Installation, Operating & Maintenance Instructions

Butterfly Pressure Control Valve
with RS232 interface

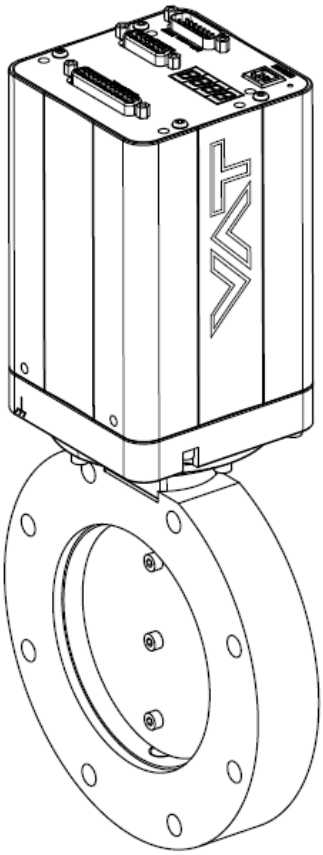
Series 613
DN 25-320 mm (I.D. 1“ - 12")

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

613 . . - . .GH -	(2 sensor inputs / analog outputs)
613 . . - . .AH -	(2 sensor inputs / analog outputs / ±15V SPS)
613 . . - . .HH -	(2 sensor inputs / analog outputs / PFO)
613 . . - . .CH -	(2 sensor inputs / analog outputs / ±15V SPS / PFO)

SPS = Sensor Power Supply PFO = Power Failure Option

configured with firmware : F01.0C.28.xx



Sample picture

Imprint

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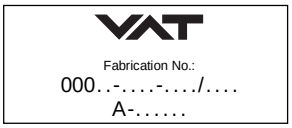
Contents

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 Firmware

Please look up the firmware version in the CPA or read it from the display at start up.
Location: CPA/Parameters: System.Identification.Firmware

1.3 Use of product

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

1.4 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

1.5 Related documents

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

1.6 Important information

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

Example:

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

1.7 Technical data

1.7.1 Control and actuating unit

See product data sheet.

1.7.2 Valve unit

See product data sheet.

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.

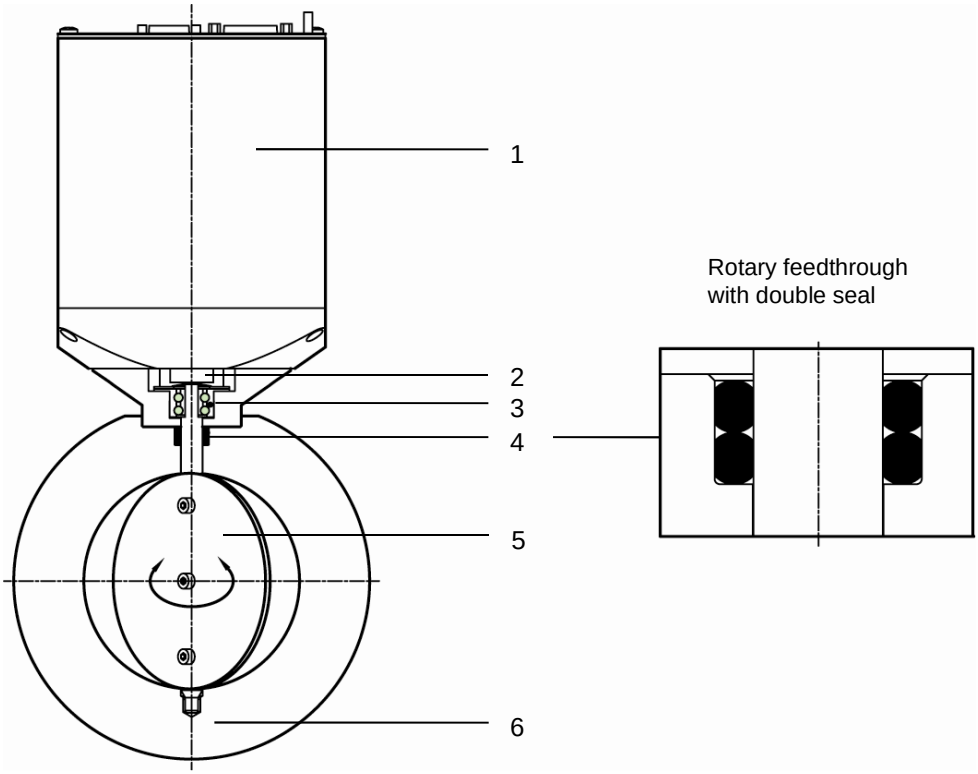
2.4 Safety labels

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

3 Design and Function

4 Design and Function

4.1 Design



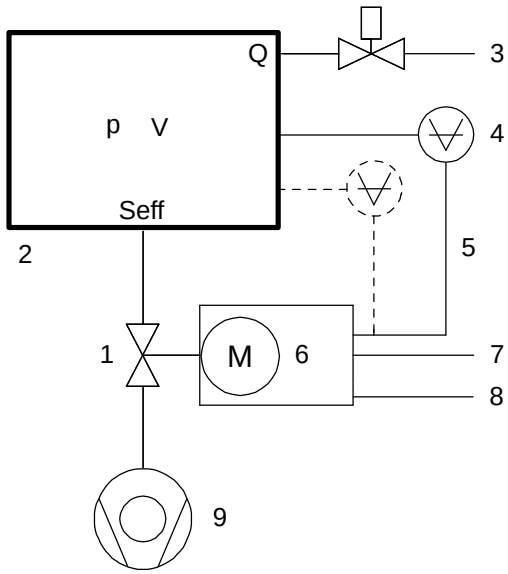
1	Integrated controller	4	Double seal
2	Coupling	5	Plate
3	Bearing	6	Valve body

4.2 Function

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

4.2.1 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)

4.2.1.1 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.

4.2.1.2 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:

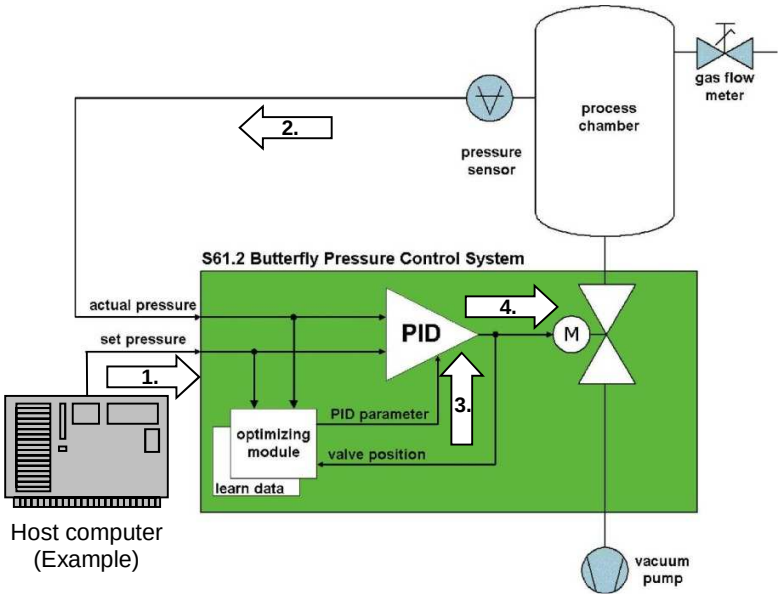
1. Downstream control (standard):
   The pressure is controlled by changing the conductance of a control valve between pump and process chamber. This changes the effective pumping speed at the process chamber. Pressure and gas flow can be independently controlled over a wide range.

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

4.2.1.3 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.

4.2.2 Principle of a pressure control system

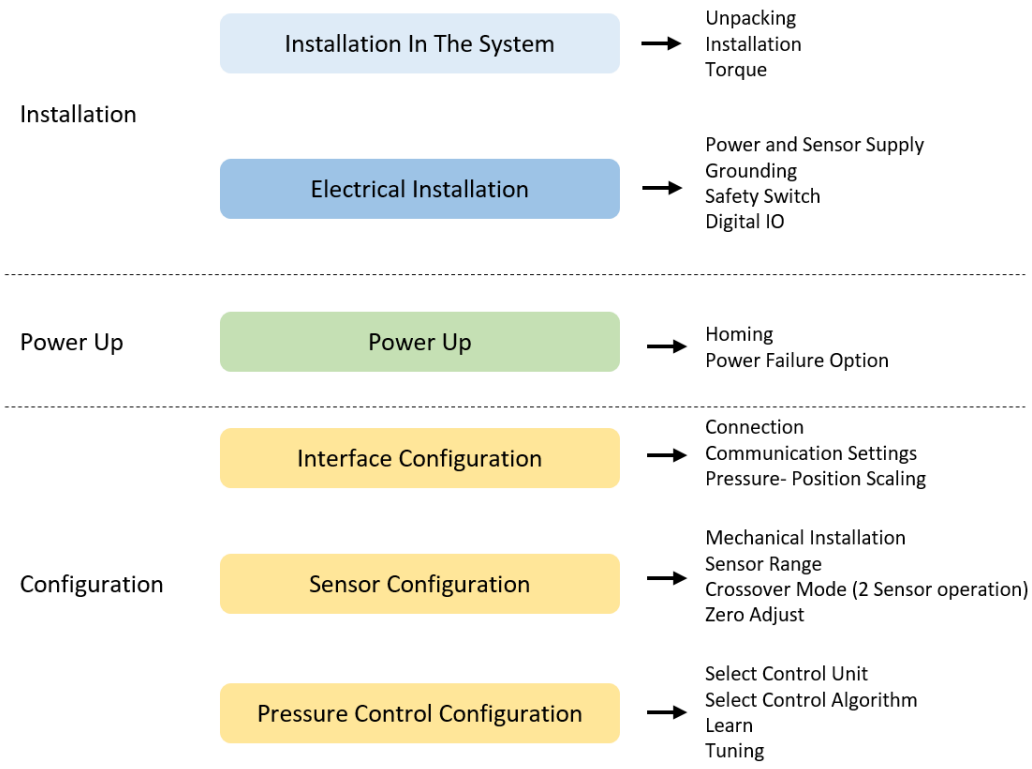


1. Host computer sends pressure set point
2. Controller reads actual pressure from sensor
3. Optimizing module sends new PID parameters
4. Actuator sets new valve position

5 Installation

	**⚠ WARNING** **Unqualified personnel** Inappropriate handling may cause serious injury or property damage. Only qualified personnel are allowed to carry out the described work.

5.1 Initial procedure



5.2 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.

NOTICE

Physical overstraining at pedestal

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

Lift valve at valve body out of transport case.

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

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

Do not remove protective foils from valve opening

5.3 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.

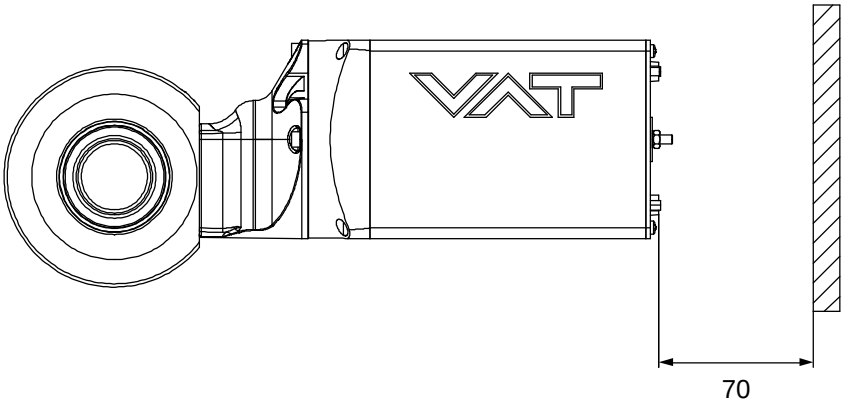
5.3.1 Installation Hints

Install valve into the vacuum system. Valve seat side shall face process chamber.

- Do not tighten the flange screws stronger than indicated under chapter «Tightening torque».
- Do not admit higher forces to the valve than indicated under chapter «Admissible forces».
- Make sure that enough space is kept free to do preventive maintenance work. The required space is indicated on the dimensional drawing.
- Control unit of valves with ISO-KF (61. . . – **K** . . .) needs support when mounted on horizontal piping and control unit does not hang.

5.3.2 Installation space condition

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



Sample picture

5.3.3 Admissible forces

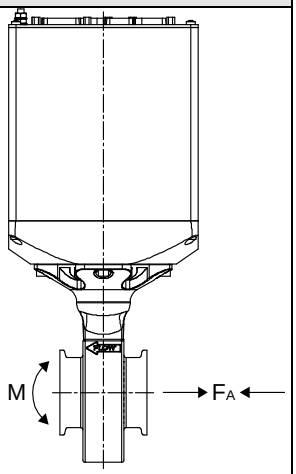
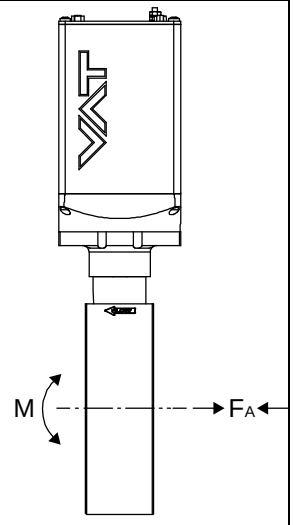
NOTICE

Force at valve body

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

Do not higher force the valve body as specified.

The following forces are admissible.

Valve size		Axial tensile or compressive force «F_A»		Bending moment «M»		
mm	inch	N	lb.	Nm	lbf.	
40	1½	100	22	6	4.5	 Sample picture
50	2	150	34	11	8	
63	2½	800	176	32	24	 sample picture
80	3	850	187	35	26.5	
100	4	1000	220	40	30	

5.3.4 Admissible forces at controller

NOTICE

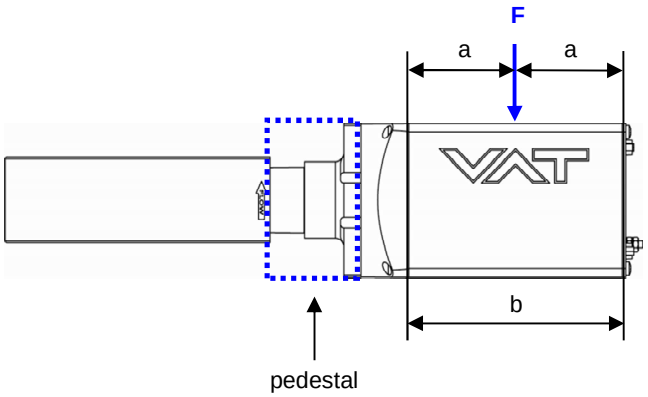
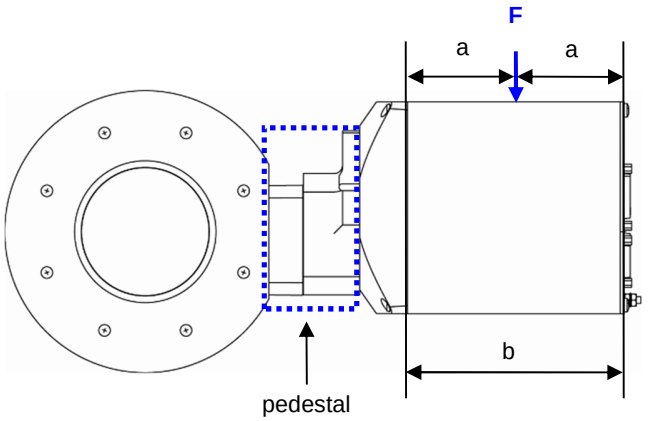
Force at pedestal

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

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

– Do not deposit anything at valve controller

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

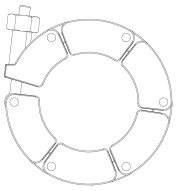
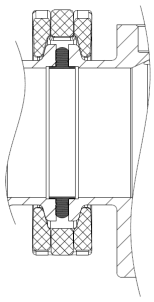
Admissible force «F»	Overview **F** = Force a = middle of aluminum part of controller (b / 2)
400 N	  sample pictures

5.3.5 Tightening torque DNs 40 – 50mm

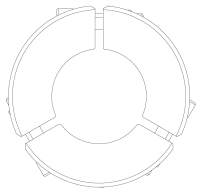
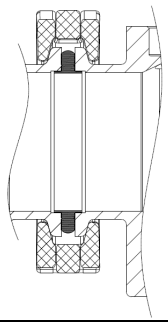
Tightening torques for ISO-KF flange connections depend on the type of seal which is used. Follow recommendations of seal manufacturer.

5.3.5.1 ISO-KF Clamping connections

Clamping chain (example)

Valve size	ISO-KF recommended tightening torque (Nm)	ISO-KF recommended tightening torque (lbs . ft)		
DN40 / 1½ “	5	3.7	 e.g.: 31032-KASA-0001 31034-KASA-0001	
DN50 / 2“	6	4.5		

Clamping device (example)

Valve size	ISO-KF recommended tightening torque (Nm)	ISO-KF recommended tightening torque (lbs . ft)		
DN40 / 1½ “	12	9	 e.g.: 31032-KASE-0001 31034-KASE-0001	
DN50 / 2“	12	9		

5.3.6 Tightening torque DNs 63 – 100mm

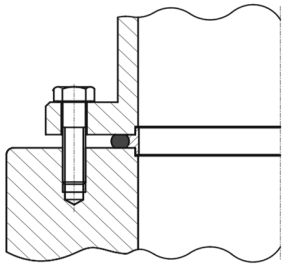
Tighten mounting screws of the flanges uniformly in crosswise order. Observe the maximum torque levels in the following table. Higher tightening torques deforms the valve body and may lead to malfunction of the valve.

5.3.6.1 Mounting of CF-F flanges

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

5.3.6.2 Mounting with centering rings

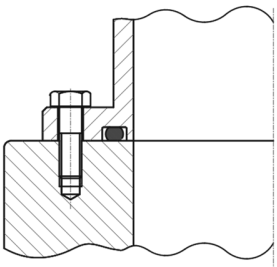
Valve size	ISO-F	ISO-F
	max. tightening torque (Nm)	max. tightening torque (lbs . ft)
DN63 / 2½ “	8-10	6-8
DN80 / 3“	8-10	6-8
DN100 / 4“	8-10	6-8
	hole depth (mm)	hole depth (inch)
DN63 / 2½ “	12	0.47
DN80 / 3“	12	0.47
DN100 / 4“	12	0.47



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

5.3.6.3 Mounting with O-ring in grooves

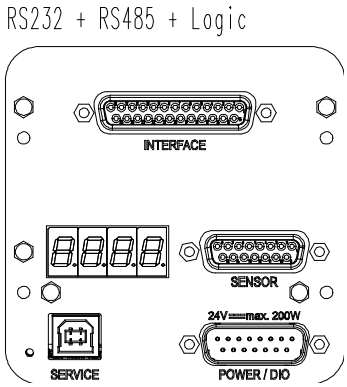
Valve size	ISO-F	JIS	ASA-LP	ISO-F	JIS	ASA-LP
	max. tightening torque (Nm)			max. tightening torque (lbs . ft)		
DN63 / 2½ “	20-23	35-40	35-40	15-17	26-30	26-30
DN80 / 3“	20-23	35-40	35-40	15-17	26-30	26-30
DN100 / 4“	20-23	35-40	35-40	15-17	26-30	26-30
	hole depth (mm)			hole depth (inch)		
DN63 / 2½ “	12	n/a	n/a	0.47	n/a	n/a
DN80 / 3“	12	n/a	n/a	0.47	n/a	n/a
DN100 / 4“	12	n/a	n/a	0.47	n/a	n/a

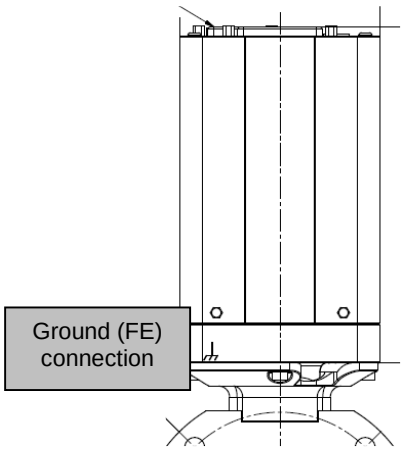


Make sure that screws in use are capable to withstand applied torques.

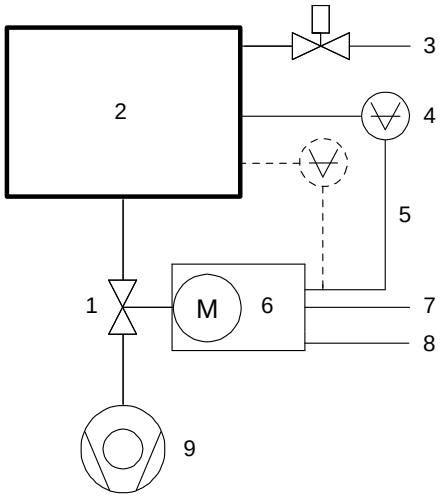
5.4 Connection overview

Controller IC2-H3:





System:



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

5.5 Power-, Ground- and Sensor 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.

5.5.1 Connection cable recommendations

For Power Supply connection cables, VAT recommends:

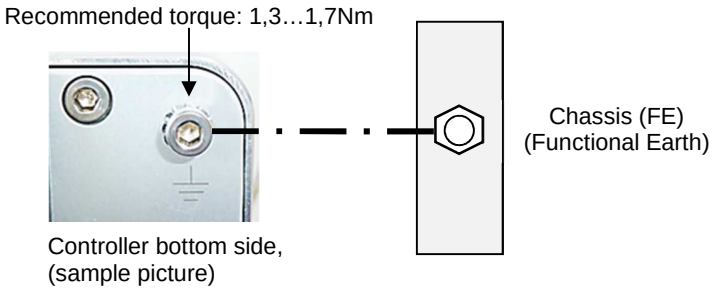
Class (min.)	L (Length max.)	d (diameter)
AWG18 (shielded)	5 m	0.823 mm^2

For Sensor & Signal connection cables, VAT recommends:

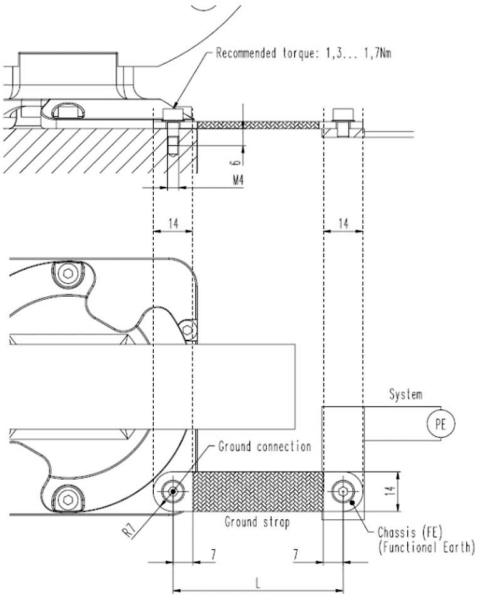
Class (min.)	L (Length max.)	d (diameter)
AWG22 (shielded)	20 m	0.326 mm^2

5.5.2 Ground connection

Recommendation for ground connection between controller and system chassis with cable or with ground strap.



- Recommendation for ground connection cable: AWG 12 (4 mm^2)
- The connection point at chassis (FE) must be blank metal (not coated).



- 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)

5.5.3 Power and Sensor supply concepts

This valve offers 3 alternative concepts to supply the sensor(s) with power. This depends on the sensor type and valve version that is used.

Concepts:

24 VDC sensors:

- External +24 VDC supplied to POWER connector is feedthrough to SENSOR connector. Refer to chapter «Power and sensor connection (+24 VDC sensors) ».

±15 VDC sensors:

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

  This concept is only possible when Sensor Power Supply (SPS) option is installed.

For max load consumption, refer to chapter «Technical Data – Control and actuating unit».

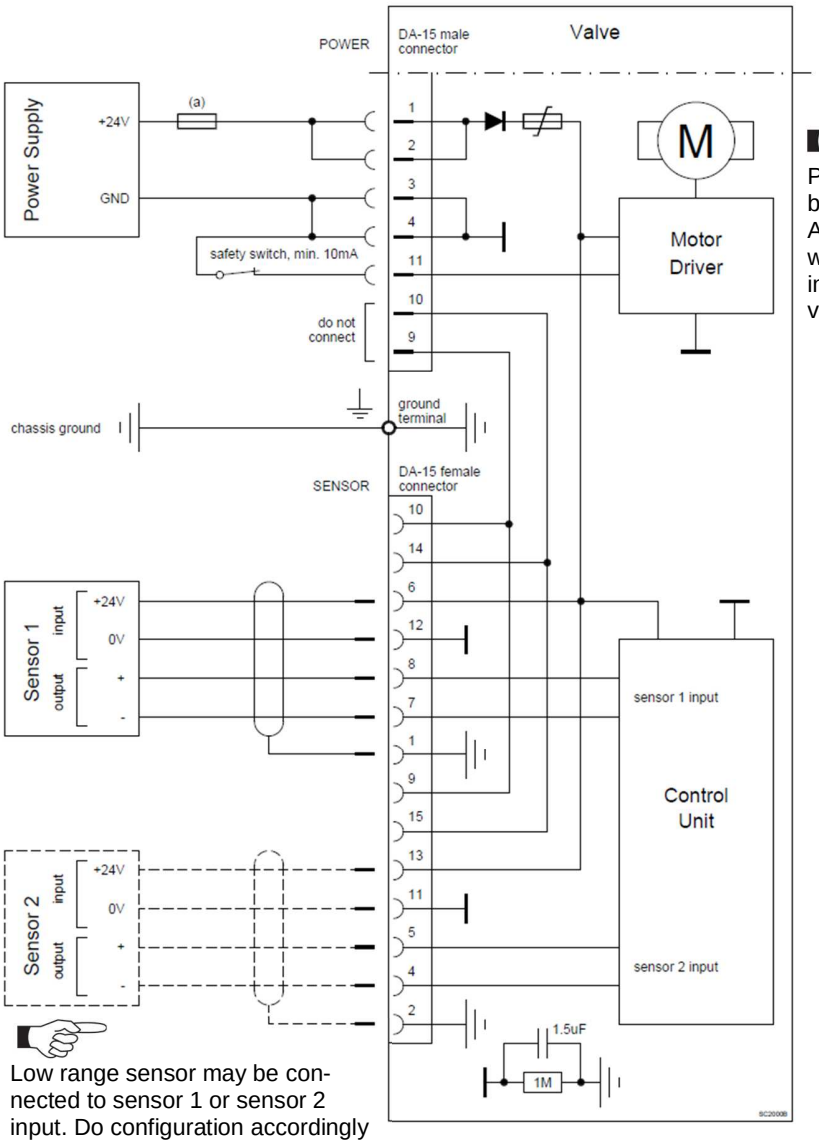
Valve versions:

- 61.. . - . . **G** . - . . . . / 61. . . - . . **T** . - . . . . / 61. . . - . . **H** . - . . . . SPS module not included
- 61. . . - . . **A** . - . . . . / 61. . . - . . **C** . - . . . . SPS module included

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

5.5.3.1 Power and 24V sensor connection

[61. . . - . . **G** . - . . . . / 61. . . - . . **H** . - . . . . versions recommended]



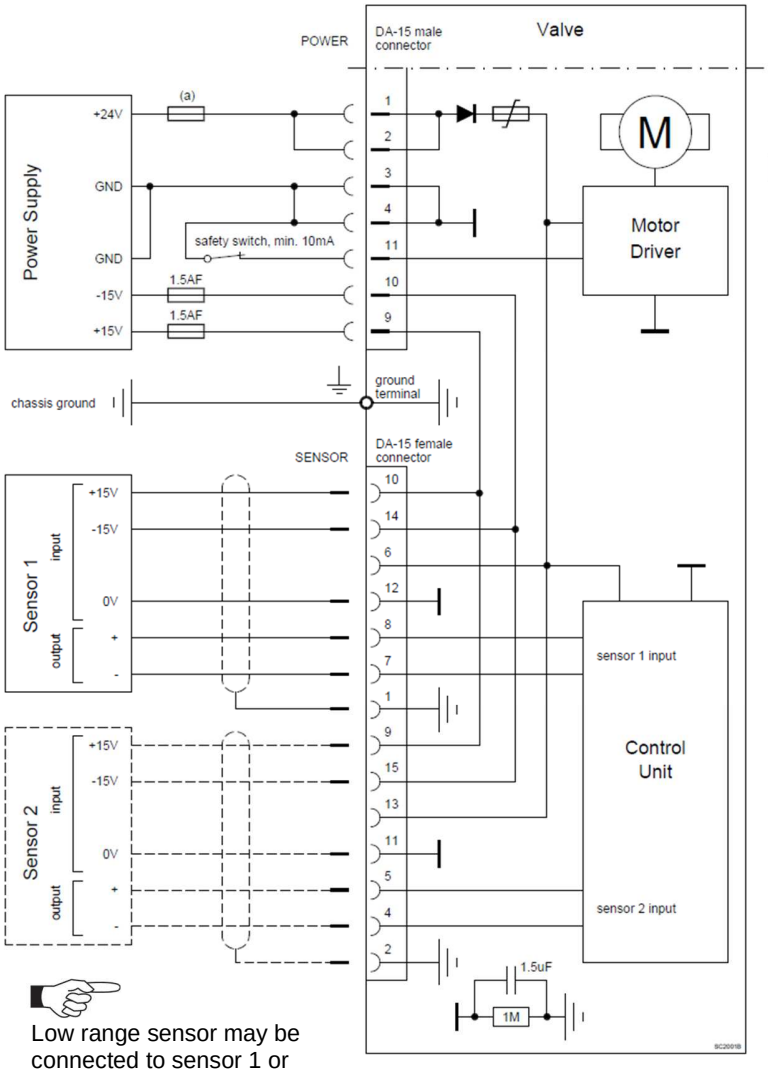
Pins 4 and 11 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

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

- **VAT fuse recommendation: (a) 3 AF**
- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connector: Use only screws with 4–40 UNC thread for fastening the connectors!

5.5.3.2 Power and 15V sensor connection

[61 .. . - . . **G** . - . . . . / 61. . . - . . **H** . - . . . . versions recommended]



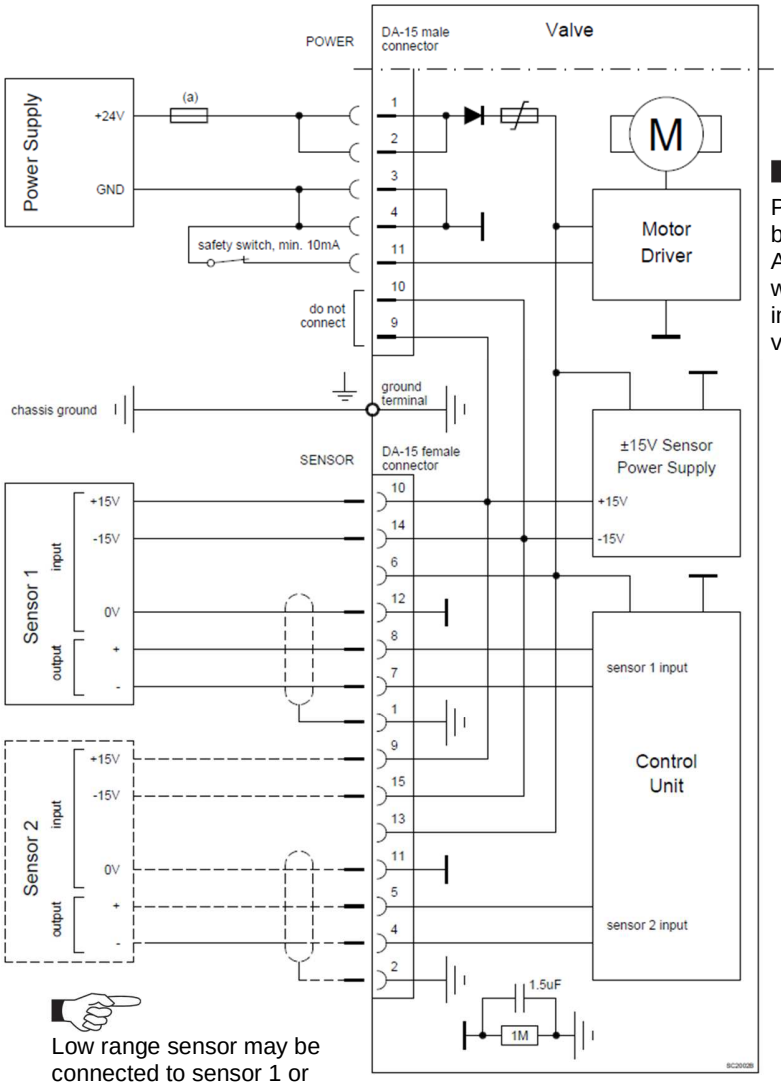
Pins 4 and 11 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

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

- **VAT fuse recommendation: (a) 3 AF**
- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connector: Use only screws with 4–40 UNC thread for fastening the connectors!

5.5.3.3 Power and 15V sensor connection with optional SPS module

[61. . . - . . **A** . - . . . . / 61. . . - . . **C** . - . . . . versions only]

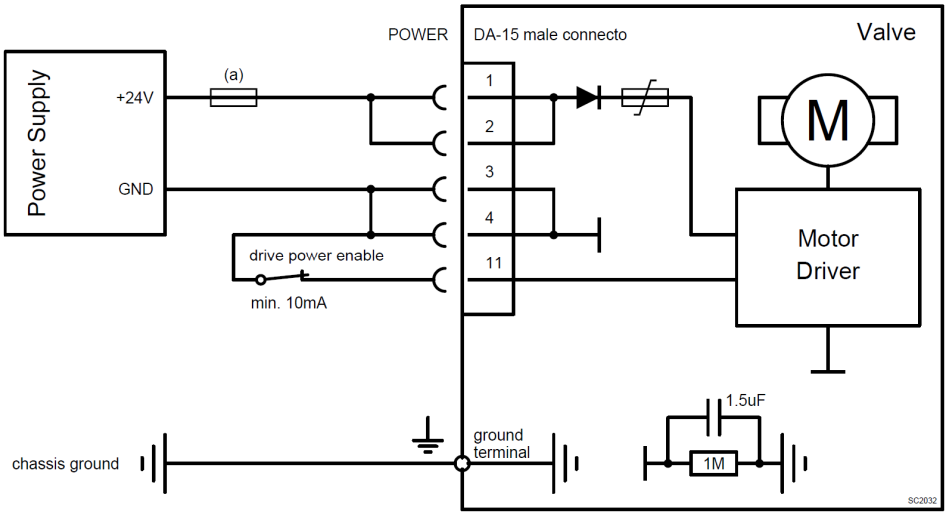


Pins 4 and 11 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

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

- **VAT fuse recommendation: (a) 3 AF**
- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connector: Use only screws with 4–40 UNC thread for fastening the connectors!

5.5.4 Drive Power Enabled Switch, Safety Mode



- By means of an external switch 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 do homing.
- When ‘safety mode’ is entered from operation (i.e. pressure control mode), the unit will automatically switch to safety control mode and remain at current position.
  Once motor interlock is deactivated the valve go to control mode ‘Init’, so a homing is necessary and will carried out depending on ‘Homing’ setting (Refer to ‘Power Up, Homing’)

For safety function without human risk it is recommend using interlock function of the digital inputs, because no new homing is necessary after release of the interlock.
Refer to ‘Power connector IO’ >> ‘Digital Input’

5.6 Power Up

After power up or possibly after a reset of the valve homing is necessary to determine the plate position.
Refer to chapter «5.11.2 Homing»

5.7 Power Down, Power Failure Option

5.7.1 Power down behavior in case of power failure

Valve position before power failure:	**Reaction of valve:**
Closed (isolated)	Valve remains closed.
Valve open or in any intermediate position	The plate remains at the current position.

All parameters are stored in a power fail save memory.

5.7.2 Power Fail Option

Power Fail Option is circuit board that can store as much energy to close or open the valve in the event of a power failure.

Technical data

Charging Time	2 minutes max.
Durability	Up to 10 years @ 25°C ambient

These settings define what the valve is doing in case the power fails.

Valve must be equipped with the 'Power Failure Option'
[61. . . - . . **C** . - . . . . or 61. . . - . . **H** . - . . . .]
For PFO retrofit and other options refer to chapter: «Spare parts».

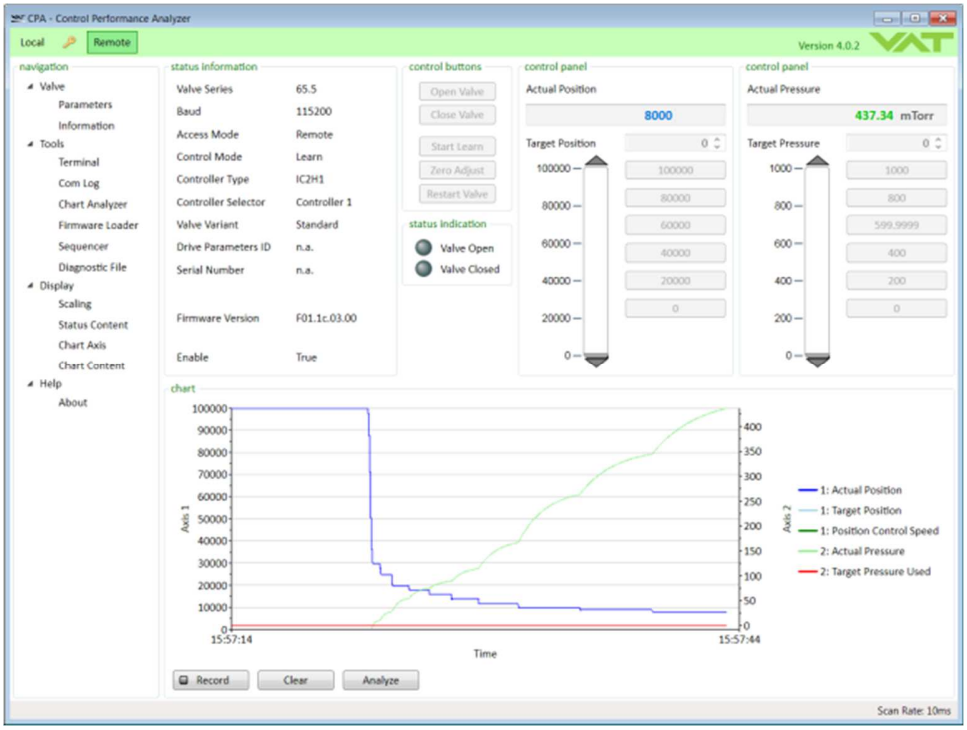
Location: CPA/Navigation/Parameters: Power Fail Option

Parameter	Description
Enable	'True' enables the power fail reaction. 'False' there is no reaction on a power fail
State	*Battery is Charging* *Ready to Use* *Active* *Failure*
Functionality	*Open* *Close*
Delay	In seconds After this delay, the power failure reaction starts after the power failed. Helps to bridge a short power interruption.
Battery Voltage	Shows state of charge
Power Fail Cycles	Counts Power Failure

5.8 Service Port, CPA software

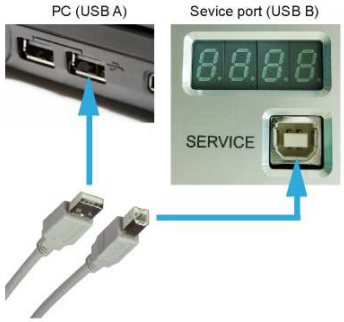
The ‘Service port is designed for ‘Local operation’ with the software CPA - Control Performance Analyzer.

Note: Detailed help on the CPA is available in the help of the CPA itself.

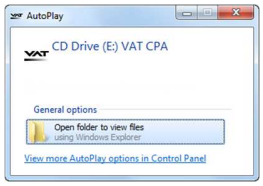


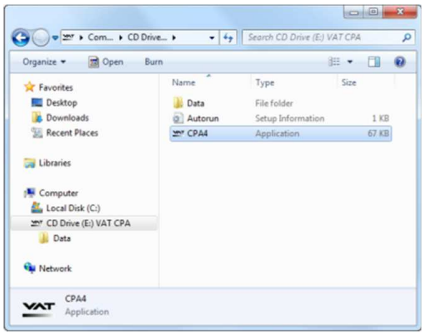
5.8.1 How to start

1. Connect service cable (USB A–B cable male-male) between PC and valve:

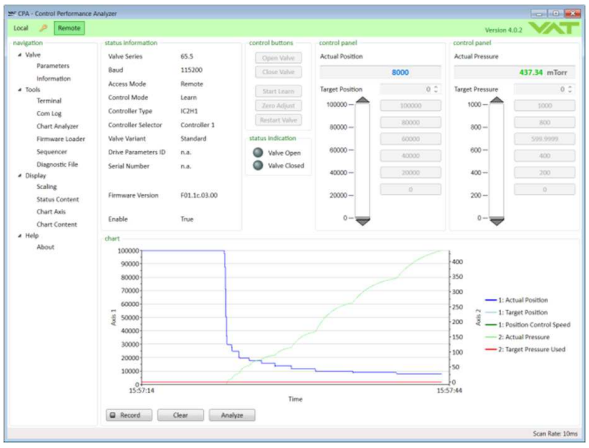


A drive opens:





2. Double Click on ‘CPA4.exe’ to open the ‘Control Performance Analyzer’

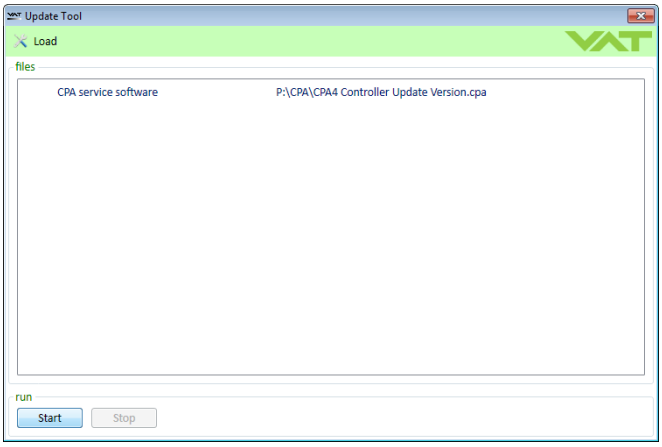


3. Click [Local] for Local operation to do configuration

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.

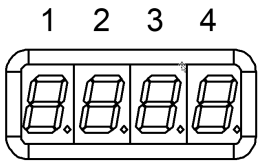
5.8.2 Update

It is easy to update to the latest version of the CPA which can be found on the VAT homepage: https://www.vatvalve.com/downloads/software



5.9 Display Information

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



5.9.1 Power up

Description	Digit 1	Digit 2	Digit 3	Digit 4
• 1st Power On: All dots are illuminated	#	#	#	#
• 2nd Valve series e.g. **67.0**		**6**	**7**	**0**
• 3rd Firmware: generation.type e.g. **01.0C**	**0**	**1**	**0**	**C**
• 4th Firmware: version.firmware e.g. **07.00**	**0**	**7**	**0**	**0**
• 5th Controller configuration: e.g. **11.00**	**Controller** **1**=H1 **2**=H2 **3**=H3 **4**=H4 **5**=H5 **6**=H6 **7**=H7	**Interface** **1**=RS232/RS485 **2**=EtherCAT **3**=DeviceNet **5**=Logic **7**=Profibus **8**=CCLink **9**=EtherNet	**Options** **00**=none **01**=SPS **02**=PFO **03**=Cluster **04**=SPS + PFO **05**=SPS + Cluster **06**=PFO + Cluster **07**=SPS + PFO & Cluster **08**=PFO2 **09**=SPS + PFO2 **0A**=PFO2 + Cluster **0B**=SPS + PFO2 + Cluster **0C**=PFO3 **0D**=SPS + PFO3 **0E**=PFO3 + Cluster **0F**=SPS + PFO3 + Cluster SPS Sensor Power Supply PFO Power Failure Option	
'Ho' homing is running	**H**	**o**		

5.9.2 Operation

Description / Mode	Digit 1	Digit 2	Digit 3	Digit 4
INIT (start up)	**I**	**n.**		
INIT (start up, leak tight)	**I**	**n.**		**C**
CLOSE	**C.**	**C, 0…100** valve position C = closed, leak tight 0 = minimal conductance 100 = maximum opened		
OPEN	**O.**			
PRESSURE control	**P.**			
POSITION control	**A.**			
INTERLOCK Valve closed or open by digital input	**I.**			
HOLD (position frozen)	**H.**			
LEARN	**L.**			
SAFETY Refer to «Safety mode» for details.	**S.**			
POWER FAILURE	**F.**			

5.9.3 Error

Description	Digit 1	Digit 2	Digit 3	Digit 4
Error number (xyz)	**E.**	**x**	**y**	**z**
alternately (if error code exist)				
Error code		**u**	**v**	**w**

For Error number / code. Refer to «Trouble shooting» for details

5.10 System Settings and States

5.10.1 Identification

5.10.1.1 Serial Number

Location: CPA/Parameters: System.Identifiaction.Serial Number

Parameter	Description
Serial Number	VAT specific number

5.10.1.2 Configuration

Location: CPA/Parameters: System.Identifiaction.Configuration

Parameter	Description
Valve Series	3-digit value representing the VAT valve series
Valve Variant	For some vale there exists different variants
Nominal Diameter	DN in mm. E.g DN250
Drive Parameter ID	ID of the last drive file loaded on the valve. Sets the parameters responsible for the movement characteristics of the valve
Configuration Parameters ID	ID of the last configuration file loaded on the valve. Configuration of Interface, Pressure Control, Pressure Sensor, …

5.10.1.3 Firmware

Location: CPA/Parameters: System.Identification.Firmware

Parameter	Description
Valve Firmware ID	VAT specific identification number
Valve Firmware Version	Faa.bb.cc.dd a = Platform, Controller Type b = Type **C**ustomer **B**asis **P**roduction **T**est c = Version d = Revision
CPA Version	VAT PC software version
Interface Firmware Version	Network controller firmware
Motion Controller Firmware Version	Motion controller firmware

5.10.1.4 Hardware

Location: CPA/Parameters: System.Identification.Hardware

Parameter	Description
Controller Type	Identification of the use controller IC2H1, IC2H2, IC2H3 …
Interface Type	RS232/RS485 EtherCAT DeviceNet Logic Profibus CCLink EtherNet
Option Type	none SPS PFO Cluster SPS & PFO SPS & Cluster PFO & Cluster SPS & PFO & Cluster SPS…Sensor Power Supply PFO…Power Failure Option

5.10.2 Statistics

Location: CPA/Parameters: System.Statistics

Parameter	Description
Start Up Counter	Each start up is counted (power on and resets) Can be used to monitor whether the valve has restarted uninvited (power loss, watchdog, …)
Total Time Powered Up	In seconds
Time Since Power On	In seconds

5.10.3 Warning/Error

Location: CPA/Parameters: System.Warning/Error

Parameter	Description		
Warning Bitmap	Bit	Hex	Description
	0	1	No Learn Data
	1	2	Isolation valve does not work
	2	4	No Sensor Active
	3	8	PFO Not Ready
	4	16	Cluster Slave Offline
	6	40	Fieldbus Data Not Valid
	8	256	Compressed Air Not Falling when valve close
	9	512	Compressed Air Too Low
	10	1024	Compressed Air Too High
	12	4096	Fan stall alarm
Error Bitmap	Bit	Hex	Description
	0	1	Homing Position Error
	1	2	Homing Not Running
	2	4	Homing Error State
	3	8	Operation Position Error
	4	10	Operation Not Running
	5	20	Operation Error State
	12	1000	Other Component
	30	40000000	General
	31	80000000	Internal
Error Number	Refer to Error Number in Troubleshooting		
Error Code	Refer to Error Code in Troubleshooting		

5.10.4 Service

5.10.4.1 Restart, Error Recovery

Location: CPA/Parameters: System.Services

Parameter	Description
Restart Controller	Emulates a power cycle of the valve
Error Recovery	Attempts to reset the Control Mode Error without restarting the valves

5.10.4.2 Settings Handling

Location: CPA/Parameters: System.Services.Store/Restore Settings

Parameter	Description
Store User Parameters	Emulates a power cycle of the valve
Restore User Parameters	Attempts to reset the Control Mode Error without restarting the valves
Restore Factory Parameters	Protective function against changing the settings. If TRUE, the settings can no longer be changed.

Location: CPA/Parameters: System.Services.Configuration Lock

Parameter	Description
Configuration Lock Mode	Protective function against changing the settings. If TRUE, the settings can no longer be changed.

5.11 Valve Settings and States

5.11.1 States

Location: CPA/Navigation/Parameters: Valve

Parameter	Description
Actual Position	Show position of the valve plate
Position State	Intermediate Closed Open
Isolation State	Not Isolated Isolated

5.11.2 Homing

After power up or possibly after a reset of the valve homing is necessary to determine the plate position.

Location: CPA/Navigation/Parameters: Valve.Homing

Parameter	Description	
Start Condition	Homing start option defines when the valve performs the homing procedure.	
	Standard	Automatically if valve is not in sealed state, otherwise it is waiting for a move command.
	Open Command	On an open command
	Move Command	On any move command
	At Startup	All the time
	Homing Command	On homing command
	Move Command Without Close	On any move command except close command if the valve is closed
End Control Mode	This control mode is set after a successful homing. *Position* *Close* *Open* *Pressure Control*	
End Position	In case the **End Control Mode** is set to 2 (Position), this parameter defines which position is set after successful homing.	

Followed description of the **standard setting**:

Valve position before power up:	**Reaction of valve:**
Closed (isolated)	Valve remains closed. Homing will be done when first movement command is received.
All other than closed (not isolated)	Valve do homing to initialize position. Display shows ‘Ho’ until homing is done Valve position after homing is closed

5.11.3 Cycle Counter

5.11.3.1 Control Cycle

A control cycle is a complete movement of the valve, from closing to opening and back to closing, or in percentage of movement it is 200%. Each movement is added up until 200% of the movement is reached, and then the cycle counter is incremented by 1.

Location: CPA/Parameters: Valve.Position Cycle Counter

Parameter	Description
Control Cycles	The value is writable to be able to reset it
Control Cycles Total	Non-resettable value

5.11.3.2 Isolation Cycle

Counts each compression of the O-ring during the closing process
(Each transition of **Isolation State** from 'Not Isolated' to 'Isolated')

Location: CPA/Parameters: Valve.Position Cycle Counter

Parameter	Description
Isolation Cycles	The value is writable to be able to reset it
Isolation Cycles Total	Non-resettable value

5.11.4 Position Restriction

This allows the position of the valve to be limited in open direction.
The limitation is effective in any control mode
If restriction is active:

- **Position State** remains in Intermediate
- Digital outputs Open becomes not active

Location: CPA/Parameters: Valve.Position Restriction

Parameter	Description
Enable	Enable the restriction
Maximum Position	High position limit
Restriction Active	Indicates that the position is currently restricted by the Position Restriction.

5.11.5 Position Adaption

5.11.5.1 Usage

Chamber Matching
Adjustment of the conductance curve of different valves to obtain the same position at the same process points in different systems.

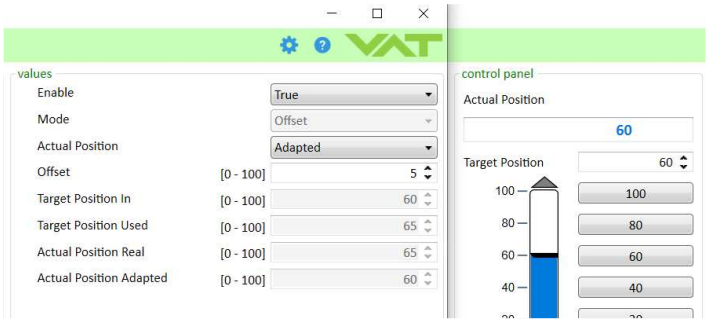
Cluster Balance
Adjusting the Position of individual valves in a valve cluster can be used to compensate certain Side-effects, e.g. keeping suction rate of downstream pump on a defined level.

5.11.5.2 Parameters

Location: CPA/Parameters: Valve.Position Adaption

Parameter	Description
Enable	Enables the adaption
Mode	Mode of the adaption. Currently only *Offset* is available.
Actual Position Mode	Selection of the position which the valve indicates *Real* *Adapted*
Offset	Amount of displacement of the position
Target Position In	Value sent via Interface or CPA Is the same as **Position Control.Target Position**
Target Position Used	Internal used Target Position = Target Position In + Offset
Actual Position Real	Internal real position If setting **Actual Position** = *Real* the valve indicates this position
Actual Position Adapted	Actual Position Real – Offset If setting **Actual Position** = *Adapted* the valve indicates this position

Example: shows parameter window with the offset values and behind the main window with the position values



5.12 Interface RS232/485

This is an asynchronous serial communication method. The term serial means that the information is sent bit by bit. Asynchronous means that the information is not sent at previously agreed times. The sending of data can start at any arbitrary moment and it is part of the recipient's task to discover when a message starts and ends.

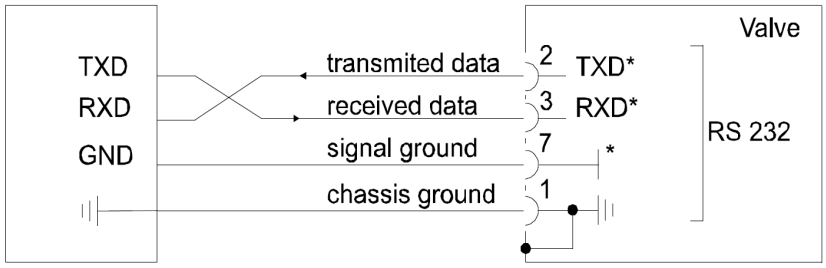
5.12.1 Operation Mode RS232/ RS485

Location: CPA\Parameters: Interface RS232/RS485.Settings

Parameter	Description	
Operation Mode	**RS232**	2-Wire Point-to-point Pin RXD and TXD
	RS485	4-Wire (Full Duplex) or 2-Wire (Half Duplex) Point-to-point, multiple-devices Pin A,B,X,Y
	Service Interface Over RS232	CPA communication via RS232, Pin RXD and TXD

5.12.2 RS232

5.12.2.1 Connection



*Isolated from other circuits

5.12.2.2 Configuration

The port settings of the valve must be identical to the settings of the host control system.

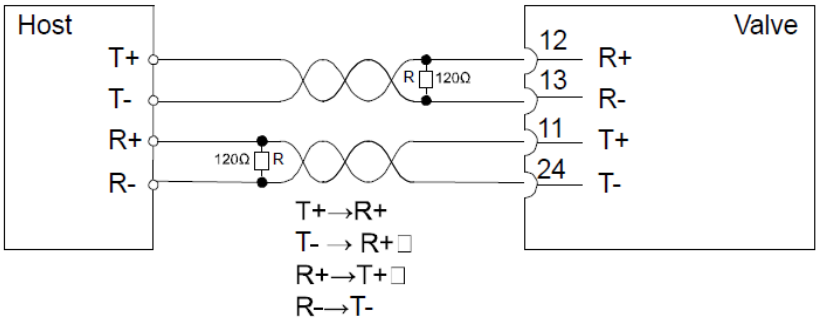
Location: CPA\Parameters: Interface RS232/RS485.Settings

Parameter	Description
Baud Rate	1200,2400,4800,9600,19200,38400,57600,**115200**
Data Bit Length	7, **8**
Stop bit	**1**,2
Parity Bit	**None**, Even, Odd
Command Termination	**CR+LF**, LF, CR

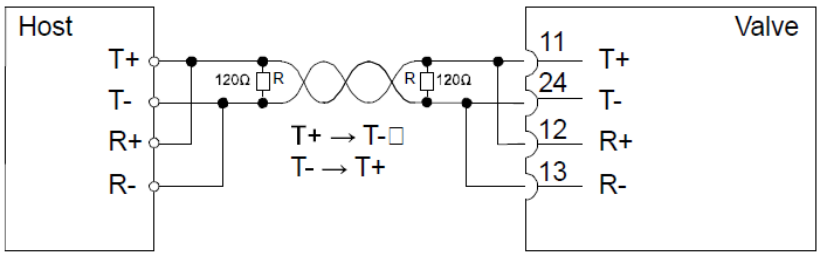
5.12.3 RS485

5.12.3.1 Connection

Full **Duplex**



Half Duplex



5.12.3.2 Configuration

The factory default configuration of the RS232 interface are marked in **bold** and might be changed to fit the application by using the CPA software.

Location: CPA\Parameters: Interface RS232/RS485.Settings

Parameter	Description
Baud Rate	1200,2400,4800,9600,19200,38400,57600,**115200**
Data Bit Length	7, **8**
Stop bit	**1**, 2
Parity Bit	**None**, Even, Odd
Topology	**Full Duplex**, Half Duplex
Network	**Multiple Devices**, Point to Point
Address	**0**…255
Command Termination	**CR+LF**, LF, CR

5.12.4 Command Set

5.12.4.1 General

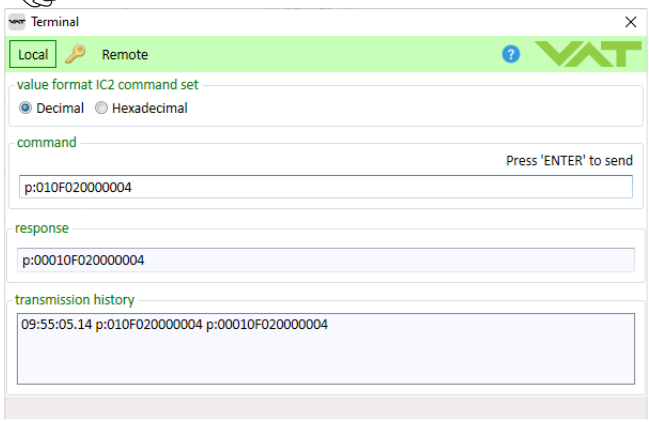
- Commands and values are case sensitive.
- Acknowledgement within 10ms after reception of command.
- Wait for acknowledgement before sending a new command.
- Default command termination is CR and LF. This is adjustable.
  CR = Carriage Return (0D hexadecimal), LF = Linefeed (0A hexadecimal)
- Same Syntax for Commands over Service (CPA) as over RS232 interface.

5.12.4.2 Syntax

Service	Command	Response
GET	p:[**service**][**parameter**][**index**]	p:[**error**][**service**][**parameter**][**index**][**value**]
SET	p:[**service**][**parameter**][**index**][**value**]	p:[**error**][**service**][**parameter**][**index**][**value**]

Part	Description	Format	Digits
service	Service code	Hex	2
parameter ID	Each parameter is identified by an uint32 value	Hex	8
error	Error code (see detail below)	Hex	2
index	Array index. If parameter is not an array use 00	Hex	2
value	Set or response value	Dec	variable

All command input can be done by local service via CPA Terminal



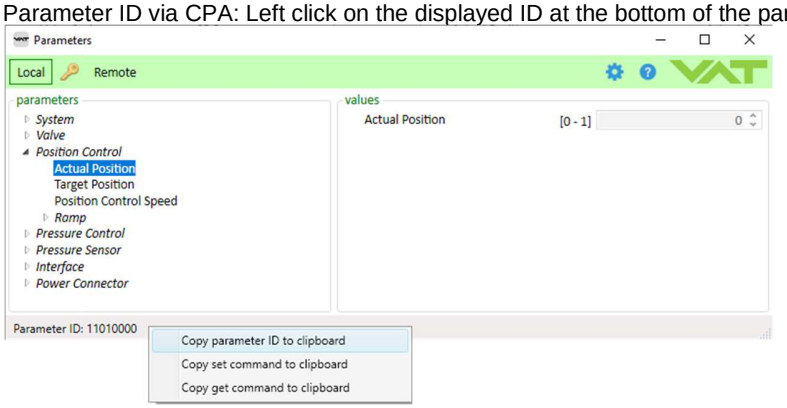
5.12.4.3 Services

Code	Description
01	SET a parameter to a value
0B	GET a value of a parameter

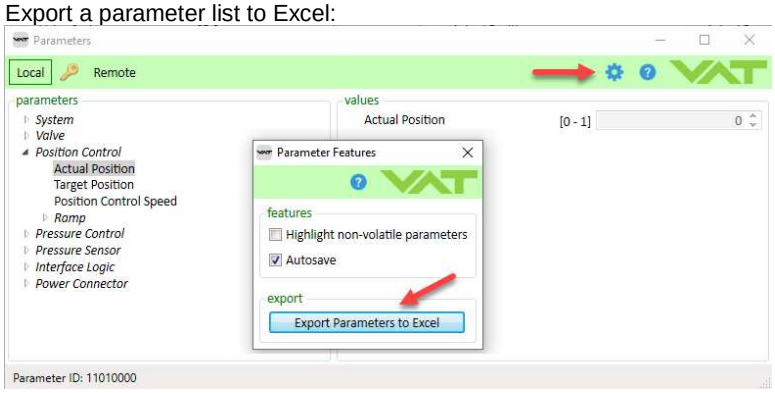
5.12.4.4 Parameter ID

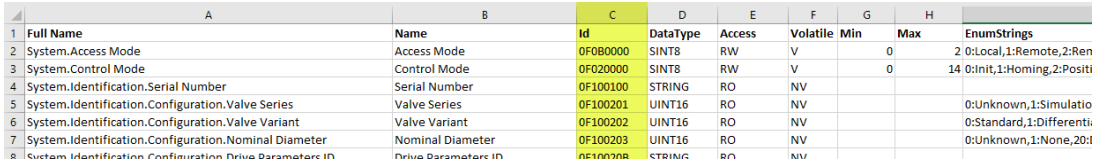
Each parameter is identified by an 8-digit hexadecimal value.

Parameter ID via CPA: Left click on the displayed ID at the bottom of the parameter window:



Export a parameter list to Excel:





	A	B	C	D	E	F	G	H	
1	**Full Name**	**Name**	**Id**	**DataType**	**Access**	**Volatile**	**Min**	**Max**	**EnumStrings**
2	System.Access Mode	Access Mode	0F0B0000	SINT8	RW	V	0	2	0:Local,1:Remote,2:Ren
3	System.Control Mode	Control Mode	0F020000	SINT8	RW	V	0	14	0:Init,1:Homing,2:Positi
4	System.Identification.Serial Number	Serial Number	0F100100	STRING	RO	NV			
5	System.Identification.Configuration.Valve Series	Valve Series	0F100201	UINT16	RO	NV			0:Unknown,1:Simulatio
6	System.Identification.Configuration.Valve Variant	Valve Variant	0F100202	UINT16	RO	NV			0:Standard,1:Differenti
7	System.Identification.Configuration.Nominal Diameter	Nominal Diameter	0F100203	UINT16	RO	NV			0:Unknown,1:None,20:

5.12.4.5 Error Codes

Code	Error text	Description
00	no error	no error
0C	wrong command length	wrong command length
1C	value too low	value out of range: lower then min limit
1D	value too high	value out of range: higher then max limit
20	resulting zero adjust offset value out of range	resulting zero adjust offset value out of range
21	not valid because no sensor enabled	not valid because no sensor enabled
50	wrong access mode	wrong access mode
51	time out	
6D	EEProm not ready	
6E	wrong parameter ID	wrong parameter ID
6F	set to default value not possible	set to default value not allowed
70	parameter not settable	set value not allowed
71	parameter not readable	get value not allowed
72	set to initial value not possible	initial value not allowed
73	wrong parameter index	wrong parameter ID index (array)
74	initial value out of range	wrong initial value
76	wrong value	wrong value within range
77	wrong value, only reset possible	only value reset possible
78	not allowed in this state	not allowed in this state
7A	wrong service	service (action) not valid
7B	parameter not active	parameter is inactive
7C	parameter system error	parameter system error
7D	communication error	communication error (e.g. buffer overrun)
7E	unknown service	
7F	unexpected character	
80	no access rights	
81	no adequately hardware	
82	wrong object state	
84	no slave command	
85	command to unknown slave	
87	command to master only	
88	only G command allowed	
89	not supported	
A0	function is disabled	
A1	already done	

5.12.4.6 Samples:

	command	response
Open: Control Mode to 4	**p:010F0200000004**	**p:00010F0200000004**
		error 00 (successfully)
	service 01 (set)	service 01 (set)
	parameter 0F020000	parameter 0F020000
	Index 00	Index 00
	value 04	value 04
Position Control: Control Mode to 2	**p:010F0200000002**	**p:00010F0200000002**
		error 00 (successfully)
	service 01 (set)	service 01 (set)
	parameter 0F020000	parameter 0F020000
	Index 00	Index 00
	value 02	value 02
Target Positon to 70.0	**p:01110200000070**	**p:001110200000070.0**
		error 00 (successfully)
	service 01 (set)	service 01 (set)
	parameter 11020000	parameter 11020000
	Index 00	Index 00
	value 70	value 70
Get Actual Pressure	**p:0B1210000000**	**p:000B121000000023.1**
		error 00 (successfully)
	service 0B (get)	service 0B (get)
	parameter 12100000	parameter 12100000
	Index 00	Index 00
		value 23.1

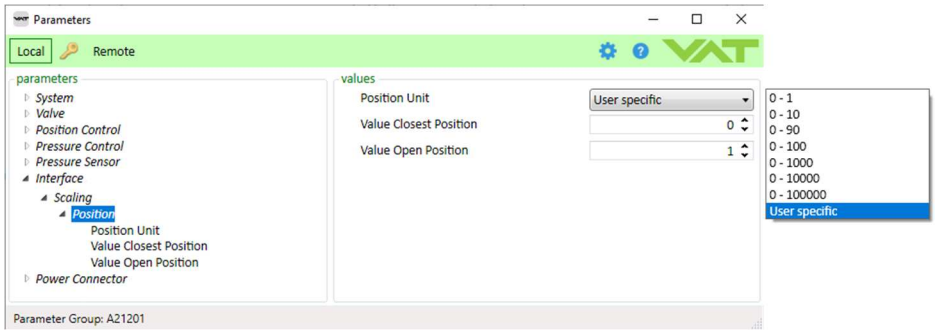
5.12.5 Position and Pressure Units

5.12.5.1 Position

Defined range is used in all commands with position values.

Location: CPA/Navigation/Parameters: Interface.Scaling.Position

Parameter	Description
Position Unit	*1,10,90,* ***100****,1000,10000, user specific*
Value Closest Position **Value Open Position**	Range if the setting of **Position Unit** is *user specific*

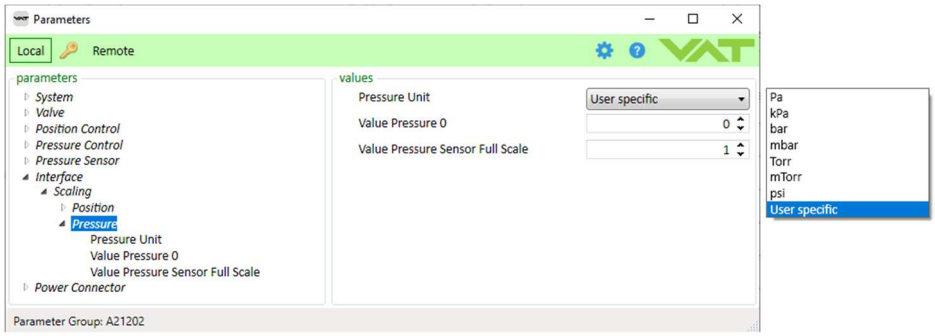


5.12.5.2 Pressure

Defined unit/range is used in all commands with pressure values.

Location: CPA/Navigation/Parameters: Interface.Scaling.Pressure

Parameter	Description
Pressure Unit	*Pa, kPa, bar,* ***mbar****, Torr, mTorr, psi, user specific*
Value Pressure 0 **Value Pressure Sensor Full Scale**	Range if the setting of **Pressure Unit** is *user specific*



5.12.6 Compound Commands

This function allows to SET and/or GET several values with one command.

Compound is a table parameter that can hold up to 20 parameters.
With the compound services 28, 29, 30 it is possible to set and/or get all the parameters contained in the compound parameter.
There are the possibilities to define up to 4 compounds:

5.12.6.1 Compound Parameter

Location: CPA/Navigation/Parameters: Interface RS232/RS485.Compound Commands

Parameter	ID [hex]	Data Type	Access	NV	Description
Compound 1	A10A0100	UINT32[20]	RW	NV	Takes parameters IDs which are then set and/or get with service 28,29, or 30
Compound 2	A10A0200	UINT32[20]	RW	NV	
Compound 3	A10A0300	UINT32[20]	RW	NV	
Compound 4	A10A0400	UINT32[20]	RW	NV	

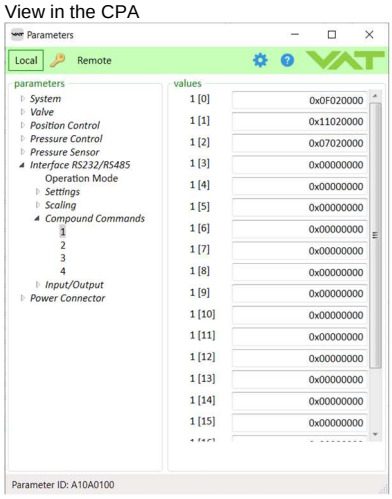
5.12.6.2 SET Compound

Build **Compound 1** A10A0100 (with 3 set values)

Index	Parameter	ID [hex]	Set compound members	Get compound members
00	*Control Mode*	0F020000	p:01A10A0100000F020000	p:0BA10A010000
01	*Target Position*	11020000	p:01A10A01000111020000	p:0BA10A010001
02	*Target Pressure*	07020000	p:01A10A01000207020000	p:0BA10A010002
03	*not used*	0	p:01A10A01000300000000	p:0BA10A010003
..	..	..	..	..

Note: All not used indexes must be set to 0

View in the CPA



Execute **Compound 1**

Service **28** SET	
Syntax	
Send	**p:|service|compound parameter ID|00|value;value;value;value**…
Receive	**p:|error|service|parameter|00|value;value;value;value**…
Execution	
Send	p:**28**A10A0100002;45.0;30.0
Receive	p:00**28**A10A0100000;2;45.0;30.0

5.12.6.3 GET Compound

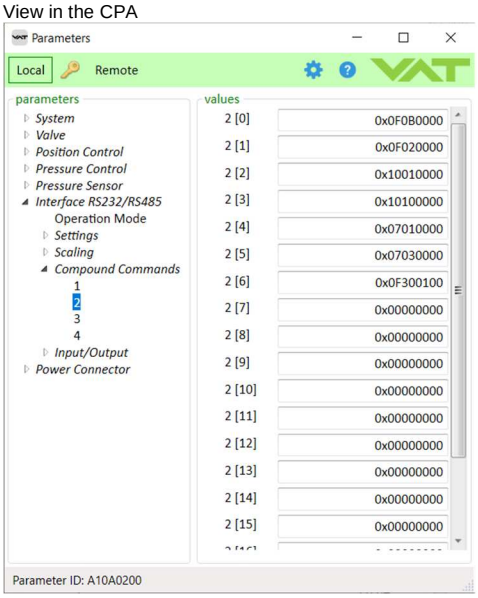
Build **Compound 2** A10A0200 (with 7 get values)

Index	Parameter	ID [hex]	Set compound members	Get compound members
00	*Access Mode*	0F0B0000	p:01A10A0200000F0B0000	p:0BA10A020000
01	*Control Mode*	0F020000	p:01A10A0200010F020000	p:0BA10A020001
02	*Actual Position*	10010000	p:01A10A02000210010000	p:0BA10A020002
03	*Position State*	00100000	p:01A10A02000310100000	p:0BA10A020003
04	*Actual Pressure*	07010000	p:01A10A02000407010000	p:0BA10A020004
05	*Target Pressure Used*	07030000	p:01A10A02000507030000	p:0BA10A020005
06	*Warning Bitmap*	0F300100	p:01A10A0200060F300100	p:0BA10A020006
07	*not used*	0	p:01A10A0200070	p:0BA10A020007

.. ..

Note: All not used indexes must be set to 0

View in the CPA



Execute **Compound 2**

Service **29** GET	
	Syntax
Send	**p:|service|compound parameter ID|00**
Receive	**p:|error|service|parameter|00|value;value;value;value**…
	Execute
Send	p:**29**A10A020000
Receive	p:00**29**A10A0200000;2;45.0;13.0;0:

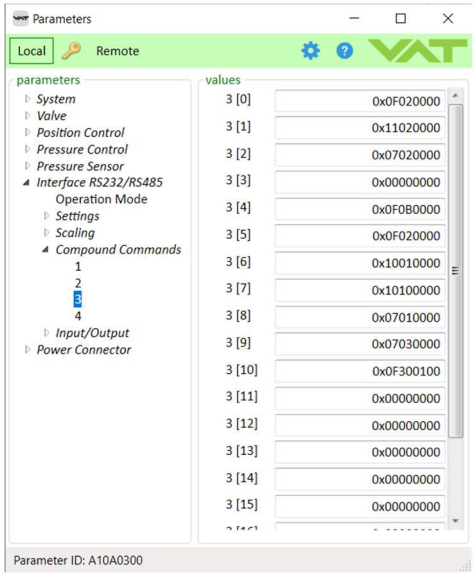
5.12.6.4 SET and GET Compound

Build **Compound 3** A10A0300 (with set and get values)

Index	Parameter	ID [hex]	Set compound members	Get
00	***Control Mode***	0F020000	p:01A10A0300000F020000	p:0BA10A030000
01	***Target Position***	11020000	p:01A10A03000111020000	p:0BA10A030001
02	***Target Pressure***	07020000	p:01A10A03000207020000	p:0BA10A030002
03	*Separation*	0	p:01A10A0300030	p:0BA10A030003
00	***Access Mode***	0F0B0000	p:01A10A0300040F0B0000	p:0BA10A030004
01	***Control Mode***	0F020000	p:01A10A0300050F020000	p:0BA10A030005
02	***Actual Position***	10010000	p:01A10A03000610010000	p:0BA10A030006
03	***Position State***	00100000	p:01A10A03000710100000	p:0BA10A030007
04	***Actual Pressure***	07010000	p:01A10A03000807010000	p:0BA10A030008
05	***Target Pressure Used***	07030000	p:01A10A03000907030000	p:0BA10A030009
06	***Warning Bitmap***	0F300100	p:01A10A03000A0F300100	p:0BA10A03000A
07	*not used*	0	p:01A10A03000B0	p:0BA10A03000B
..	..	..	..	..

Note: First Index with 0 is the separation between set and get, all other not used indexes must be set to 0

View in the CPA



Execute **Compound 3**

30 SET and GET	
	Syntax
Send	**p:|service|compound parameter ID|00|value;value;value;value**…
Receive	**p:|error|service|parameter|00|value;value;value;value**…
	Execute
Send	p:**30**A10A0300002;45.0;30.0
Receive	p:00**30**A10A0300000;2;45.0;0;24.91;0.0;0

5.12.7 Parameter Overview

A parameter list is available in the CPA if there is a connection with the CPA.
navigation → Parameters → Settings → Export Parameters to Excel

Abbreviations

RS	Read Write
RO	Read Only
NV	None Volatile
V	Volatile
Acc	Access

Data Type Info

STRING	Maximum length = 20 characters
BOOL	Boolean
SINT8	Signed Integer 8 bit (1 Byte)
UINT8	Unsigned Integer 8 bit (1 Byte)
SINT16	Signed Integer 16 bit (2 Byte)
UINT16	Unsigned Integer 16 bit (2 Byte)
SINT32	Signed Integer 32 bit (4 Byte)
UINT32	Unsigned Integer 32 bit (4 Byte)
FLOAT	Floating Point Number

5.12.7.1 System

Sub Group		Parameter	ID [hex]	Data Type	Acc	NV	Unit	Min	Max	Description
		Access Mode	0F0B0000	SINT8	RW	V		0	2	**0**:Local **1**:Remote **2**:Remote Locked
		Control Mode	0F020000	SINT8	RW	V		0	14	**0**:Init **1**:Homing **2**:Position **3**:Close **4**:Open **5**:Pressure Control **6**:Hold **7**:Learn **8**:Interlock Open **9**:Interlock Close **12**:Power Failure **13**:Safety **14**:Error
Identification		*Serial Number*	0F100100	STRING	RO	NV				Identification of the product
	Configuration	*Valve Series*	0F100201	UINT16	RO	NV		0	670	Example: **655** means series 65.5 valve
		Valve Variant	0F100202	UINT16	RO	NV		0	100	
		Nominal Diameter	0F100203	UINT16	RO	NV		0	62	**20**:DN10 **24**:DN16 **28**:DN25 **32**:DN40 **34**:DN50 **36**:DN63 **38**:DN80 **39**:DN88 **40**:DN100 **44**:DN160 **46**:DN200 **48**:DN250 **50**:DN320 **51**:DN350 **52**:DN400 **54**:DN500 **56**:DN630 **58**:DN800 **60**:DN1000 **62**:DN1250
		Drive Parameters ID	0F10020B	STRING	RO	NV				Manufactory settings ID for motion
		Configuration Parameters ID	0F10020A	STRING	RO	NV				Manufactory settings ID for customer-accessible settings: Interface, Sensor, Pressure Control,…
	Firmware	*Valve Firmware ID*	0F100301	STRING	RO	V				
		Valve Firmware Version	0F100302	STRING	RO	V				
		CPA Version	0F100306	STRING	RO	V				
		Interface Firmware Version	0F100303	STRING	RO	V				
		Motion Controller 1 Firmware Version	0F100304	STRING	RO	V				Axis 1
		Motion Controller 2 Firmware version	0F100305	STRING	RO	V				Axis 2 → displayed if available
		Motion Controller 3 Firmware version	0F100307	STRING	RO	V				Axis 3 → displayed if available
		Motion Controller 4 Firmware version	0F100308	STRING	RO	V				Axis 4 → displayed if available
	Hardware	*Controller Type*	0F100401	UINT16	RO	NV		1	5	**1 … 7**: IC2H1 … IC2H7
		Interface Type	0F100402	UINT16	RO	NV		1	8	**1**:RS232/485 **2**:EtherCAT **3**:DeviceNet **5**:Logic **7**:Profibus **8**:CC-Link **9**: Ethernet
		Option Type	0F100403	UINT16	RO	V		0	15	**0**: Not Available **1**: SPS **2**: Cluster **3**: SPS+Cluster **4**: PFO **5**: SPS+PFO **6**: PFO+Cluster **7**: SPS+PFO+Cluster **8**: PFO2 **9**: SPS+PFO2 **10**: PFO2+Cluster **11**: SPS+PFO2+Cluster **12**: PFO3 **13**: SPS+PFO3 **14**: PFO3+Cluster **15**: SPS+PFO3+Cluster
Statistics		*Start Up Counter*	0F200100	UINT32	RO	NV				
		Total Time Powered	0F200200	UINT32	RO	NV	sec			
		Time Since Power On	0F200300	UINT32	RO	V	sec			
Warning/ Error		*Warning Bitmap*	0F300100	UINT32	RO	V				Revere to Trouble shooting
		Error Bitmap	0F300500	UINT32	RO	V				Revere to Trouble shooting
		Error Number	0F300600	UINT16	RO	V				Revere to Trouble shooting
		Error Code	0F300700	UINT16	RO	V				Revere to Trouble shooting
Services		*Restart Controller*	0F500100	BOOL	RW	V				Emulates a power cycle
		Error Recover	0F506600	BOOL	RW	V				Attempts to fix the error without restart
	Store / Restore Settings	*Store User Parameters*	0F500202	BOOL	RW	V				Back-up for all setting
		Restore User Parameters	0F500203	BOOL	RW	V				Restore settings from the Back-up
		Restore Factory Parameters	0F500205	BOOL	RW	V				Restores the delivery state
		Configuration Lock Mode	0F500500	BOOL	RW	NV				Locking the valve settings. If true, no changes to the settings are possible. **0**:not locked **1**:locked

5.12.7.2 Valve

Sub Group	Parameter	ID [hex]	Data Type	Acc	NV	Unit	Min	Max	Description

	Actual Position	10010000	FLOAT	RO	V	[pos]*	0	100	
	Position State	10100000	UINT8	RO	V		0	2	**0**:Intermediate **1**:Closed **2**:Open
	Isolation State	10110000	BOOL	RO	NV		0	1	**0**:Not Isolated **1**:Isolated
Homing	*Start Condition*	10200100	UINT8	RW	NV		0	5	**0**:Standard Do homing after restart if valve is not in sealed state, if it is sealed wait to a move command (except close command) **1**:Open Command **2**:Move Command **3**:At Startup **4**:Homing Command (Control Mode Homing) **5**:Move Command/Standard Same as 4:Move Command, but except close command
	End Control Mode	10200300	SINT8	RW	NV		2	5	***Control Mode*** after homing **2**:Positon **3**:Close **4**:Open **5**:Pressure Control
	End Position	10200400	FLOAT	RW	NV	[pos]*	0	100	Position to **End Control Mode** *2: Position*
	Status	10201100	SINT16	RO	V		0	3	**0**:Not Started **1**:In Progress **2**:Completed Successfully **3**:Error Occurred
Cycle Counter	*Control Cycles*	10300100	UINT32	RW	NV				The valve movement is summarized. The distance open > close > open is 1 Control Cycle. This value can be manipulated by the customer (set to 0 after service, for example)
	Control Cycles Total	10300200	UINT32	RO	NV				This value is the number of Control Cycles in valve lifespan.
	Isolation Cycles	10300300	UINT32	RW	NV				A Isolation Cycle is done if the valve has reached the sealed state. This value can be manipulated by the customer. (set to 0 after service, for example)
	Isolation Cycles Total	10300400	UINT32	RO	NV				This value is the number of Isolation Cycle in valve lifespan.
Position Restriction	*Enable*	10640100	BOOL	RW	NV		0	1	Limit the valve movement in Control Mode **Pressure, Position, Open, Interlock Open**
	Maximum Position	10640300	FLOAT	RW	NV	[pos]*	0	100	
	Restriction Active	10640400	BOOL	RO	V		0	1	True if the position is currently limited (Target Position is within the limit)
Position Adaption	*Enable*	10660100	BOOL	RW	NV		0	1	
	Mode	10660200	UINT8	RO	V		1	1	**0**: Offset Currently, only the offset mode is available.
	Actual Position	10660300	BOOL8	RW	NV		0	1	**0**: Real, actual position shows valve position with added offset value **1**: Adapted, actual position shows valve position without added offset value
	Offset	10660400	FLOAT	RW	NV	[pos]*	0	30	
	Target Position In	10660500	FLOAT	RO	V	[pos]*	0	100	Same Value as Target Position under Position Control
	Target Position Used	10660600	FLOAT	RO	V	[pos]*	0	100	Target Position In value added with offset value
	Actual Position Real	10660700	FLOAT	RO	V	[pos]*	0	100	Actual Position with offset value
	Actual Position Adapted	10660800	FLOAT	RO	V	[pos]*	0	100	Actual Position without offset value

Sub Group	Parameter	ID [hex]	Data Type	Acc	NV	Unit	Min	Max	Descripiton
Oring Pull Out Prevention	*Enable*	10650100	FLOAT	RW	NV				Only for series 65.3
	Delay Homing	10650300	FLOAT	RW	NV	sec			Only for series 65.3
	Delay Close	10650400	FLOAT	RW	NV	sec			Only for series 65.3

	Compressed Air Pressure	10A40000	FLOAT	RW	NV	mbar*		Only for series 65.3
	Compressed Air Error Enable	10A90000	BOOL	RW	NV			Only for series 65.3
	Speed Mode	10990000						**0**: Low Speed **1**: Mid Speed **2**: High Speed **3**: Undefined **4**: IC Slow Pos/Slow Prs **5**: IC Fast Pos/Slow Prs **6**: IC Fast Pos/Fast Prs Available speed Mode depends on valve series

5.12.7.3 Position Control

Sub Group	Parameter	ID [hex]	Data Type	Acc	NV	Unit	Min	Max	Description
	Actual Position	11010000	FLOAT	RO	V	[pos]*	0	100	
	Target Positon	11020000	FLOAT	RW	V	[pos]*	0	100	
	Position Control Speed	11030000	FLOAT	RW	NV		0.001	1	Speed valid in ***Control Mode*** = Position 1.0 equals to full speed
Ramp	*Enable*	11620100	BOOL	RW	NV		0	1	Activate/Deactivate position target ramp.
	Time	11620200	FLOAT	RW	NV	sec	0	1000000	
	Slope	11620300	FLOAT	RW	NV	mbar*/sec	0	100000000	
	Mode	11620400	UINT8	RW	NV		0	1	**0**:Use Ramp Time **1**:Use Ramp Slope
	Type	11620500	UINT8	RW	NV		0	2	**0**:Linear **1**:Logarithmic **2**:Exponential

5.12.7.4 Pressure Control

Sub Group		Parameter	ID [hex]	Data Type	Acc	NV	Unit	Min	Max	Description
		Target Pressure Used	07030000	FLOAT	RO	V	mbar*	0	SFS	This value is set as pressure controller input. It differs to the Target Pressure if a pressure ramp is used.
		Pressure Control Speed	07050000	FLOAT	RW	NV**		0.001	1	Speed valid in ***Control Mode*** = Pressure 1.0 equals to full speed
		Controller Selector	07100000	UINT8	RW	NV**		1	4	Active Controller in ***Control Mode*** = Pressure **1**:Controller 1 **2**:Controller 2 **3**:Controller 3 **4**:Controller 4
Controller 1 xx = 11 Controller 2 xx = 12 Controller 3 xx = 13 Controller 4 xx = 14		*Control Algorithm*	07xx0100	UINT8	RW	NV**		0	2	**0**:Adaptive **1**:PI **2**:Soft Pump
	Adaptive Setting	*Gain Factor*	07xx0203	FLOAT	RW	NV**		0.000 1	100	
		Sensor Delay	07xx0204	FLOAT	RW	NV**	sec	0	1	
		Learn Data Selection	07xx0205	FLOAT	RW	NV**				**0**: Learn Bank 1 **1**: Learn Bank 2 **2**: Learn Bank 3 **3**: Learn Bank 4
	PI Soft Pump Settings	*P-Gain*	07xx0201	FLOAT	RW	NV**		0.001	100	Proportional Gain
		I-Gain	07xx0202	FLOAT	RW	NV**		0	100	Integral Gain
		Control Direction	07xx0206	BOOL	RW	NV**		0	1	**0**: Downstream **1**: Upstream (not supported by Adaptive Control Algorithm)
		Pressure Scaler	07xx0223	UINT8	RW	NV**		0	1	Defines the used pressure scaling inside the pressure controller. **0**: Linear **1**: Logarithmic
	Ramp	*Enable*	07xx0301	BOOL	RW	NV**		0	1	Activate/Deactivate pressure target ramp. The effective target pressure can be read in ***Target Pressure Used***
		Time	07xx0302	FLOAT	RW	NV**	sec	0	1000000	Target reach time
		Slope	07xx0303	FLOAT	RW	NV**	mbar*/sec	0	1000000	
		Mode	07xx0304	UINT8	RW	NV**		0	1	**0**:Use Ramp Time **1**:Use Ramp Slope
		Type	07xx0306	UINT8	RW	NV**		0	1	**0**:Linear **1**:Logarithmic **2**:Exponential
		Start Value	07xx0305	UINT8	RW	NV**		0	1	**0**:Previous Ramp Value **1**:Actual Pressure Value
General Settings		*Store Control Parameter Volatile*	07301100	BOOL	RW	NV		0	1	**0**: Store in NV Memory **1**: Do Not Store in NV Memory
	Control Position Restriction	*Enable*	07301201	BOOL	RW	NV				Limit the movement during pressure control
		Minimum Control Position	07301202	FLOAT	RW	NV	[pos]*	0	100	
		Maximum Control Position	07301203	FLOAT	RW	NV	[pos]*	0	100	
	Automated Controller Selector	*Enable*	07301701	BOOL	RW	NV		0	1	
		Mode	07301702	UINT8	RW	NV				**0**: Threshold **1**: Pressure Direction
		Controller Selector Bitmap	07301703	UINT8	RW	NV				Selection of those controllers that are used
		Threshold Condition	07301710	UINT8	RW	NV				**0**: Lower Or Equal **1**: Equal
		Controller 1 Threshold	07301704	FLOAT	RW	NV	mbar*			Used if Mode = *Threshold*
		Controller 2 Threshold	07301705	FLOAT	RW	NV	mbar*			Used if Mode = *Threshold*
		Controller 3 Threshold	07301706	FLOAT	RW	NV	mbar*			Used if Mode = *Threshold*
		Controller 4 Threshold	07301707	FLOAT	RW	NV	mbar*			Used if Mode = *Threshold*
		Controller Pressure Rising	07301720	UINT8	RW	NV		1	4	Used if Mode = *Pressure Direction*
		Controller Pressure Falling	07301721	UINT8	RW	NV		1	4	Used if Mode = *Pressure Direction*

Sub Group		Parameter	ID [hex]	Data Type	Acc	NV	Unit	Min	Max	Description
General Settings	Profile Ramp	*Enable*	07301801	BOOL	RW	NV		0	1	
		Threshold Mode	07301802	UINT8	RW	NV				**0**: Actual Pressure **1**: Target Pressure Used
		Ramp Type	07301840	UINT8	RW	NV				**0**:Linear **1**:Logarithmic **2**:Exponential
		Actual Slope	07301841	FLOAT	R	-	mbar*/ sec			
		Controller Selector Bitmap	07301811	UINT8	RW	NV		0	15	Selects controller which are used the Proifle Ramp
		Segment Selector Bitmap	07301810	UINT8	RW	NV		0	1023	Selects segments which are used in the profile
		Segment x Threshold	07301820	FLOAT	RW	NV	mbar*			Defines the upper limit of a segment 10 Segments are available
		Segment x Slope	07301830	FLOAT	RW	NV	mbar*/ sec			Define the slope in the segment
Adaptive Learn		*Start Learn*	07501000	BOOL	RW	V		0	1	Start learn procedure by setting to 1
		Bank Selection	07500200	SINT8	RW	NV		0	3	Select a learn bank to safe the data for the following learn procedure **0**:Bank 1 **1**:Bank 2 **2**:Bank 3 **3**:Bank 4
		Pressure Limit [SFS]	07500300	FLOAT	RW	NV	SFS	0.0001	1.2	Learn procedure will be executed to the Pressure Limit
		Pressure Limit	07500800	FLOAT	RW	NV	mbar*			See Pressure Limit [SFS] above, same functionality but user pressure scaling is used
		Open Speed	07500400	FLOAT	RW	NV		0.001	1	1.0 equals to full speed
		Status	07500600	SINT8	RO	V		0	4	**0**:Not Started **1**:In Progress **2**:Completed Successfully **3**:Aborted **4**:Failed
		Warning Info	07500700	UINT16	RO	V				Bit 1: Checksum error Bit 2: Terminated by user Bit 3: Unsuitable learn condition / pressure too high Bit 4: Unsuitable learn condition / pressure too low Bit 5: Pressure decreasing instead of rising Bit 6: Open pressure does not match
	Learn Bank 1 xx = 11 Learn Bank 2 xx = 12 Learn Bank 3 xx = 13 Learn Bank 4 xx = 14	*Status*	0750xx01	SINT8	RO	NV		0	2	**0**:Not used **1**:Avaialable **2**:Available with warnings
		Data	0750xx02	UINT32	RW	NV				To copy learn data copy this content to another bank (or valve)
		Warning Info	0750xx09	UINT16	RO	NV				Bit 1: Checksum error Bit 2: Terminated by user Bit 3: Unsuitable learn condition / pressure too high Bit 4: Unsuitable learn condition / pressure too low Bit 5: Pressure decreasing instead of rising Bit 6: Open pressure does not match
		Type	0750xx0A	SINT8	RO	NV		0	2	**0**:Standard **1:**Short **2**:Calculated
		Delete Learn Bank Data	0750xx0F	BOOL	RW	V		0	1	Set to 1 delete learn bank data.

5.12.7.5 Pressure Sensor

Sub Group		Parameter	ID [hex]	Data Type	Acc	NV	Unit	Min	Max	Description
		Actual Pressure	12100000	FLOAT	RO	V	mbar*			
Zero Adjust		***Sensor Selection***	12040100	SINT8	RW	V		0	2	**0**:Sensor 1 + 2 **1**:Sensor 1 **2**:Sensor 2 **3**: none
		Target Pressure	12040300	FLOAT	RW	V	mbar*			Typically 0.0 when the chamber is fully pumped down.
		Execute	12040400	SINT8	RW	V		1	2	**1**:Execute Zero Adjust **2**:Clear Offset Value
Sensor 1 xx = 01 Sensor 2 xx = 02		***Available***	12xx0100	BOOL	RW	NV		0	1	There is a sensor at this port
		Enable	12xx0200	BOOL	RW	NV		0	1	Used to build ***Actual Pressure,*** used for pressure control
		Input Source	12xx0600	SINT8	RW	NV		0	2	**0**:Analog **1**:Digital **2**:Simulation
	Range	***Data Unit***	12xx0301	SINT8	RW	NV		0	7	**0**:Pa **3**:mbar **6**:psia **1**:kPa **4**:Torr **7**:psig **2**:bar **5**:mTorr
		Upper Limit Data Value	12xx0302	FLOAT	RW	NV	see Data Unit			Define the range of the of the pressure sensor. E.g.: 100 mTorr sensor: ***Data Type: mTorr*** ***Upper Limit Data Value*** = 100. **Lower Limit Data Value** = 0
		Lower Limit Data Value	12xx0303	FLOAT	RW	NV	see Data Unit			
		Upper Limit Voltage Value	12xx0304	FLOAT	RW	NV	Volt			Defines the voltage range of the sensor E.g.: 0..10V
		Lower Limit Voltage Value	12xx0305	FLOAT	RW	NV	Volt			
		Voltage Per Decade	12010311	FLOAT	RW	NV	Volt			E.g.: Logarithmic Sensor with 1000Torr SFS at 9.0V and 1V/Decade: ***Upper Limit Data Value*** = 1000 ***Upper Limit Voltage Value*** = 9 ***Voltage Per Decade*** = 1
		Scale	12xx0310	SINT8	RW	NV		0	1	**0**:Linear **1**:Logarithmic
	Zero Adjust	***Enable***	12xx0401	BOOL	RW	NV		0	1	
		Offset Value [SFS]	12xx0402	FLOAT	RW	NV	SFS			Value 1.0 means sensor full scale. For example for a 0-10 Volt gauge the value 0.1 means 1 Volt
	Filter	***Enable***	12xx0501	BOOL	RW	NV		0	1	
		Time	12xx0502	FLOAT	RW	NV	sec	0	1	
	Analog Sensor Input	***Value***	12xx1101	FLOAT	RO	V	mbar*			
	Digital Sensor Input	***Value***	12xx100A	FLOAT	RW	V	mbar*			
		Value	12xx0A00	FLOAT	RO	V	mbar*			Pressure value of the sensor
Crossover		***Crossover Mode***	12050100	SINT8	RW	NV		0	2	Transition method between the sensors **0**:Soft Switch → In the transition area a summation of both pressure signals **1**:Hard Switch → Crossover with hysteresis **2**:Target Pressure → During pressure control sensor is selected depending on Target Pressure, in other modes Soft Switch is used
		Threshold High [SFS low sensor]	12050300	FLOAT	RW	NV	SFS of low sensor	0	1	Defines the transition area respectively the hysteresis limits.
		Threshold Low [SFS low sensor]	12050200	FLOAT	RW	NV	SFS of low sensor	0	1	
		Delay	12050400	FLOAT	RW	NV		0.0	10.0	Only relevant in ***Crossover Mode*** = Hard Switch Delay start after reaching the hysteresis limit
General Setting	Logarithmic Pressure	***Actual Logarithmic Value***	12A10101	FLOAT	RO	V				
		Upper Limit Value	12A10103	FLOAT	RO	V				Corresponds to the SFS according to the sensor settings
		Percent Per Decade	12A10104	FLOAT	RW	NV	%			Defines the logarithmic scaling
		Lowest Pressure	12A10107	FLOAT	RW	NV	mbar*			Limitation of the lowest pressure if a linear sensor is connected that become <= 0
		Pressure on Interface	12A10105	BOOL	RW	NV				**0**:Linear: Linear signal is used on Interface **1**:Logarithmic: Logarithmic signal is used on Interface
		Use Logarithmic from Sensor	12A10106	BOOL	RW	NV				If a logarithmic sensor is connected, the sensor signal can be used directly.

5.12.7.6 Interface RS232/RS485

Sub Group	Parameter	ID [hex]	Data Type	Acc	NV	Unit	Min	Max	Description
	Operation Mode	A1010000	SINT8	RW	NV		0	2	**0**:RS232 **1**:RS485 **2**:Service Interface Over RS232
Settings	*Baud Rate*	A1110100	SINT8	RW	NV		0	7	**0**:1200 **3**:9600 **6**:57600 **1**:2400 **4**:19200 **7**:115200 **2**:4800 **5**:38400
	Data Bit Length	A1110200	SINT8	RW	NV		0	1	**0**:7 **1**:8
	Stop Bit	A1110300	SINT8	RW	NV		0	1	**0**:1 **1**:2
	Parity Bit	A1110400	SINT8	RW	NV		0	2	**0**:None **1**:Even **2**:Odd
	Topology	A1110800	SINT8	RW	NV		0	1	Only used if **Operation Mode** = RS485 **0**:Full Duplex **1**:Half Duplex
	Network	A1110900	SINT8	RW	NV		0	1	Only used if **Operation Mode** = RS485 **0**:Multiple Devices **1**:Point to Point
	Address	A1110A00	UINT8	RW	NV		0	255	Only used if **Operation Mode** = RS485
	Command Set	A1110500	SINT8	RW	NV		0	2	**0**:IC **3**: Tylan **1**:PM **4**: Tylan Type 1 **2**:PM V2 **5**: Tylan Type 2
	Command Termination	A1110B00	SINT8	RW	NV		0	2	**0:** Carriage Return + Line Feed **1:** Line Feed **2:** Carriage Return
	R A Answer								Only for ***Command Set*** = IC,PM, PMV2 **0**: Standard **1**: i:76
	Second Answer								Only for ***Command Set*** = PM, PMV2 **0**:Off **1**:Pos/Prs **2**:Pos
	Learn Answer								Only for ***Command Set*** = PM, PMV2 **0**:Immediatelly **1**:Learn End
	Command t Mode								Only for ***Command Set*** = PM, PMV2 **0**:Without Ramp Time **1**:With Ramp Time
	Tylan M1								Only for ***Command Set*** = Tylan, Tylan Type 2 **0**:None **1**:Gain Factor/P-Gain
	Tylan X1								Only for ***Command Set*** = Tylan, Tylan Type 2 **0**:None **1**:Ramp Time/I-Gain
	Tylan J3								Only for ***Command Set*** = Tylan, Tylan Type 2 **0**:None **1**:Restart
	Tylan V								Only for ***Command Set*** = Tylan Type 1, Type 2 **0**:None **1**:Pressure Control Selector
Compound Commands	*1[20]*	A10A0100	UINT32	RW	NV				Parameter compilation for set and/or get several Parameters with one command Array of 20 Parameters
	2[20]	A10A0101	UINT32	RW	NV				
	3[20]	A10A0102	UINT32	RW	NV				
	4[20]	A10A0103	UINT32	RW	NV				

Sub Group		Parameter	ID [hex]	Data Type	Acc	NV	Unit	Min	Max	Description
Scaling	Position	***Position Unit***	A1120101	SINT16	RW	NV		0	7	**0**:0 - 1 **1**:0 - 10 **2**:0 - 90 **3**:0 - 100 **4**:0 - 1000 **5**:0 - 10000 **6**:0 - 100000 **7**:User specific (Range is defined by ***Value Closest Position*** and ***Value Open Position***)
		Value Closest Position	A1120102	FLOAT	RW	NV				Defines the *User Specific* range
		Value Open Position	A1120103	FLOAT	RW	NV				
	Pressure	***Pressure Unit***	A1120201	SINT16	RW	NV		0	7	**0**:Pa **1**:kPA **2**:bar **3**:mbar **4**:Torr **5**:mTorr **6**:psi **7**:User specific (Range is defined by ***Value Pressure 0*** and ***Value Pressure Sensor Full Scale***)
		Value Pressure 0	A1120202	FLOAT	RW	NV				Defines the *User Specific* range
		Value Pressure Sensor Full Scale	A1120203	FLOAT	RW	NV				
Compound Commands		***1[20]***	A10A0100	UINT32	RW	NV				Parameter compilation for set and/or get several Parameters with one command Array of max 20 Parameter IDs
		2[20]	A10A0101	UINT32	RW	NV				
		3[20]	A10A0102	UINT32	RW	NV				
		4[20]	A10A0103	UINT32	RW	NV				
Input Output	Digital Input 1	***Enable***	A1200101	BOOL	RW	NV		0	1	
		State	A1200102	BOOL	RO	V		0	1	
		Functionality	A1200103	SINT8	RW	NV		0	2	**0**:Interlock Open **1**:Interlock Close **2**:Hold
		Inverted	A1200104	BOOL	RW	NV		0	1	
	Digital Input 2	***Enable***	A1200201	BOOL	RW	NV		0	1	
		State	A1200202	BOOL	RO	V		0	1	
		Functionality	A1200203	SINT8	RW	NV		0	2	**0**:Interlock Open **1**:Interlock Close **2**:Hold
		Inverted	A1200204	BOOL	RW	NV		0	1	
	Digital Output 1	***Enable***	A1200301	BOOL	RW	NV		0	1	
		State	A1200302	BOOL	RO	V		0	1	
		Functionality	A1200303	SINT8	RW	NV		0	2	**0**:Open **1**:Close **2**:Hold
		Inverted	A1200304	BOOL	RW	NV		0	1	
	Digital Output 2	***Enable***	A1200401	BOOL	RW	NV		0	1	
		State	A1200402	BOOL	RO	V		0	1	
		Functionality	A1200403	SINT8	RW	NV		0	2	**0**:Open **1**:Close **2**:Hold
		Inverted	A1200404	BOOL	RW	NV		0	1	
	Analog Output Pressure	***Value***	A1200501	FLOAT	RO	V	Volt	0.0	10.0	
		User Factor	A1200502	FLOAT	RW	NV		0.1	10.0	
		User Offset	A1200503	FLOAT	RW	NV		-10.0	10.0	
	Analog Output Position	***Value***	A1200601	FLOAT	RO	V	Volt	0.0	10.0	
		User Factor	A1200602	FLOAT	RW	NV		0.1	10.0	
		User Offset	A1200603	FLOAT	RW	NV		-10.0	10.0	

5.12.7.7 Power Connector IO

Sub Group	Parameter	ID [hex]	Data Type	Acc	NV	Unit	Min	Max	Description
Digital Input 1	*Enable*	37010100	BOOL	RW	NV		0	1	Logic IO available on the valve power connector
	State	37010200	BOOL	RO	V		0	1	
	Functionality	37010300	SINT8	RW	NV		0	2	**0**:Interlock Open **1**:Interlock Close **2**:Hold
	Inverted	37010400	BOOL	RW	NV		0	1	
Digital Input 2	*Enable*	37020100	BOOL	RW	NV		0	1	Logic IO available on the valve power connector
	State	37020200	BOOL	RO	V		0	1	
	Functionality	37020300	SINT8	RW	NV		0	2	**0**:Interlock Open **1**:Interlock Close **2**:Hold
	Inverted	37020400	BOOL	RW	NV		0	1	
Digital Output 1	*Enable*	37030100	BOOL	RW	NV		0	1	Logic IO available on the valve power connector
	State	37030200	BOOL	RO	V		0	1	
	Functionality	37030300	SINT8	RW	NV		0	2	**0**:Open **1**:Close **2**:Hold
	Inverted	37030400	BOOL	RW	NV		0	1	
Digital Output 2	*Enable*	37040100	BOOL	RW	NV		0	1	Logic IO available on the valve power connector
	State	37040200	BOOL	RO	V		0	1	
	Functionality	37040300	SINT8	RW	NV		0	2	**0**:Open **1**:Close **2**:Hold
	Inverted	37040400	BOOL	RW	NV		0	1	
	Drive Power Enable	37500000	BOOL	RO	V		0	1	Drive/Motor power can be enabled/disabled by a power connector pin (safety feature). This parameter shows if the drive/motor power is enabled. Refer to manual for further information.

5.12.7.8 Power Fail Option

Only if a Power Fail Option is installed.

Sub Group	Parameter	ID [hex]	Data Type	Acc	NV	Unit	Min	Max	Description
	Enable	22010000	BOOL	RW	NV				Only valid if a Power Fail Option is available
	State	22020000	SINT8	RO	V		0	3	**0**:Battery is Charging **1**:Ready To Use **2**:Active **3**:Failure
	Functionality	22030000	SINT8	RW	NV		0	1	**0**:Open **1**:Close
	Delay	22040000	FLOAT	RW	NV		0.0	2.0	
	Battery Voltage	22050000	FLOAT	RO	V				
	Power Fail Cycles	22060000	UINT16	RW	NV				

5.12.8 Compatible Command Sets

IC2 command syntax (p: command described above) is working independent from the set compatible **Command Set**

Location: CPA\Parameters: Interface RS232/RS485.Command Set

Parameter	Description	
Command Set	**IC**	First VAT integrated controller with RS232 Service Port
	PM	VAT PM controller
	PM V2	VAT PM controller with sensor crossover
	Tylan Tylan Type 1 Tylan Type 2	These instruction sets are often used in controllers from other manufacturers

5.12.8.1 Command Set IC

Note:
All position and pressure values are integer values and they are scalable:

Default range pressure 0 … 1000000
position 0 … 100000

Location: CPA/Parameters: Interface RS232/RS485.Scaling

Command Specific Setting
Location: CPA\Parameters: Interface RS232/RS485.Settings

Parameter	Description	
R S Answer	Specifies response to R (set position) and S (set pressure) commands	
	Standard	Response is 'R:' or 'S:'
	i:76	Response is same as the i:76 request command, see below

System

Set	Resp	Get	Resp	Data Set, Get Resp	Description
c:01	c:01			aa	Access Mode: 0=Local, 1=Remote, 2=Locked
		i:80	i:80	abcdefgh	Hardware Configuration a Power Failure Option: 0=no, 1=yes b Sensor Power Supply: 0=no, 1=yes c Interface Type: 2=RS232, 3=RS323 with AO, 8=RS232/RS485, 9=RS232/485 with AO d Sensor Inputs: 0, 1 or 2 e Cluster Option: 0=no, 1=yes f External Isolation Valve: 0=no, 1=yes g Reserved h Small Size Controller: 0=no, 1=yes
		i:82	i:82	string	Firmware
		i:83	i:83	string	Serial Number
		i:30	i:30	abcdeeef	Device Status a Access Mode: 0=Local, 1=Remote, 2=Locked b Control Mode: 0=Init,1=Homing,2=Position,3=Close,4=Open,5=Pressure Control,6=Hold,7=Learn,8=Interlock Open,9=Interlock Close,12=Power Failure,13=Safety,14=Error c PFO Disabled: 0=no, 1=yes d Warning Present: (in i:51 or i:52) 0=no, 1=yes e Reserved f Sensor Simulation Active: 0=no, 1=yes

System

Set	Resp	Get	Resp	Data Set, Get Resp	Description
		i:76	i:76	aaaaaa bbbbbbbbcde	Compound a Pressure b Position c Access Mode: 0=Local, 1=Remote, 2=Locked d Control Mode: 0=Init,1=Homing,2=Position,3=Close,4=Open,5=Pressure Control,6=Hold,7=Learn,8=Interlock Open,9=Interlock Close,12=Power Failure,13=Safety,14=Error e Warning Present: (in i:51 or i:52) 0=no, 1=yes
s:04	s:04	i:04	i:04	abcdefgh	Valve Configuration a Homing End Position: 0=Close, 1=Open b Power Failure Position: 0=Close, 1=Open c External Isolation Valve Enable: 0=no, 1=yes d Control Stroke Limitation Enable: 0=no, 1=yes e Network Failure Position f Cluster Valve Offline g Homing Start: 0=Not Isolated or Move Command, 1=c:4303 Command, 2=Open Command, 3=Move Command, 1=At Power Up h Reserved
		i:50	i:50	aaa	Fatal Error Number: 20=Limit Stop Not Detected, 21=Blocked, 22=Blocked, 40=Motor Driver
c:53	c:53	i:51 i:53	i:51 i:53	abcdefgh	Warnings 1 a Service Request b Learn Data Warning c PFO not ready d Compressed Air Failure e Sensor Ratio f External Isolation Valve Warning g Cluster Slave Offline h Network Failure i:53 = nonvolatile, c :5300 = reset
c:54	c:54	i:52 i:54	i:52 i:54	abcdefgh	Warnings 2 a Rom Memory b Interface c Sensor ADC d Interface ADC e Reserved f Sensor value not valid g Cluster Slave Offline h Network Failure i:54 = nonvolatile, c :5400 = reset
c:20	c:20	i:70	i:70	aaaaaaaaaa	Counter Control Cycles c:2000 = reset
c:21	c:21	i:71	i:71	aaaaaaaaaa	Counter Isolation Cycles c:2100 = reset
c:22	c:22	i:72	i:72	aaaaaaaaaa	Counter Power Up c:2200 = reset
c:10	c:10			aa	Power Failure Option Off: 0=Off (volatile), 1=On
c:82	c:82			aa	Reset: 1=Reset

Positon

Set	Resp	Get	Resp	Data Set, Get Resp	Description
		A:	A:	aaaaaa	Actual Position
C:	C:				Close
O:	O:				Open
R:	R:	i:38	i:38	aaaaaaaa	Position Control, a Target Position
H:	H:				Hold
N:	N:				Position Mode (Release Hold)
V:	V:	i:68	i:68	aaaaaa	Speed: 0 - 1000

Pressure Reading

Set	Resp	Get	Resp	Data Set, Get Resp	Description	
		P:	P:	aaaaaaaa	Actual Pressure	
s:01	s:01	i:01	i:01	abccccccc	Setup	
					a Sensor Mode	0=No Sensor 1=Sensor1 Only 3=Sensor2 Only 2=Sensor1 High, Sensor2 Low, Crossover Soft Switch 4=Sensor2 High, Sensor1 Low, Crossover Soft Switch 5=Sensor1 High, Sensor2 Low, Crossover High Disabled 6=Sensor2 High, Sensor1 Low, Crossover High Disabled 7=Sensor1 High, Sensor2 Low, Crossover Target Pressure 8=Sensor2 High, Sensor1 Low, Crossover Target Pressure 9=Sensor1 High, Sensor2 Low, Crossover Hard Switch 10=Sensor2 High, Sensor1 Low, Crossover Hard Switch
					b Zero Adjust Enable	0=disable, 1=enable
					c Sensor Factor	Ratio between the sensors * 100 Example: Sensor 1=1Torr, Sensor 2=100mTorr → c = 010000
Z:	Z:				Zero	
		i:60	i:60	aaaaaaaa	Offset Sensor 1	
		i:61	i:61	aaaaaaaa	Offset Sensor 2	
		i:62	i:62	aaaabbbb	Offsets: a Sensor 1, b Sensor 2, range -140 ... +150 of 1000	
		i:64	i:64	aaaaaaaa	Pressure Sensor 1	
		i:65	i:65	aaaaaaaa	Pressure Sensor 2	
c:6002	c:60			aaaaaaaa	Pressure Alignment, a = Alignment pressure	
c:6102	c:61			aaaaaaaa	Pressure Alignment, a = Alignment pressure	
c:90	c:90			aa	Pressure Simulation, 0=Off, 1=On	

Pressure Control

Set	Resp	Get	Resp	Data Set, Get Resp	Description
S:	S:	i:38	i:38	aaaaaaaa	Pressure Control, a Target Pressure
H:	H:				Hold
K:	K:				Pressure Control Mode (Release Hold)
s:02 s:02a	s:02	i:02 i:02a	i:02	abcdeeff	Pressure Control Setup a Controller: 0=Adaptive,1=PI Downstream,2=PI Upstream,3=Softpump b Gain Factor (Adaptive) 0=0.1,1=0.13,2=0.18,3=0.23,4=0.32,5=0.42,6=0.56,7=0.75,8=1.0,9=1.33,A=1.78,B=2.37, C=3.16,D=4.22,E=5.62,F=7.5,G=0.0001,H=0.0003,I=0.001,J=0.003,K=0.01,L=0.02,M=0.05 c Sensor Delay (Adaptive) 0=0,1=0.02,2=0.04,3=0.06,4=0.08,5=0.1,6=0.15,7=0.2, 8=0.25,9=0.3,A=0.35,B=0.4,C=0.5,D=0.6,E=0.8,F=1.0 sec d Ramp Time 0=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,A=5.0 sec e P-Gain (PI and Softpump) 0=0.001,1=0.0013,2=0.0018,3=0.0024,4=0.0032,5=0.0042,6=0.0056, 7=0.0075,8=0.01,9=0.013,10=0.018,11=0.024,12=0.032,13=0.042, 14=0.056,15=0.075,16=0.1,17=0.13,18=0.18,19=0.24,20=0.32,21=0.42, 22=0.56,23=0.75,24=1.0,25=1.3,26=1.8,27=2.4,28=3.2,29=4.2,30=5.6, 31=7.5,32=10,33=13,34=18,35=24,36=32,37=42,38=56,39=75,40=100 f I-Gain (PI and Softpump): Same values as P-Gain
s:02a00	s:02	i:02a00	i:02	value	Sensor Delay: 0.0 – 1.0sec, **a** = Controller: A,B,C,D
s:02a01	s:02	i:02a01	i:02	value	Ramp Time: 0.0 – 1000000.0sec, **a** = Controller: A,B,C,D
s:02a02	s:02	i:02a02	i:02	value	Ramp Mode: 0=constant time, 1=constant slope, **a** = Controller: A,B,C,D
s:02a03	s:02	i:02a03	i:02	value	Control Direction: 0=downstream, 1=upstream, **a** = Controller: A,B,C,D
s:02a04	s:02	i:02a04	i:02	value	Gain Factor: 0.0001 – 7.5 (Control Algorithm = Adaptive) P-Gain: 0.001 – 100.0 (Control Algorithm = PI or Softpump) **a** = Controller: A,B,C,D
s:02a05	s:02	i:02a05	i:02	value	I-Gain: 0.001 – 100.0, **a** = Controller: A,B,C,D
s:02a06	s:02	i:02a06	i:02	value	Ramp Type: 0=linear, 1=logarithmic, 2=exponential, **a** = Controller: A,B,C,D
s:02a10	s:02	i:02a10	i:02	value	Control Algorithm: 0=Adaptive, 1=PI, 2=Softpump, **a** = Controller: A,B,C,D
s:02a15	s:02	i:02a15	i:02	value	Learn Bank, **a** = Controller: A,B,C,D 0=Learn Bank 1, 1=Learn Bank 2, 1=Learn Bank 3, 1=Learn Bank 4
s:02Z00	s:02	i:02Z00	i:02	value	Control Unit Selector: 0 .. 3
s:02Z10	s:02	i:02Z10	i:02	value	Save Volatile: 0=nonvolatile, 1=volatile
L:	L:	i:34	i:34	aaaaaaaa	Learn , a Pressure Limit
i:32	i:32			abcdefgh	Learn Status a Running b Data Not Valid c Canceled: 1=By User, 2=By Learn Routine d Pressure At Open high or negative e Pressure At Close low f Pressure Decrease g Pressure Instable h Reserved
s:08	s:08	i:08	i:08	aaaaaa	Learn Open Speed: 0 - 1000
		i:36	i:36	abbbbbbb	Pressure Control Status: a Adaptive control state: 0=roughly, 1=fine b Reserved

Interface

Set	Resp	Get	Resp	Data Set, Get Resp	Description
s:20	s:20	i:20	i:20	abcdefgh	Setup1 a Baud Rate: 0=600,1=1200,2=2400,3=4800,4=9600,5=19200,6=38400,7=57600,8=115200,9=230400 b Parity Bit: 0=Even, 1=Odd, 2=Mark, 3=Space c Data Length: 0=7bit, 1=8bit d Stop Bit: 0=1bit, 1=2bit e Command Set: 0=IC, 1=PM f Digital Input 1: 0=Interlock Open, 1=Interlock Open Inverted, 2=Disabled g Digital Input 2: 0=Interlock Close, 1=Interlock Close Inverted, 2=Disabled h Second Answer (PM Command Set): 0=disabled, 1=enabled
s:21	s:21	i:21	i:21	abbbbbb	Setup2 a Position Range: 0=1000, 1=10000, 2=100000 b Pressure Range: 1000 .. 100000
s:22	s:22	i:22	i:22	abbbcdee	Setup3 a Operation Mode: 0=RS232, 1=RS485, 2=RS485 Peer to Peer b Device Address: 0 ... 999 c Duplex Mode: 0=Full, 1=Half d Termination: 0=LF (CR/LF), 1=CR e Reserved

Errors

Description	Error message
Protocol	
Parity error	E:000001
Input buffer overflow (to many characters)	E:000002
Framing error (data length, number of stop bits)	E:000003
Overrun (Service interface: Input buffer register overflow)	E:000004
Commands	
CR or LF missing	E:000010
: missing	E:000011
Invalid number of characters (between **:** and)	E:000012
Invalid value	E:000023
Value out of range	E:000030
Hardware	
Pressure mode, Zero or Learn without Sensor	E:000040
Command not applicable for hardware configuration	E:000041
Setup	
ZERO disabled	E:000060
Device Status	
Command not accepted due to local operation	E:000080
Command not accepted, Service Interface locked	E:000081
Command not accepted due to synchronization, CLOSED or OPEN by digital input, safety mode or fatal error	E:000082
Not accepted calibration and test mode	E:000089

5.12.8.2 Command Set PM

Note:
All position and pressure values are integer values.
Default Range pressure 0 … 1000, position 0 … 1000 (see Position and Pressure Units)

Command Specific Settings

Location: CPA\Parameters: Interface RS232/RS485.Settings

Parameter	Description
R S Answer	Specifies response to R (set position) and S (set pressure) commands *Standard* Response is 'R:' or 'S:' *i:76* Response is same as the i:76 request command, see below
Second Answer	First answer after receiving the command (Standard) Second answer after reaching the setpoint *Off* Only first answer *Pos/Prs* Second answer to commands O,C,R,S *Pos* Second answer to commands O,C,R
Learn Answer	Immediately After receiving the L: command (Standard) Learn End Response after end of learning, no communication until the learn end.
Command t Mode	Setup t command without Ramp Time Setup t command with Ramp Time

System

Set	Resp	Get	Resp	Data Set, Get Resp	Description
U:01	U:01				Access Mode Local
U:02	U:02				Access Mode Remote
U:03	U:03				Access Mode Locked
U:04	U:04				Release Access Mode Locked (Remote)
		I:	I:	String	Access Mode: _LOCAL, REMOTE, LOCKED
		i:01	i:01	String	Software Version
c:	c:	n:	n:	aaaaaaaaaa	Cycle Counter, n: = reset
		M:	M:	String	Control Mode: ___POS, _PRESS
		T:	T:	String	Self-Test: ____OK, PAR-ER, ROM-ER
U:14	U:14				Disable PFO
U:15	U:15				Enable PFO
U:16	U:16				Disable Logic Input
U:17	U:17				Enable Logic Input
		v:	v:	String	Software Revision Level

Position Control

Set	Resp	Get	Resp	Data Set, Get Resp	Description
		A:	A:	aaaaaa	Actual Position
C:	C:				Close
O:	O:				Open
R:	R:			aaaaaa	Position Control, a Target Position
H:	H:				Hold
N:	N:				Position Mode (Release Hold)
V:	V:			aaaaaa	Speed: 0 - 1000
		p:	p:	String	Position Status: ____OK, POS-ER, AIR-ER
		i:04	i:04	V1:aV2:b	Valve Status: a Valve 1, 0=inactive, 1=active b Valve 2, 0=inactive, 1=active → not used
		i:05	i:05	V1:aV2:b	Valve Position a Valve 1, 0=closed,1=opem,2=intermediate b Valve 2, 0=closed,1=opem,2=intermediate → not used

Pressure Control

Set	Resp	Get	Resp	Data Set, Get Resp	Description
S:	S:	W:	W:	aaaaaa	Pressure Control, a Target Pressure
H:	H:				Hold
K:	K:				Pressure Control Mode (Release Hold)
L:	L:			aaaaaa	Learn , a Pressure Limit
		i:07	i:07	String	Learn Status: __BUSY, __DONE, __NEED

Pressure Reading

Set	Resp	Get	Resp	Data Set, Get Resp	Description
		P:	P:	aaaaaa	Actual Pressure
		X:	X:	aaaaaa	Compound
				bbbbbb	a Pressure
				cccccc	b Sensor 1 Pressure
					c Sensor 2 Pressure
Z:	Z:				Zero
		z:	z:	aaaaa	Sensor Offset: range +-140 of 1000
U:12	U:12				Select Sensor 1
U:13	U:13				Select Sensor 2

Setup

Set	Resp	Get	Resp	Data Set, Get Resp	Description

s:1 s:2	s:1 s:2	i:02 i:03	i:02 i:03	abcdef	Setup Sensor 1 and Sensor 2 a Voltage Range not used b Display Range not used c Display Unit not used d Gain Factor 0=0.1,1=0.13,2=0.18,3=0.23,4=0.32,5=0.42,6=0.56,7=0.75,8=1.0,9=1.33,A=1.78, B=2.37,C=3.16,D=4.22,E=5.62,F=7.5,G=0.0001,H=0.0003,I=0.001,J=0.003,K=0.01, L=0.02,M=0.05 e Sensor Type not used f Zero Adjust: 0=disabled, 1=enabled
t:1 t:2	t:1 t:2	i:12 i:13	i:12 i:13	abcccc_	Setup Sensor 1 and Sensor 2 a Ramp Time 0=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,A=5.0 sec b Sensor Delay 0=0,1=0.02,2=0.04,3=0.06,4=0.08,5=0.1,6=0.15,7=0.2, 8=0.25,9=0.3,A=0.35,B=0.4,C=0.5,D=0.6,E=0.8,F=1.0 sec c Reserved

Errors

Description	Error message
Parity error	**E:**000001
CR or LF missing	**E:**000002
: missing	**E:**000003
Wrong Letter Code	**E:**000004
Numeric value not given in 6 digits	**E:**000005
Numeric value out of range	**E:**000006
Pressure Mode, Zero or Learn have been selected with no sensor connected	**E:**000007
Instruction given in Access Mode Local	**E:**000008
Logic Input active	**E:**000009
Error with Learn	**E:**000101
Error With Zero, Zero Disabled	**E:**000102

5.12.8.3 Command Set PM V2

Note:
This command set is quite the same as Command Set PM.
Differences: Same commands as Command Set PM except Setup (s: instead of s:1 and s:2)
Communication range for Pressure is settable (see s: command below)
Additional commands: U:18, U:19; U:20, i:08, i:09

Set	Resp	Get	Resp	Data Set, Get Resp	Description
s:	s:	i:02	i:02	abcdefg	Setup Sensor 1 and Sensor 2 a Sensor Type 0=mBar, 1=Torr b Sensor 1 Full scale c Sensor 2 Full scale 0=0.01,1=0.02,2=0.025,3=0.05,4=0.1,5=0.2,6=0.25,7=0.58=1.0,9=2.0,A=2.5,B=5.0C=10, D=20,E=25,F=50G=100,H=200,I=25,J=500,K=1000,L=not connected d Display Unit not used 0 = mbar, 1 = µbar, 2 = Torr, 3 = mTorr, 4 = Pa, 5 = kPa, 6 = position mode only e Communication Range Pressure 0 = 0 – 1000, 1 = 0 – 2000, 2 = 0 – 2500, 3 = 0 – 5000,4 = 0 – 10000,5 = 0 - 20000 6 = 0 – 25000,7 = 0 – 50000,8 = 0 - 100000 f Gain Factor 0=0.1,1=0.13,2=0.18,3=0.23,4=0.32,5=0.42,6=0.56,7=0.75,8=1.0,9=1.33,A=1.78,B=2.37, C=3.16,D=4.22,E=5.62,F=7.5,G=0.0001,H=0.0003,I=0.001,J=0.003,K=0.01,L=0.02,M=0.05 g Zero Adjust: 0=disabled, 1=enabled
U:18	U:18				Use Sensor 1
U:19	U:19				Use Sensor 2
U:20	U:20				Use Both Sensors
	i:08	i:08		aaaaaa	Offset Sensor 1
	i:09	i:09		aaaaaa	Offset Sensor 2

Errors
Note: This are additional errors to the errors in the PM command set

Description	Error message
Error with ZERO - PM controller is switched in control mode PRESSURE MODE - ZERO function disabled with setup	**E:**000200
Sensor with the higher full scale: zero offset higher than +/- 0.14V	**E:**000201
Sensor with the lower full scale: zero offset higher than +/- 0.14V	**E:**000202
Sensor setup error, The full scale ration senor1/sensor2 is either >100 or <= 1.0	**E:**000203
RS232 commands U:18, U:19 or U:20 sent with 1 or no sensor connected	**E:**000204

5.12.8.4 Command Set Tylan

Command Specific Settings

Location: CPA\Parameters: Interface RS232/RS485.Settings

Parameter	Description
Tylan M1	Use of M command (Control Gain) *None* *Gain Factor/P-Gain*
Tylan X1	Use of X command (Control Lead) *None* *Ramp Time/I-Gain*
Tylan J1	Use of J command (Valve Type) *None* *Restart*

Commands

Note: Set commands have no response

Set	Get	Response	Description	Config
O			Open	
C			Close	
H			Hold	
Vx.x			Position Control with Target Position	
Dn			Setpoint Select n Setpoint Nr 1..5	
Snx.x	Rm	Snx.x	Setpoint Memory n Setpoint Nr 1..5 m Setpoint Request Nr 1..4,10	
Tnx	Rm	Tnx	Setpoint Type n Setpoint Nr 1..5 m Request Nr 26..30 0=Position, 1=Pressure	
Mnx.x	Rm	Mnx.x	Control Gain n Setpoint Nr 1..5 m Request Nr 46..50	Tylan M1
Xnx.x	Rm	Xnx.x	Control Lead n Setpoint Nr 1..5 m Request Nr 41..45	Tylan X1
Ax.x			Pressure Alignment with Target Value	
Z			Zero	
Jx	R23	Jx	Valve Type	Tylan J3
	R5	Px.x	Actual Pressure	
	R6	Vx.x	Actual Position	
	R0	S0x.x	Analog Setpoint Value	1
	R24	Ax	Analog Setpoint Range 0=5Volt, 1=10Volt	1
T0x	R25	T0x	Analog Setpoint Type	
	R7	Mxyz	Alternate System Status x Value of Command X y 0=Controlling, 2=Open, 4=Close z 0=Pressure <= 10%SFS, 1=Pressure > 10%SFS	
	R8	C	Slipped (no effect)	
	R9	oclxs	OOCCLXXXS	
	R11	P10	Low Threshold process limit #1	1
	R12	P20	High Threshold process limit #1	1

Set	Get	Response	Description	Config
	R13	P30	Low Threshold process limit #2	1
	R14	P40	High Threshold process limit #2	1
	Rm	In	Soft start Rate Setpoint n Setpoint Nr 1..5 m Request Nr 15 .. 19	1
	R20	I6	Soft start Rate Setpoint Analog	1
	R21	I7	Soft start Rate Open	1
	R22	I8	Soft start Rate Close	1
	R31		Position Indicator Range Output	1
	R32		Direct Reverse Control	1
	R33		Sensor Range	1
	R34		Pressure Units	1
	R35		Sensor Voltage Range	1
	R36		Sensor Type	1
	R37		System Status	1
	R38		Software Version	1
	R39		Hardware	1
	R40		Valve Response To Power Failure	1
	R51		Type Of Control	1
	R52		Checksum Error	1
	GSN		Serial Number	
	GSR		Streaming (Ethernet)	
SSRxy			Streaming (Ethernet)	

5.12.8.5 Command Set Tylan Type 2

This command set is the same as **Tylan**, except for the following settings and commands.

Command Specific Settings

Location: CPA\Parameters: Interface RS232/RS485.Settings

Parameter	Description
Tylan V	Use of V command (Controller Selector) *None* *Pressure Control Selector*

Commands

Note: Set commands have no response

Set	Get	Response	Description	No Effect
L			Learn	
Vx			Control Mode (Controller Selector) 0=Adaptive, 1=PID	
	R6	Vxxxx.xx	Position	

5.12.8.6 Command Set Tylan Type 1

Command Specific Settings

Location: CPA\Parameters: Interface RS232/RS485.Settings

Parameter	Description
Tylan V	Use of V command (Controller Selector) *None* *Pressure Control Selector*

Commands

Note: Set commands have no response

Set	Get	Response	Description	No Effect
O			Open	
C			Close	
H			Hold	
Sx.x	R1		Pressure Control with Target Pressure	
Px.x			Position Control with Target Position	
Z1			Zero Analog set point	
Z2			Zero Pressure	
A			Go to analog set point level and control	
B			Reset the controller	
D			Same as A	
Vx			Control Mode (Controller Selector) 0=Adaptive, 1=PID	
F1			Learn analog set point full scale	
F2			Learn analog pressure full scale	
Jx	R23	Jx	Valve Type	Tylan J3
Gx.x	R2	Gx.x	Control Gain	1
Lx.x	R3	Lx.x	Control Lead	1
	R4		Analog set point	
	R5	Px.x	Actual Pressure	
	R6	Vx.x	Actual Position	
	R8	Cx	Slipped 0=OK, 1=Slipped	
	R10	ZAx.x	Pressure Alignment with Target Pressure	
	R11	ZB	Pressure Zero	
	R12	FA	Set point full scale	
	R13	FB	Pressure full scale	

5.12.9 Digital IO on the RS interface connector

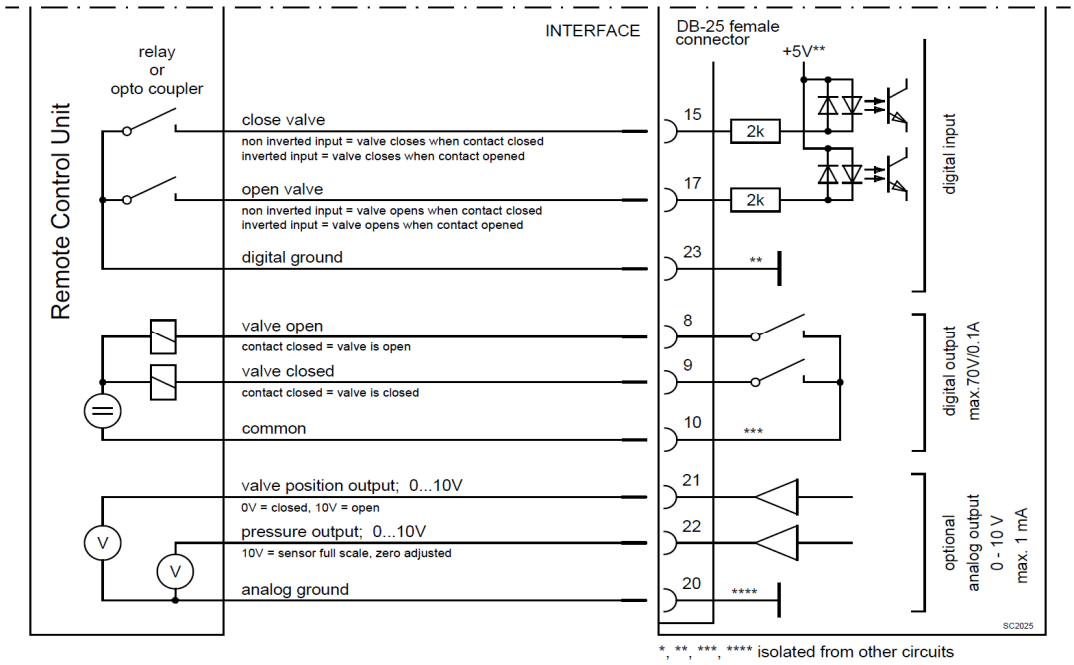
There are 2 digital inputs, 2 digital outputs and 2 analog outputs. Digital inputs may be operated either by switches or by voltage sources.

Digital inputs on the **POWER and INTERFACE connector** have the **same priority**.

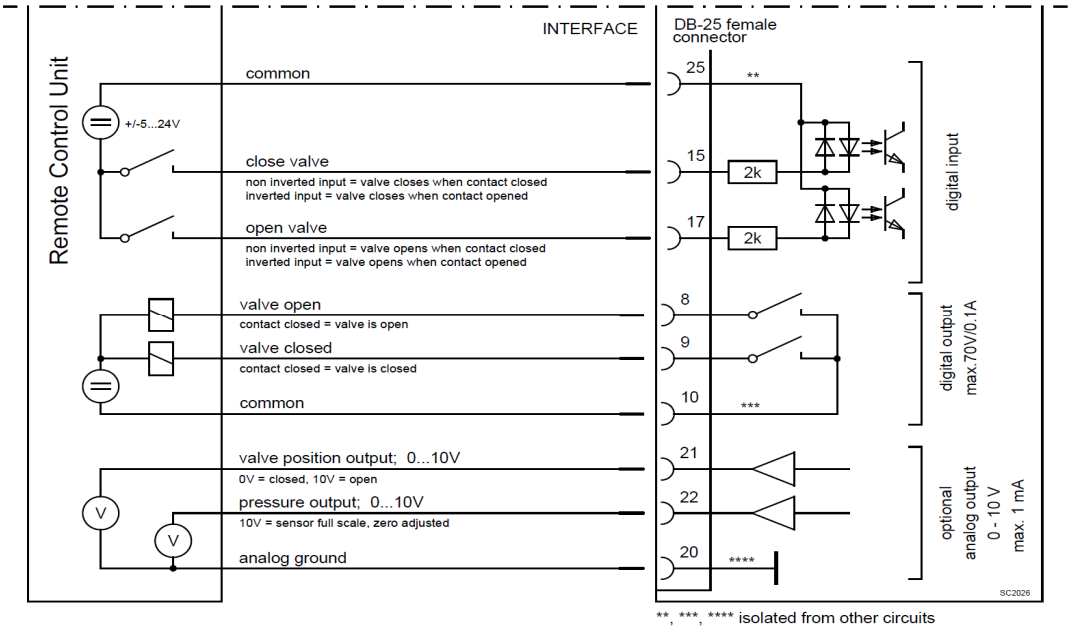
Active **digital inputs** have **higher priority than RS232/RS485** commands.

Do not connect other pins than indicated in the schematics above!
Use only screws with 4-40UNC thread for fastening the DA-15 / DB-25 connector!

5.12.9.1 Schematic, Switches for digital inputs



5.12.9.2 Schematic, Voltage source for digital inputs



, *, **** isolated from other circuits

5.12.9.3 Digital Input

Pinout

Pin		Default Function
15	**INPUT 1**	Interlock Close
17	**INPUT 2**	Interlock Open
23	**COMMON**	Switches
25	**COMMON**	Voltage Source

Configuration

Parameter	Description			
Enable	**1** Enables the input			
State	**0** Not active **1** Active			
Functionality	**0** Interlock Open **1** Interlock Close **2** Hold			
Inverted		**Input**	**State**	**Function**
	0 Not Inverted	Off	0	Off
		On	1	On
	1 Inverted	Off	1	On
		On	0	Off

The INTERLOCK function has priority over the remote interface (HOLD does not)
INTERLOCK CLOSE has priority over INTERLOCK OPEN

5.12.9.4 Digital Output

Pinout

Pin		Default Function
8	**OUTPUT 1**	Open
9	**OUTPUT 2**	Closed
10	**COMMON**	

Configuration

Parameter	Description			
Enable	**1** enables the output			
State	**0** Not active **1** Active			
Functionality	**0** OPEN valve is fully open **1** CLOSE valve is fully closed (isolated if valve has an isolation function) **2** HOLD valve is in hold state			
Inverted		**Function**	**State**	**Output**
	0 Not Inverted	inactive	0	Off
		active	1	On
	1 Inverted	inactive	1	On
		active	0	Off

5.12.9.5 Analog Output

Pinout

Pin		Function	Range
21	**OUTPUT 1**	Position	0V (Close) .. 10V (Open)
22	**OUTPUT 2**	Pressure	0 .. 10V SFS
20	**COMMON**		

Configuration

Parameter	Description
Value	Indicate the output voltage
User Factor **User Offset**	Scaling of the Analog Output ***Example:*** *The desired output should be 1-9V* *User Factor = 10V / (MaxVolt – MinVolt) = 10 / 8 =* ***1.25*** *User Offset =* ***1.0***

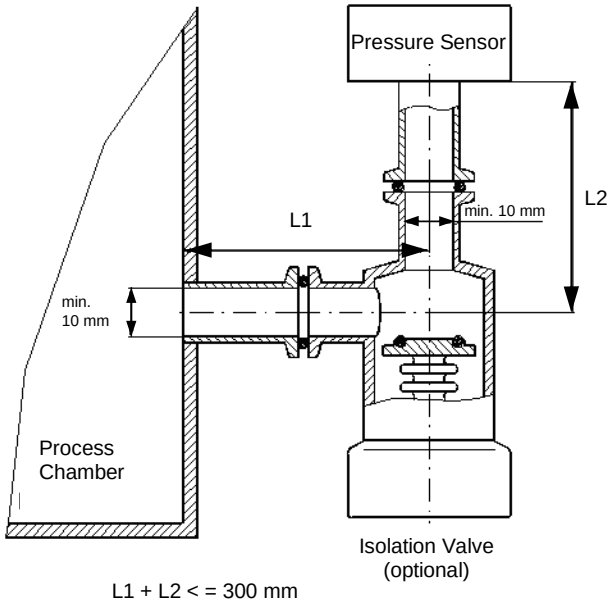
5.13 Pressure Sensor

5.13.1 Mechanical connection requirements

Fast and accurate pressure control requires a fast sensor response. Sensor response time: < 50ms. The sensor is usually connected to the chamber by a pipe. The line must be short enough and the conductance must not be reduced by a too small line diameter or a low conductance shut-off valve, 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**
- Total length L1 + L2: **< = 300 mm**

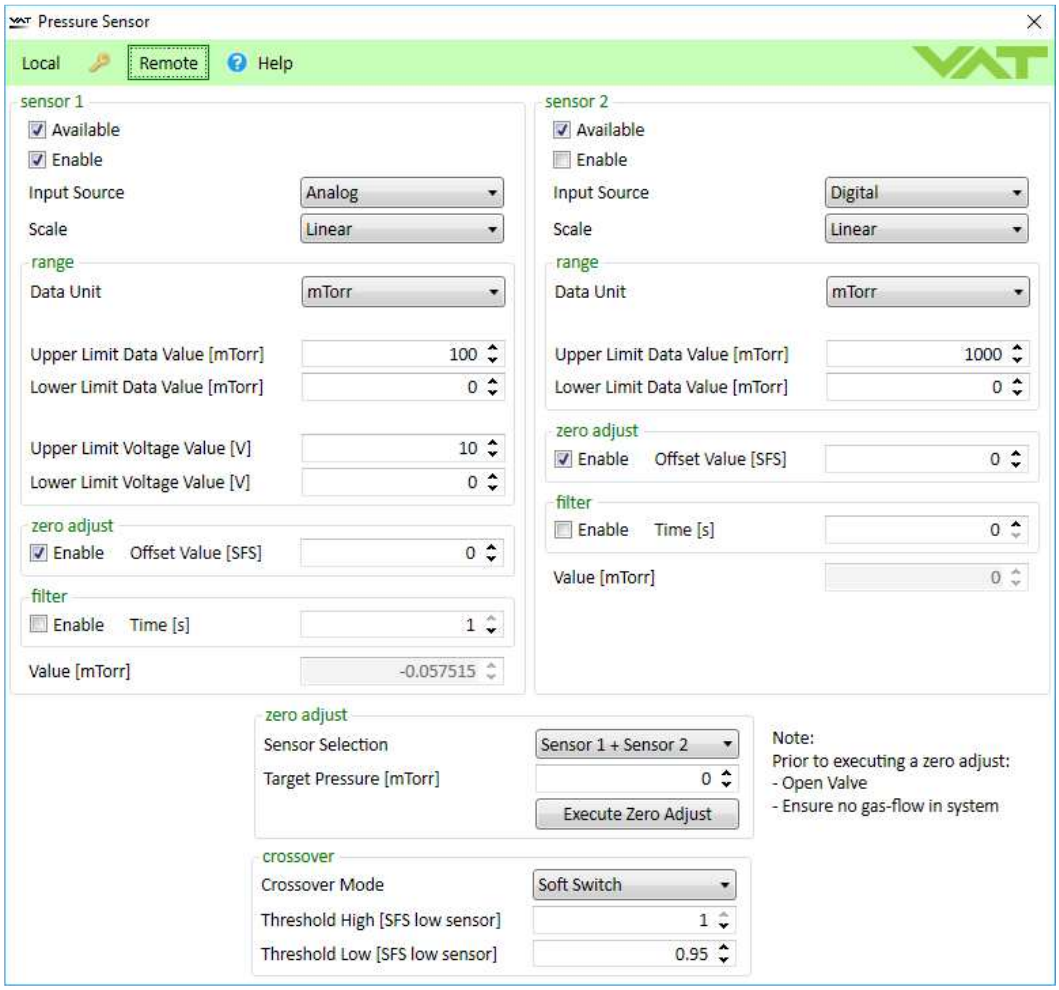
The total conductance value must include all valves and limiting orifices that may also be present. Make also sure that there is no obstruction in front of sensor connection port inside the chamber. The sensor should also be mounted free of mechanical shock and vibration. Dynamic stray magnetic fields may introduce noise to sensor output and should be avoided or shielded.



L1 + L2 < = 300 mm

5.13.2 Configuration

The CPA window shows a good overview of the sensor settings:
- The valve supports 2 sensors.
- Zero Adjust is for offset compensation of linear sensors
- Crossover is automatic switch over between 2 linear sensors



Location: CPA/Navigation/Parameters: Pressure Sensor.Sensor 1, Pressure Sensor.Sensor 2

Parameter	Description
Available	Set to 'True' if a sensor is connected
Enable	Set to 'True' if the sensor signal is used for pressure control
Input Source	'**Analog'** Sensor has an analog voltage interface and is direct connected to the valve. '**Digital'** Sensor has an EtherCAT interface and is connected to the EtherCAT bus '**Simulation'** Testing the valve and pressure control without being connected to the system
Range.Scale	Select type of the sensor signal '**Linear'** '**Logarithmic'** Most gauges are linear type gauges.
Range.Data Unit	Set the pressure data unit of the gauge: **Pa, kPa, bar, mbar, Torr, mTorr, psia, psig**
Range.Upper Limit Data Value **Range.Lower Limit Data Value**	Set the upper limit and lower limit of the gauge in the unit of "Range.Data Unit" Example for a 250mTorr linear sensor: Upper Limit = 250.0 Lower Limit = 0.0
Range.Upper Limit Voltage Value **Range.Lower Limit Voltage Value**	These parameters are only used for gauges with analog voltage interface. The values corresponds to Range.Upper Limit Data Value and Range Lower Limit Data Value Example: Upper Limit: 10.0V → 250mTorr Range Upper Limit Data Value Lower Limit: 0.0V → 0.0mTorr Range Lower Limit Data Value
Filter.Enable	'True' enables the filter
Filter.Type	Set the filter type, which should be applied to the related Sensor Input: **Low-pass, Low-pass Simple, Median, Moving Average, Line Frequency Suppression, FIR custom**
Filter.Time	Set filter time in the range of 0.0 to 1.0 second. Note: Filter delays the sensor signals which is detrimental for pressure control
Value	The actual Pressure value of the regarding Sensor

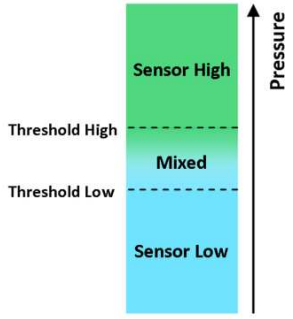
5.13.3 Crossover (2 sensor operation mode)

If two sensors are connected to the controller uses both for pressure control and pressure feedback. The controller selects each sensor or blends both sensor signals to the "**Actual Pressure**" used for control and feedback. Three different modes are selectable.

Location: CPA/Navigation/Parameters: Pressure Sensor.Crossover

Parameter	Description
Crossover Mode	Crossover between 2 sensors (see below)
Threshold High [SFS low sensor] **Threshold Low [SFS low sensor]**	Defines the crossover area (see below) The value is related to sensor full scale of low sensor (0.1 means 10% of sensor full scale of low sensor)
Delay	Switch over delay in Crossover Mode 'Hard Switch'

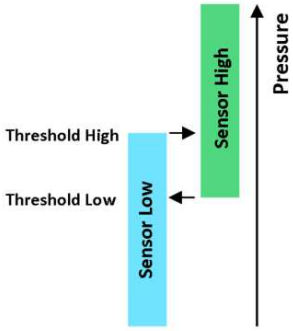
Crossover Mode Soft Switch



Between the *Threshold Low* and *Threshold High* the controller blends both pressure signals to the actual pressure.

When to use
This is the standard mode. Both pressure signals need to match in the crossover range otherwise crossover effect result (nonlinearity). Sensor full scale ratio low range to high range sensor must not exceed 1:100

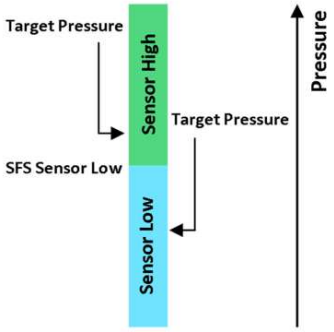
Crossover Mode Hard Switch



Switching between sensors according to the hysteresis threshold levels and an optional delay.

When to use
Preferred setting if the sensor signals do not fit together in the crossover area (for example if sensor ratio is high).

Crossover Mode Target Pressure



If Target Pressure is below low range sensor full scale low sensor is used; otherwise high range sensor.

When to use
As there is no switchover during pressure control while using this setting, undesired effects like nonlinearity or continuous switching between sensors don't occur.

Note
While in position control mode, 'Soft Switch' mode is used

5.13.4 Zero Adjust

Zero Adjust allows for the compensation of the sensor offset voltage.

Note: A maximum offset voltage of +/- 1.4 V can be compensated.

Location: CPA/Navigation/Parameters: Pressure Sensor.Zero Adjust

Parameter	Description
Zero Adjust.Sensor Selection	Select the sensor for the zero adjust: • Sensor 1 + 2 • Sensor 1 • Sensor 2
Zero Adjust.Target Pressure	Normally this parameter is set to 0 in case the process chamber is fully evacuated (pressure <=1‰ of sensor full scale). If not you can align the sensor value to a known pressure (displayed on another readout in the system). In this case set **Target Pressure** to the known pressure. Note: Target Pressure is in the unit of pressure, see chapter «Scaling of Pressure and Position Values»
Zero Adjust.Execute	1: Start the zero adjust 2: Clear offset value After executing value return to 0
Sensor 1.Enable **Sensor 2.Enable**	0: It is not possible to execute a zero adjust. A present offset value is ignored 1: It is possible to execute a zero adjust. A present offset value is respected.
Sensor 1.Offset Value [SFS] **Sensor 2.Offset Value [SFS]**	Value which is deducted from the measured sensor value. The value is related to sensor full scale (0.1 means 10% of sensor full scale)

Performing a zero adjust:

1. Turn the gas flow off
2. Fully open the valve
3. Wait until the sensor signal is not shifting anymore. Refer to manual of sensor manufacturer for warm up time.
4. Wait until process chamber is evacuated.

Do not perform Zero Adjust, if the base pressure of your vacuum system is higher than 1‰ of sensor full scale. We recommend disabling Zero Adjust function or using of Zero Adjust.Target Pressure other than 0.0 in this case. Otherwise incorrect pressure reading is the result.

5. Perform zero with setting of Zero Adjust.Execute to 1
6. Check parameter Actual Pressure if the pressure is shifted as expected

5.13.5 Logarithmic Pressure

To control wide pressure ranges, it is advantageous to control with a logarithmic signal. Note: Only the PI and the Softpump controller can control with a logarithmic signal. Adaptive controller needs a linear signal.

Location: CPA/Parameters: Pressure Sensor.General Settings.Logarithmic Pressure

Parameter	Description
Upper Limit Value	Highest Value of the logarithmic value. Corresponds to the sensor full scale defined in the sensor setup.
Percent Per Decade	Defines the logarithmic scale
Lowest Pressure	Defines the lowest pressure that is converted to a logarithmic value. Corresponds to the smallest valid signal**.**
Pressure On Interface	Defines which signal scale is used on the interface. Linear Logarithmic
Use Logarithmic Sensor	Set to True to use direct the signal of a logarithmic sensor. **Percent Per Decade** is then not used. This parameter becomes active only if **Pressure Sensor.Sensor X.Range.Scale** is set to **Logarithmic**
Actual Logarithmic Values	Shows the logarithmic value. Full Scale is **Upper Limit Value**

EXAMPLE:
Sensor 1 linear 1000Torr, Sensor 2 linear 10Torr
With these sensors the measuring range is: 0.001Torr … 1000Torr, so we cover 6 decades

Percent Per Decade	15 With 15% we cover 6.6 decades (100/15 = 6.6)
Lowest Pressure	0.001Torr (~1mV of Low Sensor)
Upper Limit Value	Shows 1000 (because SFS is 1000)
Actual Logarithmic Value Example Values	Torr 1000 1000 850 100 700 10 550 1 400 0.1 250 0.01 100 0.001
Pressure On Interface	Linear We want the logarithmic signal only on the pressure controller but not on the interface.
Use Logarithmic Sensor	False Since the sensor signal is linear, there is no possibility to use a logarithmic signal from the sensor.

Application: Soft Pump
Use of **Actual Logarithmic Value** in the pressure controller: Set **Pressure Control.Controller X.Control Settings.Pressure Scaler** to **Logarithmic**.

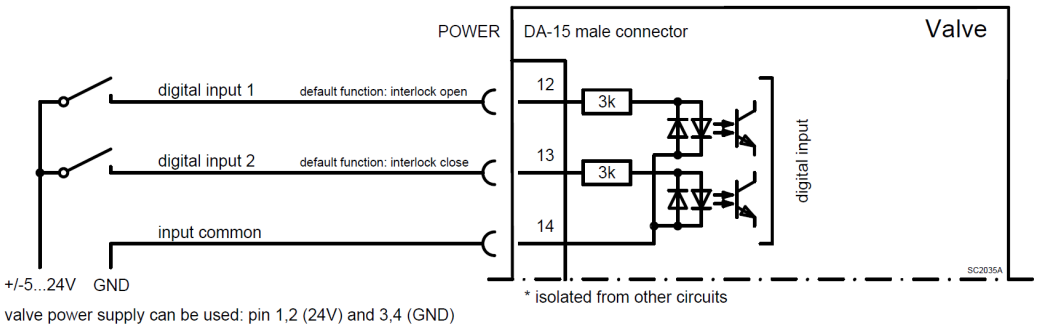
Note: Ramp value use logarithmic signal too, so **Ramp.Slope** is related to logarithmic scale.
For above example: **Slope [Torr]** = 15 means 15 of 1000 per Second what is 1.5% what corresponds to 0.15 Decade per Second.

5.14 Power Connector Digital IO

Do not connect other pins than indicated in the schematics!
Use only screws with 4-40UNC thread for fastening the DA-15 connector!

5.14.1 Digital Input

5.14.1.1 Connection



valve power supply can be used: pin 1,2 (24V) and 3,4 (GND)

Pin		Default Function
12	**INPUT 1**	Interlock Open
13	**INPUT 2**	Interlock Close
14	**COMMON**	

5.14.1.2 Configuration

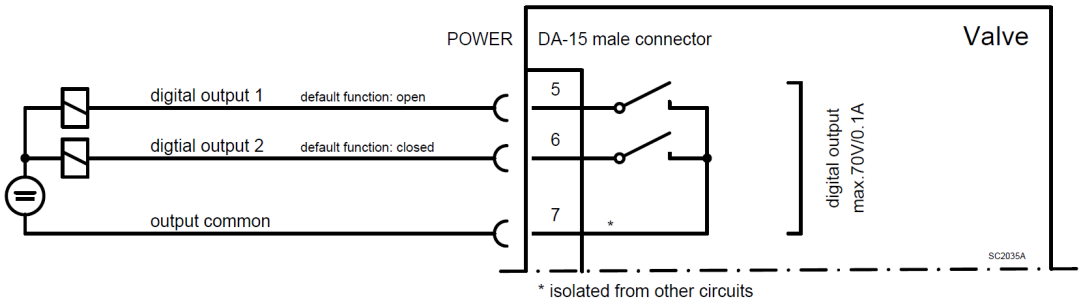
Location: CPA/Navigation/Parameters: Power Connector IO.Digital Input

Parameter	Description			
Enable	**1** enables the input			
State	**0** Not active **1** Active			
Functionality	**0** Interlock Open **1** Interlock Close **2** Hold			
Inverted		**Input**	**State**	**Function**
	0 Not Inverted	Off	0	Off
		On	1	On
	1 Inverted	Off	1	Off
		On	0	On

The INTERLOCK function has **priority** over the remote interface (HOLD does not)
INTERLOCK CLOSE has **priority** over INTERLOCK OPEN

5.14.2 Digital Output

5.14.2.1 Connection



Pin		Default Function
5	**OUTPUT 1**	Open
6	**OUTPUT 2**	Closed
7	**COMMON**	

5.14.2.2 Parameter, Configuration

Location: CPA/Navigation/Parameters: Power Connector IO.Digital Output

Parameter	Description			
Enable	**1** enables the output			
State	**0** Not active **1** Active			
Functionality	**0** OPEN valve is fully open **1** CLOSE valve is fully closed (isolated if valve has an isolation function) **2** HOLD valve is in hold state			
Inverted		**Function**	**State**	**Output**
	0 Not Inverted	inactive	0	Off
		active	1	On
	1 Inverted	inactive	1	On
		active	0	Off

6 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.

6.1 Access Mode

6.1.1 Overview

Defines whether the interface or the CPA via the service port has the rights to control the valve
Location: CPA/Parameters System

Access Mode	Control Permission	Comment
Local	CPA	
Remote	INTERFACE Master	CPA can switch to Local
Locked	INTERFACE Master	CPA can't switch to Local

Power On state is '**Remote'**

6.1.2 Remote and Locked operation

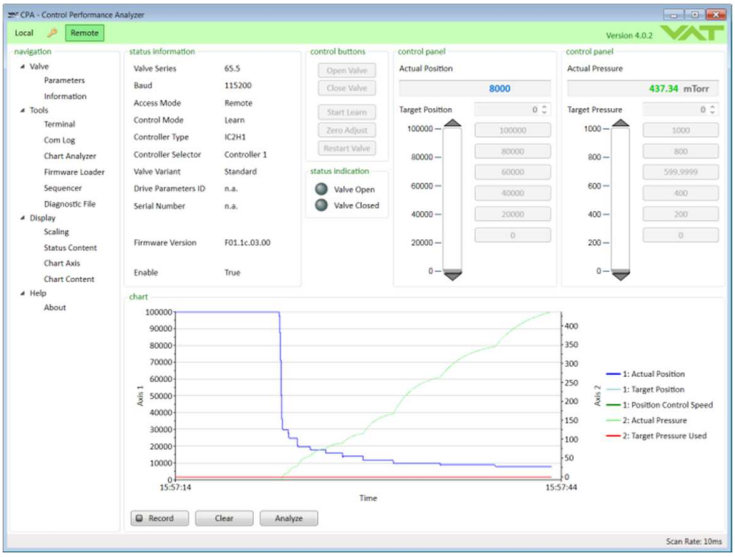
This product is equipped with an interface to allow for remote operation.
See section «Interface» for details.

'Control Performance Analyzer' software may be used for monitoring during remote control.

In case 'Control Performance Analyzer' is used, make sure 'Remote' button is pushed to enable for remote operation.

6.1.3 Local operation

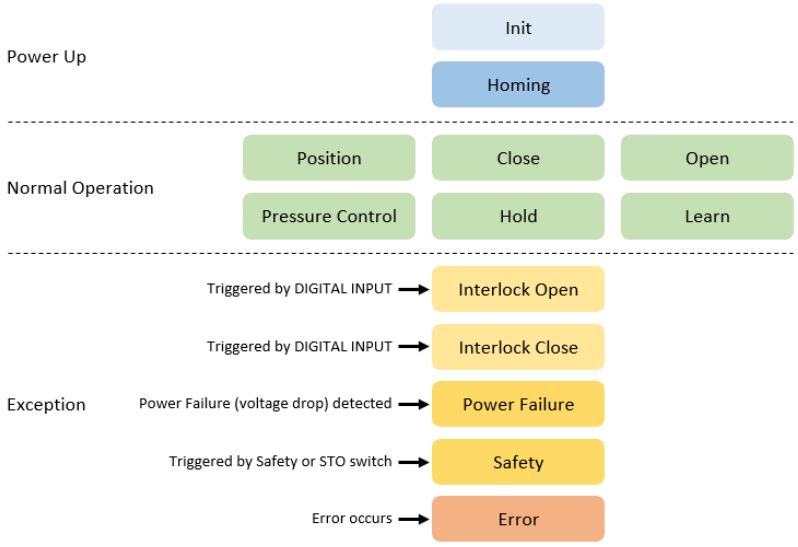
Local operation means that the valve is operated via the service port using a computer.
You can use our software 'Control Performance Analyzer' for Local operation, which is integrated in the controller. The software is beneficial especially for setup, testing and maintenance.



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.

6.2 Control Mode

The **Control Mode** represents the state machine of the valve. Writing to **Control Mode** requests a change in the state while reading **Control Mode** returns the actual state of the state machine.

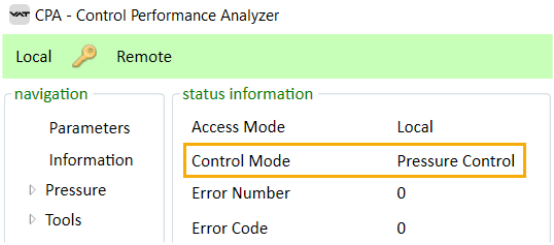


Init	**State after power up. Remains if Homing is not started or no Exception occurs**
Homing	The valve performs the homing procedure to initialize the position. Refer to chapter Homing
Position	The valve moves to the desired **Target Position**.
Close	The valve closes.
Open	The valve opens.
Pressure Control	The valve controls to the desired **Target Pressure.** Refer to chapter Pressure Control
Hold	The valve remains in the actual position. Usage during Pressure Control: Reduce valve reaction during plasma ignition. Stopping the valve movement to evaluate the stability of the sensor, flow meter, … Note: Change from **Control Mode** *Close* to *Hold* is not possible
Learn	The valve performs the system learn. Necessary for Adaptive Pressure Control. Refer to chapter Pressure Control/Adaptive Algorithm/Learn
Interlock Open	The valve opens and locks due to the actuation of a digital input. Release behavior: **Control Mode** changes to *Open* or to *Init* if no Homing was performed yet. Refer to Chapter Power IO
Interlock Close	The valve closes and locks due to the actuation of a digital input. Release behavior: **Control Mode** changes to *Close* or to *Init* if no Homing was performed yet. Refer to Chapter Power IO
Power Failure	Power loss occurred. The valve opens or closes (Only with optional Power Failure Option) Closing or opening behavior depends on set **Power Failure.Functionality** Refer to chapter Power Failure
Safety	The motor of the valve is powerless due to a digital input. Release behavior: **Control Mode** changes to *Init* Refer to chapter xxx
Error	The valve is in an error state, no movement possible. Recovery via **Services.Error Recovery** or **Services.Restart Controller**. Refer to chapter Trouble Shooting.

Location: CPA/Parameter: System.Control Mode

6.2.1 View

CPA



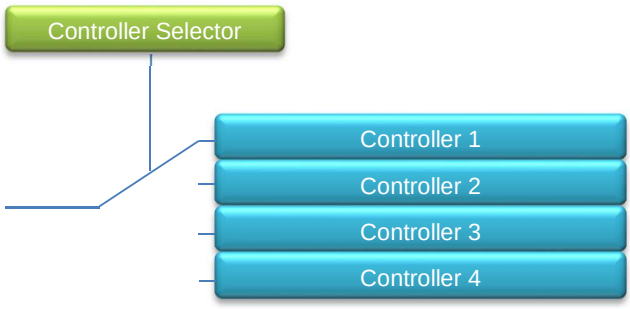
First digit on display

I	Init
H	Homing
C	Close
O	Open
P	Pressure Control
A	Position
I	Interlock Open or Close
H	Hold
L	Learn
S	Safety Mode
F	Power Failure
E	Error

6.3 Pressure Control

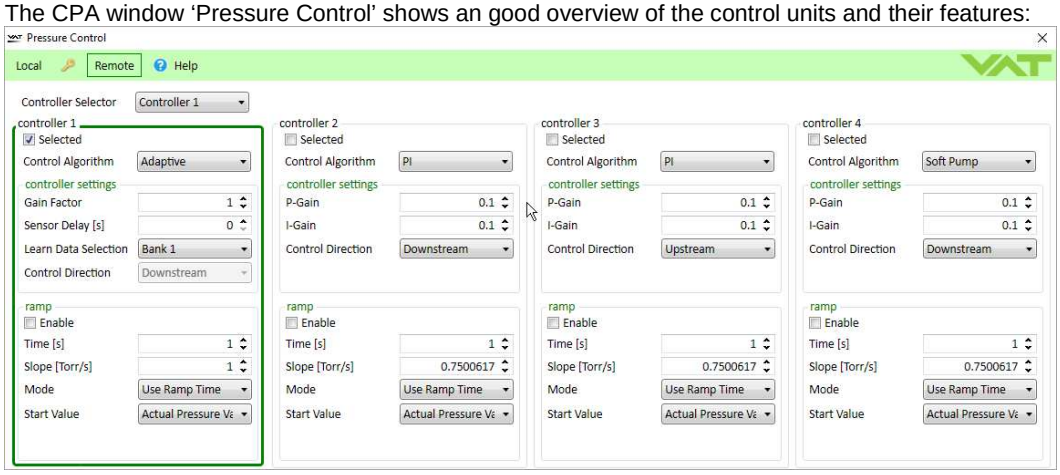
6.3.1 Controller units

The valve has four identical pressure controller units. **Controller Selector** defines which unit is used for the pressure control.



Most applications do not need more than one controller unit. But if the result of the pressure control does not meet the expectations, different controller units can be an option for optimization: With the four controller units it is possible to use a certain controller unit for a specific pressure set point. This controller unit can be parametrized optimally for this specific set point.
With the **Automated Controller Selector** (see below) it is possible to change Controller depending on pressure ranges or on up- and down control.

The CPA window ‘Pressure Control’ shows an good overview of the control units and their features:



6.3.2 Control algorithm

6.3.2.1 Overview

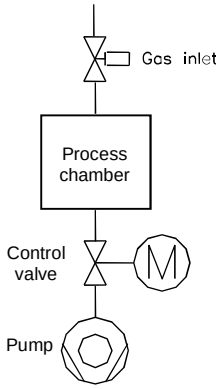
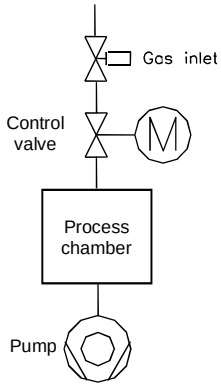
Adaptive This is the most dynamic control algorithm. Before using adaptive control algorithm, a special procedure called “learn” must be executed first (see chapter below). The valve will observe the behavior of the vacuum system by moving the valve to different positions. During the learn procedure the valve performs an internal parameter estimation correspondent to the vacuum system.

Note: Adaptive control algorithm requires a **linear** sensor signal. If a logarithmic sensor is used the signal has to be linearized or PI algorithm has to be used.

PI This is a solid algorithm for pressure control. The performance will be behind the adaptive control algorithm. But if the condition varies a lot, it’s possible that the adaptive control algorithm does not work properly so the PI algorithm provides the best result.

Soft Pump/Vent Is a modified PI control algorithm to pump down from atmospheric pressure or vent to atmospheric pressure. This control algorithm has been optimized to starts very carefully when opening the valve.

6.3.2.2 Choose correct control algorithm

System Configuration	Constant gas flow available		Constant gas flow not available
	Tv*<= 500 sec	Tv* > 500 sec	
Downstream  	**Adaptive**	**PI**	
Upstream  	**PI**		
Soft Pump	**Soft Pump**		

***** 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]

6.3.3 Adaptive algorithm

This control algorithm may be used for downstream pressure control.

Before using adaptive control algorithm, a special procedure called “learn” must be executed first (see chapter below).

6.3.3.1 Control Parameter

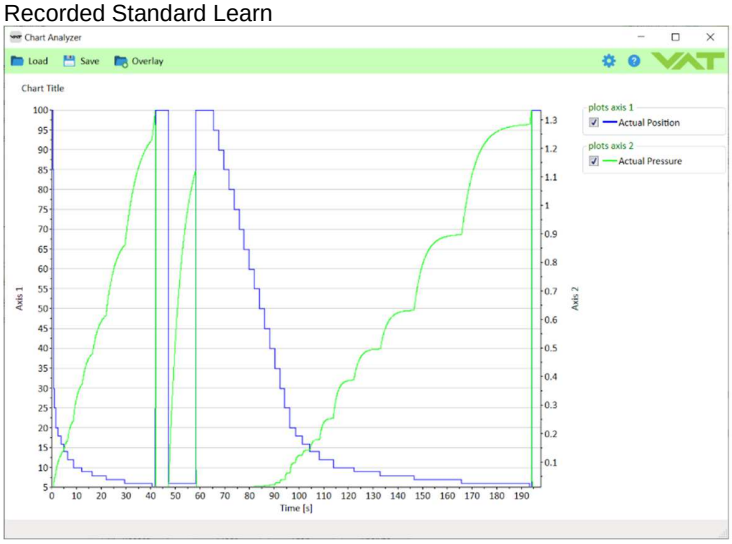
Location: CPA/Navigation/Parameters: Pressure Control.Controller x.Control Settings

Parameter	Description
Gain Factor	Main parameter to adapt the performance of the pressure control algorithm. A higher gain results in a faster response, higher over- / undershoots of pressure. A lower gain results in slower response, lower over- / undershoot of pressure.
Sensor Delay	For compensation of 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.
Learn Data Selection	There are up to 4 different learn data sets available. Select which Learn data set the adaptive controller shall use for pressure control.
Ramp	A set poin ramp can be use to avoid over shoots… See chapter «Pressure Ramp»

6.3.3.2 Learn

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

Recorded Standard Learn



Resulting Learn Data

Parameters Executing

Location: CPA/Navigation/Parameters: Pressure Control.Adaptive Learn

Parameter	Description
Start Learn	Starts the learn
Type	Standard A positioning sequence is executed and various measured values are recorded in the process. Short Opens the valve and measures the pumping speed. Information about flow and volume is required. Calculated Calculated the learn data with the pumping speed information. Short or Calculated can be used when there is no way to set a constant gas flow.
Bank Selection	Select one of four learn bank to place the result of the learn procedure. Note: Be sure pressure controller select this learn bank!
Pressure Limit [SFS]	Limit pressure to which pressure the learn shall be executed. The value is related to the sensor full scale of high sensor. 1.0 means the whole pressure range of the sensors
Pressure Limit	Same value as above but in Pressure Unit
Open Speed	Define the speed for opening the valve during the learn procedure. May be necessary to prevent a pump from crashing. 1.0 means full speed
Status	State of the current learn **0**: Not Started **1**: In Progress **2**: Completed Successfully **3**: Aborted **4**: Failed
Warning Info	Warning of current learn procedure: Bit **0**: Learn is running Bit **1**: Checksum error (learn data corrupt) Bit **2**: Learn procedure terminated by user Bit **3**: Pressure at position open > 50% of pressure limit Bit **4**: Pressure at minimal conductance position < 10 % of pressure limit Bit **5**: Pressure falls while move valve in direction of close Bit **6**: Pressure at open position does not match pressure of previous open Bit **7**: Learn procedure terminated by program Bit **8**: Pressure <= 0 at open position (no gas flow set?)

Sort Learn Parameter

Parameter	Description
Chamber Volume	Volume above the valve plate in Liter
Gas Flow	Gas flow during the short learn, must be constant during the short learn
Gas Flow Unit	Gas flow unit for above Gas Flow
Pumping Speed	Resulting pumping speed

Calculated Learn Parameter

Parameter	Description
Pumping Speed	Set pumping speed to calculate the learn data

Parameters Learn Bank

Location: CPA/Navigation/Parameters: Pressure Control.Adaptive Learn.Learn Bank x

Parameter	Description	
Status	Not Used Available Available with warnings	Empty learn bank Data available. Evaluation possible with the pressure position curve in the CPA/Navigation/Adaptive Learn Data The data may still be suitable for pressure control. Evaluation possible with the pressure position curve in the CPA/Navigation/Adaptive Learn Datas
Data	Captured data in a non-readable format	
Warning Info	Displays warnings that occurred while learning for this learning bank. Show Warning Info above	
Type	Standard Short Calculated ..See description above	
Delete Learn Bank Data	Deletes the data of the learn bank	

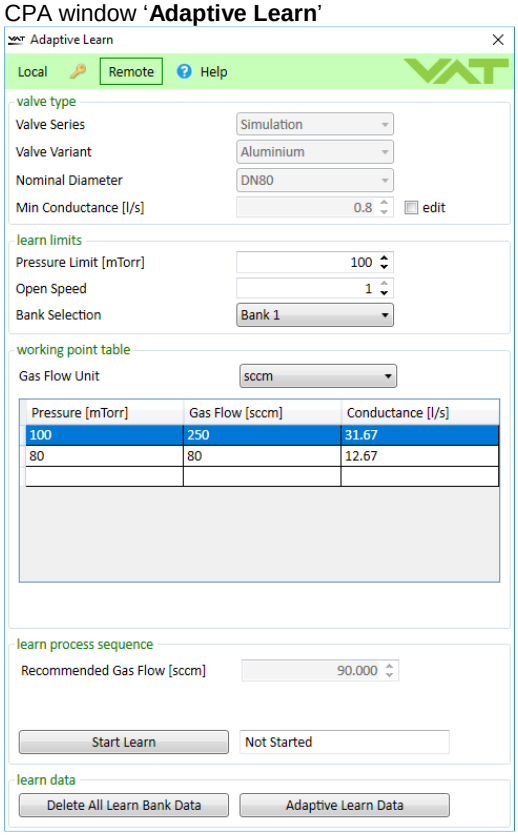
Execute a learn procedure

1. Set specific gas flow according to calculation below or the calculation in the CPA → '**Adaptive Learn**' window:

   Learn does not need to be performed with the process gas. Instead N_2 or Ar may be used.
2. Set parameter **Bank Selection**, if only one learn is used take Bank 1. Be sure that the pressure controller also selects this learn bank!
3. Reduce **Open Speed** if it is critical for the chamber if the pressure drops rapidly when the valve is opened.
4. Set a **Pressure Limit [SFS]** limit if sensor full scale cannot or should not be reached.
5. Set parameter **Controller Mode** to **LEARN**.
6. Wait until the **Controller Mode** leaves the **LEARN** state → Learn is finished
7. Check if the learn was successful by checking if **Status** shows value 2 (=Completed Successfully). In best case **Warning Info** shows no warning.

- → 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.

CPA window '**Adaptive 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.

Note: The subsequent calculation can be conveniently performed in the CPA/Navigation/Adaptive Learn > Gas Flow Calculation > Calculate

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 CR ≥ Cmin 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»)

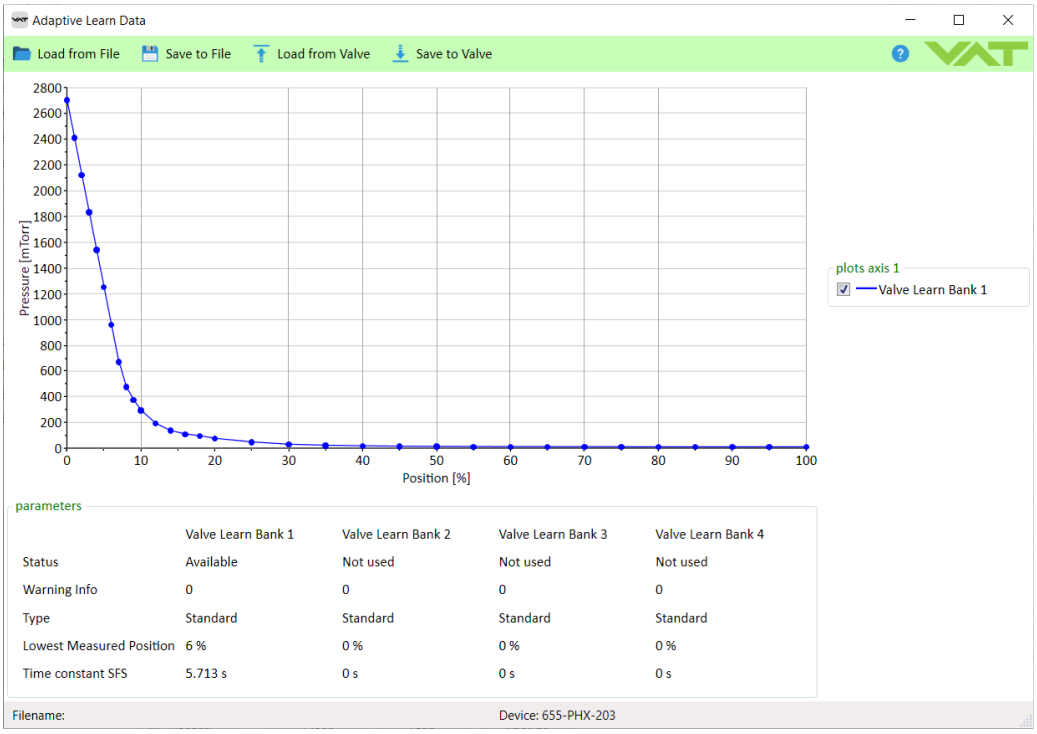
$$q_L = 71 \bullet p_{SFS} \bullet C_{min}$$

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»)

Evaluation and exchange of learn data

Location: CPA/Navigation/Adaptive Learn Data

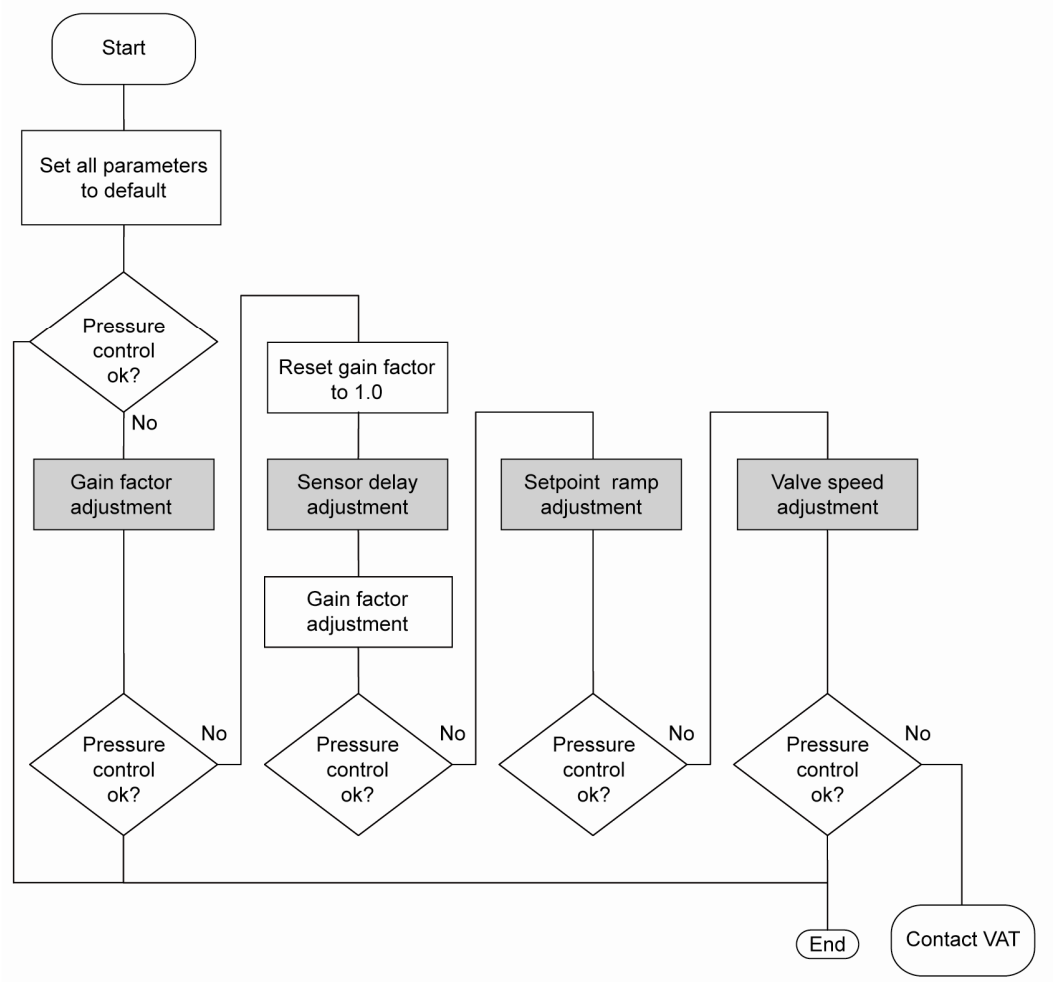
The window shows the pressure position curve of the stored data in the learning banks
With the menu buttons it is possible to exchange data between learn banks and between valves.



	Valve Learn Bank 1	Valve Learn Bank 2	Valve Learn Bank 3	Valve Learn Bank 4
Status	Available	Not used	Not used	Not used
Warning Info	0	0	0	0
Type	Standard	Standard	Standard	Standard
Lowest Measured Position	6 %	0 %	0 %	0 %
Time constant SFS	5.713 s	0 s	0 s	0 s

6.3.3.3 Tuning

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.



Gain Factor adjustment

The Gain Factor effects: **Stability, Response time**

Adjustment range is from 0.0001 to 100.0

- 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 0.1 should lead to good results. Otherwise you may need to improve sensor connection. Refer to «Requirements to sensor connection».

Sensor Delay adjustment

Sensor Delay adjustment effects: **Stability**

Adjustment range is from 0.0 to 1.0sec

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».

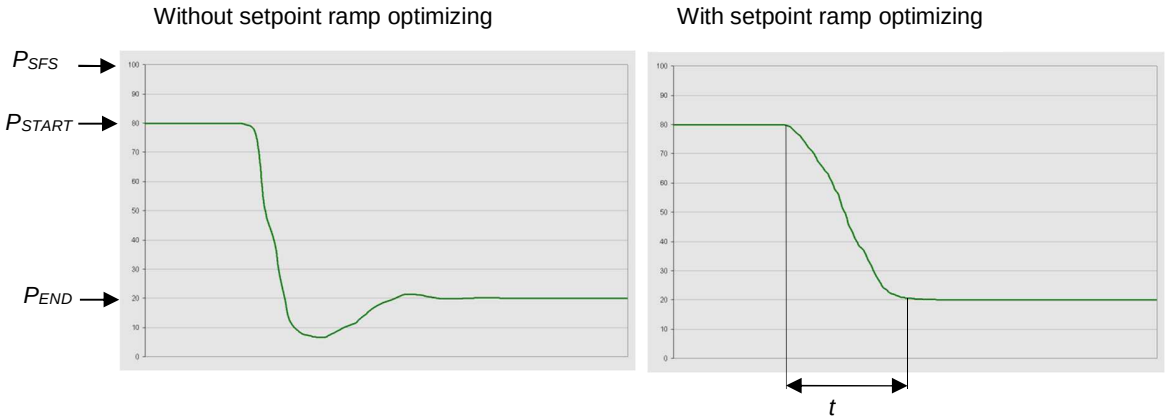
Setpoint Ramp adjustment

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

Note: The ramp is described in detail in capital Pressure Ramp**.**

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

Pressure chart



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

t	-	Setpoint Ramp
P_{SFS}	-	Pressure at Sensor full scale
P_{START}	-	Pressure at start of controlling a pressure step
P_{END}	-	Certain pressure, which should be regulated

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.

Pressure Control Speed adjustment

Valve speed effects: **Response time**

Adjustment range is from 0.001 to 1.0
Default value is 1.0

Location: CPA/Navigation/Parameters: Pressure Control.Pressure Control Speed

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 maximum Pressure Control 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 Pressure Control Speed until required response is achieved.

Required information for support:

- Go to ‘Tools / Create Diagnostic File’ in ‘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**

6.3.4 PI algorithm

This control algorithm may be used for downstream or upstream pressure control depending on configuration.

6.3.4.1 Control Parameter

Location: CPA/Navigation/Parameters: Pressure Control.Controller x,Control Settings

Parameter	Description	
P-Gain	The **P-Gain** is the proportional factor of the fixed control algorithm. A higher P-Gain results in faster response, higher over- / undershoot of pressure.	
I-Gain	The **I-Gain** is the integral factor. The **I-Gain** helps to reach the target pressure exactly.	
Pressure Scale	Linear	
	Logarithmic	Recommended if the pressure control extends over several decades. In most cases, the sensor used is a logarithmic sensor anyway.
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.	

6.3.4.2 Tuning

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.

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.

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

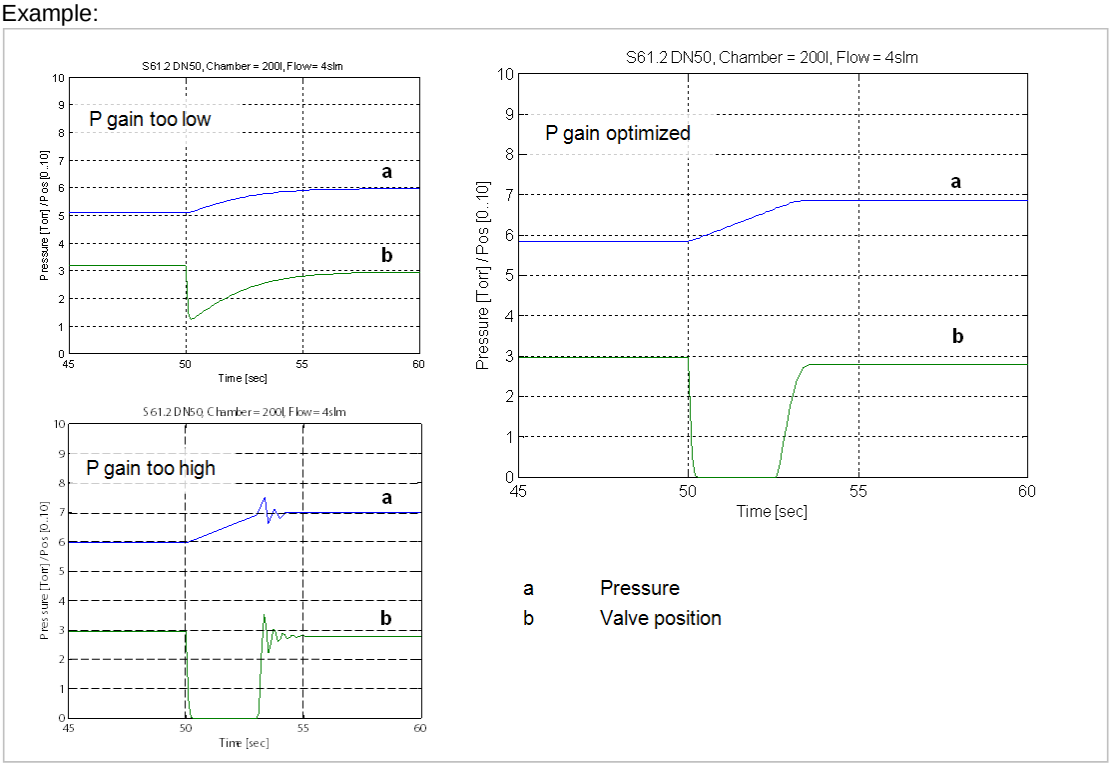
Pressure set points and gas flow for optimization:
SP1 = 7 Torr
SP2 = 6 Torr
Gas flow = 4 slm

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:

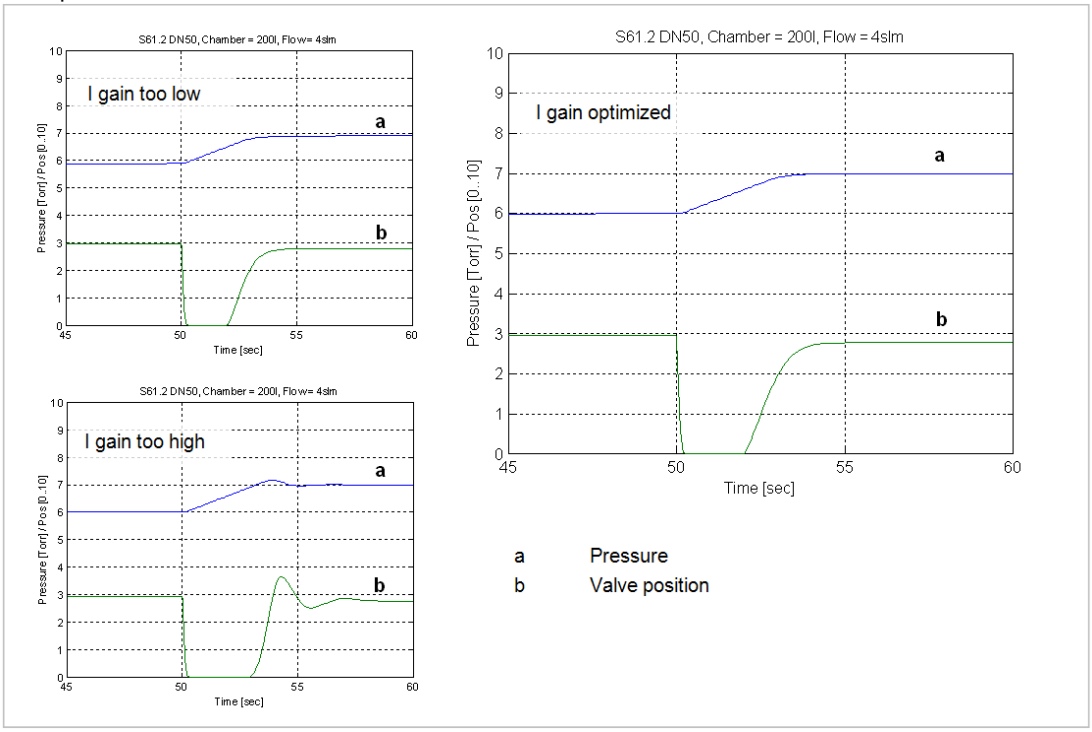


Optimizing I-Gain

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 too 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:



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

Required information for support:

- Go to ‘Tools / Create Diagnostic File’ in ‘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**

6.3.4.3 Soft Pump/Vent algorithm

This control algorithm may be used to control pressure ramps during pump down or venting the chamber. This is a modified PI controller that has been optimized to start up very gently when the valve is opened.

6.3.4.4 Control Parameter

Location: CPA/Navigation/Parameters: Pressure Control.Controller x,Control Settings

Parameter	Description
P-Gain	The **P-Gain** is the proportional factor of the fixed control algorithm. A higher P-Gain results in faster response, higher over- / undershoot of pressure.
I-Gain	The **I-Gain** is the integral factor. The **I-Gain** helps to reach the target pressure exactly.
Pressure Scale	Linear Logarithmic Recommended if the pressure control extends over several decades. In most cases, the sensor used is a logarithmic sensor anyway.
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.
Ramp	Only the ramp makes the soft pump or soft vent… See chapter «Pressure Ramp»

6.3.4.5 Tuning

Optimizing P-Gain

Start optimization with P-Gain set to 0.1 and I-Gain set to 0.0.
The control 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
- Send the pressure set point to the valve controller.

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

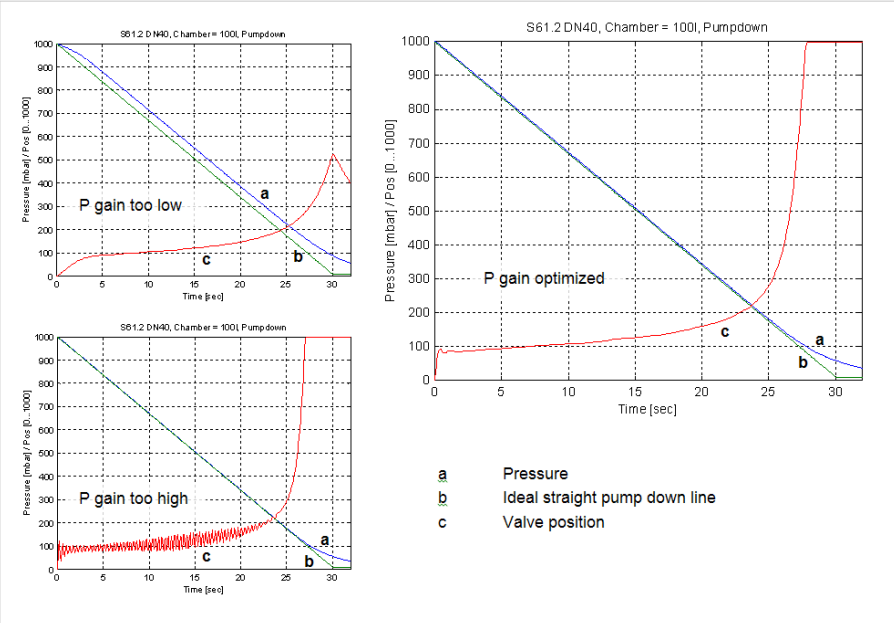
P-Gain is optimized if the pressure follows the ideal pump down line closely and the valve position is not oscillating at all.

Optimizing I-Gain

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.
If the pressure follows the ideal pump/venting line with significant delay, the I-Gain is too low.
If the pressure oscillates around the ideal pump/venting line or if the valve position oscillates, I-Gain is too high.

I-Gain is optimized if the pressure follows the ideal pump down line closely and the valve position is not oscillating at all.

Example:



Optimizing I-Gain

I-Gain is responsible to reach the setpoint. If reaching setpoint is not important (e.g. setpoint is 0) leave the I-Gain at 0. Otherwise start with P-Gain set to half of the value found when optimizing P-Gain and set I-Gain to 0.1. Keep the P-Gain constant. Start again the pump down. Check how the pressure reaches the setpoint:
If the setpoint is reached too slowly increase I-Gain
If there is an undershoot increase I-Gain

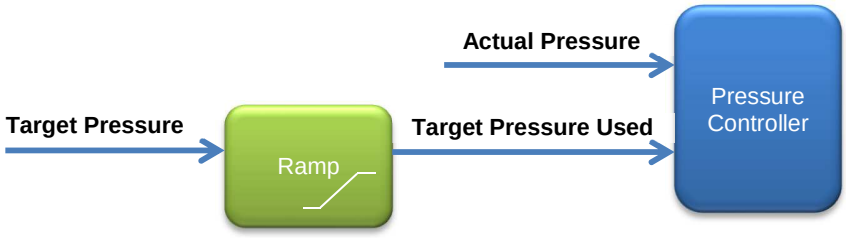
Required information for support:

- Go to ‘Tools / Create Diagnostic File’ in ‘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**

6.3.5 Pressure Ramp

Basically, the pressure ramp is used to limit the rate of pressure change.



6.3.5.1 Configuration

Location: CPA/Navigation/Parameters: Pressure Control.Controller x.Ramp

Parameter	Description
Enable	Activate / Deactivate pressure target ramp
Mode	**0**:Use ***Ramp Time*** **1**:Use ***Ramp Slope*** See description below
Time	Target reach time in seconds (Used if **Mode** = 0)
Slope	Limit the rate of pressure change in pressure per seconds (Used if **Mode** = 1)
Type	**0**:Linear **1**:Logarithmic **2**:Exponential
Start Value	**0**:Previous Ramp Value **1**:Actual Pressure Value

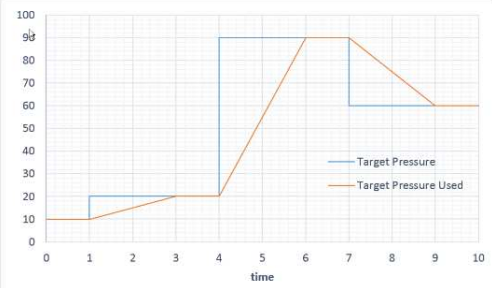
6.3.5.2 Mode

Time

Unit: seconds

Time is constant, slope varies

Example: 2 sec

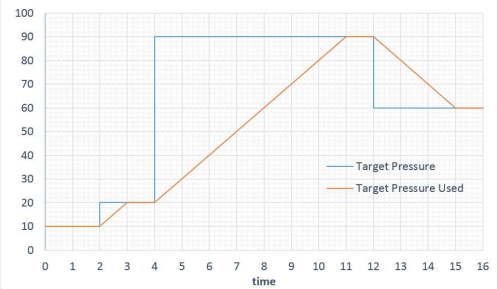


Slope

Unit: Pressure / seconds

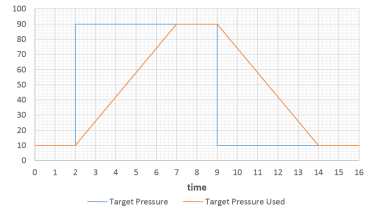
Slope is constant, time varies

Example: 10mTorr/second

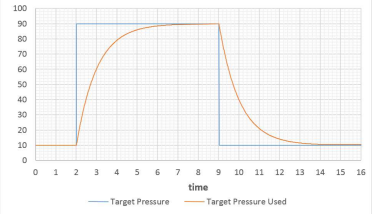


6.3.5.3 Type

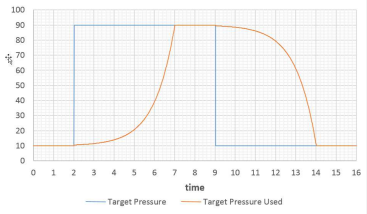
Linear



Logarithmic



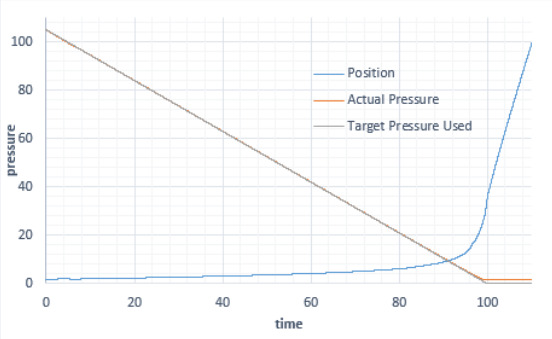
Exponential



6.3.5.4 Applications Examples

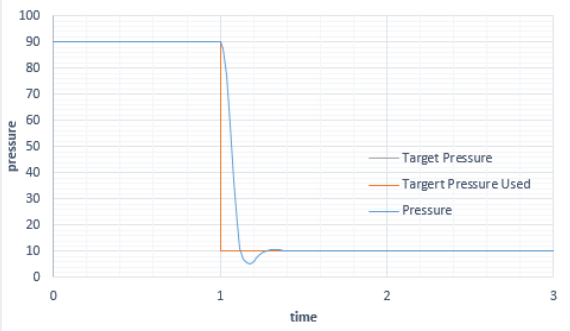
Soft pump

Ramp Mode = Time
Ramp Time = 100 sec
Ramp Type = Linear
Target Pressure = 0

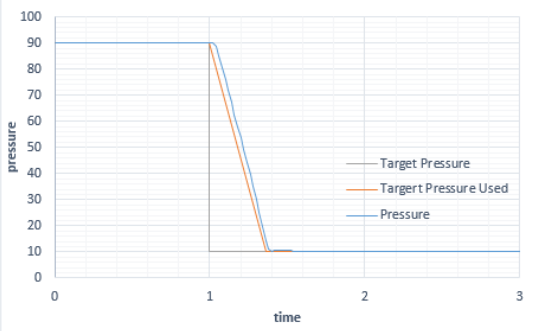


Minimize pressure over- or undershoots

New Target Pressure without pressure ramp

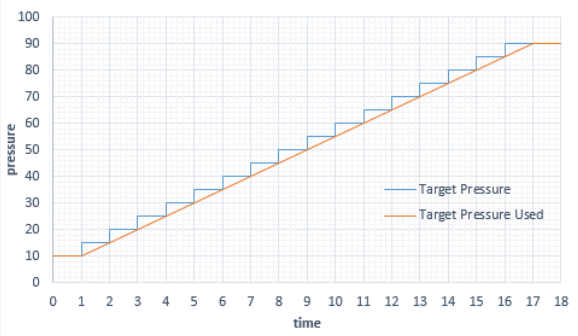


New Target Pressure with pressure ramp



Smoothing a staircase

Pressure ramp with new target pressure to the valve every second is smoothed by a 1 sec internal ramp
Ramp Time = 1sec



6.3.6 Profile Ramp

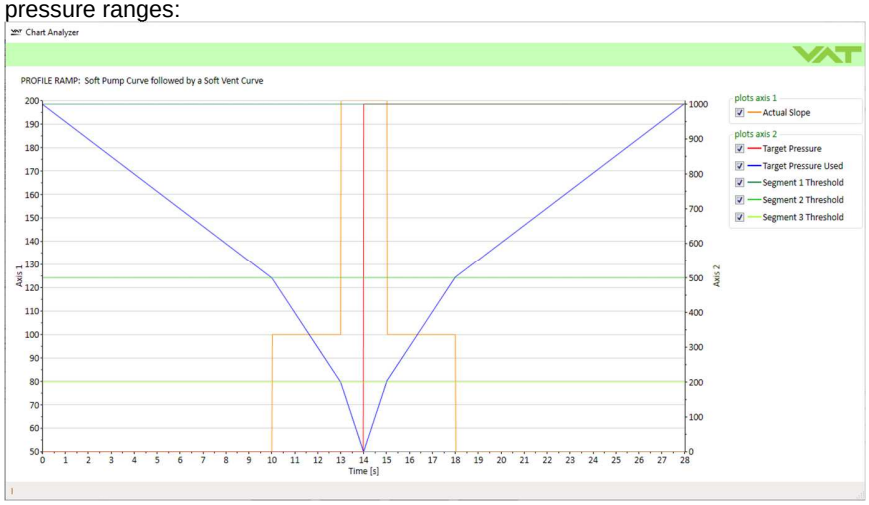
Profile Ramp is a **Target Pressure** ramp that depends on pressure ranges (segments).
It is mainly used to create soft pumping or soft venting profiles.

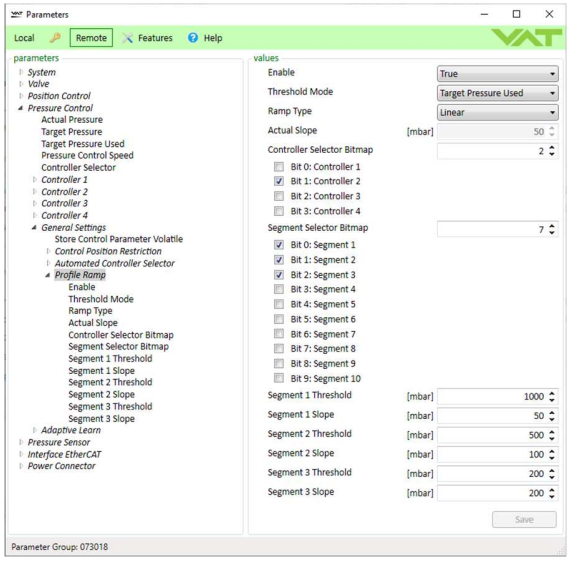
To design a profile, the segments (pressure ranges) must be defined.
A segment is defined by the pressure **Threshold** and the **Slope**.
It is possible to define up to 10 segments.

Example: Ramp Profile with 3 segments

Segment Nr	**Threshold** mBar*	Resulting Segment mBar*	**Slope** mBar*/sec
1	1000	500 to 1000	50
2	500	200 to 500	100
3	200	0 to 200	200

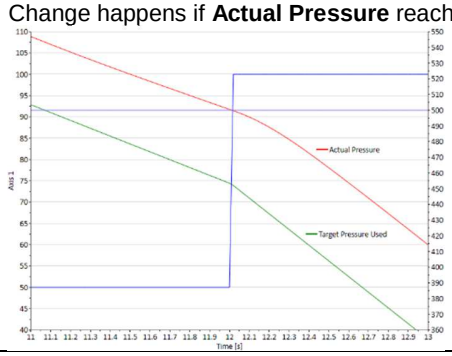
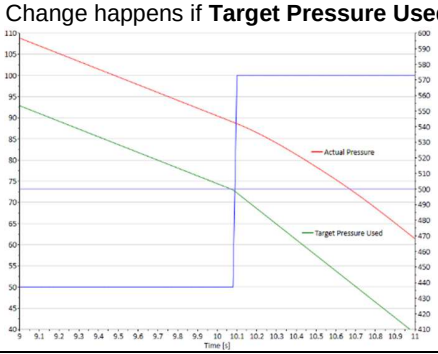
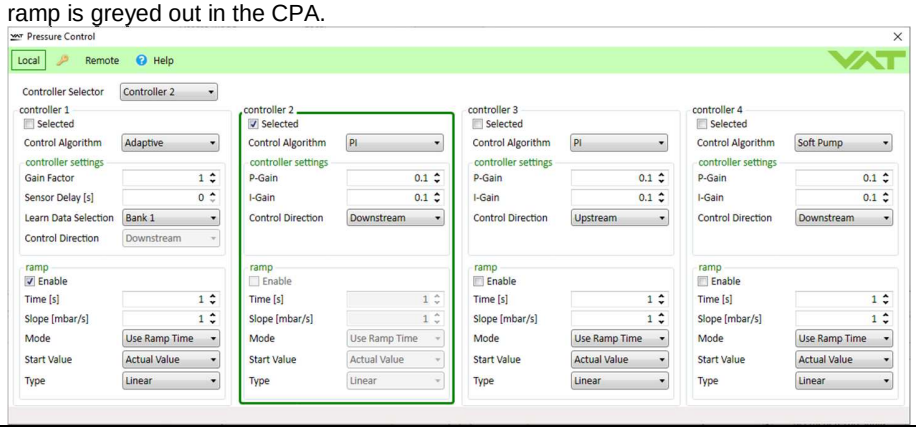
Result is a Target Pressure Ramp (**Target Pressure Used**) with different slopes depending on pressure ranges:

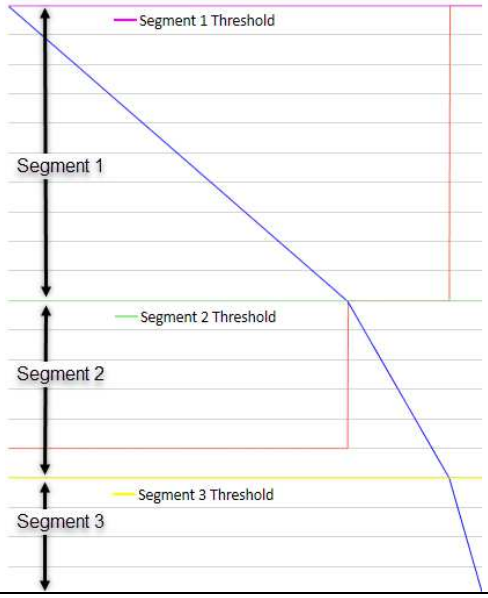




Parameters:

Location: CPA/Navigation/Parameters: Pressure Control.General Settings.Profile Ramp

Parameter	Description
Enable	Switches on/off the function
Threshold Mode	Defines which pressure the threshold refers to
	Actual Pressure — Change happens if **Actual Pressure** reaches the **Threshold** 
	Target Pressure Used — Change happens if **Target Pressure Used** reaches the **Threshold** 
Ramp Type	Defines the shape of the ramp Linear Logarithmic Exponential
Actual Slope	Show the actual use slope during pressure control in mBar*/sec.
Controller Selector Bitmap	Determines which Controller uses the profile ramp. When a Controller is selected, the ramp is no longer used in the controller itself. Therefore the ramp is greyed out in the CPA. 
Segment Selector Bitmap	Defines which segments is used for the Profile Ramp.

Segment x Threshold	This is the upper limit of the segment. The lower limit is defined by the next lower **Threshold**, or the lower limit is 0 if there is no lower **Threshold**. If the value exceeds the top threshold, the slope value of the top segment is used (Segment 1 in below example) 
Segment x Slope	Defines the slope (mBar*/sec) in the segment

** Unit adjustable*

6.3.7 Automated Controller Selector

With the 4 Controllers it is possible to define different pressure control settings.
The Automated Controller Selector can select one of the 4 Controllers depending on Target Pressure (***Mode***: *Threshold*) or Up-Down Control (***Mode***: *Pressure Direction*)

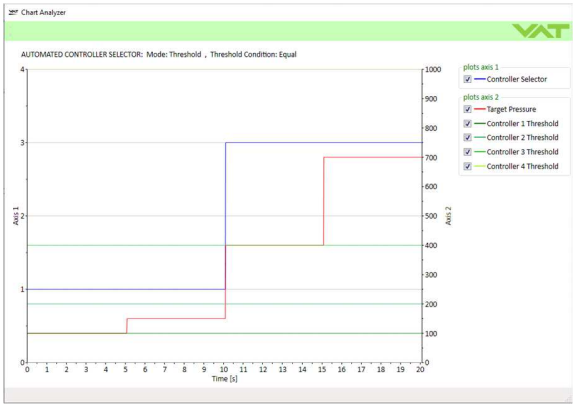
Mode: *Threshold*
Threshold Condition: *Lower or Equal*

Controller Selector *changes when the* ***Target Pressure*** *exceeds or falls below a* ***Threshold*** *value*

Mode		Threshold
Controller Selector Bitmap		15
☑ Bit 0: Controller 1		
☑ Bit 1: Controller 2		
☑ Bit 2: Controller 3		
☑ Bit 3: Controller 4		
Threshold Condition		Lower or Equal
Controller 1 Threshold	[mbar]	100
Controller 2 Threshold	[mbar]	200
Controller 3 Threshold	[mbar]	400
Controller 4 Threshold	[mbar]	1000

Threshold Condition: *Equal*

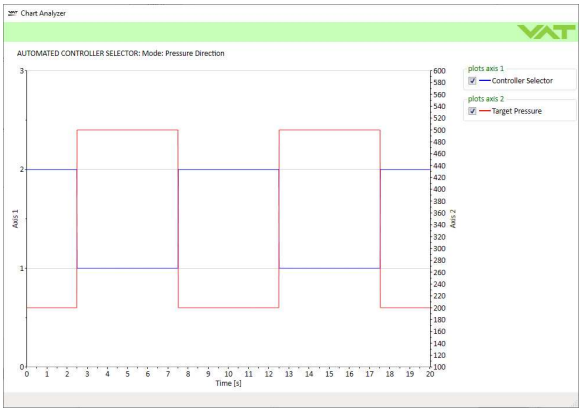
Controller Selector changes only when the ***Target Pressure*** is equal to a ***Threshold*** value



Mode		Threshold
Controller Selector Bitmap		15
☑ Bit 0: Controller 1		
☑ Bit 1: Controller 2		
☑ Bit 2: Controller 3		
☑ Bit 3: Controller 4		
Threshold Condition		Equal
Controller 1 Threshold	[mbar]	100
Controller 2 Threshold	[mbar]	200
Controller 3 Threshold	[mbar]	400
Controller 4 Threshold	[mbar]	1000

Mode: *Pressure Direction*
Controller Pressure Rising: *Controller 1*
Controller Pressure Falling: *Controller 2*

Controller Selector changes depending on whether ***Target Pressure*** is rising or falling



Mode	Pressure Direction
Controller Pressure Rising	Controller 1
Controller Pressure Falling	Controller 2

Parameter:

Location: CPA/Navigation/Parameters: Pressure Control.General Settings.Automated Controller Selector

Parameter	Description
Enable	Switches on/off the function
Mode	*Threshold* *Pressure Direction*
Controller Selector Bitmap	Used if ***Mode*** = *Threshold* Defines which controllers are automatically selected
Threshold Condition	Used if ***Mode*** = *Threshold* *Lower or Equal* *Equal* The Thresholds are related to ***Target Pressure***
Controller 1 Threshold ***Controller 2 Threshold*** ***Controller 3 Threshold*** ***Controller 4 Threshold***	Used if ***Mode*** = *Threshold* The Thresholds are related to ***Target Pressure***
Controller Pressure Rising ***Controller Pressure Falling***	Used if ***Mode*** = *Pressure Direction* Select one Controller for up control and one for down control *Controller 1* *Controller 2* *Controller 3* *Controller 4*

6.3.8 Control Position Restriction

Location: CPA/Navigation/Parameters: Pressure Control.General Settings.Control Position Restriction

Parameter	Description
Enable	False True
Minimum Control Position	Defines the lowest position during pressure control
Maximum Control Position	Defines the highest position during pressure control
Restriction Active	False True

6.3.9 Store Control Parameter Volatile

Used when the control parameters are changed frequently during the process and it is not useful to store the value in the non-volatile memory each time (the lifetime of the non-volatile value is 1 million memory cycles).

Only effective on the interface, the settings via CPA are always stored in non-volatile memory

Location: CPA/Navigation/Parameters: Pressure Control.General Settings

Parameter	Description
Store Control Parameter Volatile	False True

6.4 Position Control

6.4.1 Parameter

Location: CPA/Navigation/Parameters: Position Control

Parameter	Description
Actual Position	Position of the valve plate Range depends on Position Scaling setting (on Interface and CPA)
Target Position	Desired position of the valve plate Range depends on Position Scaling setting (on Interface and CPA)
Position Control Speed	Speed of the valve in Control Mode Position 0.001 .. 1.0 (Full speed)
Ramp	See below

6.4.2 Position Ramp

.

6.4.2.1 Configuration

Location: CPA/Navigation/Parameters: Position Control.Ramp

Parameter	Description	
Enable	Activate / Deactivate position ramp	
Mode	**0**:Use ***Ramp Time*** **1**:Use ***Ramp Slope***	See description below
Time	Target reach time in seconds (Used if **Mode** = 0)	
Slope	Limit the rate of position change per second (Used if **Mode** = 1)	
Type	**0**:Linear **1**:Logarithmic **2**:Exponential	

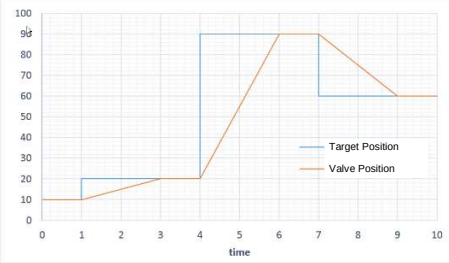
6.4.2.2 Mode

Time

Unit: seconds

Time is constant, slope varies

Example: 2 sec

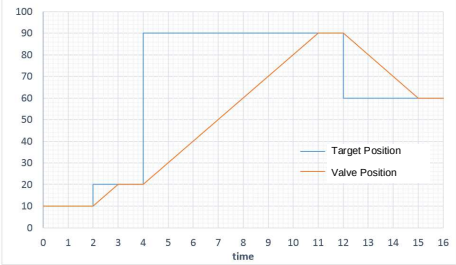


Slope

Unit: %* / seconds

Slope is constant, time varies

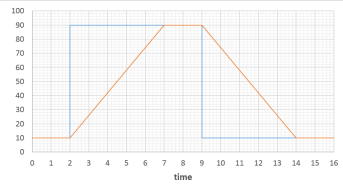
Example: 10% / sec



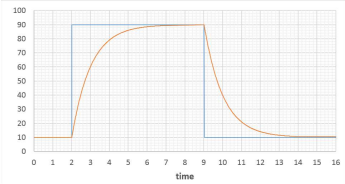
** Unit adjustable*

6.4.2.3 Type

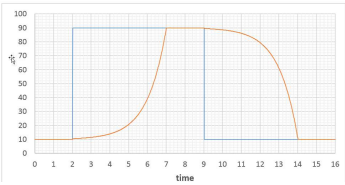
Linear



Logarithmic



Exponential



6.5 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 product data sheet.

⚠ WARNING

O-ring temperature preservation

Due to the sticking properties of elastomer O-rings being cooled down from high temperatures, operator/ integrator must ensure that the vacuum product has a similar temperature during opening of the valve as it had been for the previous closing. Otherwise, there is a high risk of damaging the O-ring.

7 Trouble shooting

7.1 Warnings

A warning does not lead to an interruption of valve operation.

Location: CPA/Parameters: System.Services

Parameter	Description		
Warning Bitmap	Bit	Hex	Description
	0	1	No learn data available for adaptive control
	1	2	Position indicator signal of the external isolation valve incorrect.
	2	4	No Sensor Active
	3	8	PFO Not Ready
	4	16	Cluster Slave Offline
	6	40	Fieldbus Data Not Valid
	8	256	Compressed Air Not Falling when valve close
	9	512	Compressed Air Too Low
	10	1024	Compressed Air Too High
	12	4096	Fan stall alarm

Failure	Check	Action
Display does not light up	- 24 V power supply	- Connect valve to power supply according to 'Power, ground and sensor connection' and make sure that power supply is working.
Remote operation does not work	- Local operation via service port active	- Switch to remote or locked operation Refer to 'Remote and local operation'
	- Safety mode active Check for S on display	- Check 'Drive Power Enable Switch' Refer to 'Power, ground and sensor connection'
	- Interlock mode active Check for I on display	- Check Digital Input Refer to 'Power connector IO' → 'Digital Input'
POSITION CONTROL does not work	- Safety mode active Check for S on display	- Check 'Drive Power Enable Switch' Refer to 'Power, ground and sensor connection'
	- Interlock mode active Check for I on display	- Check Digital Input Refer to 'Power connector IO' → 'Digital Input'
	- POSITION CONTROL selected, check for A on display?	- Select POSITION CONTROL mode. Refer to 'Control Mode' in 'EtherCAT' interface
Pressure reading is wrong Pressure reading is negative	- Sensor connection	- Refer to 'Power, ground and sensor connection'
	- ZERO done?	- Perform ZERO when base pressure is reached. Refer to 'Pressure Sensor' → 'Zero Adjust'
	- Does sensor power supply provide enough power for sensor(s)?	- Verify sensor supply voltage.
ZERO does not work	- ZERO disabled?	- Enable ZERO. Refer to 'Pressure Sensor' → 'Zero Adjust'
	- Sensor voltage shifting?	- Wait until sensor does not shift any more before Performing ZERO.
Pressure is not '0' after ZERO	- System pumped to base pressure?	- OPEN VALVE and bring chamber to base pressure before performing ZERO.
	- Sensor offset voltage exceeds ±1.4V	- Adjust the offset direct at the sensor - Check function of the sensor.
PRESSURE CONTROL does not work	- PRESSURE CONTROL selected, check for P on display?	- Select PRESSURE CONTROL mode. Refer to 'Control Mode' in 'EtherCAT' interface
	- LEARN done?	- Perform LEARN. Refer to 'Pressure control' → 'Adaptive algorithm' → 'Learn'
	- Sensor signal ok?	- Refer to 'Pressure Sensor'
	- Pressure control setup done	- Refer to 'Pressure control'
PRESSURE CONTROL not optimal	- LEARN successfully done?	- Perform LEARN. Check 'Status' and 'Warning Info' in 'Pressure control' → 'Adaptive algorithm' → 'Learn'
	- ZERO performed before LEARN?	- Perform ZERO then repeat LEARN. Refer to 'Pressure Sensor' → 'Zero Adjust'
	- Was gas flow stable during LEARN?	- Repeat LEARN with stable gas flow. Refer to 'Pressure control' → 'Adaptive algorithm' → 'Learn'
	- Tuning done?	- Tune valve for application. Refer to the tuning sections in 'Pressure Control'
	- 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.

7.2 Errors

If valve is in Control Mode Error, movement is no longer possible.

The following parameters provide information about the cause of the error:

Location: CPA/Parameters: System.Services

Parameter	Description
Error Bitmap	Information about the types of errors. Details below.
Error Number	Information about the error component. Details below. Also shown on the controller display when active.
Error Code	Information about the different error states. Details below. Also shown on the controller display when active.

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

The following information is required for VAT to analyze the error case:

- Diagnostic File: CPA → Tools → Diagnostic File
- Load Error Data: CPA → Tools → Trace Log → Mode Load Error Data → Start

7.2.1 Error Recovery

To leave the error state, the ***Error Recovery*** or ***Restart Controller*** can be used***:***

Location: CPA/Parameters: System.Services

Parameter	Description
Restart Controller	Emulates a power cycle of the valve
Error Recovery	Attempts to reset the Control Mode Error without restarting the valves

Create a diagnostic file before recovery or restart if the error is to be analyzed by VAT

7.2.2 Error Bitmap

Parameter	Description		
Error Bitmap	Bit	Hex	Description
	0	1	Homing Position Error
	1	2	Homing Not Running
	2	4	Homing Error State
	3	8	Operation Position Error
	4	10	Operation Not Running
	5	20	Operation Error State
	12	1000	Other Component
	30	40000000	General
	31	80000000	Internal

7.2.3 Error Number

Error numbers are three-digit decimal numbers (**xyz**) whereas:

x = component	**y** = mode	**z** = error type
1 = All Motor Units **2** = Motor Unit 1 **3** = Motor Unit 2 **4** = Motor Unit 3 **8** = Other	**0** = Homing **2** = Operation Mode **8** = Other	**0** = Position Error [1)] **1** = Not running: No communication with component **x** **2** = Error State: component **x** is running but in Status Error **8** = Other

7.2.4 Error Code

[1)] Mechanical movement problem:
- Check for differential pressure
- Remove foreign object in movement area
- Eliminate tight movement
- Repair mechanical failure

Code	Description	Solution
1	No valve connected	Connect valve controller to the valve
2	Nonvolatile memory failure	Replace valve controller
3	Analog digital converter of sensor input failure	Replace valve controller
4	Initialization of motion controller failed	Wrong motion controller firmware version → Update motion controller firmware
5	Encoder index pulse not found	• [1)] • Encoder failure • O-ring sticking
6	Initialization of interface module failed	• Fieldbus: Valve firmware does not support interface type → Update valve firmware • Wrong interface firmware version → Update interface firmware
7	Initialization of external drive EEProm failed	Check cables
10	Closing position can't be reached	[1)]
11	Homing position can't be reached	• [1)] • Plate not mounted
12	Motion controller: Internal voltage error	Check power supply
13	Motion controller: Internal error temperature	Check for a heat accumulation
14	Motion controller: Unexpected behavior	Contact vat support • Axis inverted • Encoder not connected • Break not released
15	Motion controller: Target position can't be reached	• [1)] • Current Settings
16	Motion controller: Position minimal conductance cannot be reached	• [1)] • Check Plate and Seal ring • Check Parameter "Isolation Position Enter [r]"
17	Motion controller: Position to push back the Differential Plate cannot be reached	• [1)] • Check Different Plate • Check Parameter "Differential Plate Push Back Position [r]"
18	Motion controller: Minimal isolation position cannot be reached	• [1)] • Check Plate and Seal ring • Check Parameter "Isolation Position [r]"
20	Break slippery detected	Replace actuator

Code	Description	Solution
30	SFV: Motion controller failure in master-slave communication	Contact vat support
40	Compressed air error	Check compressed air
42	Power supply, low voltage detected	Check if power supply is ok and is able to deliver needed power
96	SFV: Position deviation axis1 to axis2 at homing procedure	• [1)] • O-ring sticking
97	SFV: Position deviation axis1 to axis2 at operating	[1)]
98	Position error during closing procedure	[1)]
99	Position error at operating	[1)]
200	Valve configuration error, not possible to operate the valve with these configuration	Contact VAT support
701	Wrong ident code axis 1	Check wiring
702	Wrong ident code axis 2	
703	Wrong ident code axis 2 AND axis 1	
704	Wrong ident code axis 3	
705	Wrong ident code axis 3 AND axis 1	
706	Wrong ident code axis 3 AND axis 2	
707	Wrong ident code axis 3 AND axis 2 AND axis 1	
707	Do not operating mode active	

7.3 Troubleshooting List

Failure	Check	Action
Display does not light up	- 24 V power supply	- Connect valve to power supply according to 'Power, ground and sensor connection' and make sure that power supply is working.
Remote operation does not work	- Local operation via service port active	- Switch to remote or locked operation Refer to 'Remote and local operation'
	- Safety mode active Check for S on display	- Check 'Drive Power Enable Switch' Refer to 'Power, ground and sensor connection'
	- Interlock mode active Check for I on display	- Check Digital Input Refer to 'Power connector IO' → 'Digital Input'
POSITION CONTROL does not work	- Safety mode active Check for S on display	- Check 'Drive Power Enable Switch' Refer to 'Power, ground and sensor connection'
	- Interlock mode active Check for I on display	- Check Digital Input Refer to 'Power connector IO' → 'Digital Input'
	- POSITION CONTROL selected, check for A on display?	- Select POSITION CONTROL mode. Refer to 'Control Mode' in 'EtherCAT' interface
Pressure reading is wrong Pressure reading is negative	- Sensor connection	- Refer to 'Power, ground and sensor connection'
	- ZERO done?	- Perform ZERO when base pressure is reached. Refer to 'Pressure Sensor' → 'Zero Adjust'
	- Does sensor power supply provide enough power for sensor(s)?	- Verify sensor supply voltage.
ZERO does not work	- ZERO disabled?	- Enable ZERO. Refer to 'Pressure Sensor' → 'Zero Adjust'
	- Sensor voltage shifting?	- Wait until sensor does not shift any more before Performing ZERO.
Pressure is not '0' after ZERO	- System pumped to base pressure?	- OPEN VALVE and bring chamber to base pressure before performing ZERO.
	- Sensor offset voltage exceeds ±1.4V	- Adjust the offset direct at the sensor - Check function of the sensor.
PRESSURE CONTROL does not work	- PRESSURE CONTROL selected, check for P on display?	- Select PRESSURE CONTROL mode. Refer to 'Control Mode' in 'EtherCAT' interface
	- LEARN done?	- Perform LEARN. Refer to 'Pressure control' → 'Adaptive algorithm' → 'Learn'
	- Sensor signal ok?	- Refer to 'Pressure Sensor'
	- Pressure control setup done	- Refer to 'Pressure control'
PRESSURE CONTROL not optimal	- LEARN successfully done?	- Perform LEARN. Check 'Status' and 'Warning Info' in 'Pressure control' → 'Adaptive algorithm' → 'Learn'
	- ZERO performed before LEARN?	- Perform ZERO then repeat LEARN. Refer to 'Pressure Sensor' → 'Zero Adjust'
	- Was gas flow stable during LEARN?	- Repeat LEARN with stable gas flow. Refer to 'Pressure control' → 'Adaptive algorithm' → 'Learn'
	- Tuning done?	- Tune valve for application. Refer to the tuning sections in 'Pressure Control'
	- 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.

8 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.

8.1 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.

8.2 Maintenance procedures

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

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

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

VAT can give the following recommendations for preventive maintenance:

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

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

Below pictures are sample pictures. Although there may be different variants of the valve, the assembly procedure stays the same.

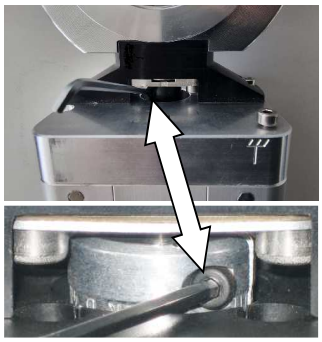
ISO-KF with heating

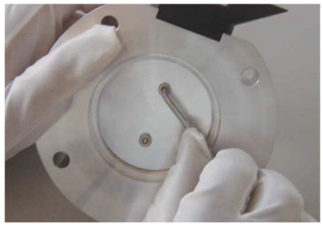
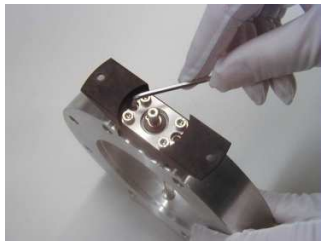
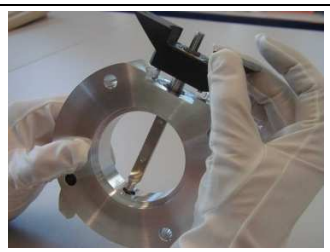
ISO-F

8.2.1 Replacement of shaft feedthrough seals and valve cleaning

8.2.1.1 Required tools

- Allen Wrench 2 mm / 2.5mm
- Allen Wrench 3 mm
- Feeler gauge
- Clean room wipes, isopropyl alcohol
- Vacuum grease

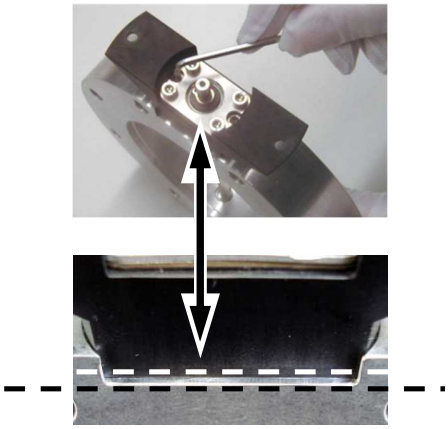
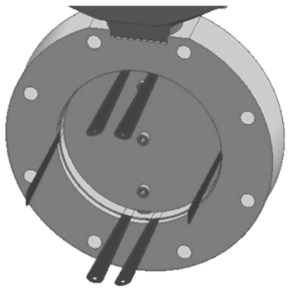
Description		Required tool
1. Vent vacuum system on both sides of the valve. 2. Make sure the valve is in closed position 3. Disconnect electrical POWER connector at valve and remove valve from vacuum system. Take care not to damage sealing surface! Do not move the plate by hands when control and actuating unit is installed.		
4. Unfasten clamp coupling		Allen Wrench: steel coupling 2.5 mm
5. Unfasten the 2 (DN-25-50) or 4 (DN 63-320) connection bolts and separate both parts. Valve size DN 160 (6”) and bigger require a shortened wrench. For ordering number refer to «Spare parts and accessories». 12 mm 		Allen Wrench 3 mm

Description		Required tool
6. Unfasten screws and remove plate from shaft.		Allen Wrench 3 mm
7. Unfasten alternately the 2 mounting screws little by little. If only one screw is fasten / unfasten, the mechanical unit will be damaged. Max. difference should be less than 1 turn or 0.5 turn of the screws.	 	Allen Wrench 3 mm
8. Remove mechanical unit and clean shaft.		
9. Remove O-rings. 10. Clean shaft feedthrough and valve body.		Clean room wipes a little soaked with isopropyl alcohol

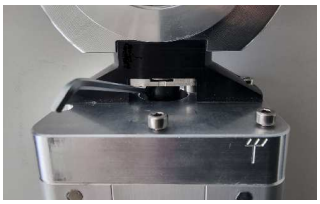
<table>
<tr><th>Description</th><th>Required tool</th></tr>
<tr><td>11. Lubricate seal contact surface of valve body with a slight film of vacuum grease (0.025 ml).
12. Lubricate each O-ring with a slight film of vacuum grease (0.0125 ml).</td><td>  </td><td></td></tr>
<tr><td>13. Lubricate seal contact surface of shaft with a slight film of vacuum grease (0.0125 ml).
14. Slide both O-rings onto shaft till the end.
15. Deposit 0.0375 ml vacuum grease between the O-rings
16. Clean shaft from vacuum grease.</td><td>  </td><td>Vacuum grease

Clean room wipes</td></tr>
<tr><td>17. Assemble mechanical unit in reverse order as disassembled (steps 6 to 5).

18. Align pedestal parallel to valve body and tighten the 2 mounting screws with 2.5 Nm

.
Make sure the pedestal is aligned to be parallel with the valve body</td><td>Allen Wrench 3mm
  </td><td></td></tr>
<tr><td>19. Center plate.<table><tr><th>Size</th><th>Feeler gauge mm</th></tr><tr><td>25</td><td>0.04</td></tr><tr><td>40</td><td>0.04</td></tr><tr><td>50</td><td>0.04</td></tr><tr><td>63</td><td>0.04</td></tr><tr><td>80</td><td>0.06</td></tr><tr><td>100</td><td>0.06</td></tr><tr><td>160</td><td>0.08</td></tr><tr><td>200</td><td>0.08</td></tr><tr><td>250</td><td>0.10</td></tr><tr><td>320</td><td>0.12</td></tr></table>20. Tighten plate screws with<table><tr><th>Size</th><th>Nm</th></tr><tr><td>25</td><td>1.1</td></tr><tr><td>40</td><td>2.5</td></tr><tr><td>>=50</td><td>2.5</td></tr></table></td><td>Actuator side
  </td><td>Allen Wrench 3 mm

Adequate feeler gauge</td></tr>
</table>

Description		Required tool
21. Assemble control and actuating unit to valve unit. Tighten mounting screws adequately.		Allen Wrench 3mm
22. Tighten clamp coupling: • with steel coupling 2.2 Nm		Allen Wrench: steel coupling 2.5 mm
23. Reinstall valve into vacuum system according to chapter «Installation».		

8.2.2 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

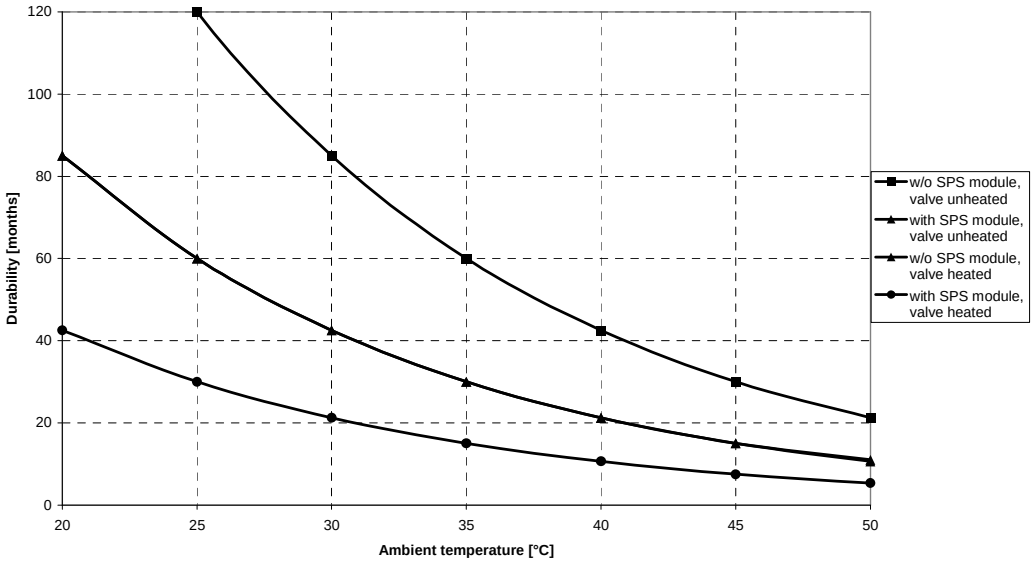
The modules may be retrofitted or replaced easily. The battery lifetime of the PFO module depends on the ambient temperature (see below). To assure PFO function the option board must be replaced after battery life has expired. For ordering number of the modules refer to chapter «Spare parts».

8.2.2.1 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.

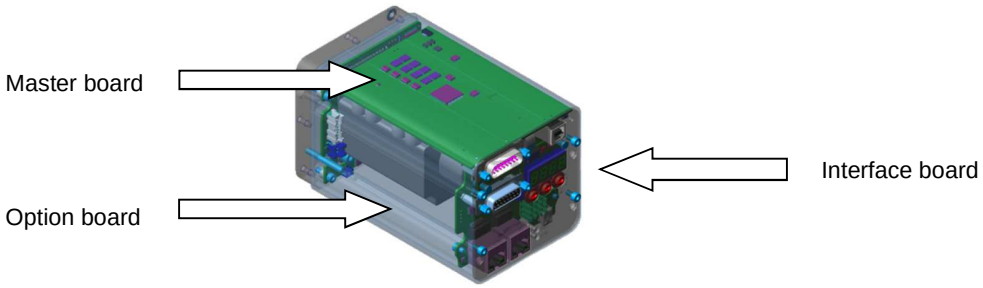
Therefore please determine the equivalent maintenance period for replacing the Ultra Cap battery (Option board).



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

8.2.2.2 Retrofit / replacement procedure

View on control and actuating unit:



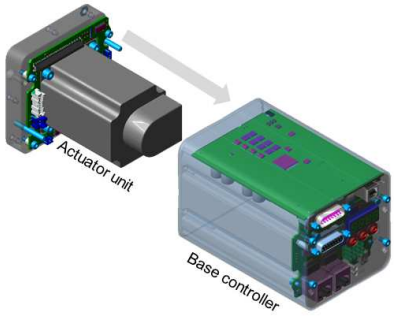
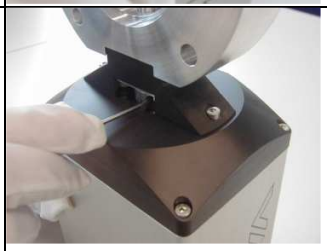
All boards have a fixed position into control and actuating unit. It is not possible to fit a board in other position as shown in picture above! Do not try out other positions, which maybe destroy the socket of boards!

8.2.2.3 Required tools

- Allen Wrench 2 mm / 2.5mm
- Allen Wrench 3 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.

Description		Required tool
Make sure that the valve is in closed position 1. Vent vacuum system, disconnect electrical connections and remove valve from vacuum system. If you only replace control and actuating unit, the valve can remain in the system. Take care not to damage sealing surface! **Attention!** Do not move the plate by hands when control an actuating unit is installed.		Depending on flange screws
2. Unfasten clamp coupling		Allen Wrench: steel coupling 2.5 mm
3. Unfasten the 4 connection bolts and separate both parts. Valve size DN 160 (6”) and bigger require a shortened wrench. For ordering number refer to «Spare parts and accessories». 12 mm 		Allen Wrench 3 mm

Description		Required tool
4. Replacement of the option board / whole controller Unfasten the two bolts from bottom side and and dismount the controller from the actuator unit. The SPS/PFO option board has to be mounted/ dismounted from bottom side of the controller. The Controller and Interface board are fix connected and shall not be dismounted. you have to work on an ESD-protected working space If you need any further information, please contact one of our service centers. You can find the addresses on our website: www.vatvalve.com		.
5. Assemble control and actuating unit to valve unit. Tighten mounting screws adequately.		Allen Wrench: 3mm
6. Tighten clamp coupling: • with elastic coupling 1.1 Nm • with steel coupling 2.2 Nm		Allen Wrench: steel coupling 2.5 mm
7. Reinstall valve into vacuum system according to chapter «Installation».		

9 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.

9.1 FPR Service

The VAT customer service can refurbish the product or individual components for you. Wear-sensitive parts are replaced, and the guarantee on the replaced parts is extended.

a) Select the desired Fixed Price Refurbishment service from our comprehensive service program for the refurbishment.
b) Contact your assigned sales person or the nearest VAT service center to learn about the options for the product in question. www.vatvalve.com.

10 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.

10.1 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.

4. Close the valve

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

10.2 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.

11 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.

11.1 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.

11.2 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.

12 Disposal

Observe the local regulations for disposal

⚠ WARNING

Harmful substances

Environmental pollution.

Discard products and parts according to the local regulations.

⚠ WARNING

Unqualified personnel

Inappropriate handling may cause serious injury or property damage.

Only qualified personnel are allowed to carry out the disposal.

⚠ CAUTION

Risk of damage

Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury. A large number of diverse materials are used in the product. Some of them could cause human and machine damage in the case of improper handling.

- Observe local regulations in regard to waste disposal without fail.
- Commission an authorized waste disposal company for the professional disposal of your waste.

NOTICE

Improper disposal

Some built-in materials can cause damage, if improperly handled**.**

- When disposing, take into account all the different materials used

- Hire an authorised waste disposal company to dispose of the waste in a professional manner.

The following list should help you to dismantle your product without making serious errors and to properly separate out the product scrap.

Material groups	Hazard level
non-ferrous metals	high
stainless steel	low
aluminum	low
plastics	medium
lubricants	high
electronic scrap	high
batteries	very high
cables and wires	medium
motors	medium
seals and rubber parts	high

13 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.

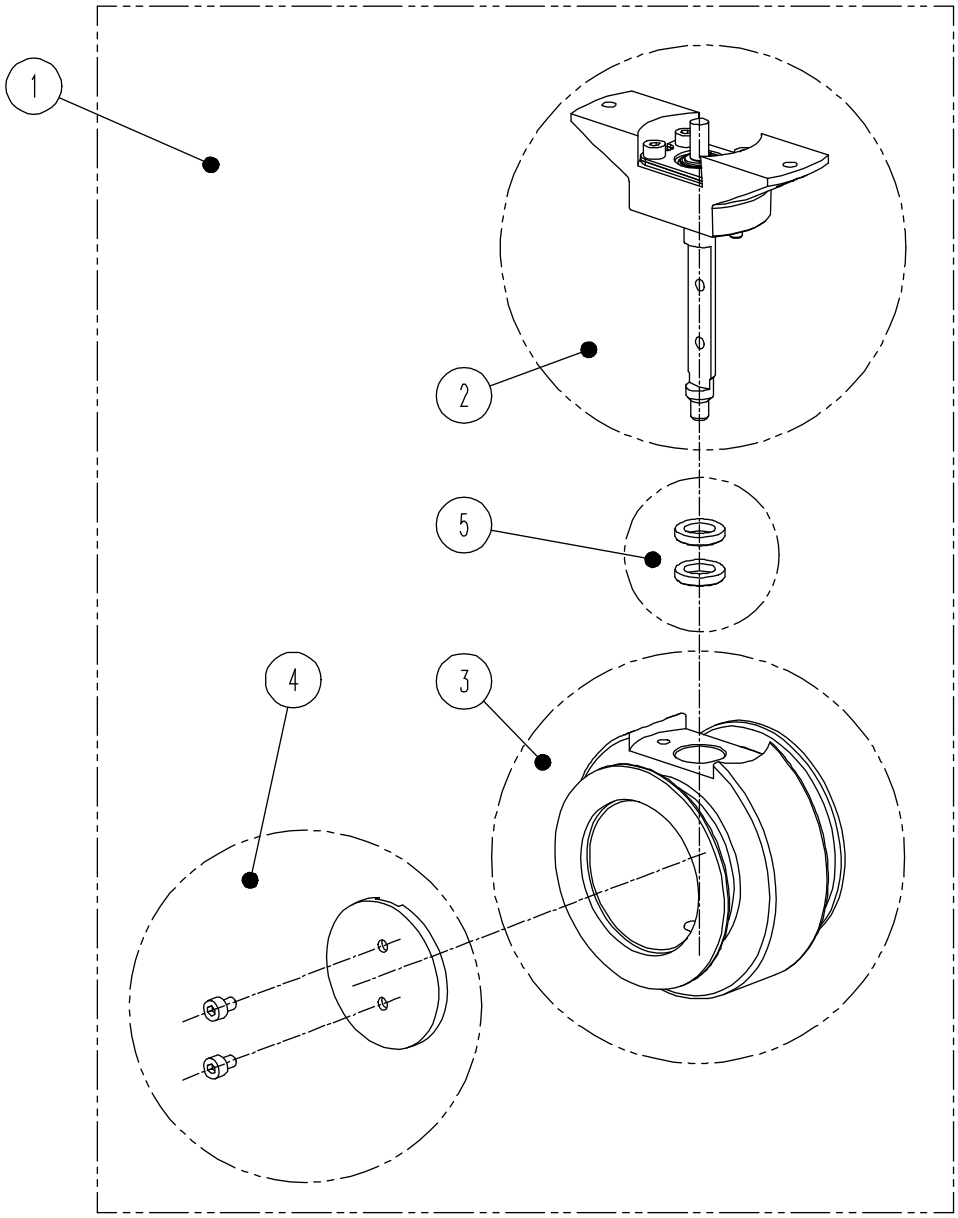
For versions such as:

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

spare parts ordering numbers are available on request.

13.1 ISO-KF for DN 25 – 50 mm

13.1.1 Drawing ISO-KF



1 Body with mechanism
2 Shaft kit
3 Valve body
4 Plate kit
5 Shaft feedthrough seals

All “Items in below table“ refer to this chapter «Drawing ISO-KF»

13.1.2 ISO-KF valve unit - aluminum blank, without heating

Item	Description			
	Valve size Product ordering number	**DN 25 / 1” 61328 - KA . . ISO-KF**	**DN 40 / 1½” 61332 - KA . . ISO-KF**	**DN 50 / 2” 61334 - KA . . ISO-KF**
1	Spare parts kit valve unit	488956	485726	486738
2	Spare parts kit mechanical unit	488946	471287	471292
3	Spare parts kit valve body	240574	232271	232272
4	Spare parts kit plate	253255	232276	232277
	Plate screws	361960 (2 pcs required)	353386 (2 pcs required)	353386 (2 pcs required)

13.1.3 ISO-KF valve unit – stainless steel, without heating

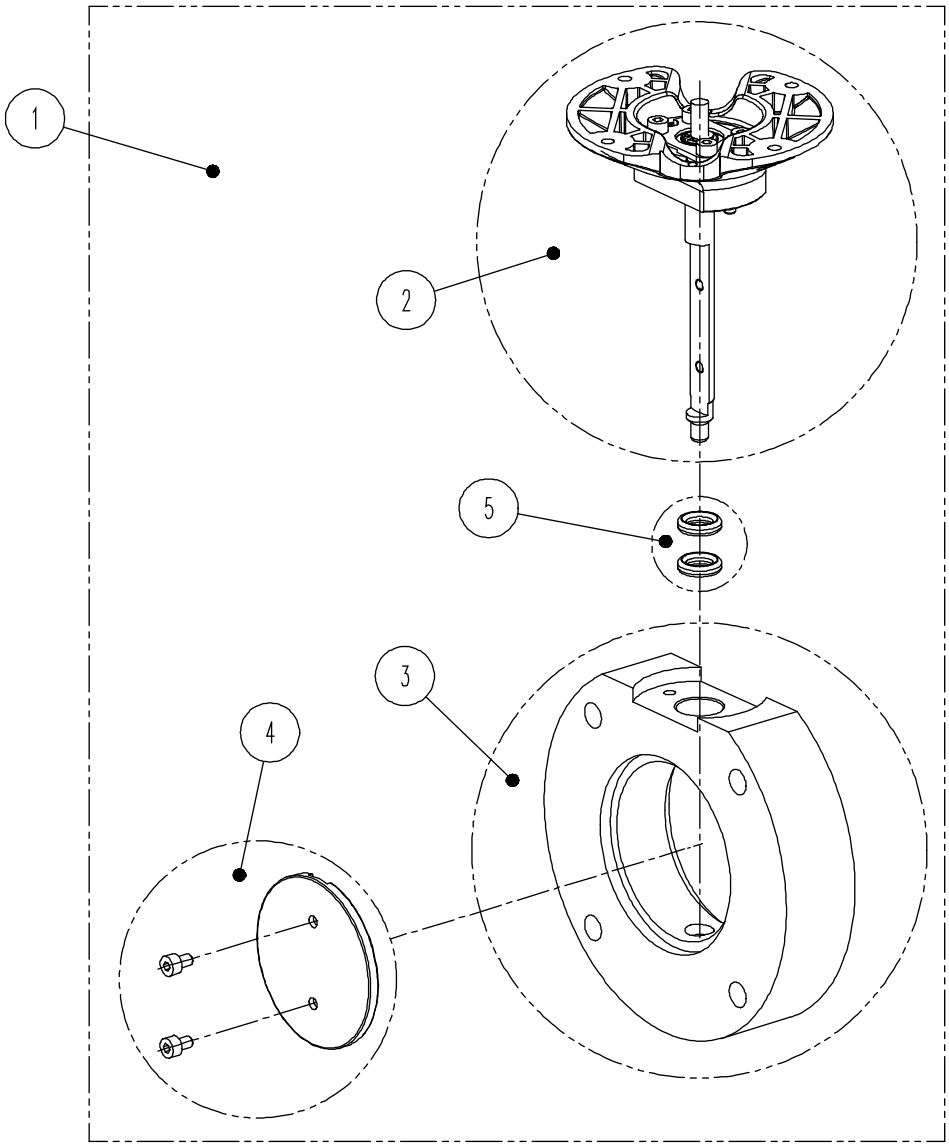
Item	Description			
	Valve size Product ordering number	**DN 25 / 1” 61328 - KE . . ISO-KF**	**DN 40 / 1½” 61332 - KE . . ISO-KF**	**DN 50 / 2” 61334 - KE . . ISO-KF**
1	Spare parts kit valve unit	489057	486772	485723
2	Spare parts kit mechanical unit	488946	471287	471292
3	Spare parts kit valve body	342558	243089	237850
4	Spare parts kit plate	342563	243090	239549
	Plate screws	361960 (2 pcs required)	353386 (2 pcs required)	353386 (2 pcs required)

13.1.4 Seals and grease

Item	Description		
	Valve size Product ordering number		**All sizes 613 . . - . . . .**
5	Vacuum seal kit	VITON ®	237235 (2x N-5100-204)
		Others	on request
	Vacuum grease syringe		206792 (2ml), 206793 (5ml)

13.2 ISO-F for DN 63 – 320 mm

13.2.1 Drawing ISO-F



1 Body with mechanism
2 Shaft kit
3 Valve body
4 Plate kit
5 Shaft feedthrough seals

All “Items in below table“ refer to this chapter «Drawing ISO-F»

13.2.2 ISO-F valve unit - aluminum blank, without heating

Item	Description							
	Valve size **Product ordering number**	**DN 63 / 2½"** **61336-PA . .**	**DN 80 / 3"** **61338-PA . .**	**DN 100 / 4"** **61340-PA . .**	**DN 160 / 6"** **61344-PA . .**	**DN 200 / 8"** **61346-PA . .**	**DN 250 / 10"** **61348-PA . .**	**DN 320 / 12"** **61350-PA . .**
1	Spare parts kit valve unit	490143	489471	490093	489026	491729	489827	249284
2	Spare parts kit mechanical unit	490144	489464	490094	489022	491728	489910	807298
3	Spare parts kit valve body	232273	232274	232275	243026	237716	241204	327111
4	Spare parts kit plate	232278	232279	232280	243028	237725	252046	327109
	Plate screws	353386 (2 pcs required)	353386 (3 pcs required)	353386 (3 pcs required)	353386 (3 pcs required)	353386 (3 pcs required)	353386 (3 pcs required)	353386 (3 pcs required)

13.2.3 ISO-F valve unit – stainless steel, without heating

Item	Description							
	Valve size **Product ordering number**	**DN 63 / 2½"** **61336-PA . .**	**DN 80 / 3"** **61338-PA . .**	**DN 100 / 4"** **61340-PA . .**	**DN 160 / 6"** **61344-PA . .**	**DN 200 / 8"** **61346-PA . .**	**DN 250 / 10"** **61348-PA . .**	**DN 320 / 12"** **61350-PA . .**
1	Spare parts kit valve unit	491837	491711	491749	491978	497131	502651	-
2	Spare parts kit mechanical unit	490144	489464	490094	489022	491728	489910	-
3	Spare parts kit valve body	252748	248433	252764	243026	252778	393073	-
4	Spare parts kit plate	252738	248463	252763	243028	244362	414211	-
	Plate screws	353386 (2 pcs required)	353386 (3 pcs required)	353386 (3 pcs required)	353386 (3 pcs required)	353386 (3 pcs required)	353386 (3 pcs required)	353386 (3 pcs required)

13.2.4 Seals and grease

Item	Description		
	Valve size **Product ordering number**		**All sizes** **613 . . - . . . .**
5	Vacuum seal kit	VITON ®	237235 (2x N-5100-204)
		Others	on request
	Vacuum grease syringe		206792 (2ml), 206793 (5ml)

13.3 Control unit and Accessories

13.3.1 Control and actuating unit

Description	Part number
Control and actuating unit	Too many to list. Please contact VAT.
Option board with SPS module (±15 VDC Sensor Power Supply)	858530
Option board with PFO module (Power Failure Option)	858529
Option board with SPS and PFO module	840512

13.3.2 Accessories

Description	Part number
24 VDC power supply unit (input: 100 – 240 VAC)	891528 (D-Sub15 connector)
Adapter cable for power supply with D-Sub9 connector	(735567) (D-Sub15 to D-Sub9)
Plug D-sub 15 pin female with 4-40UNC screws for the power input and Logic interface (plug only)	81177-R1
Service cable (PC to valve Service connector)	809474 (USB A–B male-male)
Special Allen wrench (SW3) for disassembly and assembly	244873
O-ring removal tool	234859

13.3.3 Centering ring with VITON ® O-ring

Description				
Valve size **Product ordering number**		**DN 25 / 1** **61328 - . . . .**	**DN 40 / 1½”** **61332 - . . . .**	**DN 50 / 2”** **61334 - . . . .**
Centering ring with VITON ® O-ring (for ISO-KF and ISO-F installation only)	Aluminum	31028-KAZV-0001	31032-KAZV--0001	32034-KAZV-0001
	Stainless steel	31028-KEZV-0001	31032-KEZV-0001	32034-KEZV-0001

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