-Parameters Refer to chapter «Pressure control configuration» for details.	It's not possible to optimize P-gain via DeviceNet®

Introduction

Soft pump control mode allows a completely user-defined pressure profile, usually from atmosphere down to some process pressure
The P gain value evaluated for soft pump control mode might be different than the P gain value evaluated for PI controller mode. When switching to soft pump control mode the P gain value evaluated fort the PI controller has to be send to the valve controller. When switching back into PI controller mode the respective P gain value has to be send again.
Adaptive pressure control mode ignores any P gain value.

1. Basic settings

The pump down characteristic is determined by start pressure, end pressure and pump down time. This straight line from start pressure to end pressure.
The VAT soft pump controller requires a pump down time shorter than 10 sec. for good control results. If the required pump down time is longer than 10 sec., the pump down curve has to be partitioned into sections shorter than 10 sec. with corresponding end pressure.

Example:

Start pressure: 760 Torr
End pressure: 10 Torr
Pump down time: 30 sec.

Here the pump down time and the corresponding pressure is being divided into three sections. The host sends a new pressure set point every 10 sec.:

Time	Set point
0 sec.	760 Torr
10 sec.	510 Torr
20 sec.	260 Torr
30 sec.	10 Torr

2. Optimizing P gain

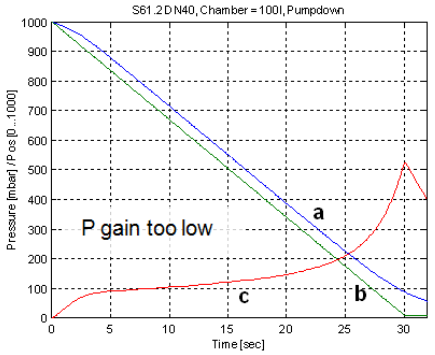
WE start by setting the P gain to 1.0 as a trial value and adjust according to the response.
The pump down routine has to be controlled as follows:

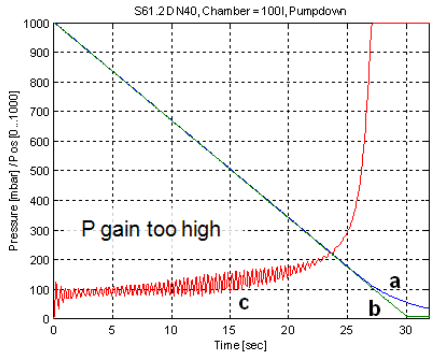
- Move control valve into close position
- Start pump down by opening the pump isolation valve or starting the pump and sending the first pressure set point to the valve controller. With the example above, the first pressure set point is 510 Torr.
- At each new interval (exceeding 10 sec) send the new pressure set point.
- Repeat until process pressure is achieved.

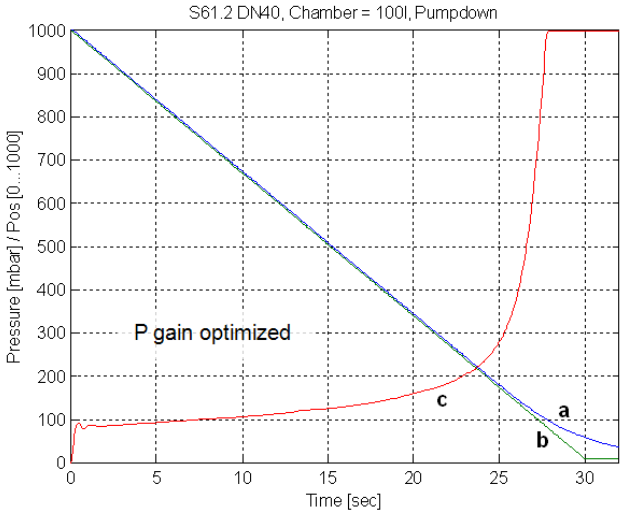
While pumping down chamber pressure and valve position should be data logged to compare the actual pump down curve with the ideal straight pump down line.
If the pressure follows the ideal pump down line with significant delay, the P gain is too low.
If the pressure oscillates around the ideal pump down line or if the valve position oscillates, P gain is too high.

P gain is optimized if the pressure follows the ideal pump down line closely and the valve position is not oscillating at all.

Example:







a Pressure
b Ideal straight pump down line
c Valve position

4.7.3.1 Required information for support (in case of unsuccessful tuning procedure):

- 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

4.8 DeviceNet interface commands

4.8.1 Assembly objects

Factory default assemblies are: Input assembly 3 / Output assembly 8

Number	Type	Composition [2]	[number of data bytes] [1]
3	Input	EXCEPTION STATUS PRESSURE POSITION	[1] [2] or [4] [2] or [4]
4	Input	EXCEPTION STATUS PRESSURE SETPOINT [3]	[1] [2] or [4] [2] or [4]
5	Input	EXCEPTION STATUS PRESSURE SETPOINT [3] POSITION	[1] [2] or [4] [2] or [4] [2] or [4]
7	Output	SETPOINT [3] SETPOINT TYPE	[2] [1]
8	Output	CONTROL MODE SETPOINT [3] SETPOINT TYPE	[1] [2] or [4] [1]
13 (Dh)	Input	EXCEPTION STATUS EXCEPTION DETAIL ALARM EXCEPTION DETAIL WARNING	[1] [15] [15]
14 (Eh)	Input	EXCEPTION STATUS PRESSURE POSITION VALVE CLOSED / OPEN CHECK [4]	[1] [2] or [4] [2] or [4] [1]
100 (64h)	Input	EXCEPTION STATUS PRESSURE POSITION DEVICE STATUS 2 ACCESS MODE	[1] [2] or [4] [2] or [4] [1] [1]
101 (65h)	Input	EXCEPTION STATUS PRESSURE POSITION VALVE CLOSED / OPEN CHECK [4] DEVICE STATUS 2	[1] [2] or [4] [2] or [4] [1] [1]
102 (66h)	Output	CONTROL MODE SETPOINT [3] SETPOINT TYPE LEARN [5] LEARN PRESSURE LIMIT ZERO [5]	[1] [2] or [4] [1] [1] [2] or [4] [1]

1) Depending on DATA TYPE configuration (signed integer or floating point) the length may vary. DATA TYPE may be changed via Explicit Messaging refer to «Explicit messaging setup commands» for details or via EDS file.
2) For data format details refer to «Explicit messaging commands».
3) PRESSURE SETPOINT or POSITION SETPOINT depending on related SETPOINT TYPE
4) 0 = Valve is neither closed nor open, 1 = Valve is CLOSED, 2 = Valve is OPEN
5) To activate ZERO or LEARN use 1 as data else 0. Apply always correct procedures as described in «ZERO (setup step 4)» or «LEARN (setup step 5)»

4.8.2 Assembly object bit map

This is an example based on output assembly 8 and input assembly 3 to illustrate bit map.
DATA TYPE in this example is signed integer.

4.8.2.1 Output assembly

Assembly	Type	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
8	Output	1	MODE							
		2	SETPOINT low byte							
		3	SETPOINT high byte							
		4	SETPOINT TYPE							

CONTROL MODE may be set to one out of below selections, see also «Explicit messaging control commands»:

Description	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Control valve	0	0	0	0	0	0	0	0
Close valve	0	0	0	0	0	0	0	1
Open valve	0	0	0	0	0	0	1	0
Hold valve	0	0	0	0	0	0	1	1

SETPOINT may be set to any value between the lowest and the highest value. Depending on SETPOINT TYPE it reflects position or pressure setpoint , see also «Explicit messaging control commands».

Description		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Lowest value (0)	low byte	0	0	0	0	0	0	0	0
	high byte	0	0	0	0	0	0	0	0
Highest value (10000)	low byte	0	0	0	1	0	0	0	0
	high byte	0	0	1	0	0	1	1	1

SETPOINT TYPE may be set to one out of below selections, see also «Explicit messaging control commands».

Description	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Pressure control	0	0	0	0	0	0	0	0
Position control	0	0	0	0	0	0	0	1

4.8.2.2 Input assembly

Instance	Type	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
3	Input	1	EXCEPTION STATUS							
		2	PRESSURE low byte							
		3	PRESSURE high byte							
		4	POSITION low byte							
		5	POSITION high byte							

EXCEPTION STATUS will respond with one out of below selections, see also «Explicit messaging inquiry commands».

Description	Value	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Manufacturer specific alarm present	84h	1	0	0	0	0	1	0	0
Manufacturer specific warning present	C0h	1	1	0	0	0	0	0	0
No warning, no error present	80h	1	0	0	0	0	0	0	0

PRESSURE will respond with any value between the lowest and the highest value, see also «Explicit messaging inquiry commands»:

Description			Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Lowest value 0 0000h	low byte	00h	0	0	0	0	0	0	0	0
	high byte	00h	0	0	0	0	0	0	0	0
Highest value 10000 2710h	low byte	10h	0	0	0	1	0	0	0	0
	high byte	27h	0	0	1	0	0	1	1	1

POSITION will respond with any value between the lowest and the highest value, see also «Explicit messaging inquiry commands»:

Description			Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Lowest value 0 0000h	low byte	00h	0	0	0	0	0	0	0	0
	high byte	00h	0	0	0	0	0	0	0	0
Highest value 10000 2710h	low byte	10h	0	0	0	1	0	0	0	0
	high byte	27h	0	0	1	0	0	1	1	1

4.8.3 Explicit messaging control commands

Command (DeviceNet® term if deviant)	Service Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field
	Description					
EXECUTING	6	48	1	3		
	This command changes the valve to executing state. EXECUTING must to be selected to enable for all executing commands such as control mode, close valve and open valve. If valve is already in executing state and anew EXECUTING command is sent DeviceNet® will return an error message.					
IDLE	7	48	1	3		
	This command changes the valve to idle state.					
RESET	5	1	1	0		
	This command resets the DeviceNet® interface.					
FACTORY RESET	5	1	1	1		
	This command resets the DeviceNet® interface to factory default settings. All previously done configurations will be overwritten.					
SETPOINT TYPE	Set	16	51	0	8	1	Y
	Get	14	51	0	8	1	
	Y: **0** pressure control **1** position control This command selects / returns current setpoint type. It toggles valve operation mode between position and pressure control. To perform either position or pressure control also correct CONTROL MODE must be selected.					
CONTROL MODE	Set	16	51	1 (pressure) 2 (position)	5	1	Y
	Get	14	51	1 (pressure) 2 (position)	5	1	
	Y: **0** control mode (pressure resp. position control) **1** close valve (valve will close) **2** open valve (valve will open) **3** hold (stops the valve at the current position) **4** safe state (valve will close) This command preselects / returns the control mode for pressure resp. position control. By means of instance ID either pressure or position must be addressed. To activate either pressure or position control you must select correct SETPOINT TYPE separately.					

Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter ‘h‘ (e.g. 31h)

Command (DeviceNet® term if deviant)	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field
	Description						
POSITION SETPOINT	Set	16	51	2	6	2 or 4	Y
	Get	14	51	2	6	2 or 4	
	Y: position setpoint according to selected DATA TYPE, **0** (closed) … **10'000** (open) This command transfers/reads the position setpoint to/from the valve.						
PRESSURE SETPOINT	Set	16	51	1	6	2 or 4	Y
	Get	14	51	1	6	2 or 4	
	Y: pressure setpoint according to selected DATA TYPE, nominal pressure range is **0** … **10'000** (sensor full scale) but it may be scaled, refer also to command GAIN for details. This command transfers/reads the pressure setpoint to/from the valve.						
ASSEMBLY OBJECTS	Set	16	4	7 8 102	3	X	Y
	Get	14	4	3 4 5 13 14 100 101	3	X	
	X, Y: depending on respective assembly object, refer to «Assembly objects» for details. Instance ID = assembly object number. This command writes/reads the respective assembly object.						

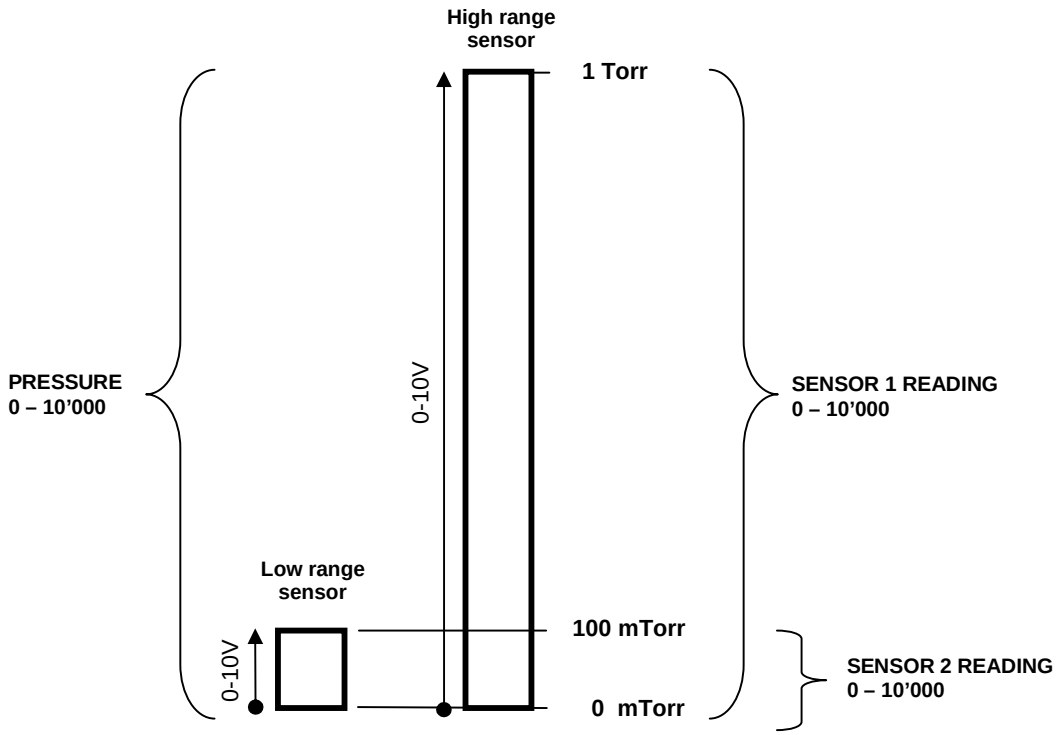
Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter 'h' (e.g. 31h)

4.8.4 Explicit messaging inquiry commands

Command (DeviceNet® term if deviant)	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field
	Description						
VALVE CLOSED CHECK (discrete input 1)	Get	14	8	1	3	1	
	This command returns: **0** valve is not closed **1** valve is closed						
VALVE OPEN CHECK (discrete input 2)	Get	14	8	2	3	1	
	This command returns: **0** valve is not open **1** valve is open						
POSITION	Get	14	49	3	6	2 or 4	
	This command returns the current valve position according to selected DATA TYPE. Position range is **0** (closed) … **10'000** (open).						
PRESSURE	Get	14	49	1	6	2 or 4	
	This command returns the actual pressure according to selected DATA TYPE. Nominal pressure range is **0** … **10'000** (sensor full scale) but it may be scaled. Refer also to command GAIN and picture on the following page for details.						
SENSOR 1 READING	Get	14	100	1	108	2 or 4	
	This function returns direct reading from sensor 1 according to selected DATA TYPE. Nominal range is **0** … **10'000** but it may be scaled. Refer also to command GAIN and picture on the following page for details.						
SENSOR 2 READING	Get	14	100	1	109	2 or 4	
	This function returns direct reading from sensor 2 according to selected DATA TYPE. Nominal range is **0** … **10'000** but it may be scaled. Refer also to command GAIN and picture on the following page for details.						
SENSOR 1 OFFSET VALUE (Sensor 1 offset A)	Get	14	49	1	12	2 or 4	
			100	1	110		
	These commands return the offset voltage (adjusted by ZERO) of the sensor 1 according to selected DATA TYPE. Both commands are identical. Value range is **-1400** … **+1400** (-1.40V … +1.40V).						
SENSOR 2 OFFSET VALUE (Sensor 2 offset A)	Get	14	100	1	111	2 or 4	
	This command returns the offset voltage (adjusted by ZERO) of the sensor 2 according to selected DATA TYPE. Value range is **-1400** … **+1400** (-1.40V … +1.40V).						

Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter 'h' (e.g. 31h)

Example of PRESSURE and SENSOR READING allocation:



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).
Switchover between sensors is done automatically according to «Pressure control operation with 2 sensors».

<table>
<tr><th rowspan="2">Command
(DeviceNet® term
if deviant)</th><th colspan="2">Service Code</th><th>Class ID</th><th>Instance ID</th><th>Attribute ID</th><th>Service data length
(number of bytes)</th><th>Service data field</th></tr>
<tr><th colspan="7">Description</th></tr>
<tr><td rowspan="2">LEARN STATUS
(calibration state)</td><td>Get</td><td>14</td><td>51</td><td>1</td><td>106</td><td>2</td><td></td></tr>
<tr><td colspan="7">This command returns the status of the LEARN procedure. The status is binary coded.

Bit — Explanation:

(LSB) 0 — 0 = LEARN not running
1 = LEARN running

1 — 0 = LEARN data set present
1 = LEARN data set not present

2 — 0 = ok
1 = LEARN terminated by user

3 — 0 = ok
1 = pressure in position OPEN
> 50% sensor full scale (of high range sensor in case of a 2 sensor system)
or
> LEARN PRESSURE LIMIT

4 — 0 = ok
1 = pressure in position 0
< 10% sensor full scale (of low range sensor in case of a 2 sensor system)

5 — 0 = ok
1 = pressure falling during LEARN

6 — 0 = ok
1 = sensor not stable during LEARN

7 — reserved
8 — reserved
9 — reserved

10 — 0 = ok
1 = LEARN terminated by controller

11 — 0 = ok
1 = pressure in position OPEN negativ

12 — reserved
13 — reserved
14 — reserved
15 — reserved
(MSB) 16 — reserved</td></tr>
</table>

Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter ‘h‘ (e.g. 31h)

Command (DeviceNet® term if deviant)	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field
	Description						
DEVICE STATUS 1	Get	14	48	1	11	1	Y
	Y: **1** self test **2** idle **3** self test exception **4** executing **5** abort This command returns the device status.						
DEVICE STATUS 2	Get	14	100	1	103	1	
	This command returns the device status. **1** = synchronization, **2** = POSITION CONTROL, **3** = CLOSED **4** = OPEN, **5** = PRESSURE CONTROL, **6** = HOLD , **7** = LEARN **12** = power failure, **13** = safety mode **14** = fatal error (read EXCEPTION DETAIL ALARM for details)						
EXCEPTION STATUS (status)	Get	14	48	1	12	1	
	This command returns the exception status. Bit Explanation: (LSB) 0 **0** (reserved) 1 **0** (reserved) 2 This bit is set to 1 in case of a manufacturer specific alarm. 3 **0** (reserved) 4 **0** (reserved) 5 **0** (reserved) 6 This bit is set to 1 in case of a manufacturer specific warning. (MSB) 7 **1** The exception status byte only indicates that alarms or warnings are present. In order to find out which alarm or warning is present, you must read EXCEPTION DETAIL ALARM resp. EXCEPTION DETAIL WARNING.						
EXCEPTION DETAIL ALARM **EXCEPTION DETAIL WARNING**	Get	14	48	1	13 14	15	
	With Attribute ID = 13 EXCEPTION DETAIL ALARM bytes will be returned. With Attribute ID = 14 EXCEPTION DETAIL WARNING bytes will be returned. For meaning see table on next page.						

Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter ‘h‘ (e.g. 31h)

Command (DeviceNet® term if deviant)	Service Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field
	Description					

Table with EXCEPTION DETAIL ALARM resp. EXCEPTION DETAIL WARNING bits.
0 OK
1 Exception / Failure / Error (except for detail size bytes)

EXCEPTION DETAIL ALARM

EXCEPTION DETAIL WARNING

Data Component	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
PCV Common Exception Detail Size	0	0	0	0	0	0	1	0
PCV Common Exception Detail Byte #0	0	0	0	0	0	0	0	0
PCV Common Exception Detail Byte #1	0	0	0	0	0	0	0	0
PCV Device Exception Detail Size	0	0	0	0	0	1	0	0
PCV Device Exception Detail Byte #0	0	0	0	0	0	0	0	0
PCV Device Exception Detail Byte #1	0	0	0	0	0	0	0	0
PCV Device Exception Detail Byte #2	0	0	0	0	0	0	0	0
PCV Device Exception Detail Byte #3	0	0	0	0	0	0	0	0
Manufacturer Exception Detail Size	0	0	0	0	0	1	1	0
Manufacturer Exception Detail Byte #1	Reserved	Reserved	Isolation valve position failure	Sensor ratio exceeded	PFO not ready	Compressed air failure	Learn data set invalid	Service request
Manufacturer Exception Detail Byte #2	Reserved	Reserved	Reserved	Reserved	Reserved	ADC not responding	Reserved	Reserved
Manufacturer Exception Detail Byte #3	Reserved	Reserved	Reserved	Wrong Device Status 2	Wrong Access Mode	ZERO disabled	Optional hardware missing	No sensor
Manufacturer Exception Detail Byte #4	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	PFO off	Simulation active
Manufacturer Exception Detail Byte #5	Reserved	Reserved	Reserved	Reserved	E40 1)	E22 1)	E21 1)	E20 1)
Manufacturer Exception Detail Byte #6	Reserved	Reserved	Reserved	Valve power OFF or internal com. error	Setpoint invalid (safe state)	IO data missing (safe state)	Setpoint type invalid (safe state)	Control mode invalid (safe state)

1) Refer to «Trouble shooting» for details on these fatal errors.

Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter ‘h‘ (e.g. 31h)

Command (DeviceNet® term if deviant)	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field
	Description						
THROTTLE CYCLE COUNTER	Get	14	100	1	101	4	
	This command returns the number of throttle cycles. Data type is unsigned long integer. 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.						
ISOLATION CYCLE COUNTER	Get	14	100	1	106	4	
	This command returns the number of isolation cycles. Data type is unsigned long integer. Each closing of the sealing ring counts as one cycle.						

Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter ‘h‘ (e.g. 31h)

4.8.5 Explicit messaging setup commands

Command (DeviceNet® term if deviant)	Service Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field
	Description					
DATA TYPE	Set 16	49	1	3	1	X
	Get 14	49	1	3	1	
	X: **195** signed integer **202** floating point This command defines the data type for PRESSURE, SENSOR READING, OFFSET and POSITION.					
GAIN PRESSURE	Set 16	49	1	14	4	X
	Get 14	49	1	14	4	
	X: gain, max. value is **3.2767**, data type is floating point This command selects the gain for PRESSURE and allows for scaling. Default value is 1 (3Fh 80h 00h 00h). e.g.: Gain = 0.1 pressure value range results in 0-1'000 Gain = 1 pressure value range results in 0-10'000 Gain = 3.2767 pressure value range results in 0-32'767					
GAIN POSITION	Set 16	49	3	14	4	X
	Get 14	49	3	14	4	
	X: gain, max. value is **3.2767**, data type is floating point This command selects the gain for POSITION and allows for scaling. Default value is 1 (3Fh 80h 00h 00h, "high byte first" notation). e.g.: Gain = 0.1 position value range results in 0-1'000 (3Dh CCh CCh CCh) Gain = 1 position value range results in 0-10'000 (3Fh 80h 00h 00h) Gain = 3.2767 position value range results in 0-32'767 (40h 51h B5h 73h)					
POLL OUTPUT	Set 16	5	2	100	1	X
	Get 14	5	2	100	1	
	X: output assembly object number (**7**, **8**, **102**) This command configures resp. reads the output assembly for poll connection.					
POLL INPUT	Set 16	5	2	101	1	X
	Get 14	5	2	101	1	
	X: input assembly object number (**3**, **4**, **5**, **13**, **14**, **100**, **101**) This command configures resp. reads the input assembly for polling.					
BIT STROBE INPUT	Not implemented					

Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter 'h' (e.g. 31h)

Command (DeviceNet® term if deviant)	**Service Code**		**Class ID**	**Instance ID**	**Attribute ID**	**Service data length** (number of bytes)	**Service data field**
CHANGE OF STATE / CYCLING INPUT	Set	16	5	4	101	1	X
	Get	14	5	4	101	1	
	X: input assembly object number (**3**, **4**, **5**, **13**, **14**, **100**, **101**) This command configures resp. reads the input assembly for change of state / cycling.						
ACCESS MODE	Set	16	100	1	107	1	X
	Get	14	100	1	107	1	
	X: **0** Local (operation via service port) **1** Remote (operation via DeviceNet®) **2** Locked (in remote mode) This command controls / returns the access mode of the valve.						
POWER UP CONFIGURATION	Set	16	100	1	112	1	X
	Get	14	100	1	112	1	
	X: **0** closed **1** open This command controls / returns the valve position after power up.						
POWER FAIL CONFIGURATION	Set	16	100	1	113	1	X
	Get	14	100	1	113	1	
	X: **0** closed **1** open This command controls / returns the target valve position in case of a power failure. Only for versions that have Power Fail Option equipped [642 . . - . . **C** . - . . . . or 642 . . - . . **H** . - . . . . or 642 . . - . . **U** . - . . . . or 642 . . - . . **W** . - . . . .].						

Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter ‘h‘ (e.g. 31h)

Command (DeviceNet® term if deviant)	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field
SENSOR MODE	Set	16	49	1	101	1	X
	Get	14	49	1	101	1	
	X: **0** no sensor **1** 1 sensor operation (sensor 1 input) **2** 2 sensor operation with automatic changeover (low range = sensor 2 input, high range = sensor 1 input) **3** 1 sensor operation (sensor 2 input) **4** 2 sensor operation with automatic changeover (low range = sensor 1 input, high range = sensor 2 input) This command controls / returns the sensor mode for pressure control. Sensor modes 2, 3 and 4 are possible with 2 sensor hardware [642 . . - . . . **Q** - . . . .] only. 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 1 READING resp. SENSOR 2 READING.						
SENSOR RATIO	Set	16	49	1	103	2 or 4	X
	Get	14	49	1	103	2 or 4	
	X: sensor ratio according to selected DATA TYPE, range is **100** … **10'000** This command defines the sensor ratio for 2 sensor operation. Sensor ratio = high range sensor full scale / low range sensor full scale * 100.						
ZERO CONTROL	Set	16	49	1	102	1	X
	Get	14	49	1	102	1	
	X: **0** Disable **1** Enable This command enables resp. disables the ZERO command. In case it is disabled ZERO does not work.						
ZERO	75		49	1	-	2 or 4	0
	This command initiates ZERO. Refer to «ZERO (setup step 4)» for correct zero procedure.						

Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter 'h' (e.g. 31h)

Command (DeviceNet® term if deviant)	**Service Code**		**Class ID**	**Instance ID**	**Attribute ID**	**Service data length** (number of bytes)	**Service data field**
LEARN PRESSURE LIMIT (calibration scale)	Set	16	51	1	100	2 or 4	Y
	Get	14	51	1	100		
	Y: learn pressure limit according to selected DATA TYPE, nominal pressure range is **0** … **10'000** (sensor full scale) but it may be scaled, refer also to command GAIN for details. This command transfers/reads the pressure limit for LEARN. Refer to «LEARN (setup step 5)» for correct learn pressure limit setting.						
LEARN (calibration service)	100		51	1	0		
	This command starts LEARN. With MODE commands open valve or close valve the routine may be interrupted. Without LEARN the PID controller is not able to perform pressure control. Refer to «LEARN (setup step 5)» for correct learn gas flow and procedure.						
DOWNLOAD LEARN DATA	51		48	1		11	XY
	X: index (**000** .. **103**, whereas these indices must be ASCII coded, e.g. 000 = 30h 30h 30h, 001 = 30h 30h 31h, etc.) Y 8 data bytes ASCII coded (e.g. 30h 32h 33h 33h 33h 30h 33h 36h) Example of XY: 30h 30h 30h 30h 32h 33h 33h 33h 30h 33h 36h (11 bytes in total) This command loads the learn data sets from the host down to the valve. There are a total number of 104 data sets. Each data set needs to be downloaded separately.						
UPLOAD LEARN DATA	50		48	1		3	X
	X: index (**000** .. **103**, whereas these indices must be ASCII coded, e.g. 000 = 30h 30h 30h, 001 = 30h 30h 31h, etc.) This command loads the learn data sets from the valve up to the host. There are a total number of 104 data sets which need to be uploaded separately. Each answer consists of 11 bytes. Whereas the leading 3 bytes are the data set index followed by 8 data bytes. Data are ASCII coded.						

Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter 'h' (e.g. 31h)

Command (DeviceNet® term if deviant)	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field
PID CONTROLLER GAIN FACTOR	Set	16	51	1	105	1	X
	Get	14	51	1	105	1	
	X: **0** = 0.10, **1** = 0.13, **2** = 0.18, **3** = 0.23, **4** = 0.32, **5** = 0.42, **6** = 0.56 **7** = 0.75, **8** = 1.00, **9** = 1.33, **10** = 1.78, **11** = 2.37, **12** = 3.16, **13** = 4.22 **14** = 5.62, **15** = 7.50, **16** = 0.0001, **17** = 0.0003, **18** = 0.001, **19** = 0.003, **20** = 0.01, **21** = 0.02, **22** = 0.05 This command selects/returns the gain factor for the PID controller. Refer to «Gain factor adjustment» for details.						
PID CONTROLLER SENSOR DELAY	Set	16	51	1	107	1	X
	Get	14	51	1	107	1	
	X: **0** = 0, **1** = 0.02, **2** = 0.04, **3** = 0.06, **4** = 0.08, **5** = 0.10, **6** = 0.15 **7** = 0.20, **8** = 0.25, **9** = 0.30, **10** = 0.35, **11** = 0.4, **12** = 0.5, **13** = 0.6 **14** = 0.8, **15** = 1.0 This command selects/returns the sensor delay for the PID controller. Refer to «Sensor delay adjustment» for details.						
PID CONTROLLER SETPOINT RAMP	Set	16	51	1	108	1	X
	Get	14	51	1	108	1	
	X: **0** = 0, **1** = 0.5, **2** = 1.0, **3** = 1.5, **4** = 2.0, **5** = 2.5, **6** = 3.0 **7** = 3.5, **8** = 4.0, **9** = 4.5, **10** = 5.0, **11** = 5.5, **12** = 6.0, **13** = 6.5 **14** = 7.0, **15** = 7.5, **16** = 8.0, **17** = 8.5, **18** = 9.0, **19** = 9.5, **20** = 10.0 This command selects/returns the setpoint ramp for the PID controller. Refer to «Setpoint ramp adjustment» for details.						
VALVE SPEED	Set	16	51	2	101	2	X
	Get	14	51	2	101	2	
	X: valve speed, **1** … **1000** (1 = min. speed, 1000 = max. speed), This command selects/returns the actuating speed for the valve plate. Data type is unsigned integer. Speed selection is effective for pressure control and position control. Open valve and close valve are always done with max. speed. Refer to «Valve speed adjustment» for details.						

Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter ‘h‘ (e.g. 31h)

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 Normal operation

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 is required.
You can use our Software (freeware) 'Control Performance Analyzer' which can be downloaded from:
http://www.vatvalve.com/customer-service/informations-and-downloads/control-performance-analyzer.

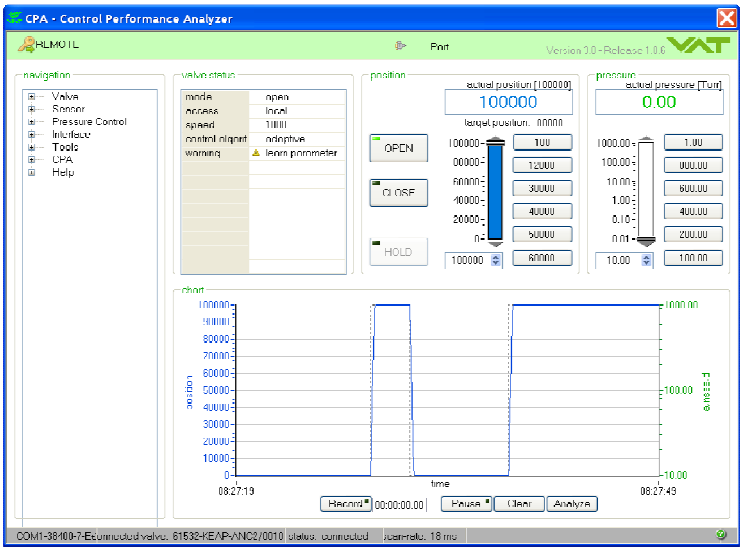
These softwares are beneficial especially for setup, testing and maintenance.

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

‘

'Control Performance Analyzer' supports:

- Valve setup
- Sensor setup
- Pressure control
- Interface setup
- Manual control
- Sequence ontrol
- Numeric and graphical monitoring
- Data recording
- Data analysis
- Advanced diagnostic



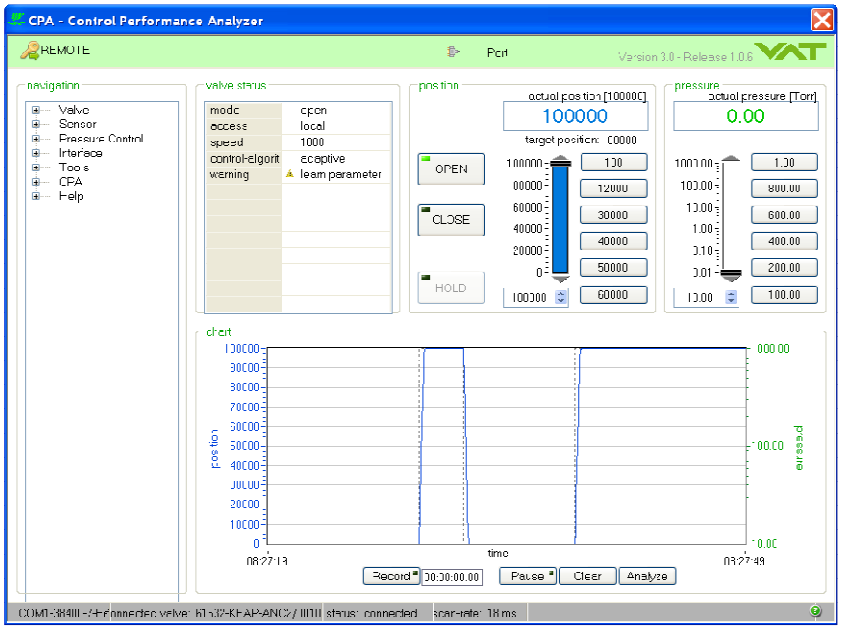
When communication to service port is interrupted the valve will change to remote operation. So when service cable will be disconnected or software will be shut down, the valve returns automatically to remote operation. This may result in an immediate movement of the valve depending on remote control.

Refer to «Accessories» for ordering numbers of service cable and Service Box 2.

5.1.2 Remote operation

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

'Control Performance Analyzer' software



'Service Box 2'

In case ‘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.

5.2 Close valve

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Explicit messaging control commands» for details)
Push CLOSE button	1. Send EXECUTING (if not yet selected)
	2. Send SETPOINT TYPE = position control
	3. Send CONTROL MODE for position = close valve

5.3 Open valve

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Explicit messaging control commands» for details)
Push OPEN button	1. Send EXECUTING (if not yet selected)
	2. Send SETPOINT TYPE = position control
	3. Send CONTROL MODE for position = open valve

5.4 Position control

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

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Explicit messaging control commands» for details)
Select or enter position setpoint	1. Send EXECUTING (if not yet selected)
	2. Send SETPOINT TYPE = position control
	3. Send CONTROL MODE for position = control mode
	4. Send CONTROL SETPOINT = position

5.5 Pressure control

To prepare valve for PRESSURE CONTROL perform complete «Setup procedure». The valve has parameters that may be modified to tune pressure control performance. Refer to «Tuning of control performance».

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

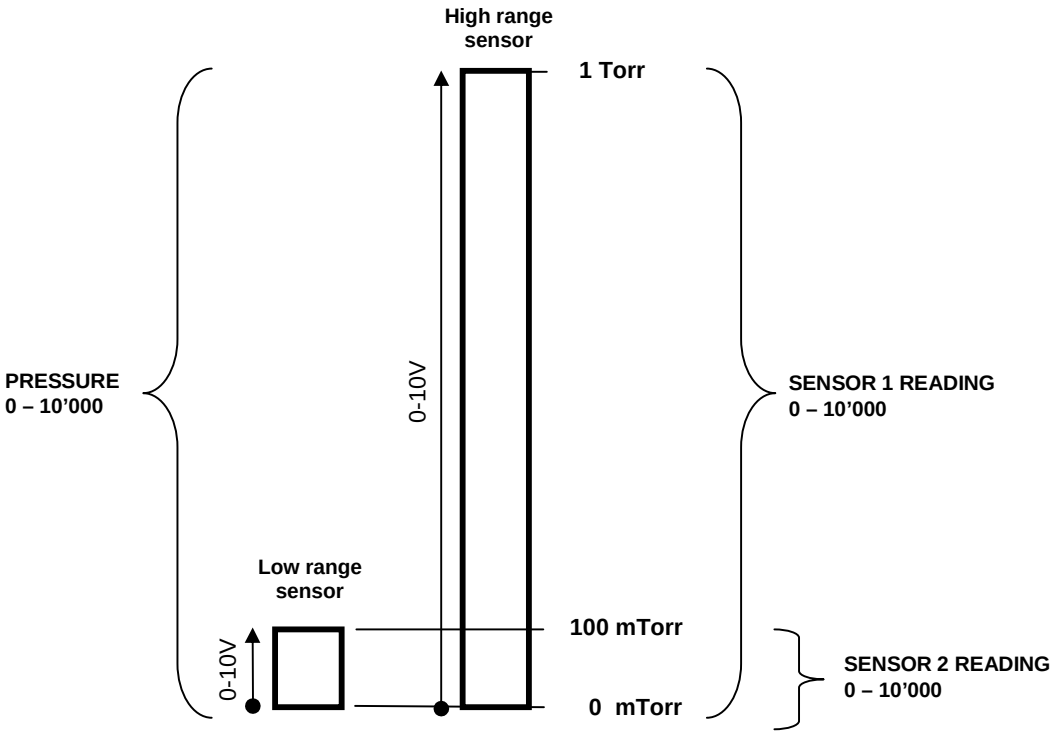
Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Explicit messaging control commands» for details)
Select or enter pressure setpoint	1. Send EXECUTING (if not yet selected)
	2. Send SETPOINT TYPE = pressure control
	3. Send MODE for pressure = control mode
	4. Send CONTROL SETPOINT = pressure

5.5.1 Pressure control operation with 2 sensors

[applicable with 642 . . - . . . **Q** - . . . . version only]

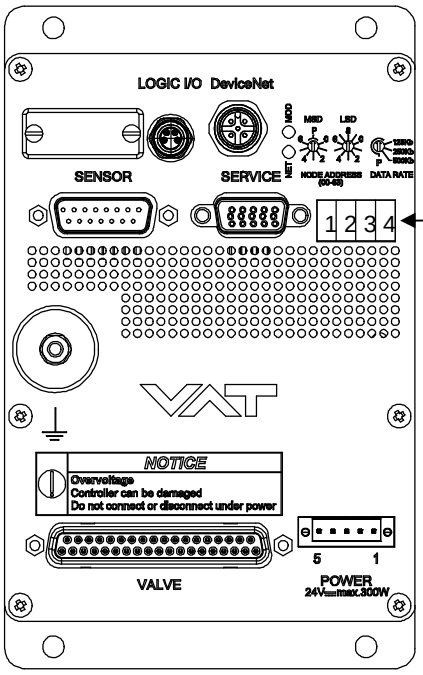
If 2 sensor operation is enabled, changeover between the sensors is done automatically during pressure control. For configuration refer to chapter «Setup procedure». We recommend a ratio of 10:1 between the pressure gauges. Max. ratio is 100:1. High range respectively low range pressure gauge may be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



5.6 Display information

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



5.6.1 Power up

Description	Digit 1	Digit 2	Digit 3	Digit 4
● Power On: All dots are illuminated	#	#	#	#
● 1st information for about 3s: Firmware generation [e.g. **1G..**]	**1**	**G**		
● 2st information for about 3s: Firmware version and firmware revision [e.g. **00 08**]	**0**	**0**	**0**	**8**
● 3nd information for about 3s: Valve type [e.g. **612**]		**6**	**1**	**2**
● 4nd information for about 3s: Controller configuration In case **D999** is displayed, motor interlock is active. Refer to «Safety mode» for details.		**4** = DeviceNet® Interface	**0** = basic **1** = with SPS[1)] **2** = with PFO[2)] **3** = with SPS[1)] and PFO[2)]	**1** = 1 sensor version **2** = 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

5.6.2 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**			
HOLD (position frozen) activated	**H**			
ZERO running	**Z**			
LEARN running	**L**			
Safety mode established. Refer to «Safety mode» for details.	**D**			
Service request[1)]			**S**	**R**
Power failure	**F**			

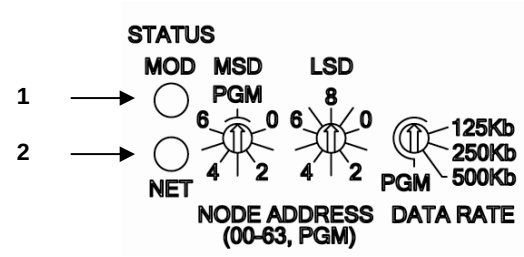
1) SR is blinking alternatively with the actual mode display (e.g. C ←→ SR)

5.6.3 Errors

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

5.6.4 DeviceNet® LEDs

#	Description
1	Module Status LED
2	Network Status LED



Module and Network Status LEDs at Power–Up

A LED test is to be performed at power–up. To allow a visual inspection to be performed, the following sequence is to be followed:

- Turn Network Status LED off.
- Turn Module Status LED on Green for approximately 0.25 seconds.
- Turn Module Status LED on Red for approximately 0.25 seconds.
- Turn Module Status LED on Green.
- Turn Network Status LED on Green for approximately 0.25 seconds.
- Turn Network Status LED on Red for approximately 0.25 seconds.
- Turn Network Status LED off.

5.6.4.1 Module Status LED

This bi–color (green/red) LED provides device status. It indicates whether or not the device has power and is operating properly. Table below define the Module Status LED states.

State	LED	Description
No Power	Off	There is no power applied to the device.
Device Operational	Green	The device is operating in a normal condition.
Unrecoverable Fault	Red	The device has an unrecoverable fault; may need replacing.
Device Self Testing	Flashing Red–Green	The Device is in Self Test.

5.6.4.2 Network Status LED

This bi–color (green/red) LED indicates the status of the communication link. Table below define the Network Status LED states.

State	LED	Description
Not Powered/Not On–line	Off	Device is not on–line. - The device has not completed the Dup_MAC_ID test yet. - The device may not be powered, look at 'Status LED' - No network power present.
On–line, Not Connected	Flashing Green	Device is on–line but has no connections in the established state. - The device has passed the Dup_MAC_ID test, is on–line, but has no established connections to other nodes. - The device has no established connections.
Link OK On–line, Connected	Green	The device is on–line and has connections in the established state. - Is allocated to a Master. - The device has one or more established connections.
Connection Time–Out	Flashing Red	One or more I/O Connections are in the Timed–Out state.
Critical Link Failure	Red	Failed communication device. The device has detected an error that has rendered it incapable of communicating on the network (Duplicate MAC ID, or Bus–off).

5.6.5 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.

5.6.6 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.

5.7 Operation during power up

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

Refer also to chapter: «Display information».

5.8 Behavior in case of power failure

Valve position before power failure:	Reaction of valve:	
	Without Power Failure Option (PFO) 642 . . - . . **G** . - . . . . 642 . . - . . **A** . - . . . . 642 . . - . . **T** . - . . . . 642 . . - . . **V** . -	With Power Failure Option (PFO) 642 . . - . . **H** . - . . . . 642 . . - . . **C** . - . . . . 642 . . - . . **U** . - . . . . 642 . . - . . **W** . - . . . .
Any	Valve remains at current position.	Valve will close or open depending on valve configuration 1). Default is not defined. Display indicates **F**.

1) Provide 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.

5.9 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».

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.
Module Status LED is off	- DeviceNet® power supply ok?	- Connect valve to DeviceNet® according to «DeviceNet® connection» and make sure that power is provided.
Module Status LED is flashing green		- The controller needs commissioning due to missing, incomplete or incorrect configuration.
Module Status LED is flashing red (**recoverable fault**)	- Refer to ODVA specification volume II, release 2.0 (incl. errata 1) «IDENTITY OBJECT, figure 6.2, state event matrix for identity object»	- Refer to ODVA specification volume II, release 2.0 (incl. errata 1) «IDENTITY OBJECT, figure 6.2, state event matrix for identity object»
Module Status LED is red (**unrecoverable fault**)	- Refer to ODVA specification volume II, release 2.0 (incl. errata 1) «IDENTITY OBJECT, figure 6.2, state event matrix for identity object»	- Refer to ODVA specification volume II, release 2.0 (incl. errata 1) «IDENTITY OBJECT, figure 6.2, state event matrix for identity object»
Network Status LED is off (**Device is not on line**)	- DeviceNet® power supply ok?	- Connect valve to DeviceNet® according to «DeviceNet® connection» and make sure that power is provided.
Network Status LED is flashing green (**on line but no connections in the established state**)		- Allocate device to master
Network Status LED is flashing red (**time out**)	- Are I/O connections in the time out state?	- Reestablish I/O connections.
Network Status LED is red		- Failed communication device. The device has detected an error that has rendered it incapable of communicating on the network.
Controller does not respond to DeviceNet® commands	- Node number and baudrate correct?	- Proceed according to «Setup procedure, DeviceNet® CONFIGURATION».
Controller does either not respond or respond in an unexpected way to DeviceNet® commands	- Configuration correct?	- Send FACTORY RESET and redo complete configuration. Refer to «Explicit messaging control commands, FACTORY RESET» and «Setup procedure, DeviceNet® configuration» for details.
Read back from contoller is wrong during polling	- Check poll rate	- Refer to «Setup procedure, DeviceNet® configuration» for details.

Failure	Check	Action
Remote operation (DeviceNet®) does not work	- Local operation via service port active - Safety mode active, check for D on display?	- Switch to remote operation. - Provide power to motor to allow for operation. - Refer to «Electrical connection» for details.
Display shows «**E 20**»and position is 009999 (**fatal error** - limit stop of valve unit not detected)	Internal mechanical valve problem?	- Open valve bonnet. Check all mechanical parts are correct installed? - Solve mechanical problem. - Reset control unit. Cycle power (OFFàON) or - Send reset command: local via service port with CV/CPA/Service Box2
Display shows «**E 21**»and position is 009999 (**fatal error** - movement of valve plate limited during power up)	- Valve unit heavy contaminated? - Valve plate mechanically obstructed? - Check differential pressure on gate	- Clean valve unit according to «Maintenance procedure». - Resolve obstruction. - Reset control unit. Cycle power (OFFàON) or - Send reset command: local via service port with CV/CPA/Service Box2
Display shows «**E 22**» or «**E 23**» and position is 009999 (**fatal error** - movement of valve plate limited during operation)	- Valve unit heavy contaminated? - Valve plate mechanically obstructed? - Check differential pressure on gate	- Clean valve unit according to «Maintenance procedure». - Resolve obstruction. - Reset control unit. Cycle power (OFFàON) or - Send reset command: local via service port with CV/CPA/Service Box2
Display shows «**E 40**» (**fatal error** - motor driver failure detected)		- Replace control and actuating unit according to «Maintenance procedures».
Display shows «**D999**»	- Motor power supplied?	- Provide power to motor to allow for operation. - Refer to «Electrical connection» for details.
CLOSE VALVE does not work	- Safety mode active, check for D on display?	- Provide power to motor to allow for operation. - Refer to «Electrical connection» for details.
OPEN VALVE does not work	- Safety mode active, check for D on display?	- Provide power to motor to allow for operation. - Refer to «Electrical connection» for details.
POSITION CONTROL does not work	- Safety mode active, check for D on display?	- Provide power to motor to allow for operation. - Refer to «Electrical connection» for details.
	- POSITION CONTROL selected, check for V on display?	- Select POSITION CONTROL mode. Refer to «Position control» for details.

Failure	Check	Action
Pressure reading is wrong or pressure reading is negative	- Sensor(s) connected?	- Refer to «Electrical connection».
	- 2 sensor version present at valve controller?	- Check valve version on page 1. Verify configuration. Refer to «Setup procedure». - Refer to «Pressure control operation with 2 sensors».
	- ZERO done?	- Perform ZERO when base pressure is reached. Refer to «ZERO» for details.
	- Does sensor power supply provide enough power for sensor(s)?	- Verify sensor supply voltage.
ZERO does not work	- Valve in open position, check for O on display?	- OPEN VALVE and bring chamber to base pressure before performing ZERO.
	- ZERO disabled?	- Enable ZERO. Refer to «Valve configuration» for details.
Pressure is not '0' after ZERO	- Sensor voltage shifting?	- Wait until sensor does not shift any more before performing ZERO.
	- System pumped to base pressure?	- OPEN VALVE and bring chamber to base pressure before performing ZERO.
	- Sensor offset voltage exceeds ±1.4V	- Replace pressure gauge.
PRESSURE CONTROL does not work	- Safety mode active, check for D on display?	- Provide power to motor to allow for operation. - Refer to «Electrical connection» for details.
	- PRESSURE CONTROL selected, check for P on display?	- Select PRESSURE CONTROL mode. Refer to «Pressure control» for details.
	- LEARN done?	- Perform LEARN. Refer to «Setup procedure» for details.
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.

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

One maintenance procedures are defined for this valve:

- **Replacement of gate seal** (gate and bonnet seal) **and valve cleaning**

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

VAT can give the following recommendations for preventive maintenance:

Replacement of	**Recommendation**
Gate seal (gate and bonnet seal)	Every 100’000 cycles

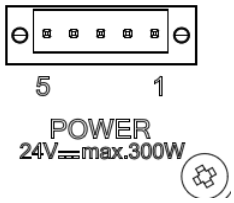
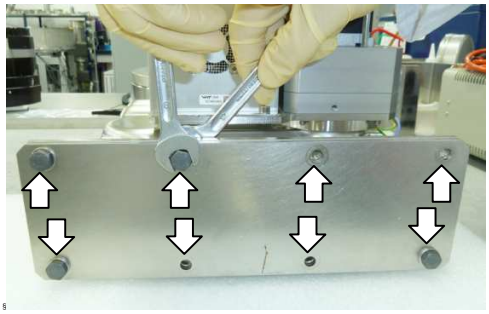
For spare parts of gate and bonnet seal refer to chapter: «Spare parts»

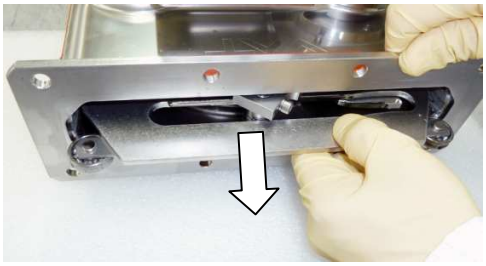
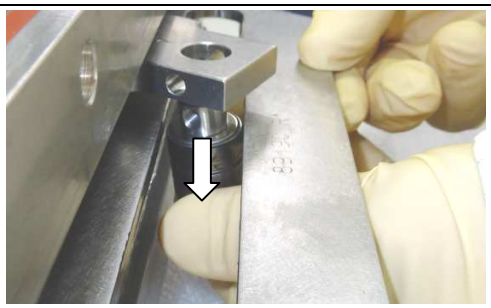
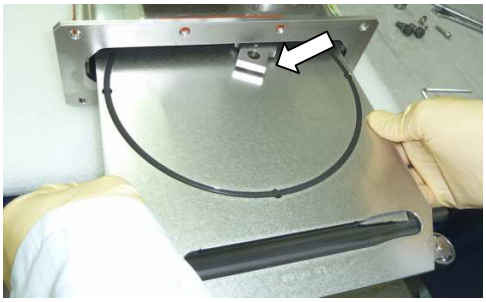
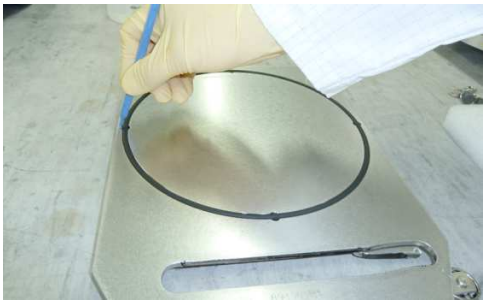
All pictures in maintenance procedure are sample pictures (DN63…400)

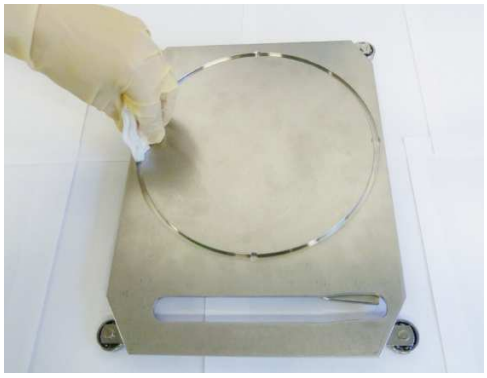
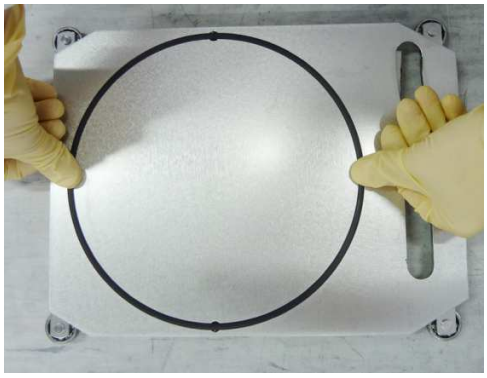
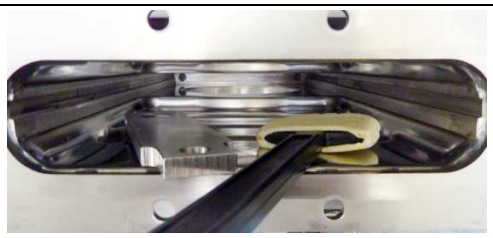
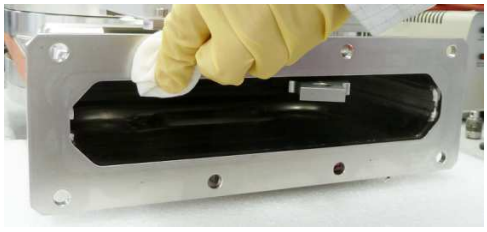
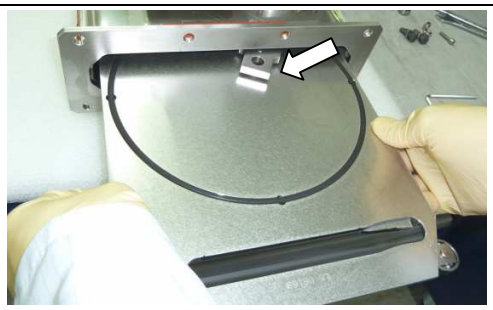
7.2.1 Replacement of gate seals and valve cleaning

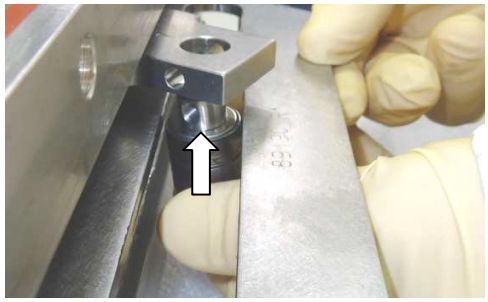
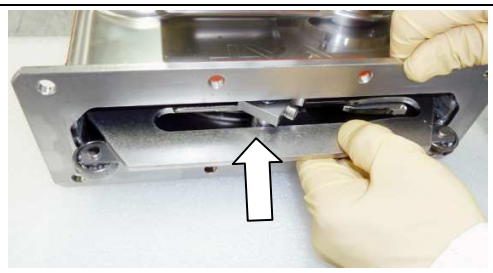
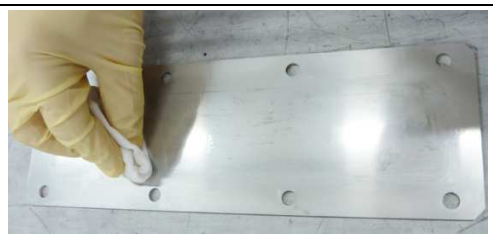
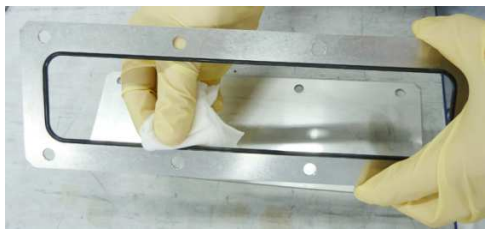
7.2.1.1 Required tools

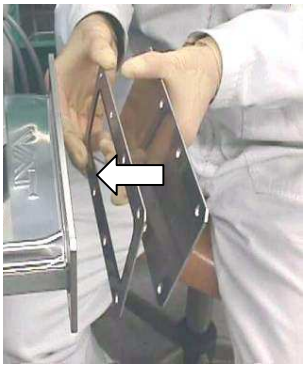
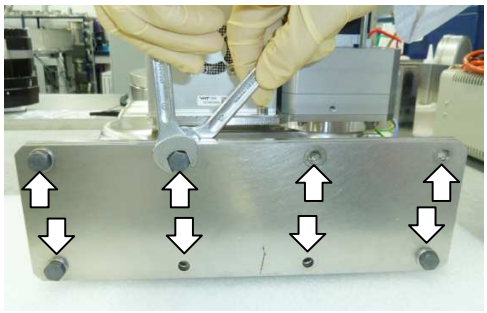
- Allen Wrench 4 mm (Allen torque wrench 4 mm)
- 2 × Open end wrench 13 mm
- Open end torque wrench 13 mm
- 2 × Open end wrench 10 mm
- Open end torque wrench 10 mm
- Isopropyl alcohol
- Vacuum grease (see chapter spare parts)
- O-ring removal tool (see chapter Accessories)
- Clean room wiper

Description		Required tool
1. Vent both valve chambers 2. Open the valve 3. Turn off power to valve controller 4. Disable power-fail option (wait 60 seconds)		CPA or Service Box 2
5. Disconnect power cable at controller		
6. Unfasten and remove the bonnet screws		2 × Open end wrench 10 mm (DN 63 / 100) 2 × Open end wrench 13 mm (DN160…400)
7. Remove valve bonnet and bonnet seal 8. Deposit both parts on a clean place		

Description		Required tool
9. Pull out the gate until the crank bolt can be reached		
10. Loosen and remove the crank bolt screw		Allen wrench 4 mm
11. Remove the crank bolt from lever		
12. Pull out the gate assembly complete **Caution!** Take care that gate is not scratching at lever while pulling out		
13. Place the gate on a clean place 14. Remove the gate o-ring		O-ring removal tool

Description		Required tool
15. Clean the o-ring groove and the gate assembly		Clean room wiper a little soaked with isopropyl alcohol
16. Install the new o-ring equally in o-ring groove (for new o-ring refer to chapter: «Spare parts»)		
17. Clean the valve body inside		Cleaning tool a little soaked with isopropyl alcohol (refer to chapter «Spare parts» for cleaning tool)
18. Clean the sealing surface of valve		Clean room wiper a little soaked with isopropyl alcohol
19. Push in the gate assembly until…see step 20 **Caution!** Take care that gate is not scratching at lever and body while pushing in.		

Description		Required tool
20. Insert the crank bolt at lever If necessary use a new crank bolt (for new crank bolt refer to chapter: «Spare parts»).		
21. Fasten the crank bolt screw adequately		Allen torque wrench 4 mm
22. Push in the gate assembly into valve body		
23. Clean the valve bonnet		Clean room wiper a little soaked with isopropyl alcohol
24. Clean or replace the bonnet seal 25. Lubricate the seal side with 0.1 ml vacuum grease If necessary to use a new bonnet seal (for new bonnet seal refer to chapter: «Spare parts»). If new bonnet seal is used (also in case of VATSEAL), no cleaning and lubrication is needed.		Clean room wiper Vacuum grease

Description		Required tool
26. Reassemble the bonnet and bonnet seal with valve		
27. Fasten the bonnet screws with: • DN 63 / 100 with 10 Nm • DN 160…400 with 18 Nm		DN 63 / 100 1 × Open end torque wrench 13 mm 1 × Open end wrench 13 mm DN 160…400 1 × Open end torque wrench 13 mm 1 × Open end wrench 13 mm

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

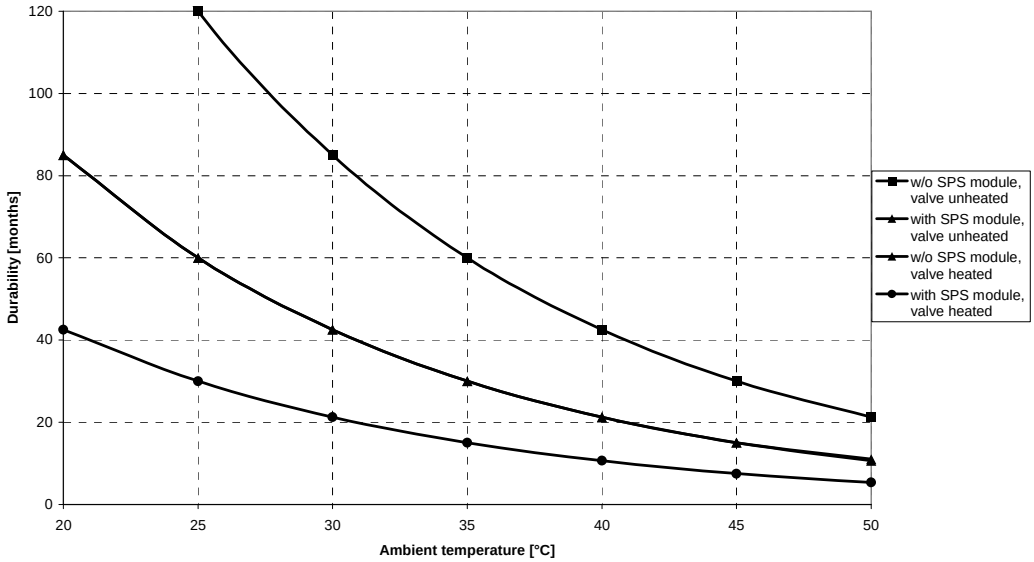
The modules may be retrofitted or replaced easily. The battery lifetime of the PFO module depends on the ambient temperature (see below). To assure PFO function the option board must be replaced after battery life has expired. For ordering number of the modules refer to chapter «Spare parts».

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.

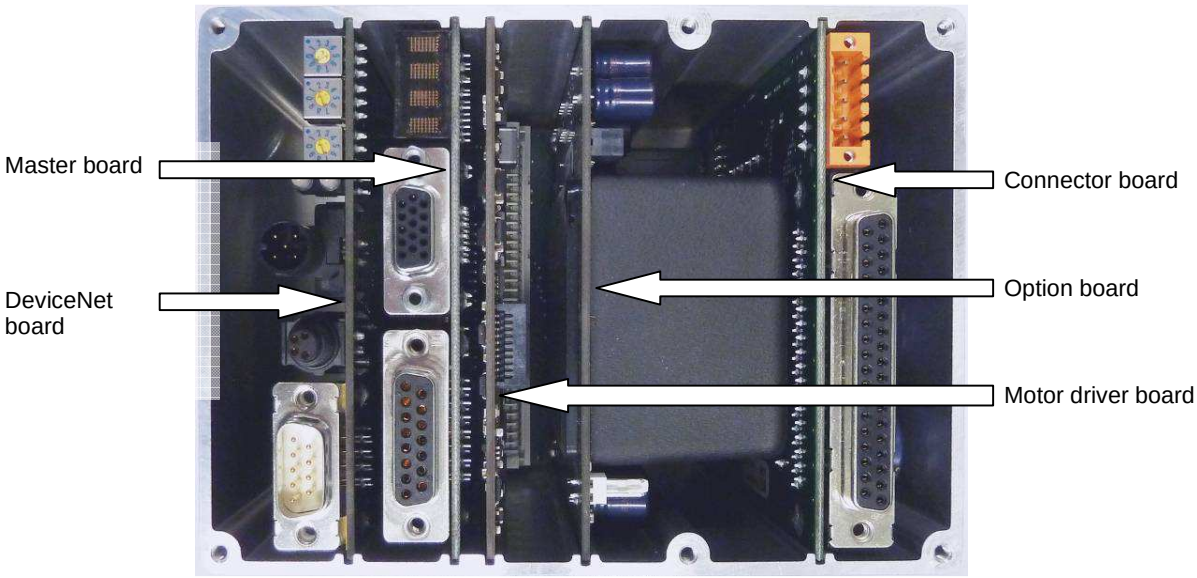
Therefore please determine the equivalent maintenance period for replacing the Ultra Cap battery (Option board).



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

7.2.3 Retrofit / replacement procedure

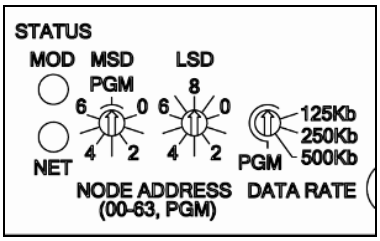
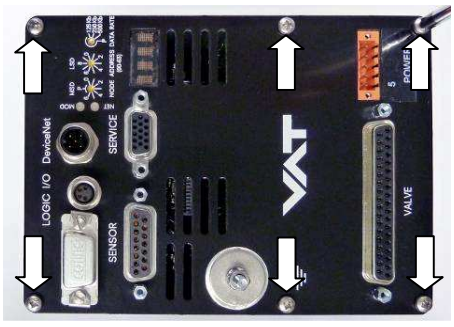
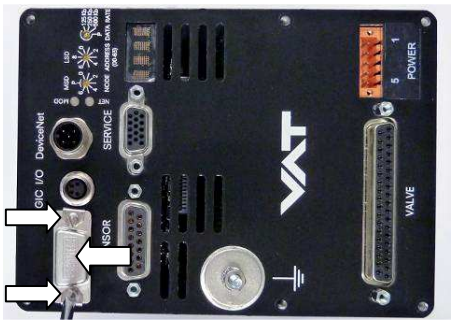
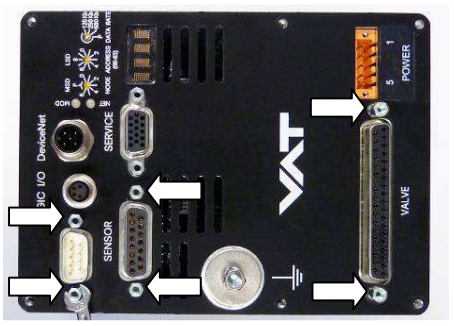
Top view on control unit with panel removed:

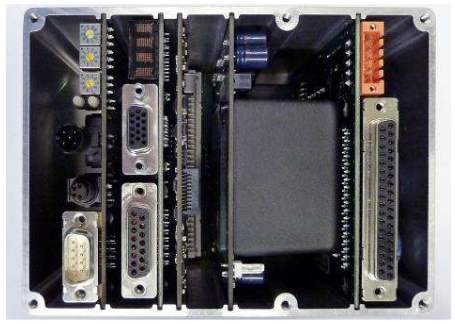
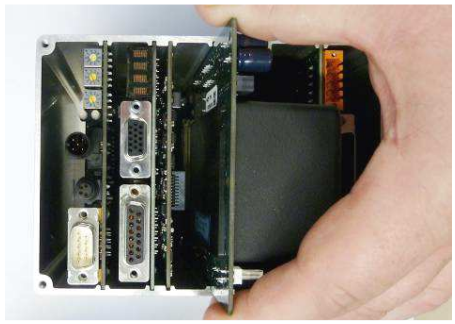
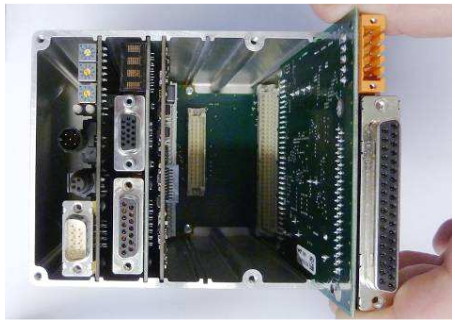


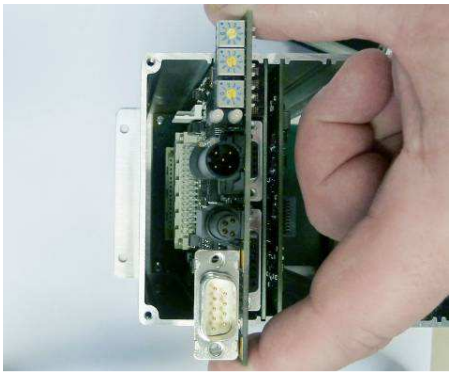
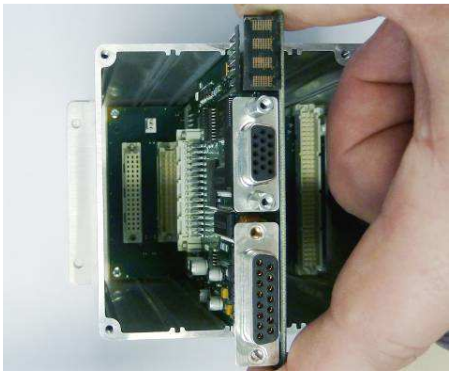
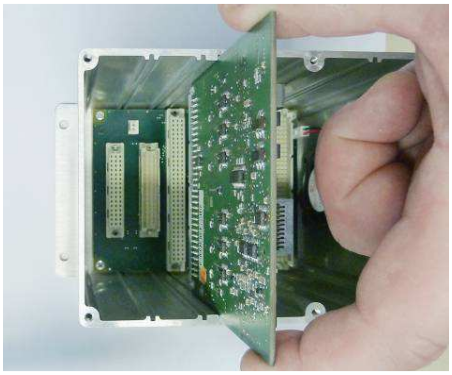
All boards have a fixed position into control and actuating unit. It is not possible to fit a board in other position as shown in picture above!

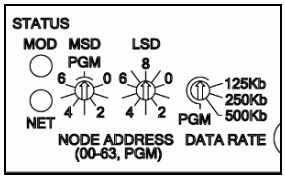
7.2.3.1 Needed tools

- Ballpoint
- Open end wrench 10 mm
- Open end wrench 7 mm
- Open end wrench 4.5 mm
- Pozidriv screw driver size 1
- Screw driver size 2
- Screw driver size 00

Description		Required tool
1. Disconnect all electrical connections at controller.	**Attention to ESD protection!** 	Pozidriv screw driver size1 Open end wrench 7 mm
2. Write down the «NODE ADDRESS» and «DATA RATE» in case of Interface board replacement.		Ballpoint
3. Remove the panel screws.		Pozidriv screw driver size1
4. Remove this screws and the cover.		Screw driver size 2
5. Remove female screw locks from connectors.		Open end wrench 4.5 mm

Description		Required tool
6. Loosen and remove the LOCIC connector screw		Open end wrench 10mm
7. Lift controller panel carefully.		
8. Remove or replace option board.		
9. Remove or replace connector board.		

Description		Required tool
10. Remove or replace interface board.		
11. Remove or replace master board.		
12. Remove or replace motor driver board		
13. Insert all boards in reverse order as they disassembled at correct positions (see steps 12 to 7).		
14. Reassemble all parts in reverse order (see steps 6…3). 15. Tighten panel screws with 1.1 Nm (see step 3).		

Description		Required tool
16. In case of replacement Interface board, adjust the «NODE ADDRESS» and «DATA RATE» (see step 2).		Screw driver size 00
17. Connect all electrical connections.		Pozidriv screw driver size1 Open end wrench 7 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.

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 +50 °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

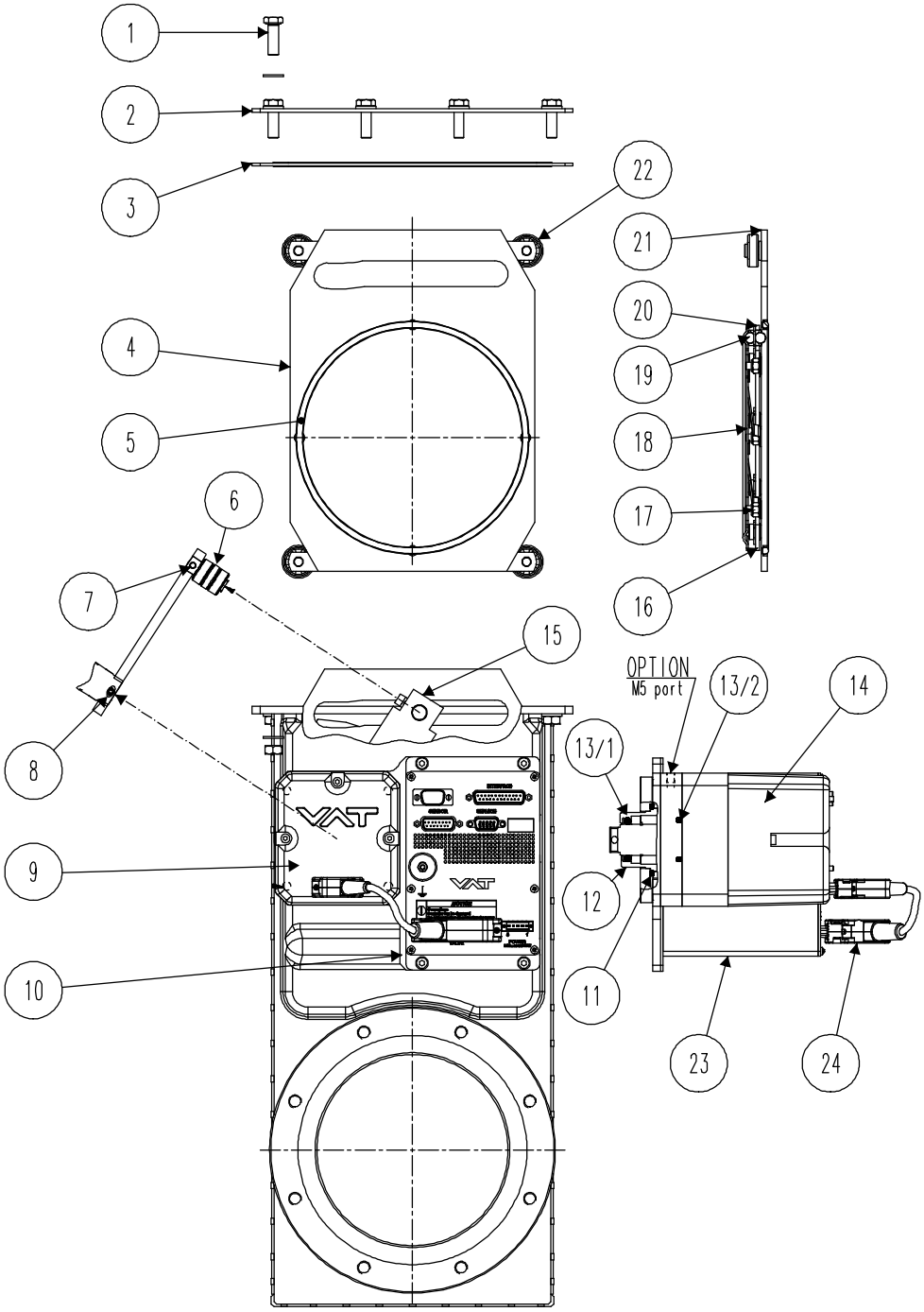
Non-original spare parts

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 table(s) 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 Valve unit with seals and grease

Item	Description	DN 63	DN 80	DN 100	DN 160	DN 200	DN 250	DN 320 DN 350	DN 400
3	Bonnet seal	77775-R1	77775-R1	77778-R1	77781-R1	77784-R1	N-5100-378	N-5100-382	N-5100-383
4	Gate assembly	591063	590996	590858	84275-R1	84608-R1	83481-R1	409173	215561
5	Gate O-ring	N-5102-340	220113	N-5102-351	N-5102-364	N-5100-372	N-5102-453	N-5102-457	N-5100-461
6	Crank bolt	79090-R1	79090-R1	79090-R1	79090-R1	79090-R1	85783-R1	85783-R1	87749-R1
7	Crank bolt mounting screw with spring washer	N-6005-458 N-6162-405	N-6005-458 N-6162-405	N-6005-458 N-6162-405	N-6005-458 N-6162-405	N-6005-458 N-6162-405	N-6005-502 N-6162-407	N-6005-502 N-6162-407	N-6005-502 N-6162-407
8	Feedtrough connection pin	N-6097-478	N-6097-478	N-6097-478	N-6097-480	N-6097-480	N-6097-509	N-6097-509	N-6097-509
14	Actuator: standard with pumping port	 546656 489236	 546656 489236	 546656 489236	 478357 487706	 478357 487706	 711045 539937	 711045 539937	 707681 587193
11	Static actuator seal	N-5100-222	N-5100-222	N-5100-222	N-5100-225	N-5100-225	N-5100-228	N-5100-228	N-5100-228
21	Locking balls	N-6121-052 (8 pcs)	N-6121-052 (8 pcs)	N-6121-052 (12 pcs)	N-6121-051 (18 pcs)	N-6121-051 (24 pcs)	N-6121-081 (18 pcs)	N-6121-081 (24 pcs)	N-6121-097 (32 pcs)
23	Controller	On request. To many to list.							
22	Ball bearing assembly	66856-R1 (1 pc)	66856-R1 (1 pc)	67064-R1 (2 pcs)	84326-R1 (2 pcs)	80642-R1 (2 pcs)	99205-R1 (4 pcs)	99205-R1 (4 pcs)	77286-01 (4 pcs)
	Seal kit vacuum	97442-R1	225315	97446-R1	85047-R1	95939-R1	98472-R1	98474-R1	98476-R1
	Feedtrough assembling tool		91001-R1				227400		
	VAT vacuum grease (40g)		N-6951-012						

12.1.2 Controller

Item	Description	Part number
	Control and actuating unit	Too many to list. Please contact VAT.
	Option board with SPS module (±15 VDC sensor power supply)	371399
	Option board with PFO module DN63…250 (power failure option)	376419
	Option board with PFO module DN320…400 (power failure option)	875669
	Option board with SPS und PFO module DN63…250 (power failure option)	376098
	Option board with SPS und PFO module DN320…400 (power failure option)	875668

12.1.3 Accessories

Description	Part number
24 VDC power supply unit (input: 100 – 240 VAC)	572699
'Control Performance Analyzer' package for Windows®	free download from: http://www.vatvalve.com/customer-service/informations-and-downloads/control-performance-analyzer
Service cable (PC to valve Service connector)	230327 free wiring information available for download from www.vatvalve.com
Connector of: • DB-15 male SENSOR plug	81177-R1
Service Box 2	601BS-29NN-000
Control panel (rack-mount version of Service Box 2)	602BS-29LE-000
O-ring removal tool	234859
VAT valve cleaning tool	305709

12.1.3.1 Centering ring with Viton o-ring

Valve size **Product ordering number**		**DN 63 / 2½"** **64236 - . . . .**	**DN 80 / 3"** **64238 - . . . .**	**DN 100 / 4"** **64240 - . . . .**
Centering ring with Viton o-ring (for ISO-F installation only)	Aluminum	32036-QAZV	32038-QAZV	32040-QAZV
	Stainless steel	32036-QEZV	32038-QEZV	32040-QEZV

Valve size **Product ordering number**		**DN 160 / 6"** **64244 - . . . .**	**DN 200 / 8"** **64246 - . . . .**	**DN 250 / 10"** **64248 - . . . .**
Centering ring with Viton o-ring (for ISO-F installation only)	Aluminum	32044-QAZV	32046-QAZV	32048-QAZV
	Stainless steel	32044-QEZV	32046-QEZV	32048-QEZV

Valve size **Product ordering number**		**DN 320 / 12"** **64250 - . . . .**	**DN 350 / 14"** **64251 - . . . .**	**DN 400 / 16"** **64252 - . . . .**
Centering ring with Viton o-ring (for ISO-F installation only)	Aluminum	32050-QAZV	none	32052-QAZV

13 Appendix

No information entered on time.

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