thermionics laboratory, inc.

Installation, Operating & Maintenance Instructions

Butterfly Pressure Control Valve

with RS232 interface

DN 40-250 mm

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.

1.2 Use of product

This product is a Butterfly control valve for downstream pressure control in vacuum systems. Use product for clean and dry vacuum applications only.

1.3 Used abbreviations

Abbreviation	Description
NVM	Valve manager
PFO	Power Failure Option
SFS	Sensor Full Scale
SPS	Sensor Power Supply
ADC	Analog-to-digital converter

1.4 Related documents

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

1.5 Important information

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

Example:

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

1.6 Technical data

1.6.1 Control and actuating unit

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

[1] Internal overcurrent protection by a PTC device.

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

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

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

[3] Refer to chapter «Schematics» for details.

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

1.6.2 Valve unit

Description						
Pressure range at 20°C - Aluminum (612 . . - . A.....) - Aluminum hard anodized (612 . . - . H.....) - Aluminum nickel coated (612 . . - . I.....) - Stainless steel (612 . . - . E.....)						1 × 10E-8 mbar to 1.2 bar (abs) 1 × 10E-6 mbar to 1.2 bar (abs) 1 × 10E-8 mbar to 1.2 bar (abs) 1 × 10E-8 mbar to 1.2 bar (abs)
Leak rate to outside at 20°C - Aluminum (612 . . - . A.....) - Aluminum hard anodized (612 . . - . H.....) - Aluminum nickel coated (612 . . - . I.....) - Stainless steel (612 . . - . E.....)						1 × 10E-9 mbar l/s 1 × 10E-5 mbar l/s 1 × 10E-9 mbar l/s 1 × 10E-9 mbar l/s
Cycles until first service						2'000'000 (unheated and under clean conditions)
Admissible operating temperature						+10°C to +150°C
Mounting position						Any Control unit for ISO-KF version needs support when mounted on horizontal piping and control unit does not hang.
Wetted materials - Body, plate (612 . . - . A.....) - Body, plate (612 . . - . H.....) - Body, plate (612 . . - . I.....) - Body, plate (612 . . - . E.....) - Shaft - Plate screws						Aluminum 3.2315 (AA6082) Aluminum 3.2315 (AA6082) hard anodized Aluminum 3.2315 (AA6082) nickel coated Stainless steel 316L (1.4404 or 1.4435) Stainless steel 316L (1.4404 or 1.4435) Stainless steel 316L (A4)
- Shaft seal						Viton® (standard). Other materials available on request. Seal materials are declared on dimensional drawing of specific valve ordering number.
- Slide bearing for shaft						iglidur® X
	DN 63 2½"	DN 80 3"	DN 100 4"	DN 160 6"	DN 200 8"	DN 250 10"
	(61236 - ....)	(61238 - ....)	(61240 - ....)	(61244 - ....)	(61246 - ....)	(61248 - ....)
Max. differential pressure on plate	1000 mbar	1000 mbar	800 mbar	300 mbar	150 mbar	100mbar
Min. controllable conductance (C_{min}) [N_2 molecular flow]	0.45 l/s	0.65 l/s	0.85 l/s	1.7 l/s	2.8 l/s	5 l/s
Conductance in open position [N_2 molecular flow]	360 l/s	850 l/s	1400 l/s	3800 l/s	7800 l/s	15000 l/s
Dimensions	Refer to dimensional drawing of specific valve ordering number (available on request)					

2 Safety

2.1 Compulsory reading material

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

NOTICE

Lack of knowledge

Failing to read this manual may result in property damage. Firstly, read manual.

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

2.2 Danger levels

DANGER

High risk

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

WARNING

Medium risk

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

CAUTION

Low risk

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

NOTICE

Command

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

2.3 Personnel qualifications

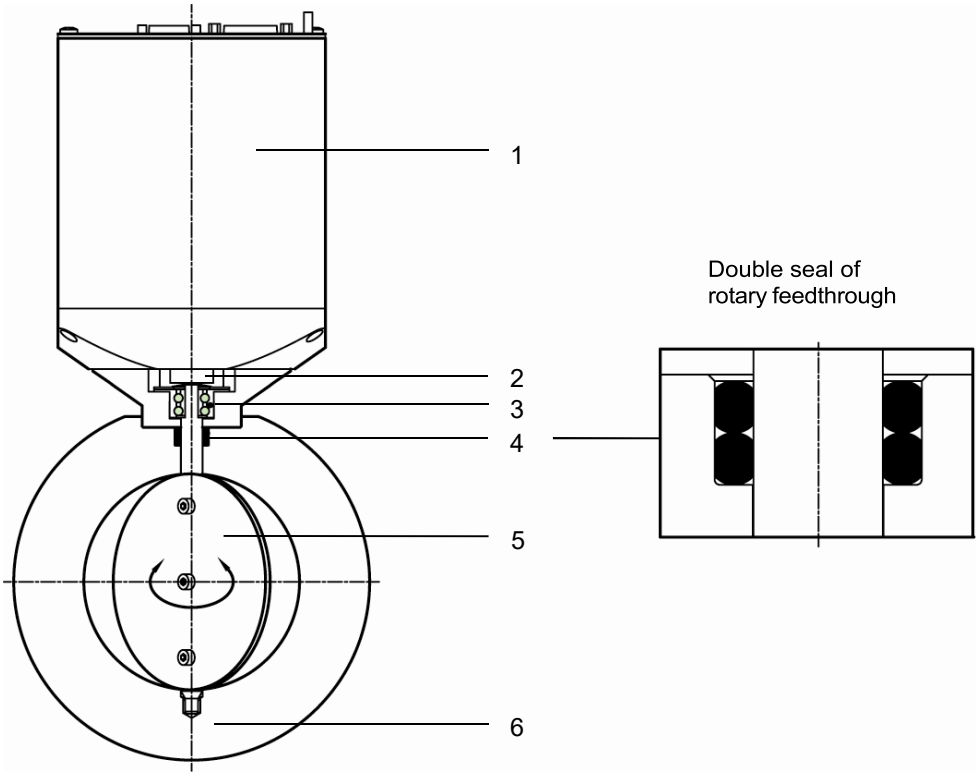
	**WARNING** Unqualified personnel Inappropriate handling may cause serious injury or property damage. Only qualified personnel are allowed to carry out the described work.

2.4 Safety labels

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

3 Design and Function

3.1 Design



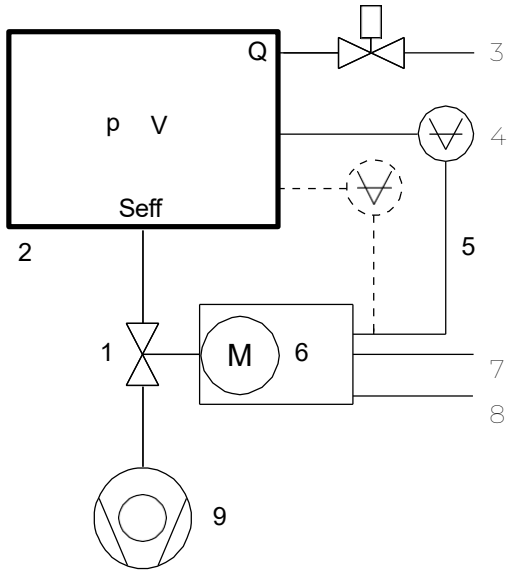
1	Integrated controller	4	Double seal
2	Coupling	5	Plate
3	Bearing	6	Valve body

3.2 Function

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

3.2.1 Pressure control system overview and function

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



Example: Downstream control

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

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

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

3.2.1.1 Way of operation

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

3.2.1.2 Pressure control

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

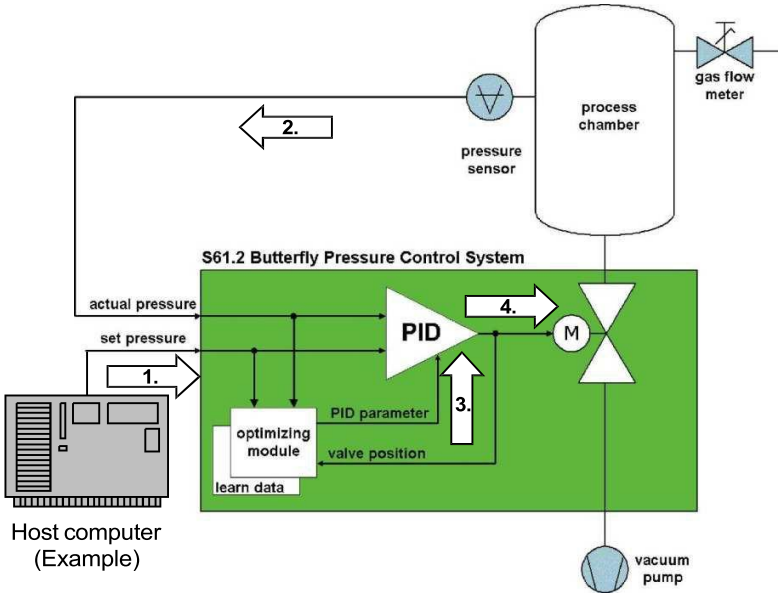
1. Downstream control (standard):
   The pressure is controlled by changing the conductance of a control valve between pump and process chamber. This changes the effective pumping speed at the process chamber. Pressure and gas flow can be independently controlled over a wide range.

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

3.2.1.3 Adaptive controller (standard)

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

3.2.2 Principle of a pressure control system



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

4 Installation

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

4.1 Unpacking

	*NOTICE* Physical overstraining at controller Inappropriate handling with the valve may cause in damage of controller. Do not place the valve on the controller.

	*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.
- Store the original packaging material.

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

Do not remove protective foils from valve opening

4.2 Installation into the system

WARNING

Valve opening

Risk of serious injury.

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

NOTICE

Sealing surfaces

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

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

NOTICE

Wrong connection

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

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

NOTICE

Burned connector pins (spark)

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

Do not plug or unplug connectors under power.

NOTICE

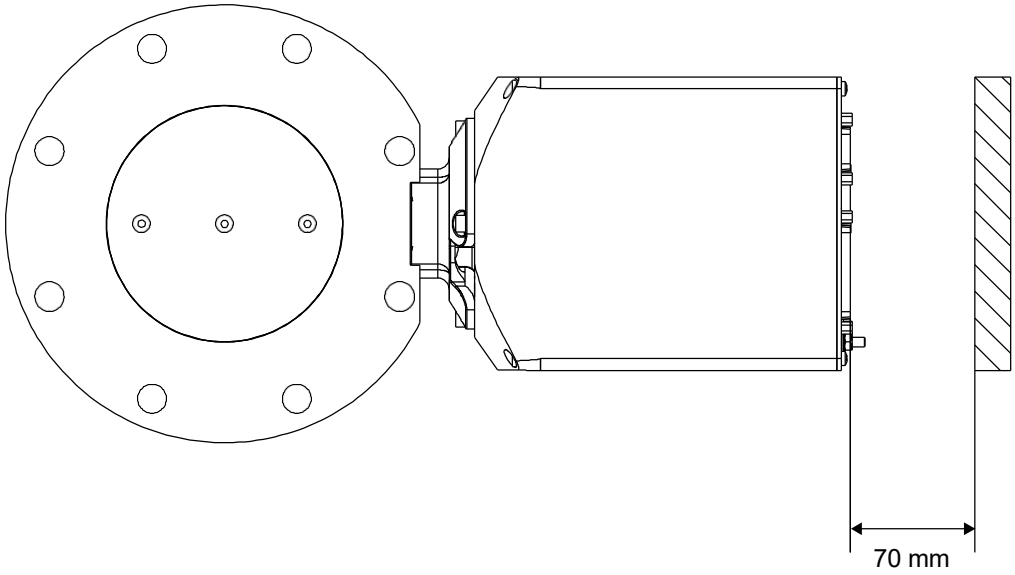
Contamination

Gate and other parts of the valve must be protected from contamination. Always wear clean room gloves when handling the valve.

Mount valve to a clean system only.

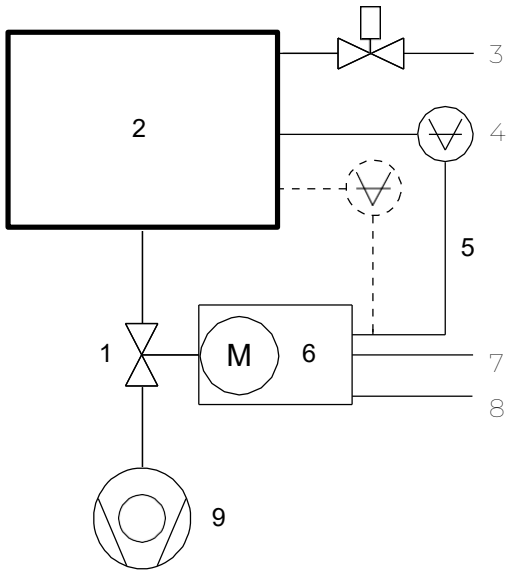
4.2.1 Installation space condition

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



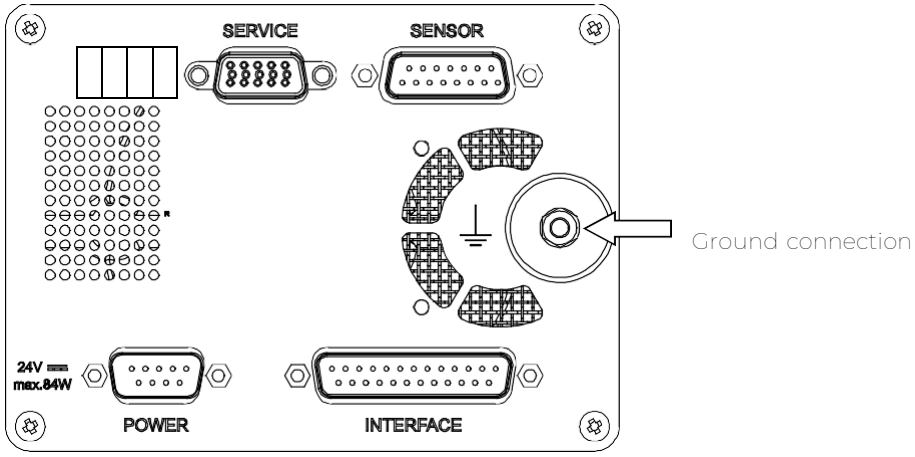
4.2.2 Connection overview

System:



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

Controller:



4.2.3 Installation procedure

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

1. Remove protective covers from body flanges.
2. Install [1] valve into the vacuum system.

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

3. Install the ground connection cable at controller. Refer to chapter «Electrical connection».
4. Install sensor(s) [4] according to the recommendations of the sensor manufacturer and directives given under chapter «Requirements to sensor connection».
5. Connect sensor cable [5] to sensor(s) and then to valve (connector: SENSOR). Refer to chapter «Electrical connection» for correct wiring.
6. Connect valve with cable [7] to remote control unit (connector: INTERFACE). Refer to chapter «Functions and Wiring» for correct wiring.
7. Connect power supply cable [8] to valve (connector: POWER). Refer to chapter «Electrical connection» for correct wiring.

To provide power to the valve motor pins 4 and 8 must be bridged, otherwise motor interlock is active and the valve enters the safety mode and is not operative. Refer also to chapter «Safety mode».

8. This valve may optionally be equipped with a heating device.

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

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

4.3 Tightening torque

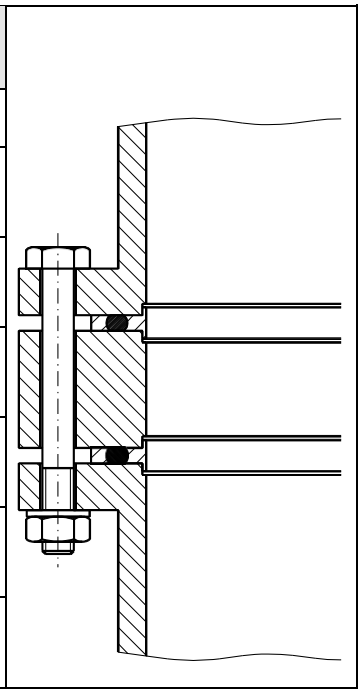
Tighten mounting screws of the flanges uniformly in crosswise order. Observe the maximum torque levels in the following table. Higher tightening torques deforms the valve body and may lead to malfunction of the valve.

4.3.1 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.

4.3.2 Mounting with centering rings

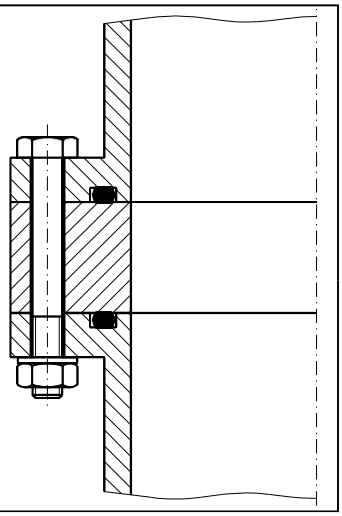
Valve size		max. tightening torque (Nm)	max. tightening torque (lbs . ft)
mm	inch	ISO-F	ISO-F
63	2½	8-10	6-8
80	3	8-10	6-8
100	4	8-10	6-8
160	6	13-15	9-11
200	8	13-15	9-11
250	10	13-15	9-11



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

4.3.3 Mounting with O-ring in grooves

Valve size		max. tightening torque (Nm)		max. tightening torque (lbs . ft)	
mm	inch	ISO-F	JIS	ISO-F	JIS
63	2½	20-23	35-40	15-17	26-30
80	3	20-23	35-40	15-17	26-30
100	4	20-23	35-40	15-17	26-30
160	6	40-45	35-40	30-35	26-30
200	8	40-45	65-70	30-35	48-52
250	10	40-45	65-70	30-35	48-52



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

4.4 Admissible forces

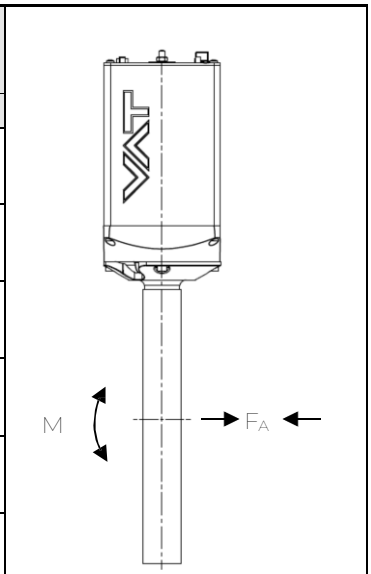
NOTICE

Force at valve body

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

Do not higher force the valve body as specified.

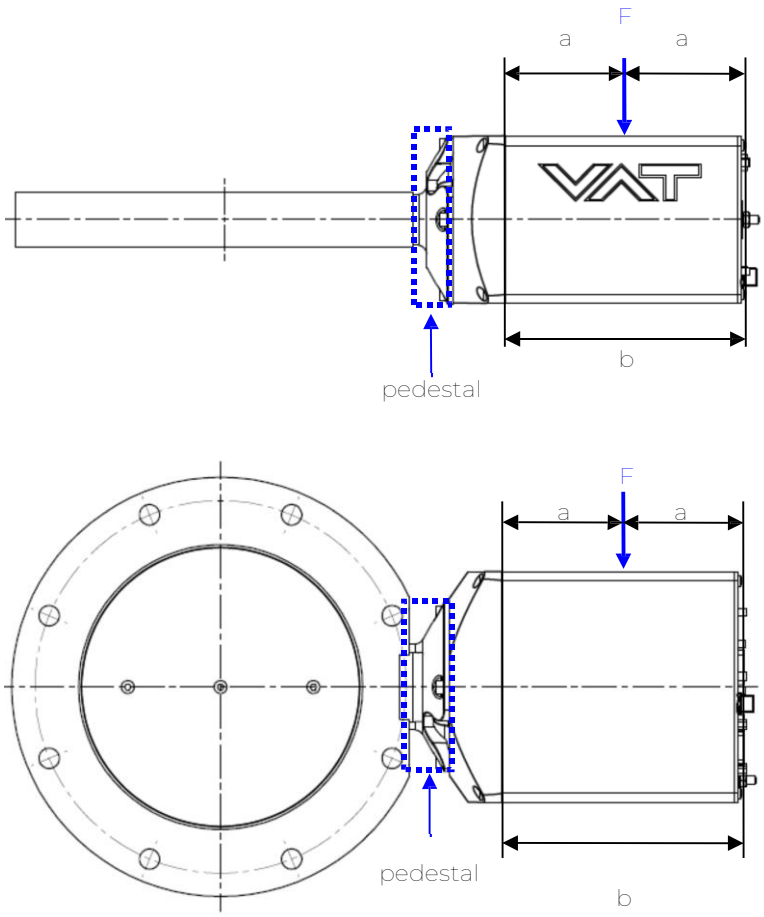
The following forces are admissible.

Valve size		Axial tensile or compressive force «F_A»		Bending moment «M»		
mm	inch	N	lb.	Nm	Lbf.	
63	2½	800	176	32	24	
80	3	850	187	35	26.5	
100	4	1000	220	40	30	
160	6	1200	264	60	45	
200	8	1200	264	60	45	
250	10	1200	264	60	45	

4.4.1 Admissible forces at controller

NOTICE
Force at pedestal In case higher force is applied, the pedestal could be permanently damaged. – Do not pushing, shocking load, or stressing the valve controller – Do not deposit anything at valve controller

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

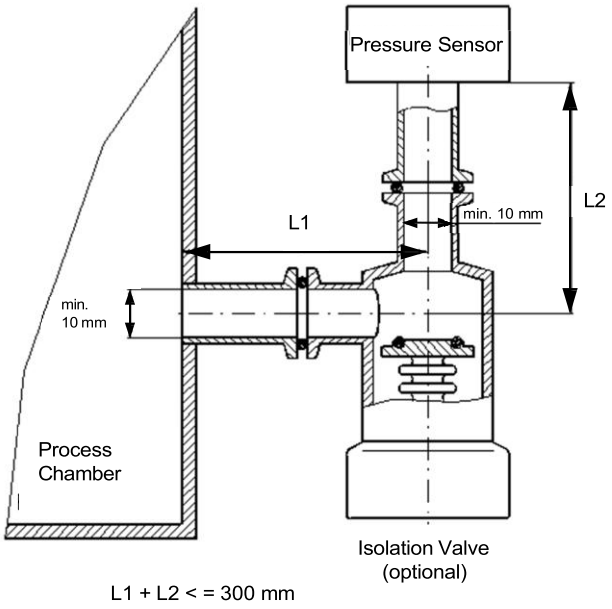
Admissible force «F»	Overvie w F = Force a = middle of aluminium part of controller (b / 2)
400 N	

4.4.2 Requirements to sensor connection

To achieve fast and accurate pressure control a fast sensor response is required. Sensor response time:
< 50ms. The sensor is normally connected to the chamber by a pipe. To maintain that the response time is not degraded by this connection it needs to meet the following requirements:

- Inner diameter of connection pipe: > = 10 mm
- Length of connection pipe: < = 300 mm

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



4.5 Electrical connection

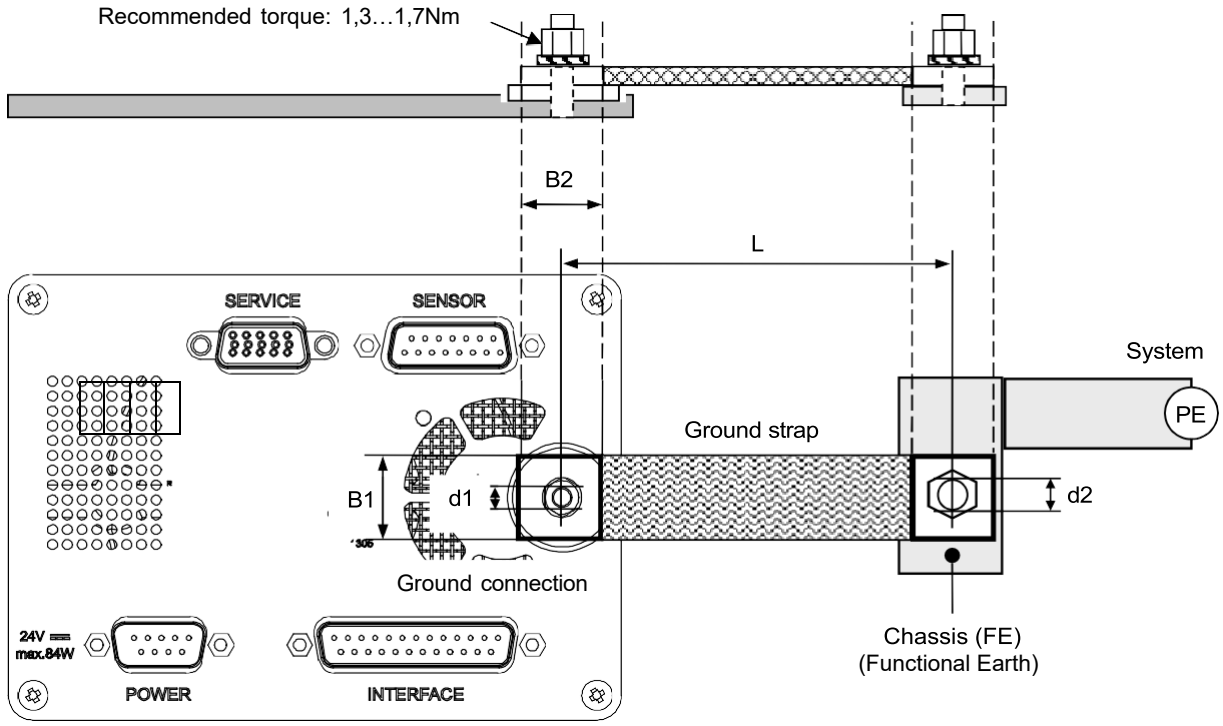
	NOTICE
	Wrong connection Wrong connection may result in damage of controller or power supply. Connect all cables exactly as shown in the following descriptions and schematics.

	NOTICE
	Burned connector pins (spark) Connector pins or electronic parts could damage, if plugged and unplugged under power. Do not plug or unplug connectors under power.

4.5.1 Ground connection

Recommendation for ground strap between controller and system (chassis)

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



Valve controller

- Connection plates of ground strap must be total plane for a good electrical contact!
- The connection point at chassis (FE) must be blank metal (not coated). It is also possible to connect the ground strap at system chamber if it is well connected to PE.
- Avoid low chassis cross section to the system PE connection. (min. same cross section as ground strap)

4.5.2 Sensor supply concepts

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

Concepts:

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

This concept is only possible when SPS retrofit is installed.

Valve versions:

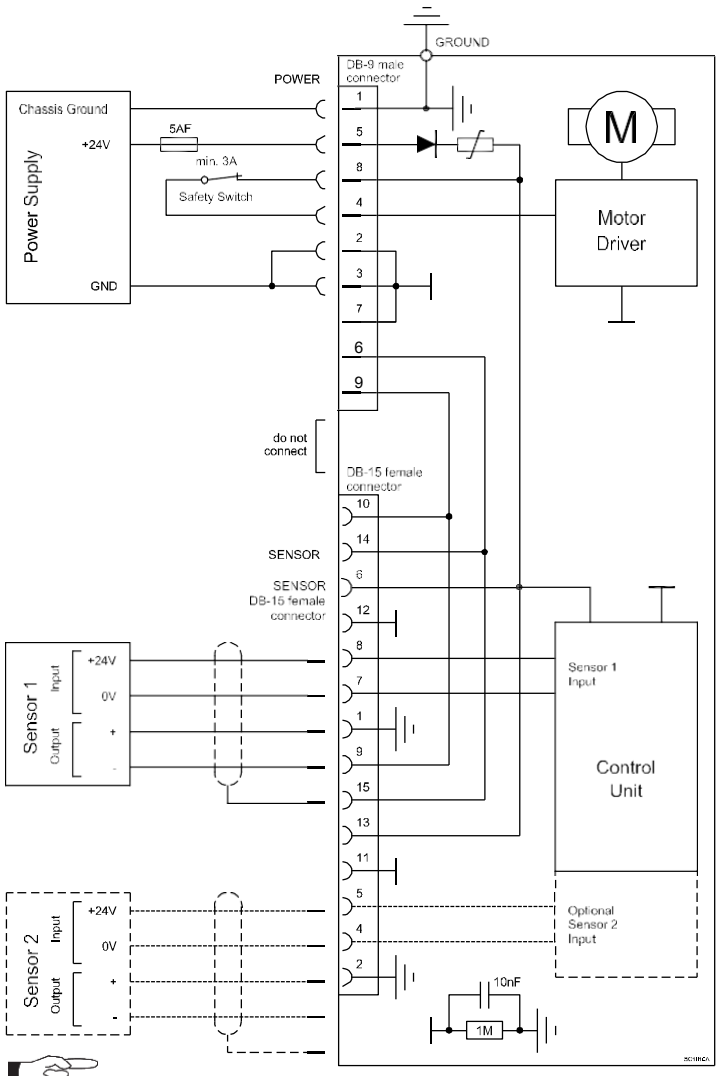
- 612. . - . . G . - . . . . and 612 . . - . . H . - . . . . SPS module not included
- 612 . . - . . A . - . . . . and 612 . . - . . C . - . . . . SPS module included

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

4.5.3 Power and sensor connection (+24 VDC sensors)

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

4.5.3.1 Sensor power wiring via controller

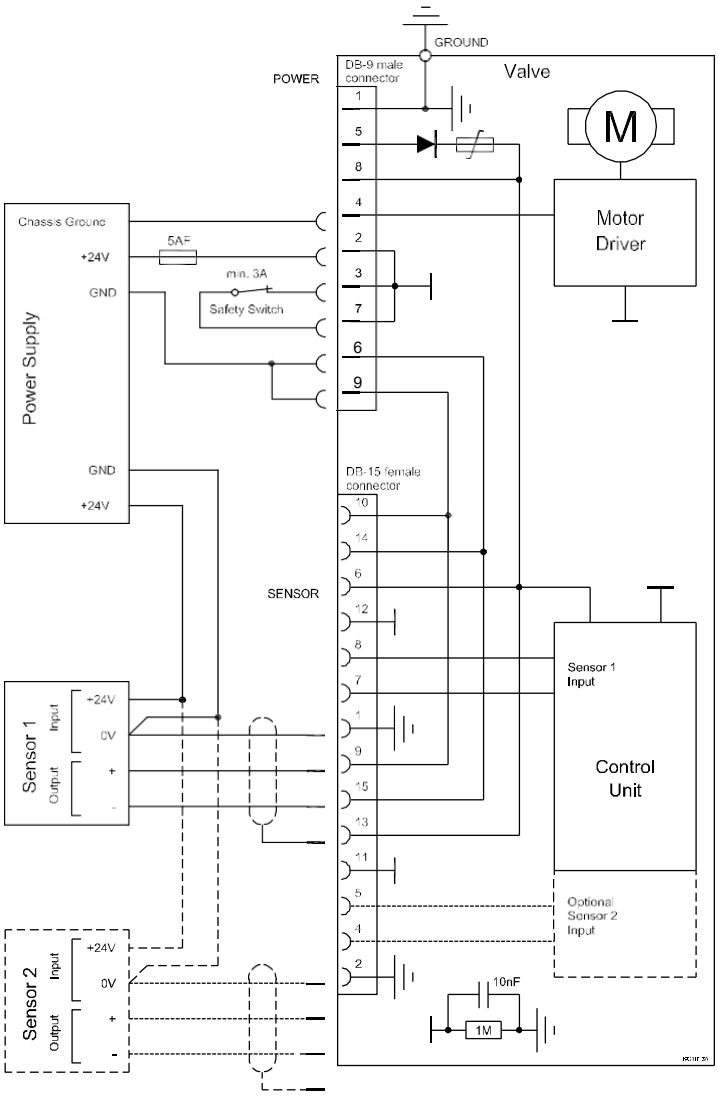


Pins 4 and 8 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

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

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

4.5.3.2 Sensor power wiring external



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

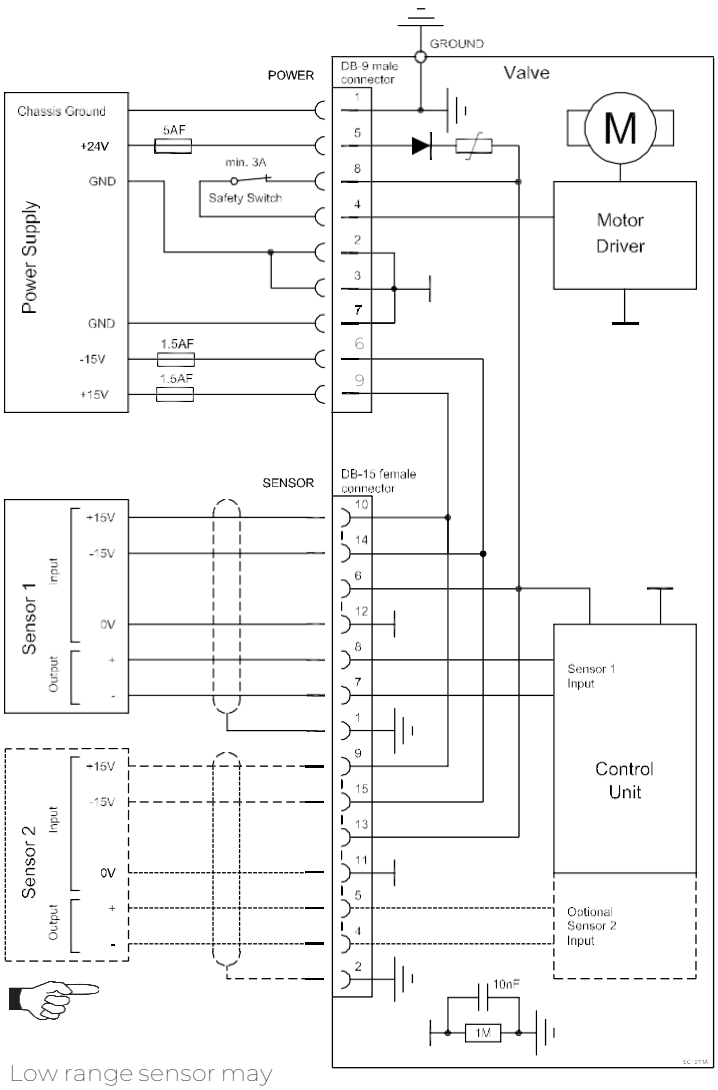
Low range sensor may be connected to sensor 1 or sensor 2 input. Do configuration accordingly.

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

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

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

4.5.4.1 Sensor power wiring via controller

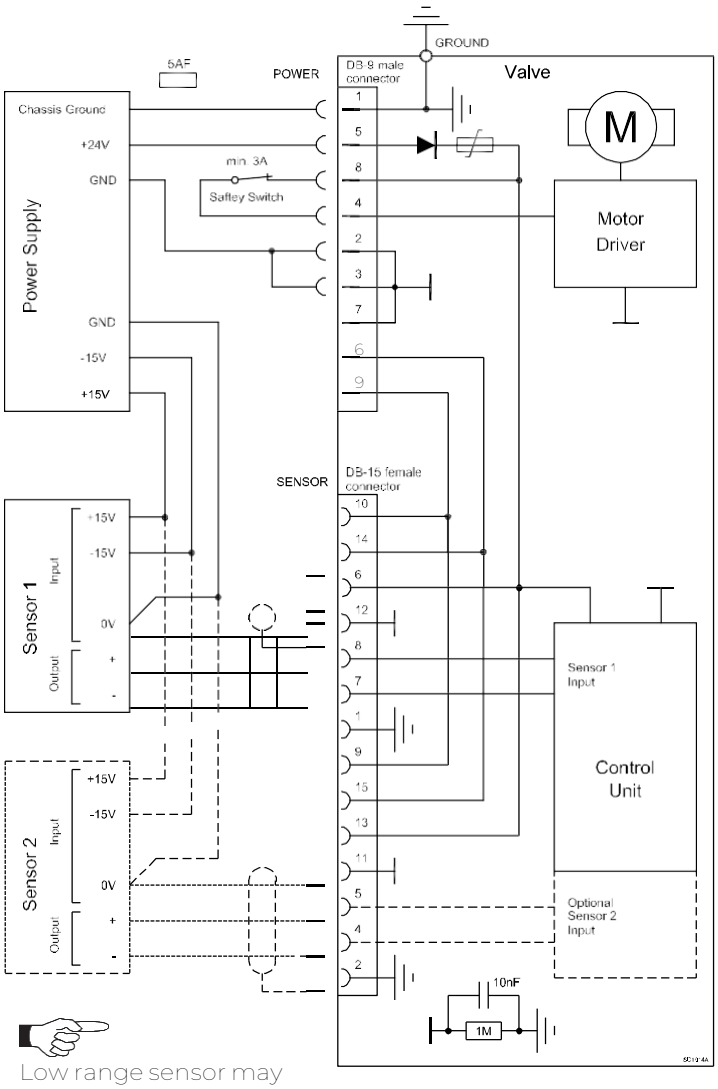


Pins 4 and 8 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

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

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

4.5.4.2 Sensor power wiring external



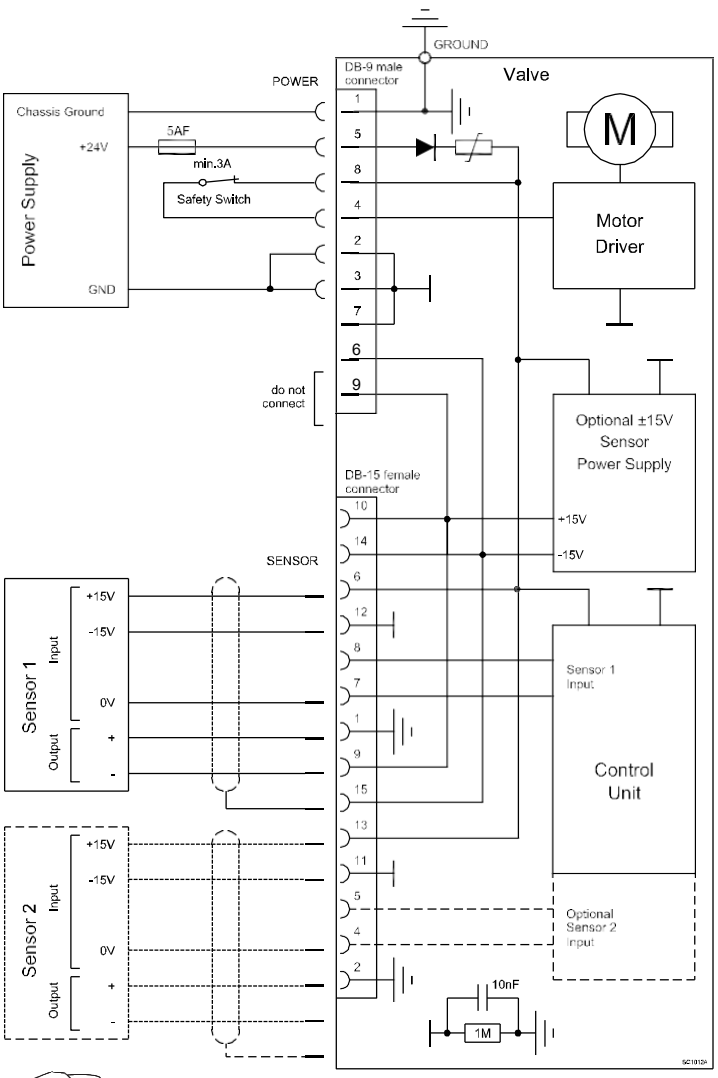
Pins 4 and 8 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

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

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

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

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



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

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

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

4.5.6 Service port connection

The service port (connector: SERVICE) allows to connect the valve to a RS232 port of a computer. This requires a service cable and software from the manufacturer. You can use our Software (freeware) 'NVM.

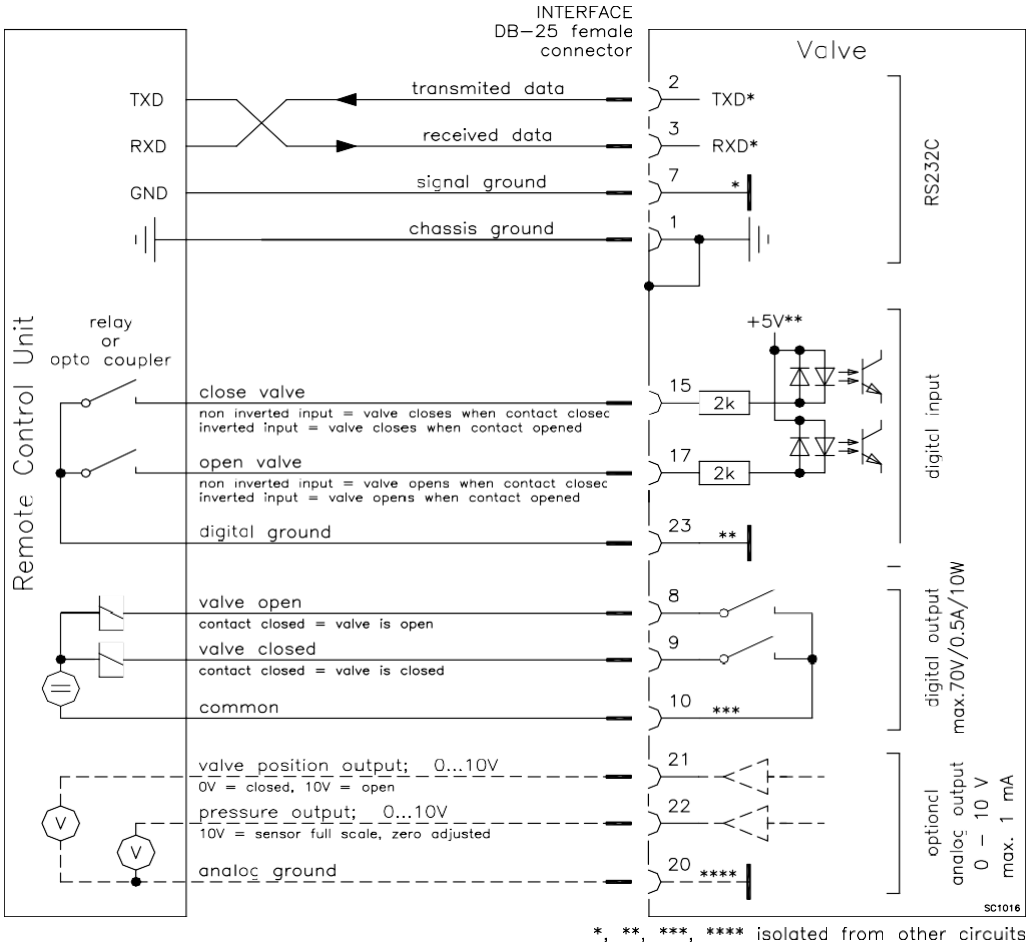
Use only screws with 4–40 UNC thread for fastening the service port connector.

4.5.7 Functions and Wiring

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

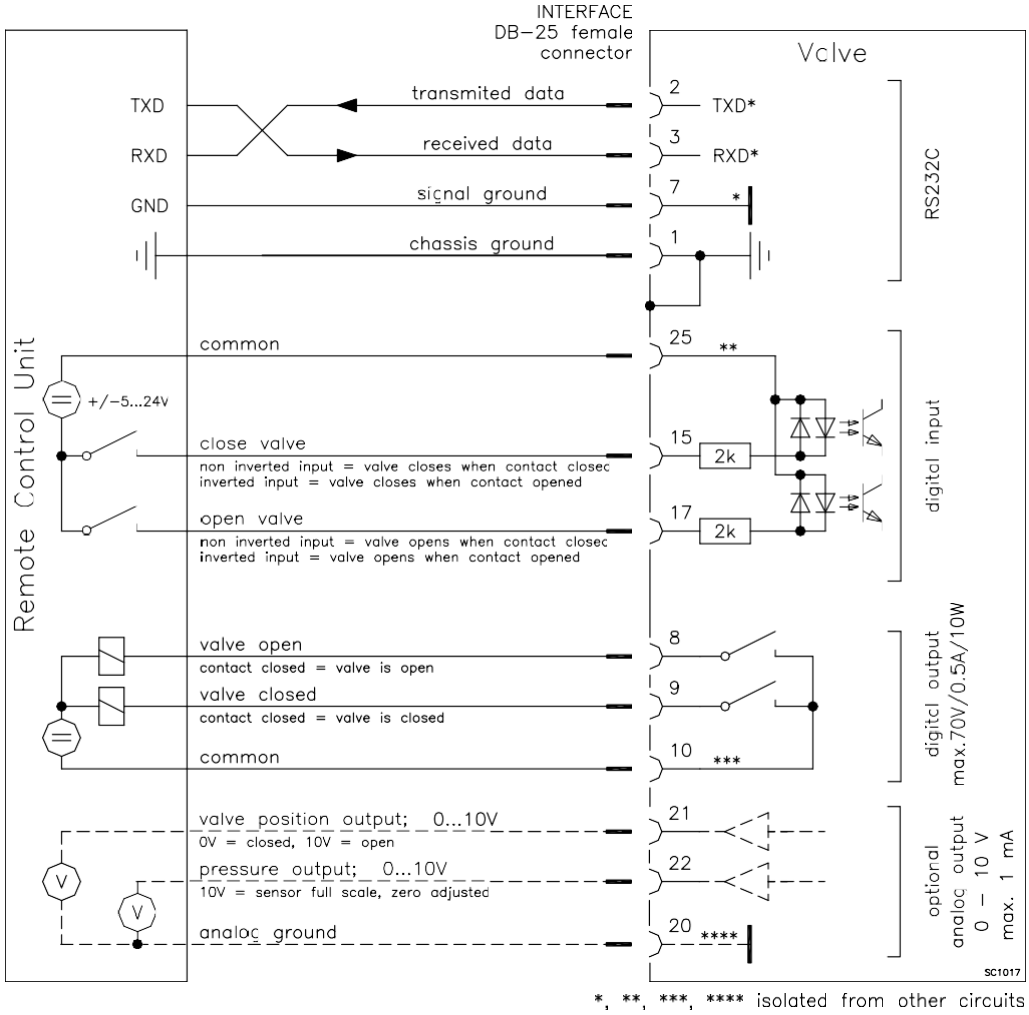
Optional analog outputs are available on 612 . . - . . . V - . .
. . and 612 . . - . . . W ..... versions only.
Active digital inputs have higher priority than RS232 commands.

a) Configuration with switches for digital inputs:



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

b) Configuration with voltage source for digital inputs:



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

4.5.7.1 Digital inputs

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

1) All digital inputs are digitally filtered. Filter delay is 50ms. This means that digital signals must be applied for at least 50ms to be effective. Refer to chapter «Schematics» for details about input circuit.

2) Highest priority is 1. Functions with lower priorities will not be effective as long as higher priority functions are active. These digital inputs have higher priority than all RS232 commands. RS232 commands will not be accepted while digital inputs are active.

4.6 Initial operation

To enable the valve cluster for pressure control setup steps 1 to 7 must be performed.
In case position control is required only it's sufficient to perform steps 1 to 4.

Setup step		Description
1	POWER UP	Turn on external + 24VDC power supply (and external ±15 VDC for sensor power supply if required). Refer to chapter «Behavior during power up» for details.
2	INTERFACE CONFIGURATION	RS232 Baud rate, parity, data length and number of stop bits for valve must be selected. Refer to chapter «Interface configuration» for details.
3	VALVE CONFIGURATION	Basic configurations of the valve must be adapted according to application needs. Refer to chapter «Valve configuration» for details.
4	SENSOR CONFIGURATION	Basic configurations of the valve must be adapted according to application needs. Refer to chapter «Sensor configuration» for details.
5	ZERO	Compensation of the sensor offset voltage. Refer to chapter «ZERO» for details.
6	LEARN	For adaptive pressure controller only. Determination of the vacuum system characteristic to accommodate the PID controller. Refer to chapter «LEARN adaptive» for details.
7	PRESSURE CONTROL COFIGURATION	Accommodation of PID controller to the vacuum system characteristic. Refer to chapter: «Pressure Control configuration» for details.

Without «LEARN adaptive» or «Pressure Control configuration» the valve is not able to run pressure control.

For ease setup (in Local mode) of 'Interface', 'Valve', 'Sensor', 'Senor ZERO', 'LEARN' and 'PRESSURE CONTROL COFIGURATION' it is possible to use the NVM.

4.6.1 RS232 Interface configuration

The factory default configuration of the RS232 interface might be changed to fit the application by using the NVM.

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

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

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

Local operation: (NVM)	Remote operation: (Refer to chapter «Setup commands» for details)
With NVM: • Do the Interface configuration in menu 'Interface / Setup'.	1. Send INTERFACE CONFIGURATION
	2. Send RANGE CONFIGURATION

4.6.2 Valve configuration

Basic valve configuration must be adapted according to application needs. Definition of valve plate position in case of:

- After power up, default is 'close'.
- Power failure, default is 'not defined'. Only for versions that have Power Fail Option equipped [612 . .
  - . . C . - . . . or 612 . . - . . H.....].
- Network failure, for default settings refer to individual product data sheet.

Local operation: (NVM)	Remote operation: (Refer to chapter «Setup commands» for details)
With NVM: • Do valve configuration in menu 'Valve / Setup'.	1. Send VALVE CONFIGURATION

4.6.3 Sensor configuration

Basic sensor configuration must be adapted according to application needs.

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

Local operation: (NVM)	Remote operation: (Refer to chapter «RS232setup commands» for details)
With NVM: • Do sensor configuration in menu 'Sensor / Setup'.	Send SENSOR CONFIGURATION

4.6.4 ZERO

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

Local operation: (NVM)	Remote operation: (Refer to chapter «Control commands» resp. «Setup commands» for details)
With NVM: • Do the ZERO in menu 'Sensor / Zero'.	1. Send OPEN VALVE
	2. Wait until process chamber is evacuated and sensor signal is not shifting anymore.
	3. Send ZERO

- Do not perform ZERO as long as pressure gauge voltage is shifting otherwise incorrect pressure reading is the result. Refer to manual of sensor manufacturer for warm up time.
- Do not perform ZERO, if the base pressure of your vacuum system is higher than 1‰ of sensor full scale. We recommend disabling ZERO function in this case; refer to «Valve and sensor configuration» of the setup procedure. Otherwise incorrect pressure reading is the result.

4.6.5 LEARN (adaptive)

LEARN adapts the PID controller of the valve to the vacuum system and its operating conditions. LEARN must be executed only once during system setup. The LEARN routine determines the characteristic of the vacuum system. Based on this, the PID controller is able to run fast and accurate pressure control cycles.
This characteristic depends on various parameters such as chamber volume, conductance and flow regime. Therefore it must be performed with a specific gas flow according to instruction below.
The result of LEARN is a pressure versus valve position data table. This table is used to adapt the PID parameters. The data table is stored in the device memory which is power fail save. The data table can be up-/downloaded via 'NVM' 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.

<table>
<tr><td>Local operation:
(NVM)</td><td>Remote operation:
(Refer to chapter «Control commands» resp.
«Setup commands» for details)</td></tr>
<tr><td rowspan="3">With NVM:
• Do the LEARN in menu 'Pressure Control
/ Learn'.

Gasflow calculation according to recommendation below is done automatically based on inputs.</td><td>1. Send OPEN VALVE</td></tr>
<tr><td>2. Set specific gas flow according to calculation below and wait until flow is stable.
LEARN does not need to be performed with the process gas. Instead N_2 or Ar may be used.</td></tr>
<tr><td>3. Send LEARN with pressure limit set to pmax
(max. pressure to control during process)</td></tr>
</table>

Sensor signal must not shift during LEARN. Wait until sensor signal is stable before LEARN is performed. Learn may take several minutes. Do not interrupt the routine as a single full run is required to ensure fast and accurate pressure control. The
PID controller covers 5% to 5000% of the gas flow which was used for learn.

Gasflow calculation for LEARN:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

q_L gasflow for learn [Pa m³/s]
p_{SFS} sensor full scale pressure [Pa]
C_{min} min. controllable conductance of valve [l/s], (refer to «Technical data»)

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

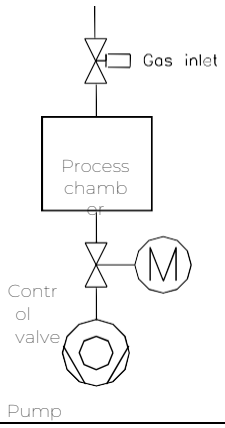
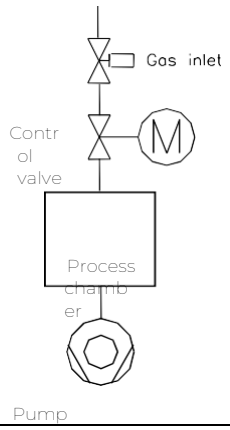
q_L gasflow for learn [mbar l/s]
p_{SFS} sensor full scale pressure [mbar]
C_{min} min. controllable conductance of valve [l/s], (refer to «Technical data»)

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

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

4.6.6 Pressure control configuration

Select the configuration what your application needs.

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

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

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

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

4.6.6.1 Pressure controller

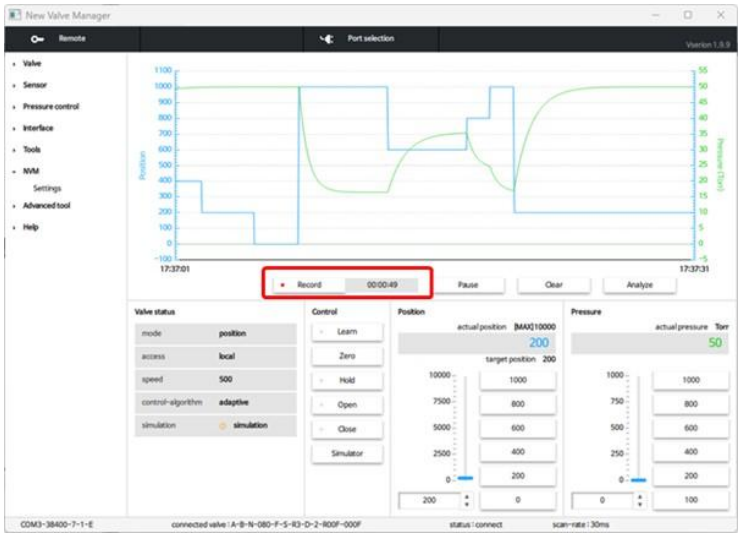
Configuration of three possible pressure controller.

<table>
<tr><th>Local operation:
('NVM')</th><th>Remote operation:</th></tr>
<tr><td>
1. Open NVM
2. Go to «Tools» > «Terminal» and send setup command s:02 according to application needs. (possibility of adjustment see
<table>
<tr><th rowspan="2"></th><th>Command</th><th>Acknowledgement
(within 10ms after reception of command)</th></tr>
<tr><th colspan="2">Describtion</th></tr>
<tr><td>Set</td><td>s:02Z00a
configure pressure controller a</td><td>s:02</td></tr>
<tr><td>Get</td><td>i:02Z00
get the actual pressure controller a</td><td>i:02Z00a</td></tr>
</table>
This command selects pressure controller.

a Pressure controller
0 = Adaptive downstream
1 = Fixed 1
2 = Fixed 2
3 = Soft pump
</td><td>Refer to chapter:
«RS232 interface commands»</td></tr>
</table>

4.6.6.2 With NVM direct setup (standard)

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



4.6.6.3 Pressure control parameter

<table>
<tr><th>Local operation:</th><th>Remote operation:</th></tr>
<tr><td>
• Open RS232 terminal program
• Send setup command s:02 according to application needs. (possibility of adjustment see below)
<table>
<tr><th></th><th>Command</th><th>Acknowledgement
(within 10ms after reception of command)</th></tr>
<tr><th></th><th colspan="2">Describtion</th></tr>
<tr><td>Set</td><td>s:02abbc
configure pressure control parameters</td><td></td></tr>
<tr><td>Get</td><td>i:02abbc
get pressure control parameters</td><td>i:02abbc</td></tr>
</table>
This command selects pressure control parameter.

a pressure controller (one digit) see table:

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

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

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

Refer to chapter: «RS232 interface commands»
</td></tr>
</table>

4.6.6.4 Overview parameter number

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

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

4.6.7 Pressure control algorithem

- Remote operation: Refer to chapter «RS232 interface commands»
- Local operation:
  - With NVM direct setup, see chapter: With NVM direct setup (standard).

4.6.7.1 Adaptive control algorithm (downstream)

Parameter	Command		Request	Data Type	Values
SENSOR DELAY	Set	s:02A00c	s:02	FLOAT	c = 0.00...1.00 Default is: 0.00 s
	Get	i:02A00	i:02A00c		
RAMP TIME	Set	s:02A01c	s:02	FLOAT	c = 0.00...1'000'000.0 Default is: 0.00 s
	Get	i:02A01	i:02A01c		
RAMP MODE	Set	s:02A02c	s:02	UINT	c = 0 or 1 0 = constant time 1 = constant slope Default is: 0
	Get	i:02A02	i:02A02c		
GAIN FACTOR	Set	s:02A04c	s:02	FLOAT	c = 0.0001...100.0 Default is: 0.1
	Get	i:02A04	i:02A04c		
DELTA FACTOR	Set	s:02A05c	s:02	FLOAT	c = 0.0001...100.0 Default is: 0.1
	Get	i:02A05	i:02A05c		

Explanation:

SENSOR DELAY
Sensor response time [s]
The SENSOR DELAY is a control parameter to compensate delays during the pressure detection. Pipes and orifices for sensor attachment can cause delays in response time and could impact badly the pressure control stability. By adapting this parameter to the approximate delay time stability problems can be reduced. But control response time will be slowed down by this measure.

RAMP TIME
Pressure setpoint ramp time [s]
RAMP MODE

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

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

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

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

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

s:02A000.75

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

4.6.7.2 Fixed 1 control algorithm

Parameter	Command		Request	Data Type	Values
RAMP TIME	Set	s:02B01c	s:02	FLOAT	c = 0.00...1'000'000.0 Default is: 0.00
	Get	i:02B01	i:02B01c		
RAMP MODE	Set	s:02B02c	s:02	UINT	c = 0 or 1 0 = constant time 1 = constant slope Default is: 0
	Get	i:02B02	i:02B02c		
CONTROL DIRECTION	Set	s:02B03c	s:02	UINT	c = 0 or 1 0 = downstream 1 = upstream Default is: 0
	Get	i:02B03	i:02B03c		
P-GAIN	Set	s:02B04c	s:02	FLOAT	c = 0.001...100 Default is: 0.1
	Get	i:02B04	i:02B04c		
I-GAIN	Set	s:02B05c	s:02	FLOAT	c = 0...100.0 Default is: 0.1
	Get	i:02B05	i:02B05c		

Explanation:

RAMP TIME
Pressure setpoint ramp time [s]

RAMP MODE

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

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

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

Example:

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

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

s:02B020

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

4.6.7.3 Fixed 2 control algorithm

Parameter	Command		Request	Data Type	Values
RAMP TIME Pressure setpoint ramp time [s]	Set	s:02C01c	s:02	FLOAT	c = 0.00...1'000'000.0 Default is: 0.00
	Get	i:02C01	i:02C01c		
RAMP MODE	Set	s:02C02c	s:02	UINT	c = 0 or 1 0 = constant time 1 = constant slope Default is: 0
	Get	i:02C02	i:02C02c		
CONTROL DIRECTION	Set	s:02C03c	s:02	UINT	c = 0 or 1 0 = downstream 1 = upstream Default is: 0
	Get	i:02C03	i:02C03c		
P-GAIN	Set	s:02C04c	s:02	FLOAT	c = 0.001...100 Default is: 0.1
	Get	i:02C04	i:02C04c		
I-GAIN	Set	s:02C05c	s:02	FLOAT	c = 0...100.0 Default is: 0.1
	Get	i:02C05	i:02C05c		

Explanation: Refer to: «Fixed 1 control algorithm»

4.6.7.4 Soft pump control algorithm

Parameter	Command		Request	Data Type	Values
RAMP TIME	Set	s:02D01c	s:02	FLOAT	c = 0.00...1'000'000.0 Default is: 0.00
	Get	i:02D01	i:02D01c		
RAMP MODE	Set	s:02D02c	s:02	UINT	c = 0...1 0 = constant time 1 = constant slope Default is: 0
	Get	i:02D02	i:02D02c		
P-GAIN	Set	s:02D04c	s:02	FLOAT	c = 0.001...100 Default is: 0.1
	Get	i:02D04	i:02D04c		

Explanation:

RAMP TIME
Pressure setpoint ramp time [s]

RAMP MODE

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

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

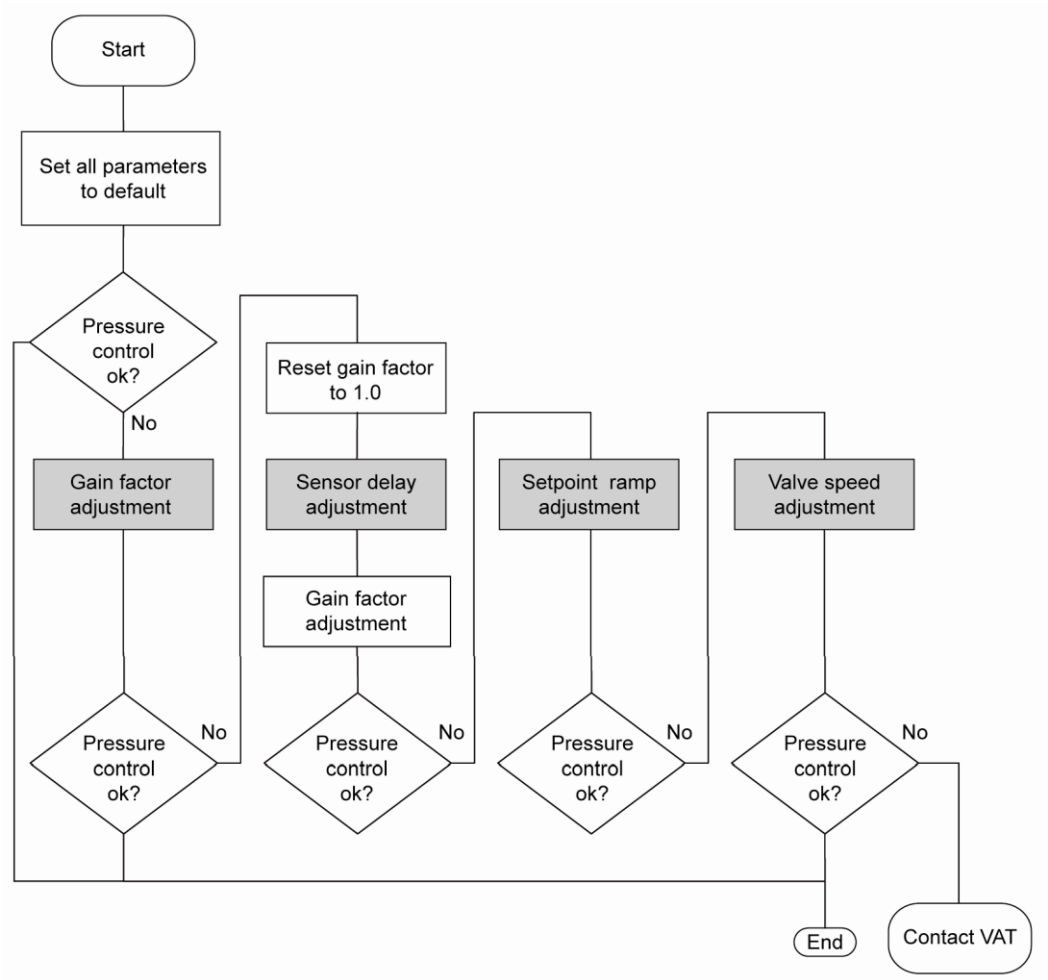
To optimize soft pump algorithm, refer to chapter «Tuning of control performance».

4.7 Tuning of control performance

- Tuning of pressure control performance with adaptive control, refer to chapter: 4.7.1 Tuning of control performance with adaptive pressure controller
- Tuning of pressure control performance with PI control, refer to chapter: 4.7.2 Tuning of control performance with fixed PI pressure controller
- Tuning of control pressure performance with Soft pump , refer to chapter: 4.7.3 Tuning of control performance with soft pump pressure controller

4.7.1 Tuning of control performance with adaptive pressure controller

Normally the default settings will result in good pressure control performance. For some applications tuning may be required to improve performance. The tuning procedures for each parameter (grey boxes) and its default values are described separately below. Strictly keep the procedure order.



4.7.1.1 Gain factor adjustment

The gain factor effects: Stability, Response time

Adjustment range is from 0.0001 to 7.5.

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

pressure Adjustment procedure:

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

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

Local operation: (NVM)	Remote operation: (Refer to chapter «Pressure control algorithm» > «Adaptive control algorithm» for details)
With NVM: • Do the 'Gain Factor' adjustment in menu 'Pressure Control' / 'Setup' / 'adaptive downstream'.	Send 'GAIN FACTOR'

4.7.1.2 Sensor delay adjustment

Sensor delay adjustment effects: Stability

Adjustment range is from 0 to 1.0s.

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

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

Adjustment procedure:

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

Local operation: (NVM)	Remote operation: (Refer to chapter «Pressure control algorithm» > «Adaptive control algorithm» for details)
With NVM: • Do the 'Sensor Delay' adjustment in menu 'Pressure Control' / 'Setup' / 'adaptive downstream'.	Send 'SENSOR DELAY'

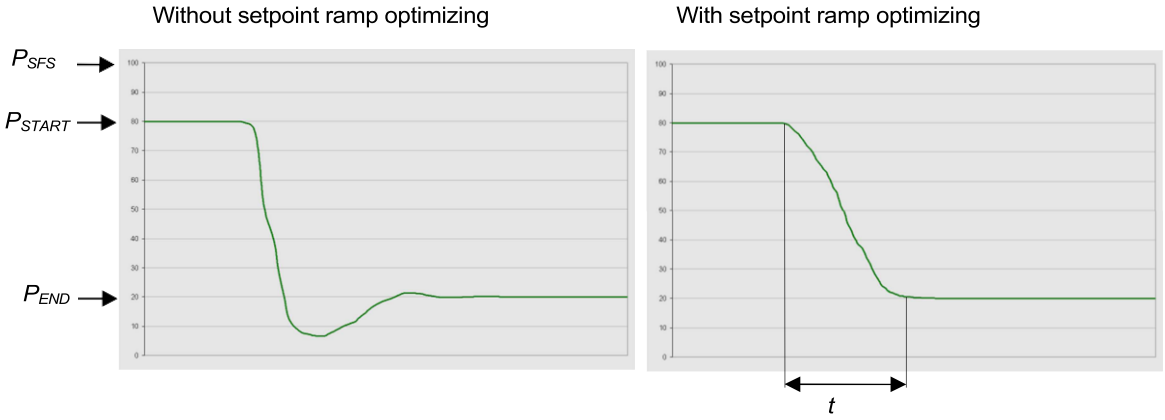
4.7.1.3 Setpoint ramp adjustment

Setpoint ramp effects: Undershoot of pressure, Response time

Adjustment range for Setpoint Ramp is from 0 to 10 s.

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

Pressure chart



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

t = Setpoint Ramp

Adjustment procedure:

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

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

Local operation: (NVM)	Remote operation: (Refer to chapter «Pressure control algorithm» > «Adaptive control algorithm» for details)
With NVM: • Do the 'Ramp Time' and 'Ramp Mode' adjustment in menu 'Pressure Control' / 'Setup' / 'adaptive downstream'.	Send 'RAMP TIME ' and 'RAMP MODE'

4.7.1.4 Valve speed adjustment

Valve speed effects: Response time

Default value is 1000. Adjustment range is from 1 to

1000. This parameter effects valve plate actuating

speed.
Speed adjustment is effective for PRESSURE CONTROL and POSITION CONTROL.

Normally best pressure control response is achieved with max. valve speed. In particular applications it may be of advantage to have a slower valve response. OPEN and CLOSE are always done with maximum speed.

Adjustment procedure:

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

Local operation: (NVM)	Remote operation: (Refer to chapter «Setup command» > «VALVE SEED» for details)
With NVM: • Do the 'Valve Speed in menu 'Valve' / 'Setup' / 'valve speed'.	Send 'VALVE SEED'

4.7.2 Tuning of control performance with fixed PI pressure controller

4.7.2.1 Optimizing P gain and I gain

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

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

Local operation: ('NVM')	Remote operation: (Refer to chapter «Pressure control algorithm» > «Fixed 1 or Fixed 2 control algorithm» for details)
With NVM: • Do the 'Fixed 1' or 'Fixed 2' adjustment in menu 'Pressure Control' / 'Setup' / 'fixed 1' / 'fixed 2'.	Send 'Fixed 1 or 2 control algorithm parameter'.

Introduction

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

1. Optimizing P gain and I gain

1.1 Pressure and gas flow for optimization

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

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

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

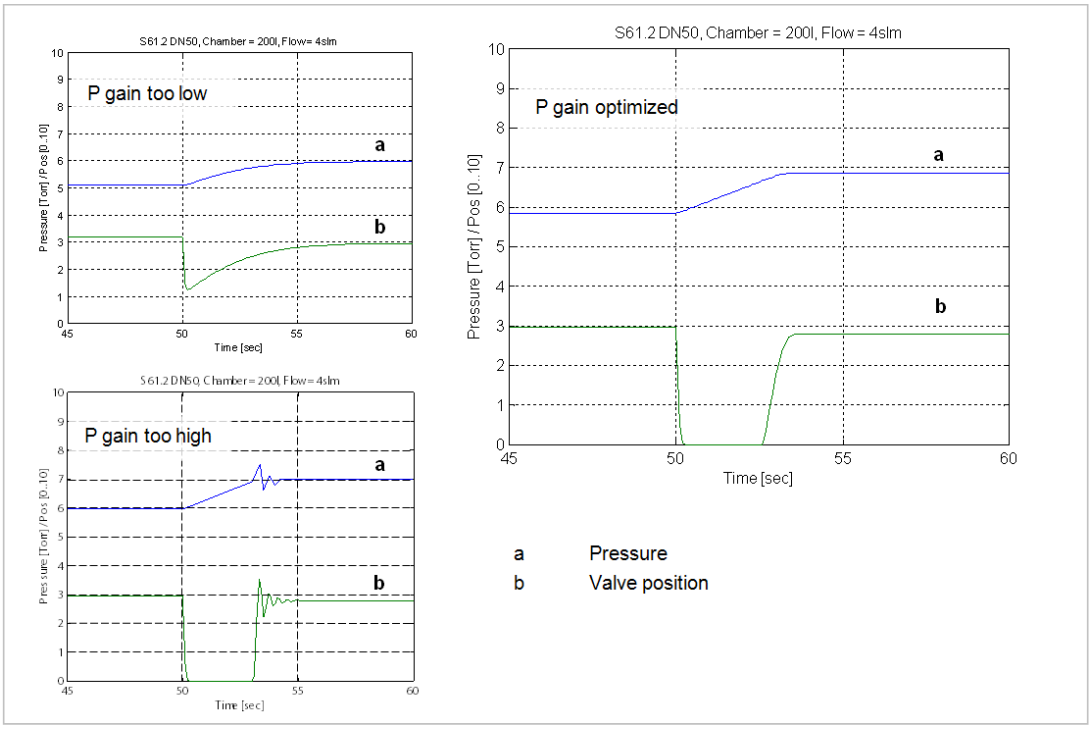
Pressure set points and gas flow for
optimization: SP1 = 7
Torr
SP2 = 6 Torr
Gas flow = 4slm

1.2 Optimizing P gain

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

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

Example:

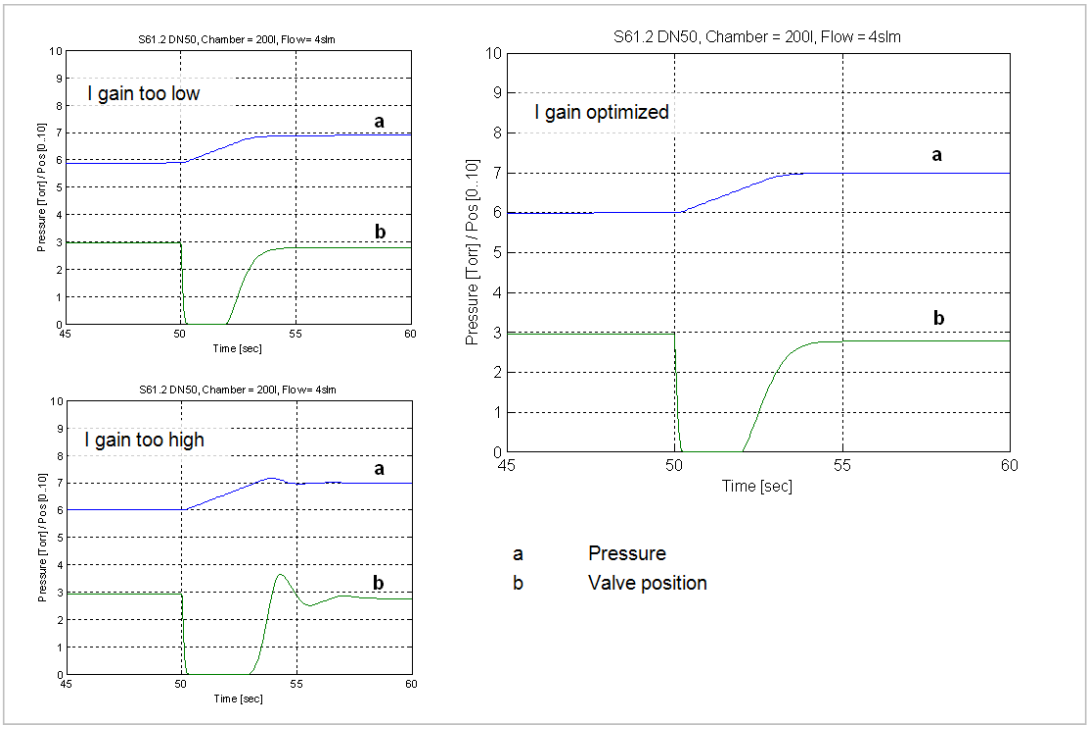


1.3 Optimizing I gain

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

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

Example:



4.7.3 Tuning of control performance with soft pump pressure controller

4.7.3.1 Optimizing P gain

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

Local operation: ('NVM')	Remote operation: (Refer to chapter «Pressure control algorithm» > «Soft pump control algorithm» for details)
With NVM: • Do the 'Soft pump' adjustment in menu 'Pressure Control' / 'Setup' / 'soft pump'.	Send 'Soft pump control algorithm parameter'.

Introduction

Pump down control mode allows a completely user-defined pressure profile, usually from atmosphere down to some process pressure

1. Optimizing P gain

The P gain value evaluated for soft pump control mode might be different than the P gain value evaluated for PI controller mode. When switching to pump down control mode the P gain value evaluated fort he PI controller has to be send to the valve controller. When switching back into PI controller mode the respective P gain value has to be send again. Adaptive pressure control mode ignores any P gain value.

1.1 Basic settings

The pump down characteristic is determined by start pressure, end pressure and pump down time. This straight line from start pressure to end pressure.

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

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

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

1.2 Optimizing P gain

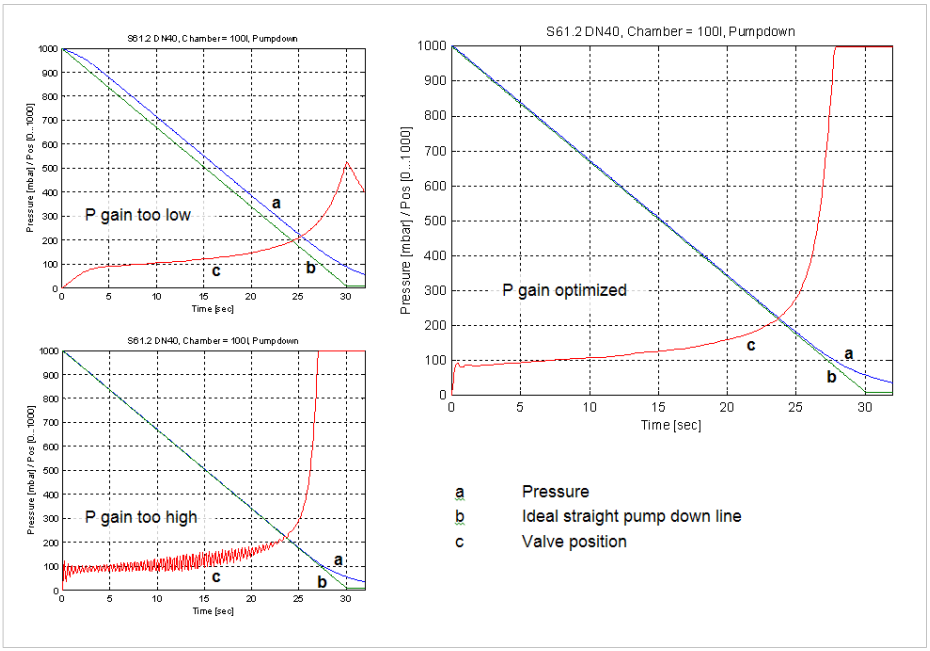
WE start by setting the P gain to 1.0 as a trial value and adjust according to the response. The pump down routine has to be controlled as follows:

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

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

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

Example:



4.8 RS232 interface commands

4.8.1 RS232 command syntax

- Commands and values are case sensitive.
- Acknowledgement within 10ms after reception of command.
- Wait for acknowledgement before sending a new command.
- Command termination of each command is CR and LF.
  CR = Carriage Return (0D hexadecimal), LF = Linefeed (0A hexadecimal)

4.8.2 Control commands

Control function	Command		Acknowledgement
	Description		
CLOSE VALVE	Set	C:	C:
	Valve will close.		
OPEN VALVE	Set	O:	O:
	Valve will open.		
HOLD	Set	H:	H:
	This function stops the valve at the current position. It is effective in PRESSURE CONTROL and POSITION CONTROL. The function can be revoked by a POSITION CONTROL, PRESSURE CONTROL, OPEN VALVE or CLOSE VALVE command.		
POSITION CONTROL	Set	R:aaaaaa	R:
	Get	i:38	i:38aaaaaaaa
	data length for Set 6 characters, for Get 8 characters aaaaaa position SETPOINT, value depends on configuration, refer to «RS232 setup commands, COMMUNICATION RANGE» for details Change to POSITION CONTROL mode and transfer of position SETPOINT value resp. reading of position SETPOINT. Remark: Reading returns position setpoint only in case pressure control is not selected.		
PRESSURE CONTROL	Set	S:aaaaaaaa	S:
	Get	i:38	i:38aaaaaaaa
	data length 8 characters aaaaaaaa pressure SETPOINT, value depends on configuration, refer to «RS232 setup commands, COMMUNICATION RANGE» for details Change to PRESSURE CONTROL mode and transfer of pressure SETPOINT resp. reading of pressure SETPOINT. Remark: Reading returns pressure setpoint only in case pressure control is selected, otherwise position setpoint is returned.		

4.8.3 Inquiry commands

Inquiry function	Command		Acknowledgement
	Description		
POSITION	Get	A:	A:aaaaaa
	data length 6 characters aaaaaa position, return value depends on configuration, refer to «RS232 setup commands, COMMUNICATION RANGE» for details This function returns the current valve position. Remark: 999'999 is returned when the position is unknown, for example after power up during synchronization		
PRESSURE	Get	P:	P:saaaaaaa
	data length 8 characters s sign, 0 for positive readings, - for negative readings aaaaaaa pressure, return value depends on configuration, refer to «RS232 setup commands, COMMUNICATION RANGE» for details This function returns the actual pressure.		
SENSOR 1 OFFSET	Get	i:60	i:60aaaaaaaa
	data length 8 characters aaaaaaaa sensor 1 offset (-140000 ... 0140000 = -1.4V ... +1.4V) This function returns the sensor 1 offset voltage (adjusted by ZERO).		
SENSOR 2 OFFSET	Get	i:61	i:61aaaaaaaa
	data length: 8 characters aaaaaaaa sensor 2 offset (-140000 ... 0140000 = -1.4V ... +1.4V) This function returns the sensor 2 offset voltage (adjusted by ZERO).		
SENSOR 1 READING	Get	i:64	i:64saaaaaaa
	data length 8 characters s sign, 0 for positive readings, - for negative readings aaaaaaa sensor 1 reading, return value depends on configuration, refer to «RS232 setup commands, COMMUNICATION RANGE» for details This function returns direct reading from sensor 1 input.		
SENSOR 2 READING	Get	i:65	i:65saaaaaaa
	data length 8 characters s sign, 0 for positive readings, - for negative readings aaaaaaa sensor 2 reading, return value depends on configuration, refer to «RS232 setup commands, COMMUNICATION RANGE» for details This function returns direct reading from sensor 2 input.		

Inquiry function	Command		Acknowledgement
	Description		
DEVICE STATUS	Get	i:30	i:30abcdefgh
	data length 8 characters a Access Mode 0 = local operation 1 = remote operation 2 = locked remote operation b Control Mode 1 = synchronization 2 = POSITION CONTROL 3 = CLOSED 4 = OPEN 5 = PRESSURE CONTROL 6 = HOLD 7 = LEARN 8 = INTERLOCK OPEN (by digital input) 9 = INTERLOCK CLOSED (by digital input) C = power failure D = safety mode E = fatal error (read «FATAL ERROR STATUS» for details) c Power Failure Option 0 = disabled 1 = enabled d Warning 0 = no warnings 1 = warnings (read «WARNINGS» and «ERROR STATUS» for details) efg Reserved h Simulation 0 = normal operation 1 = system simulation running This function returns status information about the valve. Remark: In simulation mode the valve can demonstrate pressure control capability independent of other equipment such as vacuum chamber, flow controller and gauge. Normal operation is not possible when simulation is running.		

Control function	Command		Acknowledgement
	Description		
LEARN STATUS (adaptive pressure controller)	Get	i:32	i:32abcdefgh
	data length 8 characters a Running 0 = No 1 = Yes b Data set present 0 = Ok 1 = No (Learn necessary) **c** Abortion 0 = Ok, Learn completed 1 = Abort by user 2 = Abort by control unit **d** Open pressure 0 = Ok 1 = > 50% learn pressure limit (gas flow too high) 2 = < 0 (no gas flow or zero done with gas flow) **e** Close pressure 0 = OK 1 = < 10% learn pressure limit (gas flow too low) f Pressure raising 0 = Ok 1 = pressure not raising during LEARN (gasflow missing) g Pressure stability 0 = OK 1 = sensor unstable during LEARN h Reserved do not use This function checks the status of LEARN and indicates if the conditions during LEARN were ok.		
LEARN PRESSURE LIMIT (adaptive pressure controller)	Get	i:34	i:34aaaaaaaa
	data length 8 characters aaaaaaaa pressure limit for LEARN, return value depends on configuration, refer to «RS232 setup commands, COMMUNICATION RANGE» for details This function returns the pressure limit applied for LEARN.		
FATAL ERROR STATUS	Get	i:50	i:50abc
	data length 3 characters abc error code See in chapter «Trouble shooting» for details. This function returns an error code in case of any malfunction of the device.		

Inquiry function	Command	Acknowledgement
	Description	
WARNINGS	Get i:51	i:51abcdefgh
	data length 8 characters **a** 0 = no service required 1 = service request, it is indicated when the control unit detects that motor steps are apparently not effective. This may happen when the valve is heavily contaminated or the gate seal is heavily sticking. These ‚lost' steps are recognized and will be repeated to attempt target position in the short term. But in the medium term the valve requires cleaning or inspection. **b** 0 = LEARN data set present, 1 = LEARN data set not present **c** 0 = power failure battery ready 1 = power failure battery not ready **d** 0 = compressed air supply ok 1 = compressed air supply not ok efgh reserved, do not use This function returns warning information about the valve. If a warning is present countermeasure should be taken. Use RESET command to delete service request bit. Remark: Without LEARN the valve is not able to run pressure control	
ERROR STATUS	Get i:52	i:52abcdefgh
	data length 8 characters **a** reserved, do not use **b** 1 = sensor 1 signal converter failure **c** reserved, do not use **d** 1 = firmware memory failure efgh reserved, do not use This function returns an error code in case of any malfunction of the device otherwise 0 is returned.	
THROTTLE CYCLE COUNTER	Get i:70	i:70aaaaaaaaaa
	data length 10 characters aaa...aaa number of throttle cycles This function returns the number of throttle cycles. A movement from max. throttle position to open back to max. throttle position counts as one cycle. Partial movements will be added up until equivalent movement is achieved.	
ISOLATION CYCLE COUNTER	Get i:71	i:71aaaaaaaaaa
	data length 10 characters aaa...aaa number of isolation cycles This function returns the number of isolation cycles. Each closing of the sealing ring counts as one cycle.	
POWER UP COUNTER	Get i:72	i:72aaaaaaaaaa
	data length 10 characters aaa...aaa number of power ups This function returns the number of control unit power ups.	

<table>
<tr><th rowspan="2">Inquiry function</th><th colspan="2">Command</th><th>Acknowledgement</th></tr>
<tr><th colspan="3">Description</th></tr>
<tr><td>ASSEMBLY</td><td>Get</td><td>i:76</td><td>i:76xxxxxxsyyyyyyyabc</td></tr>
<tr><td></td><td colspan="3">data length 17 characters
xxxxxx position, return value depends on configuration, refer to «RS232 setup commands, COMMUNICATION RANGE» for details
s sign, 0 for positive pressure readings, - for negative pressure readings
yyyyyyy pressure, return value depends on configuration, refer to «RS232 setup commands, COMMUNICATION RANGE» for details
a 0 = local operation
1 = remote operation
2 = locked remote operation
b 0 = Initialization (refer to chapter: «Behavior during power up»)
1 = synchronization
2 = POSITION CONTROL
3 = CLOSE
4 = OPEN
5 = PRESSURE CONTROL
6 = HOLD
7 = LEARN
8 = INTERLOCK OPEN (by digital input)
9 = INTERLOCK CLOSE (by digital input)
C = power failure
D = safety mode
E = fatal error (read «FATAL ERROR STATUS» for details)
c 0 = no warning
1 = warning present
(read «WARNINGS» and «ERROR STATUS» for details)
This function returns an assembly consisting of POSITION, PRESSURE and main status information for the valve.</td></tr>
<tr><td>HARDWARE CONFIGURATION</td><td>Get</td><td>i:80</td><td>i:80abcdefgh</td></tr>
<tr><td></td><td colspan="3">data length 8 characters
a 0 = Power Failure Option (PFO) not equipped
1 = Power Failure Option (PFO) equipped
b 0 = ±15V sensor power supply (SPS) not equipped
1 = ±15V sensor power supply (SPS)
equipped c 2 = RS232 Interface without analog outputs
3 = RS232 Interface with analog outputs
d 1 = 1 sensor version, 2 = 2 sensor version
efgh reserved, do not use
This function returns the hardware configuration of the device.</td></tr>
<tr><td>FIRMWARE CONFIGURATION</td><td>Get</td><td>i:82</td><td>i:82aaaaaaaa</td></tr>
<tr><td></td><td colspan="3">data length 8 characters
aaaaaaaa firmware version, e.g. 600P1G0002
This function returns firmware version of the device.</td></tr>
</table>

Inquiry function	Command		Acknowledgement
	Description		
IDENTIFICATION	Get	i:83	i:83aaaaaaaaaaaaaaaaaaa
	data length 20 characters aaa...aaa identification code, e.g. 612..-..G-.... 612..-..H-..../0001/, unused digits are filled up with spaces (20 hexadecimal) This function returns an identification code. This code is unique for each valve and allows tracing.		
FIRMWARE NUMBER	Get	i:84	i:84aaaaaa
	data length 20 characters aaaaaa Firmware number e.g. 700989 This function returns the Firmware number.		

4.8.4 Setup commands

<table>
<tr><th rowspan="2">Setup function</th><th colspan="2">Command</th><th>Acknowledgement</th></tr>
<tr><th colspan="3">Description</th></tr>
<tr><td>ACCESS MODE</td><td>Set</td><td>c:01aa</td><td>c:01</td></tr>
<tr><td></td><td colspan="3">data length: 2 characters
aa 00 = local operation (service port)
01 = remote operation, change to local enabled
02 = locked remote operation, change to local not possible via service port

This function selects the access authorization to the valve. To read access mode use inquiry command DEVICE STATUS.
Remark: If ACCESS MODE is local operation and communication to service port is interrupted the valve will automatically change to remote operation.</td></tr>
<tr><td rowspan="3">VALVE CONFIGURATION</td><td>Set</td><td>s:04abcdefgh</td><td>s:04</td></tr>
<tr><td>Get</td><td>i:04</td><td>i:04abcdefgh</td></tr>
<tr><td colspan="3">data length 8 characters
a Valve position after power up 0 = close
1 = open

b Valve position after power failure 0 = close
1 = open

c External isolation valve function 0 = no
1 = yes

d Control stroke limitation 0 = no
1 = yes

e Network failure end position 0 = valve will close
1 = valve will open
2 = valve stay on actual position

f Slave offline position 0 = valve will close
1 = valve will open
2 = valve stay on actual position

g Synchronization start 0 = standard
1 = special command
2 = open command
3 = all move commands
4 = always

h Synchronization mode 0 = short
1 = full

This function does the valve configuration.</td></tr>
</table>

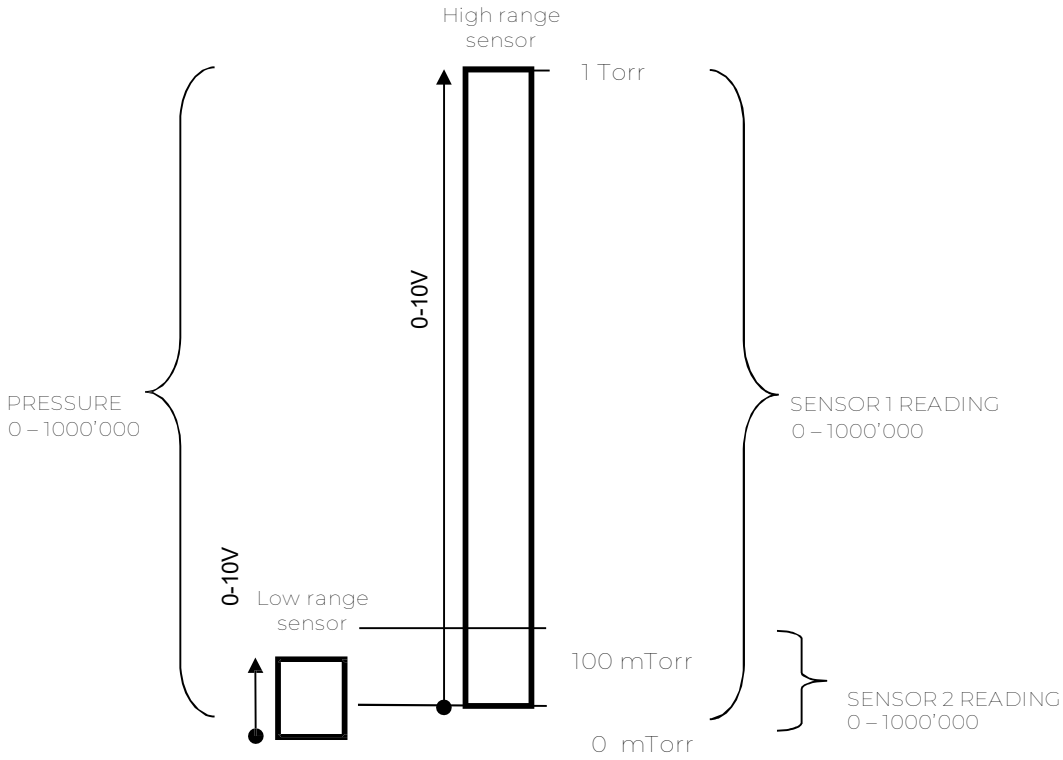
Setup function	Command		Acknowledgement
	Description		
SENSOR CONFIGURATION	Set	s:01abcdefgh	s:01
	Get	i:01	i:01abcdefgh

data length 8
characters a 0 = no sensor
1 = 1 sensor operation (sensor 1 input)
2 = 2 sensor operation with automatic changeover
(low range = sensor 2 input, high range = sensor 1 input)
3 = 1 sensor operation (sensor 2 input)
4 = 2 sensor operation with automatic changeover
(low range = sensor 1 input, high range = sensor 2 input)
Remark: Sensor operation modes 2, 3 and 4 are possible with 2 sensors (612 . . - . . . H - . . . . and 612 . . - . . . W) only.
Remark: For applications where the high range sensor is used for for monitoring purpose only, select sensor operation modes 1 or 3 for pressure control with low range sensor and read high range sensor from
«SENSOR 2 READING» resp. «SENSOR 1 READING».

b 1 = ZERO enabled, 0 = ZERO disabled

cdefgh High range / Low range sensor full scale ratio * 1'000 (1000 ... 100000).
In case of a 1 sensor valve use any value within the valid range.

This function does the sensor configuration.



Above picture shows a 2 sensor system. In this configuration sensor 2 covers low range (100 mTorr) and sensor 1 covers high range (1 Torr). RANGE CONFIGURATION for PRESSURE resp. SENSOR READING is

set to 1000’000. Switchover between sensors is done automatically.

<table>
<tr><td rowspan="2">Setup function</td><td colspan="2">Command</td><td>Acknowledgement</td></tr>
<tr><td colspan="3">Description</td></tr>
<tr><td rowspan="3">SENSOR SCALE</td><td>Set</td><td>s:05aaaaabcd</td><td>s:05</td></tr>
<tr><td>Get</td><td>i:05</td><td>i:05aaaaabcd</td></tr>
<tr><td colspan="3">data length 8 characters

a Value 00001... 99999 (10000 = 1.0000)
b Sign Exponent 0 = "-", 1 = "+"
c Exponent 0... 4
d Pressure Unit 0 = Pa
1 = bar
2 = mbar
3 = ubar
4 = Torr
5 = mTorr
6 = atm
7 = psi
8 = psf

Example: 10000114 = 10Torr (input from high range sensor)</td></tr>
<tr><td rowspan="3">SENSOR 1
LINEARIZATION</td><td>Set</td><td>s:17aaaabbbb</td><td>s:17</td></tr>
<tr><td>Get</td><td>i:17</td><td>i:17aaaabbbb</td></tr>
<tr><td colspan="3">data length 8 characters

a logarithmic resolution[millivolt /decade]
0000 = linearizing
off 0001 = min.
value 9999 = max.
value
(default value: 0000 = linearizing off)

b full scale
[millivolt] 0001 =
min. value 9999
= max. value
(default value in logarithmic mode: 5324 =
5.324V) (becomes linear full scale = 1000000)

Pressure control algorithm adaptive downstream needs a linear sensor signal, therefore a logarithmic signal must be linearized.

Example: s:1700000000 = Linear sensor
Example: s:1810007800 = Logarithmic sensor (1.0V/decade, Linear full scale at 7.8V)</td></tr>
</table>

<table>
<tr><td rowspan="2">Setup function</td><td colspan="2">Command</td><td>Acknowledgement</td></tr>
<tr><td colspan="3">Description</td></tr>
<tr><td rowspan="3">SENSOR 2
LINEARIZATION</td><td>Set</td><td>s:18aaaabbbb</td><td>s:18</td></tr>
<tr><td>Get</td><td>i:18</td><td>i:18aaaabbbb</td></tr>
<tr><td colspan="3">data length 8 characters

a logarithmic resolution[millivolt /decade]
0000 = linearizing
off 0001 = min.
value 9999 = max.
value
(default value: 0000 = linearizing off)

b full scale
[millivolt] 0001 =
min. value 9999
= max. value
(default value in logarithmic mode: 5324 =
5.324V) (becomes linear full scale = 1000000)

Pressure control algorithm adaptive downstream needs a linear sensor signal, therefore a logarithmic signal must be linearized.

Example: s:1700000000 = Linear sensor
Example: s:1810007800 = Logarithmic sensor (1.0V/decade, Linear full scale at 7.8V)</td></tr>
<tr><td rowspan="3">SENSOR AVERAGE</td><td>Set</td><td>s:19abbbbbbb</td><td>s:19</td></tr>
<tr><td>Get</td><td>i:19</td><td>i:19abbbbbbb</td></tr>
<tr><td colspan="3">data length 8 characters

a Average time 0 = 0.0 sec
1 = 0.1 sec
2 = 0.2 sec
3 = 0.3 sec
4 = 0.4 sec
5 = 0.5 sec
6 = 0.6 sec
7 = 0.7 sec
8 = 0.8 sec
9 = 0.9 sec
A = 1.0 sec
b Reserved set to 0000000

Remark: For pressure control averaging of sensor signal is not recommended. This function does the sensor average configuration.</td></tr>
</table>

Setup function	Command		Acknowledgement
	Description		
COMMUNICATION RANGE CONFIGURATION	Set	s:21abcdefgh	s:21
	Get	i:21	i:21abcdefgh
	data length 8 characters a range for POSITION: 0 = 0 – 1'000, 1 = 0 – 10'000, 2 = 0 – 100'000 bcdefgh upper value for PRESSURE and SENSOR READING: 1000 ... 1000000 e.g. 0010000 -> pressure range 0 – 10'000 This function defines the communication range between the valve and the host computer for POSITION, PRESSURE and SENSOR READING. Remark: In case ZERO has been performed, gauge offset for PRESSURE and SENSOR READING is compensated. Remark: In case 2 sensor operation for pressure control is selected, PRESSURE covers high range gauge because switchover between sensors is done automatically. SENSOR 1 READING and SENSOR 2 READING always return full scale values according to selected range.		

Setup function	Command		Acknowledgement)
	Description		
INTERFACE CONFIGURATION	Set	s:20abcdefgh	s:20
	Get	i:20	i:20abcdefgh
	data length 8 characters a baud rate: 0 = 600 1 = 1200k 2 = 2400 3 = 4800 4 = 9600 5 = 19.2k 6 = 38.4k 7 = 57.6k 8 = 115.2k **b** parity bit: 0 = even 1 = odd 2 = mark 3 = space 4 = no **c** data length: 0 = 7 bit 1 = 8 bit **d** number of stop bits: 0 = 1 1 = 2 **e** 0 (reserved, do not change) **f** digital input OPEN VALVE: 0 = not inverted 1 = inverted 2 = disabled **g** digital input CLOSE VALVE: 0 = not inverted 1 = inverted 2 = disabled **h** 0 (reserved, do not change) This function does the RS232 and digital input configuration. Note: Digital outputs are always enabled.		

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

<table>
<tr><td rowspan="2">Setup function</td><td colspan="2">Command</td><td>Acknowledgement</td></tr>
<tr><td colspan="3">Description</td></tr>
<tr><td rowspan="3">VALVE SPEED</td><td>Set</td><td>V:00aaaa</td><td>V:</td></tr>
<tr><td>Get</td><td>i:68</td><td>i:680000aaaa</td></tr>
<tr><td colspan="3">data length 6 characters starting with double zero for writing
8 characters starting with quadruple zero for reading
aaaa valve speed, 1 ... 1000 (1 = min. speed, 1000 = max. speed)
This command allows changing the actuating speed of the valve plate. Speed selection is effective for pressure control and position control. Open valve and close valve are always done with max. speed.
Remark: Refer to «Valve speed adjustment» for details.</td></tr>
<tr><td rowspan="2">RESET</td><td>Set</td><td>c:82aa</td><td>c:82</td></tr>
<tr><td colspan="3">data length 2 characters
aa 00 = reset service request bit from WARNINGS
01 = reset FATAL ERROR (restart control unit)
This function resets warnings and errors.</td></tr>
<tr><td rowspan="3">PRESSURE CONTROLLER</td><td>Set</td><td>s:02Z00a
select pressure controller as active pressure controller</td><td>s:02</td></tr>
<tr><td>Get</td><td>i:02Z00
get active pressure controller</td><td>i:02Z00a</td></tr>
<tr><td colspan="3">This command selects the pressure controller mode.
a Pressure controller:
0 = Adaptive downstream
1 = Fixed 1 (downstream or upstream)
2 = Fixed 2 (downstream or upstream)
3 = Soft pump
Examples:
• To set the soft pump pressure controller as active pressure controller, send s:02Z003
• If the answer of the command i:02Z00 is i:02Z002, the fixed 2 pressure controller is active.</td></tr>
</table>

<table>
<tr><td rowspan="2">Setup function</td><td colspan="2">Command</td><td>Acknowledgement</td></tr>
<tr><td colspan="3">Description</td></tr>
<tr><td rowspan="3">PRESSURE CONTROLLER CONFIGURATION</td><td>Set</td><td>s:02abbc
configure parameter: set parameter
bb of pressure controller a to value c</td><td>s:02</td></tr>
<tr><td>Get</td><td>i:02abb
get value c of parameter bb of pressure controller a</td><td>i:02abbc</td></tr>
<tr><td colspan="3"><table>
<tr><td>a</td><td>Pressure controller:
A = Adaptive downstream pressure controller
B = Fixed 1 pressure controller (downstream or upstream)
C = Fixed 2 pressure controller (downstream or upstream)
D = Soft pump pressure controller</td></tr>
<tr><td>bb</td><td>Parameter number (see table below)</td></tr>
<tr><td>c</td><td>Parameter value, depends on parameter number a floating-point type or a integral type value, max length = 20 characters

floating-point type format: x.y
or x
Maximum length of expression: 12
Examples: 3455.1505, 21154.0 or 318

integer type format: x
Maximum length of expression: 12
Examples: 9785, 4565, 1</td></tr>
</table>
For details (commands etc.), see the next tables.</td></tr>
</table>

4.8.4.1 Overview pressure controller

Parameter	Parameter number (bb)	Pressure controller (a)			
		A Adaptive	B Fixed 1	C Fixed 2	D Soft pump
SENSOR DELAY	00	☐	–	–	–
RAMP TIME	01	☐	☐	☐	☐
RAMP MODE	02	☐	☐	☐	☐
CONTROL DIRECTION	03	–	☐	☐	–
P-GAIN (for A = GAIN FACTOR)	04	☐	☐	☐	☐
I-GAIN	05	–	☐	☐	–

✓ Existent for this pressure controller / – Not used for this pressure controller

Command examples:

Set GAIN FACTOR of the adaptive pressure controller to the value 1.075	s:02A041.075
GET GAIN FACTOR of adaptive pressure controller	i:02A04 ▯ Answer is i:02A041.075 ▯ Value = 1.075
Set RAMP TIME of soft pump pressure controller to the value 281 seconds	s:02D01281
Get RAMP TIME of soft pump pressure controller	i:02D01 ▯ Answer is i:02D01281▯ Value = 281

4.8.5 Pressure control algorithem

4.8.5.1 Adaptive control algorithm (downstream)

Parameter	Command		Request	Data Type	Values
SENSOR DELAY	Set	s:02A00c	s:02	FLOAT	c = 0.00...1.00 Default is: 0.00 s
	Get	i:02A00	i:02A00c		
RAMP TIME	Set	s:02A01c	s:02	FLOAT	c = 0.00...1'000'000.0 Default is: 0.00 s
	Get	i:02A01	i:02A01c		
RAMP MODE	Set	s:02A02c	s:02	UINT	c = 0 or 1 0 = constant time 1 = constant slope Default is: 0
	Get	i:02A02	i:02A02c		
GAIN FACTOR	Set	s:02A04c	s:02	FLOAT	c = 0.0001...7.5 Default is: 1.0
	Get	i:02A04	i:02A04c		

Explanation:

SENSOR DELAY
Sensor response time [s]
The SENSOR DELAY is a control parameter to compensate delays during the pressure detection. Pipes and orifices for sensor attachment can cause delays in response time and could impact badly the pressure control stability. By adapting this parameter to the approximate delay time stability problems can be reduced. But control response time will be slowed down by this measure.

RAMP TIME
Pressure setpoint ramp time [s]

RAMP MODE

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

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

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

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

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

s:02A000.75

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

4.8.5.2 Fixed 1 control algorithm

Parameter	Command		Request	Data Type	Values
RAMP TIME	Set	s:02B01c	s:02	FLOAT	c = 0.00...1'000'000.0 Default is: 0.00
	Get	i:02B01	i:02B01c		
RAMP MODE	Set	s:02B02c	s:02	UINT	c = 0 or 1 0 = constant time 1 = constant slope Default is: 0
	Get	i:02B02	i:02B02c		
CONTROL DIRECTION	Set	s:02B03c	s:02	UINT	c = 0 or 1 0 = downstream 1 = upstream Default is: 0
	Get	i:02B03	i:02B03c		
P-GAIN	Set	s:02B04c	s:02	FLOAT	c = 0.001...100 Default is: 0.1
	Get	i:02B04	i:02B04c		
I-GAIN	Set	s:02B05c	s:02	FLOAT	c = 0...100.0 Default is: 0.1
	Get	i:02B05	i:02B05c		

Explanation:

RAMP TIME
Pressure setpoint ramp time [s]

RAMP MODE

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

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

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

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

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

s:02B020

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

4.8.5.3 Fixed 2 control algorithm

Parameter	Command		Request	Data Type	Values
RAMP TIME	Set	s:02C01c	s:02	FLOAT	c = 0.00...1'000'000.0 Default is: 0.00
	Get	i:02C01	i:02C01c		
RAMP MODE	Set	s:02C02c	s:02	UINT	c = 0 or 1 0 = constant time 1 = constant slope Default is: 0
	Get	i:02C02	i:02C02c		
CONTROL DIRECTION	Set	s:02C03c	s:02	UINT	c = 0 or 1 0 = downstream 1 = upstream Default is: 0
	Get	i:02C03	i:02C03c		
P-GAIN	Set	s:02C04c	s:02	FLOAT	c = 0.001...100 Default is: 0.1
	Get	i:02C04	i:02C04c		
I-GAIN	Set	s:02C05c	s:02	FLOAT	c = 0...100.0 Default is: 0.1
	Get	i:02C05	i:02C05c		

Explanation: Refer to: «Fixed 1 control algorithm»

4.8.5.4 Soft pump control algorithm

Parameter	Command		Request	Data Type	Values
RAMP TIME	Set	s:02D01c	s:02	FLOAT	c = 0.00...1'000'000.0 Default is: 0.00
	Get	i:02D01	i:02D01c		
RAMP MODE	Set	s:02D02c	s:02	UINT	c = 0...1 0 = constant time 1 = constant slope Default is: 0
	Get	i:02D02	i:02D02c		
P-GAIN	Set	s:02D04c	s:02	FLOAT	c = 0.001...100 Default is: 0.1
	Get	i:02D04	i:02D04c		

Explanation:

RAMP TIME
Pressure setpoint ramp time [s]

RAMP MODE

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

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

4.8.6 Error messages

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 Operation

WARNING

Unqualified personnel

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

WARNING

Valve opening

Risk of serious injury.

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

5.1 Normal operation

This valve is designed for downstream pressure control in vacuum chambers. It can be employed in a pressure control mode or a position control mode. In both cases local or remote operation is possible.

5.1.1 Local operation

Local operation means that the valve is operated via the service port using a computer . When using a computer, a service cable and a software from the manufacturer is required.

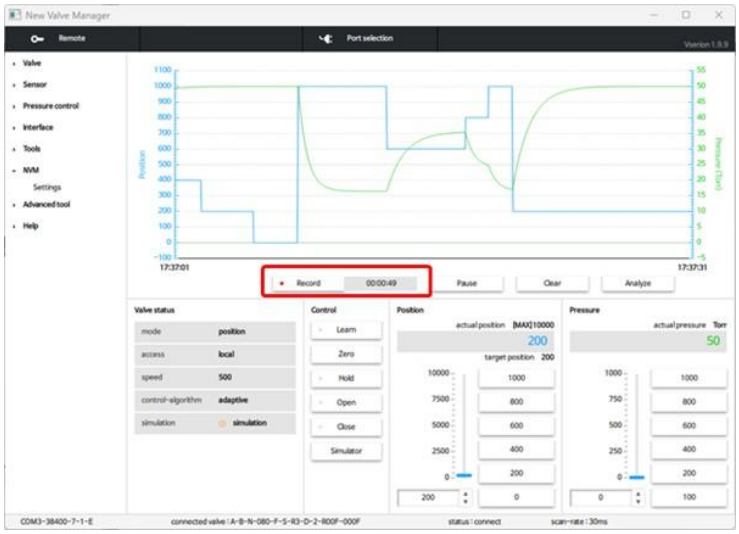
These softwares are beneficial especially for setup, testing and maintenance.

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

‘

'NVM' supports:

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

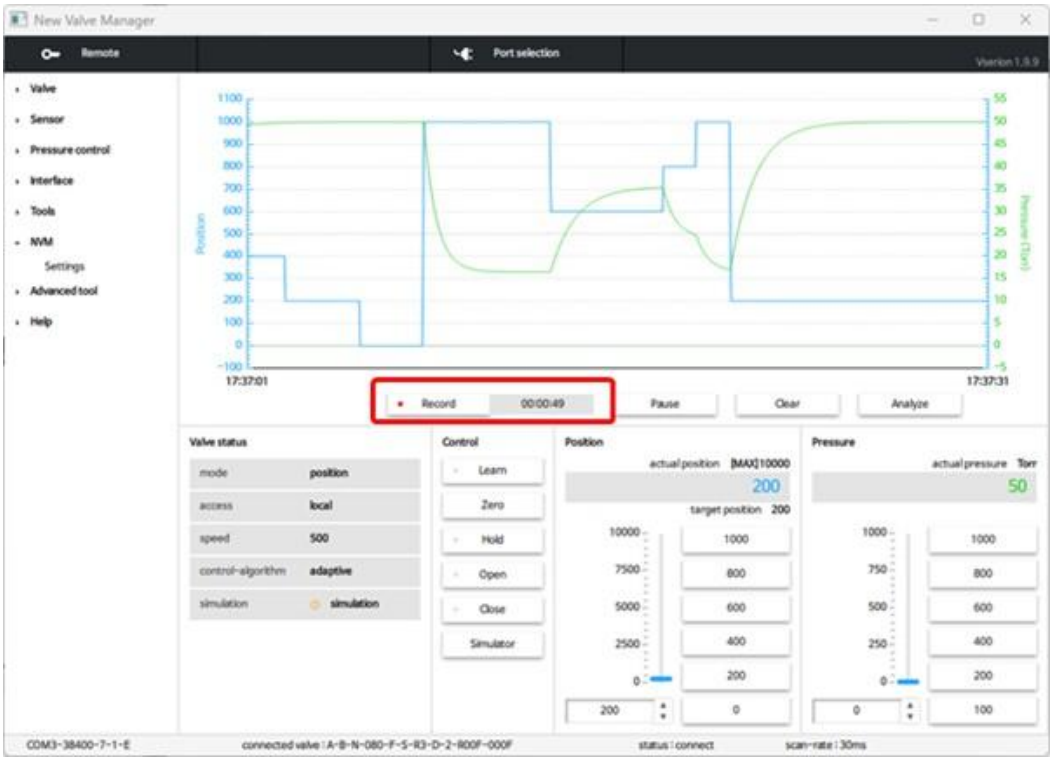


When communication to service port is interrupted the valve will change to remote operation. So when service cable will be disconnected or software will be shut down, the valve returns automatically to remote operation. This may result in an immediate movement of the valve depending on remote control.

5.1.2 Remote operation

This product is equipped with a RS232 interface to allow for remote operation. See section «RS232 interface» for details. 'NVM' may be used for monitoring during remote

control. 'NVM' software



5.2 Close valve

Local operation: (NVM)	Remote operation: (Refer to chapter «Control commands» for details)
Push CLOSE button	Send CLOSE VALVE

5.3 Open valve

Local operation: (NVM)	Remote operation: (Refer to chapter «Control commands» for details)
Push OPEN button	Send OPEN VALVE

5.4 Position control

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

Local operation: (NVM')	Remote operation: (Refer to chapter «Control commands» for details)
Select or enter position setpoint	Send POSITION CONTROL

5.5 Pressure control

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

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

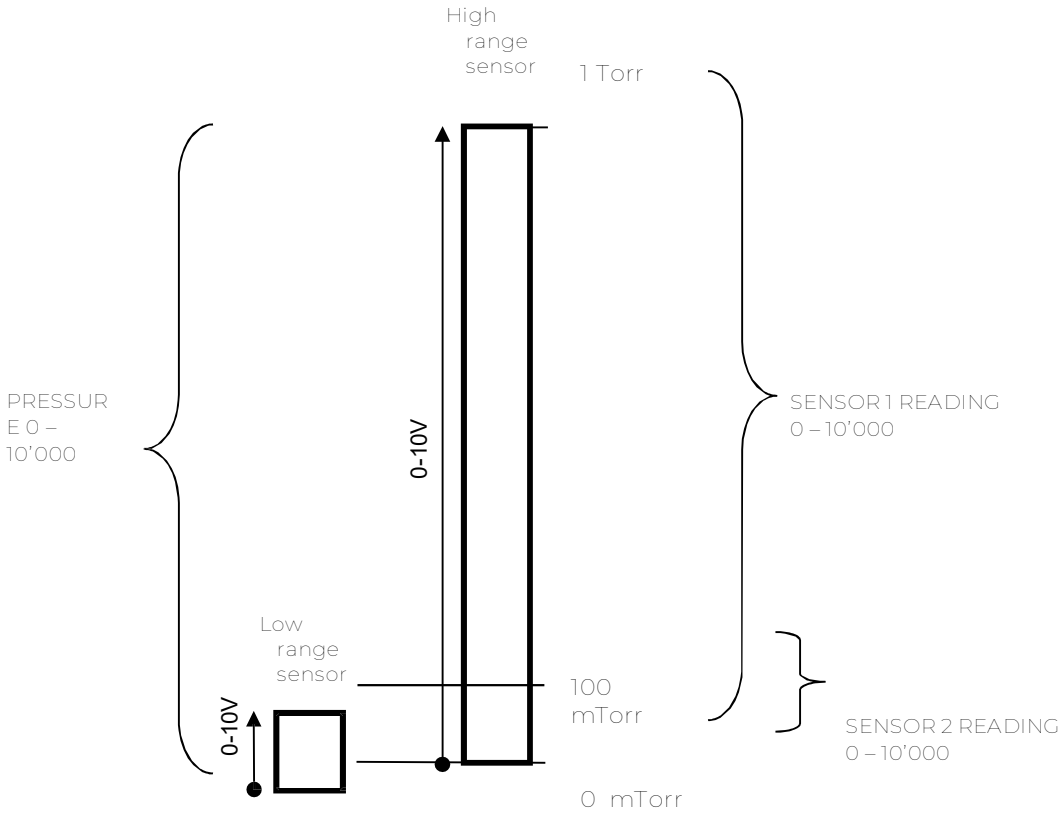
Local operation: (NVM)	Remote operation: (Refer to chapter «Control commands» for details)
Select or enter pressure setpoint	Send PRESSURE CONTROL

5.5.1 Pressure control operation with 2 sensors

[applicable with 612 . . - . . . H - . . . . and 612 . . - . . . W .....versions only]

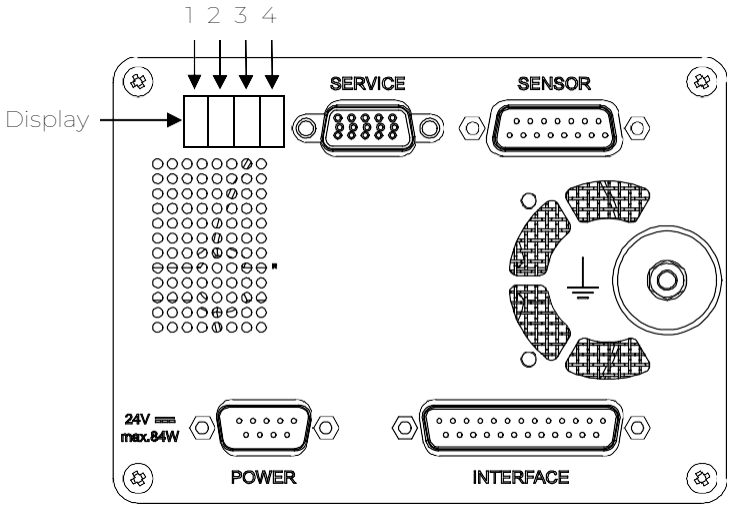
If 2 sensor operation is enabled, changeover between the sensors is done automatically during pressure control. For configuration refer to chapter «Setup procedure». We recommend a ratio of 10:1 between the pressure gauges. Max. ratio is 100:1. High range respectively low range pressure gauge may be either connected to sensor 1 or sensor 2 input. It's required to do correct sensor configuration.
Between 90 and 100% of the low range sensor full scale, the low range sensor is phased out while high range sensor is phased in during pressure rise. During pressure decrease the high range sensor is phased out while low range sensor is phased in. This maintains a functional response behavior in case of small calibration errors between the two sensors. The PRESSURE output in this range is a blend between both sensors.
For monitoring purpose each sensor signal may be read out individually. Refer to «inquiry commands SENSOR 1 READING and SENSOR 2 READING»

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



5.6 Display information

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



5.6.1 Power up

Description	Digit 1	Digit 2	Digit 3	Digit 4
● Power On: All dots are illuminated	#	#	#	#
● 1st information for about 3s: Firmware generation [e.g. 1G..]	1	G		
● 2st information for about 3s: Firmware version and firmware revision [e.g. 00 03]	0	0	0	3
● 3nd information for about 3s: Valve type [e.g. .612]		6	1	2
● 4nd information for about 3s: Controller configuration In case D999 is displayed, motor interlock is active. Refer to «Safety mode» for details.		2 = RS232 interface 3 = RS232 interface with analog outputs	0 = basic 1 = with SPS[1)] 2 = with PFO[2)] 3 = with SPS[1)] and PFO[2)]	1 = 1 sensor version 2 = 2 sensor version
SYNC indicates that powerup synchronization is running.	S	Y	N	C

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

5.6.2 Operation

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

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

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

5.6.3 Fatal error

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

5.6.4 Safety mode

By means of an external switch (see connection diagrams «Electrical connection») the motor power supply can be interrupted. In this case the valve enters the 'safety mode'. This motor interlock prevents the valve from moving (e.g. maintenance work). Data reading from the control unit remains possible.
When motor interlock is active during power up the valve directly enters the 'safety mode' and is not able to synchronize. Display shows 'D C' or 'D999'. In this case synchronization cycle will be done when motor interlock is deactivated. Then Display shows 'INIT' for a moment followed by 'SYNC'.
When 'safety mode' is entered from operation (i.e. pressure control mode), the unit will automatically switch to position control mode and remain at current position. Once motor interlock is deactivated the unit remains in position control mode.

5.6.5 Service indication

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

5.7 Operation during power up

Valve position before power up:	Reaction of valve:
Any	Valve runs a synchronization cycle (close-open-close) to detect the limit stops. This cycle is performed with reduced torque (80%). Display shows configuration of product until synchronization cycle is done. Refer also to chapter «Display information».

5.8 Behavior in case of power failure

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

All parameters are stored in a power fail save memory.

5.9 Operation under increased temperature

	⚠ CAUTION
	Hot valve Heated valve may result in minor or moderate injury. Do not touch valve and heating device during operation. Once heating is switched off (valve and system) await until the valve is cooled down complete before doing any work.

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

6 Trouble shooting

Failure	Check	Action
No dots lighted on display	24 V power supply ok?	Connect valve to power supply according to «Electrical connection» and make sure that power supply is working.
Remote operation does not work	- Local operation via service port active - Safety mode active, check for D on display?	- Switch to remote operation. - Provide power to motor to allow for operation. - Refer to «Electrical connection» for details.
Display shows «E 20»and position is 009999 (fatal error - limit stop of valve unit not detected)	Clamp coupling screw not fastened?	Tighten clamp coupling screw. Refer to chapter «Maintenance» for details. RESET or restart of valve is necessary.
Display shows «E 21»and position is 009999 (fatal error - rotation angle of valve plate limited during power up)	- Valve plate centric adjusted? - Valve unit heavy contaminated? - Valve plate mechanically obstructed?	- Adjust valve plate according to «Maintenance procedure». - Clean valve unit according to «Maintenance procedure». - Resolve obstruction. - Reset control unit. Cycle power (OFF/ON) or - Send reset command: local via service port with NVM
Display shows «E 22»and position is 009999 (fatal error - rotation angle of valve plate limited during operation)	- Valve unit heavy contaminated? - Valve plate mechanically obstructed?	- Clean valve unit according to «Maintenance procedure». - Resolve obstruction. - Reset control unit. Cycle power (OFFàON) or - Send reset command: local via service port with NVM
Display shows «E 40»and position is 009999 (fatal error - motor driver failure detected)		Replace control and actuating unit according to «Maintenance procedure».
Display shows «D 0» Motor Interlock is open	Motor power supplied?	- Provide power to motor to allow for operation. - Refer to «Electrical connection» for details.
Display shows «SR» (Service Request)	Valve unit heavy contaminated? Or gate seal is sticking.	- Clean valve unit according to «Maintenance procedures». - Reset control unit. Cycle power (OFFàON) or - Send reset command: local via service port with NVM

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

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

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