**Characterised control valve (CCV) with adjustable flow rate and sensor-operated flow control, as well as power and energy-monitoring function, 2-way, with flange PN 16**

• For closed cold and warm water systems
• For modulating water-side control of air purification and heating systems
• Nominal voltage AC/DC 24 V
• Ethernet 10/100 Mbit/s, TCP/IP, integrated web server
• Communication via BACnet IP, BACnet MS/TP, MP-Bus or conventional control
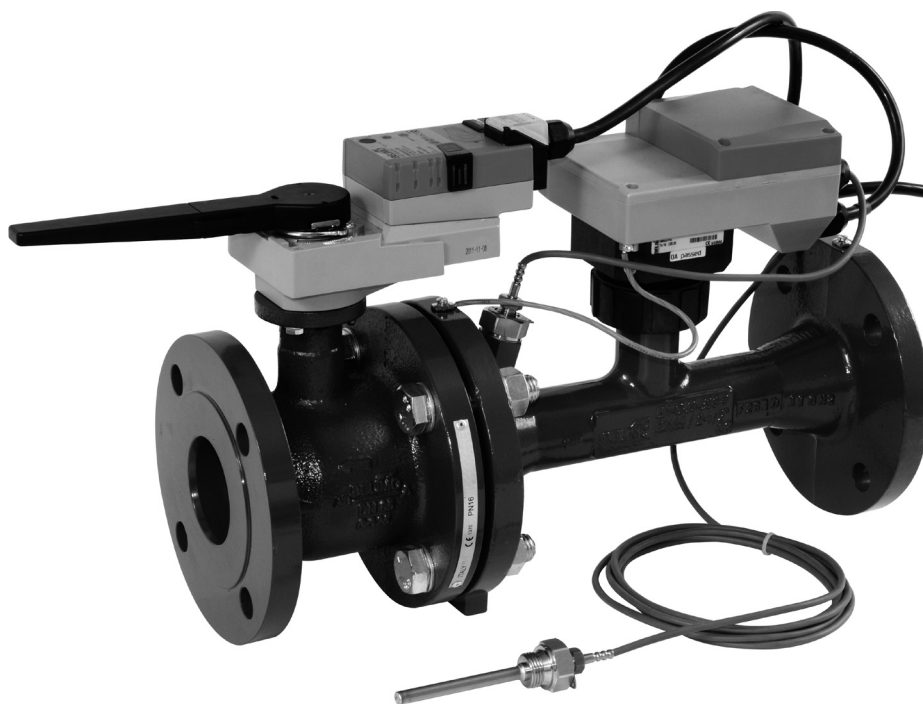
Type overview

Type	$\dot{V}_{nom}$		k_{vs} [1]	DN	
	[l/s]	[l/min]	[m³/h]	[mm]	[inches]
P6065W800EV-BAC	8	480	40	65	2 1/2"
P6080W1100EV-BAC	11	660	60	80	3"
P6100W2000EV-BAC	20	1200	100	100	4"
P6125W3100EV-BAC	31	1860	160	125	5"
P6150W4500EV-BAC	45	2700	240	150	6"

[1] Theoretical k_{vs} value for pressure drop calculation.

Technical data

Electrical data	Nominal voltage	AC 24 V, 50 Hz / DC 24 V
	Nominal voltage range	AC 19.2 ... 28.8 V / DC 21.6 ... 28.8 V
	Power consumption Operation	10 W
	Rest position	8.5 W
	Dimensioning	14 VA
	Connection	RJ45 socket (Ethernet)
		Cable 1 m, 6 x 0.75 mm²
Functional data	Torque (nominal torque)	20 Nm (DN 65 ... 100) / 40 Nm (DN 125 ... 150)
	Communicative control	BACnet Application Specific Controller (B-ASC) BACnet IP, BACnet MS/TP (for details, see separate document «PICS»)
		MP bus (for details, see separate document «Data-Pool Values»)
	Conventional control Positioning signal Y	DC 0 ... 10 V, typical input impedance 100 kΩ
	Operating range	DC 0.5 ... 10 V
	Adjustable flow rate $\dot{V}_{max}$	45 ... 100% of $\dot{V}_{nom}$
	Configuration	via integrated web server
	Parameterisation setting	see page 8
	Feedback	DC 0.5 ... 10 V, max. 1 mA (measuring voltage U)
	Manual override	Gearing latch with push-button (temporary-permanent)
	Running time	90 s / 90°
	Sound power level, actuator	45 dB (A)
	Position indication	mechanical, plug-in

Technical data   *(continued)*

|		
Safety	Protection class	**III** Safety extra-low voltage
	Degree of protection	IP54 (for use of cover cap or grommet for RJ45 socket)
	EMC	CE according to 2004/108/EC
	Principle of operation	Type 1
	Rated current voltage	0.8 kV
	Control pollution degree	3
	Ambient temperature	$-10°C ... +50°C$
	Non-operating temperature	$-20°C ... +80°C$
	Ambient humidity	95% r.h., non-condensating
	Maintenance	Maintenance-free
Functional data control valve sensor unit	Media	Cold and warm water, Water with max. 50% volume of glycol
	Medium temperature	$-5°C ... +120°C$ in the characterised control valve (CCV) (lower temperatures on request)
	Approved working pressure p_s Differential pressure Δp_{max}	1600 kPa 340 kPa
	Flow characteristic	Equal percentage (according to VDI/VDE 2178) n(gl): 3.2 (optimised in the opening range)
	Leakage rate	A: air bubble-tight (according to EN 12266-1)
	Pipe connectors	Flange PN 16 (according to EN 1092/1)
	Closing pressure Δp_s	690 kPa
	Min. pressure loss, valve	22 kPa @ $\dot{V}_{nom}$
	Angle of rotation	90°◁
	Installation position	Upright to horizontal (in relation to the spindle)
	Maintenance	Maintenance-free
Materials	Valve	EN-JL1040 (GG25 with protective paint)
	Valve cone	Stainless steel AISI 316
	Spindle	Stainless steel AISI 304
	Stem seal	EPDM Perox
	Valve seat	PTFE, O-ring Viton
	Characterising disk	Stainless steel
Standards	Pressure equipment directive	CE according to 97/23/EC
Flow measurement	Measuring principle	Magnetic inductive volumetric flow measurement
	Measuring accuracy	$\pm6\%$ (of 25 ... 100% $\dot{V}_{nom}$)
	Control accuracy	$\pm10\%$ (of 25 ... 100% $\dot{V}_{nom}$)
	Min. flow measurement	2.5% von $\dot{V}_{nom}$
	Measuring pipe	EN-GJS-500-7U (GGG50 with protective paint)
	Max. pressure drop measuring pipe	30 kPa @ $\dot{V}_{nom}$
Temperature measurement	Measuring accuracy Absolute temperature	$\pm1\%$
	Temperature difference	$\pm0.25\%$ @ $\Delta T = 20$ K
	Repetition accuracy display	$\pm0.5\%$
	Resolution	0.05 °C
Dimensions / weights	See «Dimensions and weights» on page 8	

Safety notes

⚠

- The device has been designed for use in stationary heating, ventilation and air conditioning systems and is not allowed to be used outside the specified field of application, especially in aircraft or in any other airborne means of transport.
- It may only be installed by suitably trained personnel. Any legal regulations or regulations issued by authorities must be observed during installation.
- The device may only be opened at the manufacturer's site. It does not contain any parts that can be replaced or repaired by the user.
- The connection between the control valve and the measuring tube should not be separated.
- The cable must not be removed from the device.
- The device contains electrical and electronic components and is not permitted to be disposed of as household refuse. All locally valid regulations and requirements must be observed.

Product features

| Principle of operation | The actuator is comprised of four components: characterised control valve (CCV), measuring pipe with medium velocity sensor, temperature sensors and the actuator itself. First of all, the maximum flow rate ($\dot{V}_{max}$) is set on the actuator, whereby $\dot{V}_{max}$ is permitted to represent 45% to 100% of the greatest possible flow rate $\dot{V}_{nom}$. At the same time, the $\dot{V}_{max}$ value is assigned to the maximum positioning signal (typically 10 V). Because of the fact that the characterised control valve (CCV) exhibits an equal percentage valve characteristic curve, the positioning signal for the flow rate is also depicted in equal percentages, i.e. 70% of the positioning signal corresponds to 38% of the $\dot{V}_{max}$ value. |

The actuator control can be either communicative or analogue. The medium flows in the measuring pipe with a velocity of up to 2 m/s, is detected by the sensor and is applied as the flow value. The measured value is compared with the setpoint. Depending on the deviation, the actuator moves the ball of the characterised control valve (CCV) into the required position and acts as a throttling device. The angle of rotation α varies according to the differential pressure through the final controlling element (see volumetric flow curves).

Flow rate curves

$\alpha_1 < \alpha_2 < \alpha_3$
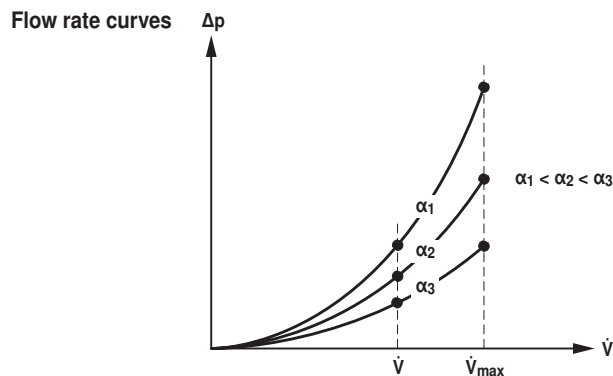
The angle of rotation (α) will differ, depending on the differential pressure (Δp) and the volumetric flow required ($\dot{V}$),

Power and energy monitoring function

The actuator is equipped with two temperature sensors. One sensor (T2) is integrated in the measuring pipe, the second sensor (T1) is enclosed with the system, already wired, and must be installed in the water circulation at the site. The sensors are used to record the medium temperatures of the supply and return lines of the consumer (heat/cold register). As the water quantity is also known thanks to the volumetric flow measurement integrated in the system, the power released from the consumer can be calculated. Furthermore, the heating/cooling energy is also determined automatically by means of the evaluation of the power over time.
The current data, e.g. temperatures, volumetric flow volumes, exchanger energy consumption, etc. can be recorded and accessed at any time by means of web browsers or communication (BACnet or MP bus).

Data recording

The recorded data (integrated data recording for 13 months) can be used for the optimisation of the overall system and for the determination of the performance of the consumer.
Download csv files through web browser.

Manual override

Manual override with push-button possible (the gear is disengaged for as long as the key is pressed or remains locked).

High functional reliability

The actuator is overload-protected, requires no limit switches and automatically stops when the end stop is reached.

Home position

The actuator moves to the home position when the supply voltage is switched on for the first time, i.e. at the time of commissioning or after pressing the «gear disengagement» key,
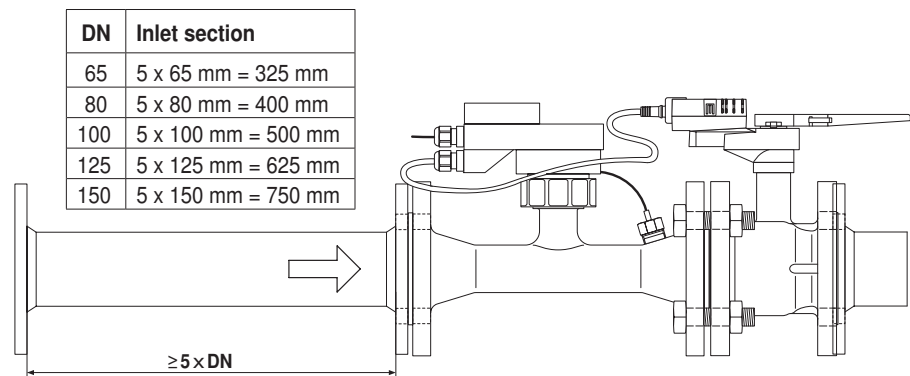The actuator then moves into the position defined by the positioning signal.

Parameterisation

The parameterisation can be carried out simply and rapidly through the integrated web server.

Recommended installation positions

The actuator can be installed **standing** to **lying**.
The characterised control valve may not be installed in a hanging position i.e. with the spindle pointing downwards.

Characterised control valves (CCV) with adjustable flow rate, sensor-operated flow control and monitoring

BELIMO®
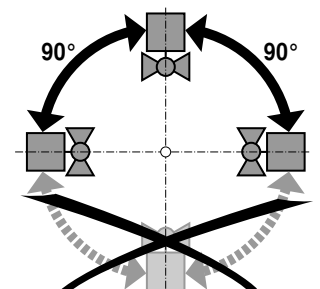
Installation instructions

Water quality requirements	• The water quality requirements specified in VDI 2035 must be adhered to.
	• Ball valves are sensitive regulating devices. The use of **dirt filters** is recommended in order to prolong their service life as modulating instruments.
Maintenance	• Ball valves, rotary actuators and sensors are maintenance-free.
	• Before any kind of service work is carried out, it is essential to isolate the rotary actuator from the power supply (by disconnecting the power lead). Any pumps in the part of the piping system concerned must also be switched off and the appropriate slide valves closed (allow everything to cool down first if necessary and reduce the system pressure to ambient pressure level).
	• The system must not undergo recommissioning until the ball valve and the rotary actuator have been properly reassembled according to the instructions and the pipeline has been refilled in the proper manner.
Direction of flow	The direction of flow, specified by an arrow on the housing, is to be complied with, since otherwise the flow rate will be measured incorrectly.
Installation in the return	As a general rule, the device is to be installed in the return.
Inlet section	In order to achieve the specified measuring accuracy, a flow-calming section or inflow section in the direction of the flow is to be provided upstream from the measuring pipe flange. Its dimensions should be at least 5 x DN.

DN	Inlet section
65	5 x 65 mm = 325 mm
80	5 x 80 mm = 400 mm
100	5 x 100 mm = 500 mm
125	5 x 125 mm = 625 mm
150	5 x 150 mm = 750 mm

$\geq 5 \times DN$

Earthing	It is imperative that the measuring pipe be correctly earthed in order to ensure that the medium velocity sensor does not make any unnecessary incorrect measurements.
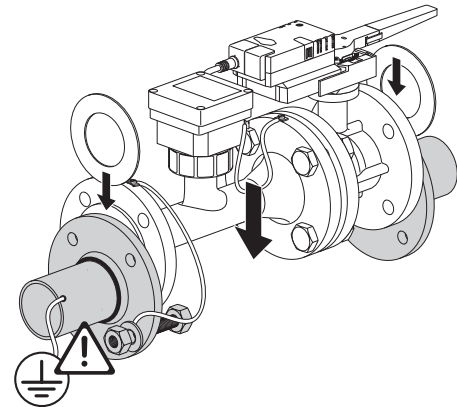
|	
Valve design	If no hydraulic data are available, then the same valve DN can be selected as the heat exchanger connection DN.
	If the valve is assigned to the last consumer, then the pressure drop in the measuring pipe is 30 kPa with $\dot{V}_{nom}$. If the flow rate is 50% of the $\dot{V}_{nom}$, then the pressure drop for the length of the measuring pipe will be only ¼ and equals around 8 kPa. (The measuring pipe/valve pressure drop ratio is 58:42)

Installation instructions
(continued)

Installation of immersion sleeve and temperature sensor

The valve is equipped with two temperature sensors:
- T2: One sensor is already mounted in the valve unit.
- T1: The second sensor must be mounted at the installation site ahead of the consumer (valve in the return line; recommended) or after the consumer (valve in the supply line). The immersion sleeve required is supplied already screwed onto the temperature sensor and must be unscrewed for this for installation. The temperature sensor is already wired with the valve.

Note
- The cable between valve unit and temperature sensor may not be either shortened or lengthened. ⚠

~ 10 m

Pipe DN	Length of weld-on nozzle L [1]	Thread G	Thread length L_T
65 ... 400	≤30 mm	½"	≥15 mm
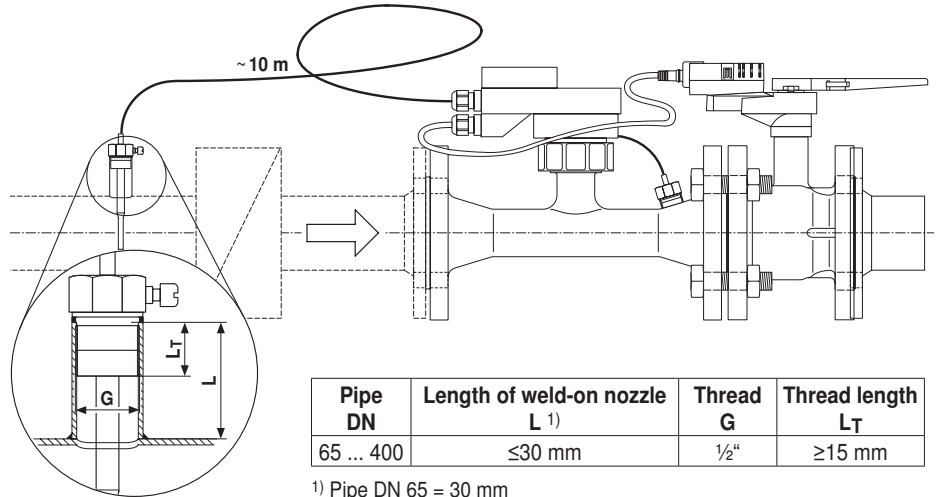
[1] Pipe DN 65 = 30 mm
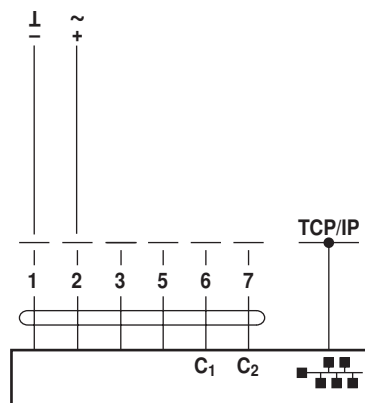
Electrical installation

Wiring diagrams

Notes
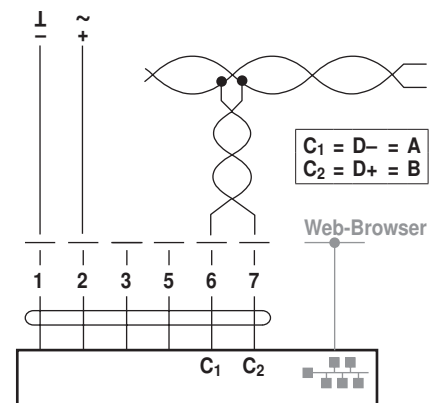- Connection via safety isolating transformer. ⚠
- Parallel connection of other actuators possible. Note the performance data.
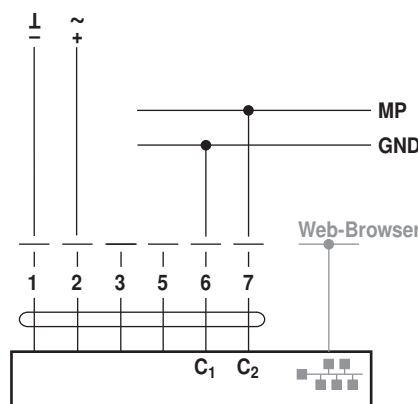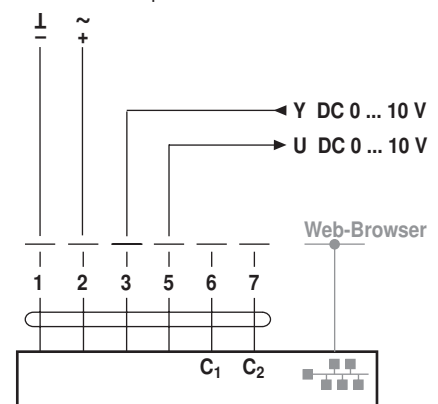
BACnet IP

⊥ —
~ +

TCP/IP

1 2 3 5 6 7

C_1 C_2

BACnet MS/TP

⊥ —
~ +

C_1 = D– = A
C_2 = D+ = B

Web-Browser

1 2 3 5 6 7

C_1 C_2

MP bus

⊥ —
~ +

MP
GND

Web-Browser

1 2 3 5 6 7

C_1 C_2

Conventional operation:

⊥ —
~ +

◄ Y DC 0 ... 10 V
► U DC 0 ... 10 V

Web-Browser

1 2 3 5 6 7

C_1 C_2

Cable colours:
1 = black
2 = red
3 = white
5 = orange
6 = pink
7 = grey

P6..W..EV-BAC   Characterised control valves (CCV) with adjustable flow rate, sensor-operated flow control and monitoring

BELIMO®

Display and operating elements

① **Push-button and LED display yellow**
Illuminated: Angle of rotation adaptation active
Press key: Switches on angle of rotation adaptation followed by standard mode

② **LED display green**
Off   No supply or wiring errors
Illuminated   Supply and wiring OK
Flickering   Internal communication (valve/sensor)

③ **Gear disengagement key**
Press key: Gear disengaged, motor stops, manual override possible
Release key: Gear engaged, standard operation

Tool connection

Parameterisation   The parameterisation can be carried out simply and rapidly through the integrated web server (RJ45 connection to the web browser) or by communicative means.
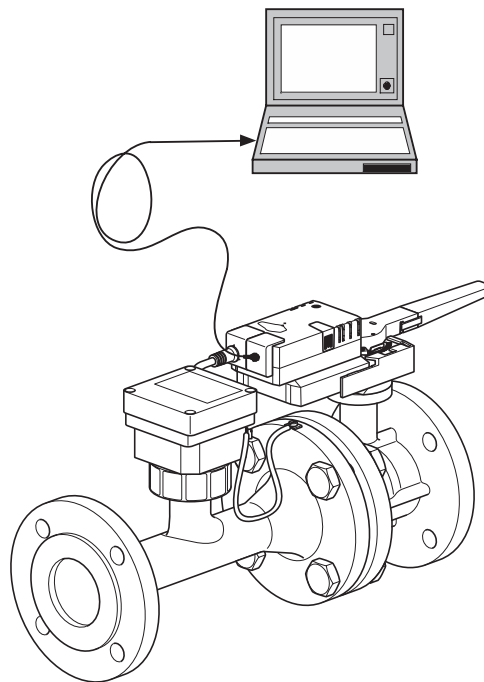
Web browser
- http://192.168.0.10:8080
- The notebook needs an address in the same IP range
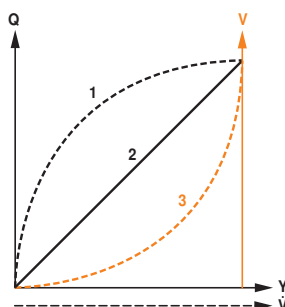
IP address setting
- Default:
  IP address: 192.168.0.10
  Subnetwork mask: 255.255.255.0

Password (read-only)
- User name: «guest»
- Password: «guest»

Additional information regarding the integrated web server can be found in the separate documentation.

Flow rate measurement/setting

Principle of operation EV

Heat exchanger transfer response

Depending on the construction, temperature spread, medium and hydraulic circuit, the power Q is not proportional to the volumetric flow of the water $\dot{V}$ (curve 1). With the classical type of temperature control, an attempt is made to maintain the control signal Y proportional to the power Q (curve 2) and is achieved by means of an equal-percentage valve characteristic curve (curve 3).

| Flow rate measurement/setting	*(continued)*

Control characteristics

The specially configured control parameters in connection with the precise velocity sensor
– ensure a stable quality of control. They are however not suitable for rapid control processes,
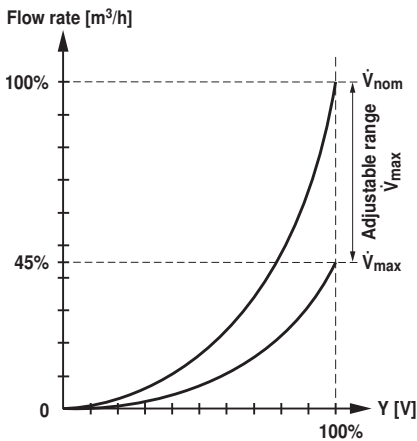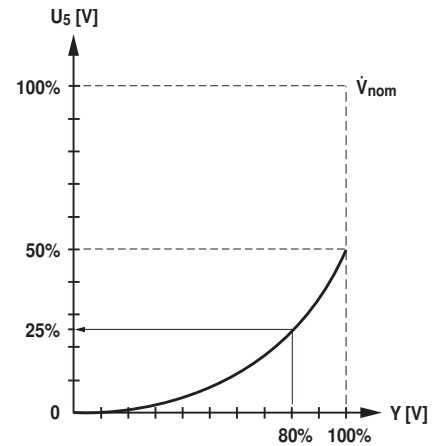i.e. for domestic water control.

U_5 displays the measured volumetric flow as voltage (factory setting).
It is always in reference to the respective $\dot{V}_{nom}$, i.e. if $\dot{V}_{max}$ is e.g. 50% of $\dot{V}_{nom}$, then Y = 10 V,
U_5 = 5V.

1. Standard equal percentage
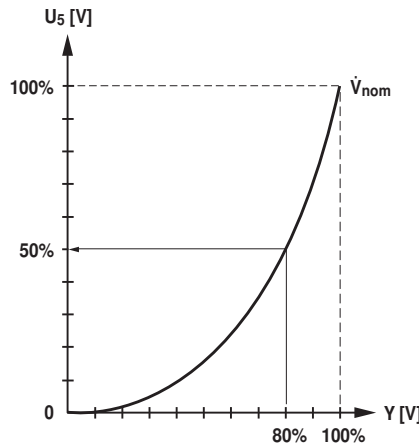
**2. Effect $\dot{V}_{max} < \dot{V}_{nom}$**

Definitions

$\dot{V}_{nom}$ Is the maximum possible flow rate and corresponds to approximately 2 to 2.4 m/s medium
velocity in the connection pipes with the same DN size.
(For DN 65, the cross-section is approximately 0.065 m² x Pi /4 = 0.0033 m² and for
2.4 m/s medium velocity, this results in 480 L/min or 28.8 m³/h)

$\dot{V}_{max}$ Is the maximum flow rate which has been set with the greatest positioning signal, e.g. 10 V.
$\dot{V}_{max}$ can be set to between 45% and 100% of $\dot{V}_{nom}$.

$\dot{V}_{min}$ 0% (non-variable).

Creep flow suppression

The medium velocity is <0.06 m/s in the opening point and can no longer be measured by the
sensor within a reasonable tolerance. This range is overridden electronically.

Opening valve The valve remains closed until the volumetric flow required by the positioning
signal Y corresponds to 2.5% of $\dot{V}_{max}$. The control along the valve characteristic
curve is active after this value has been exceeded.

Closing valve The control along the valve characteristic curve is active up to the required
flow rate of 2.5% of $\dot{V}_{nom}$. Once the level falls below this value, the flow rate is
maintained at 2.5% of $\dot{V}_{nom}$. If the level falls below the flow rate of 0.5% of $\dot{V}_{nom}$
required by the reference variable Y, then the valve will close.
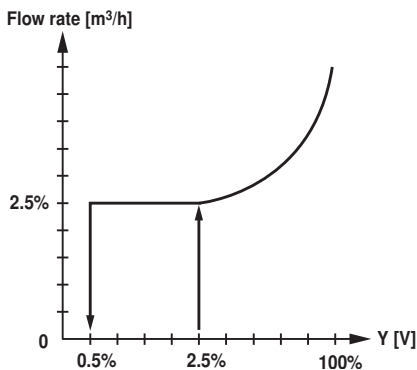
Parameterisation setting *(Selection)*

Functional data actuator		Factory settings	Variable	Setting
Control	Positioning signal Y	DC 0.5 … 10 V, input impedance 100 kΩ	DC 2 ... 10 V	....
	Operating range	DC 0.5 … 10 V	DC 2 ... 10 V	....
Position feedback (measuring voltage U)		DC 0.5 ... 10 V, max. 0.5 mA	DC 0 ... 10 V	
			DC 2 ... 10 V	....
Flow rate setting		$\dot{V}_{max} = \dot{V}_{nom}$	$\dot{V}_{max}$ 45 ... 100% ($\dot{V}_{nom}$)	....
Installation position		Return	Supply	....
Glycol concentration		0%	0 ... 50%	....

Dimensions and weights

Dimensional drawings
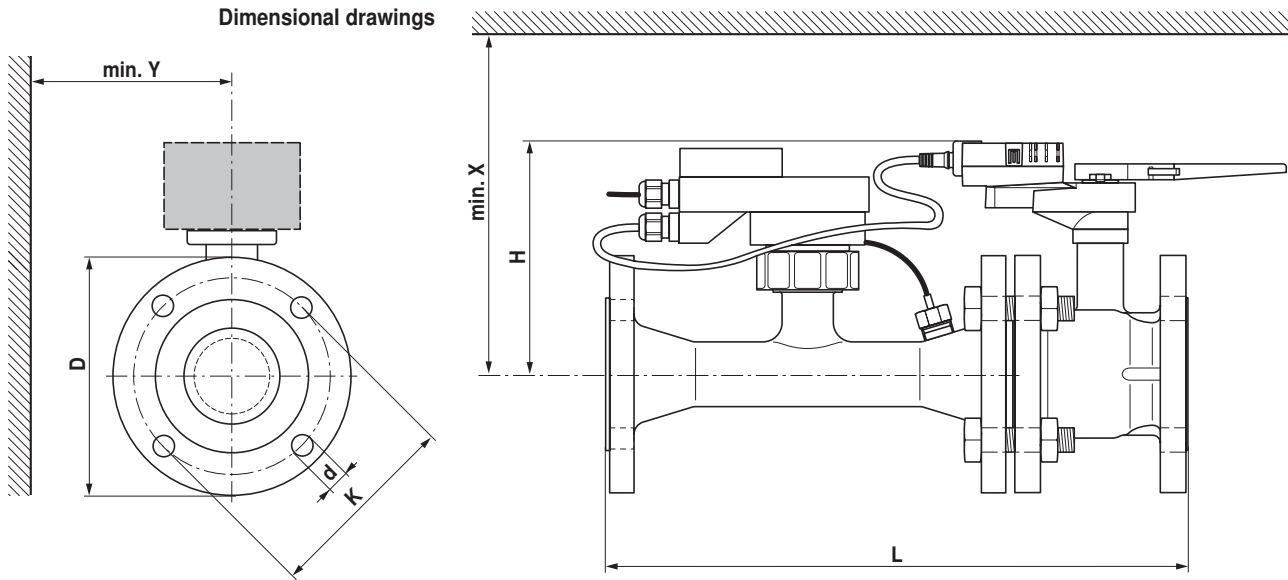
DN [mm]	L [mm]	H [mm]	D [mm]	K [mm]	d [mm]	X [1] [mm]	Y [1] [mm]	Weight [kg]
65	454	200	185	145	4 x 19	220	140	23.6
80	499	200	200	160	8 x 19	220	150	28.7
100	582	200	224	180	8 x 19	220	160	40.5
125	640	240	252	210	8 x 19	260	180	54.7
150	767	240	282	240	8 x 24	260	190	70.0

[1] Minimum distance with respect to the valve centre. If Y <180 mm, then the extension of the hand crank must be dismantled as necessary.

1

AB

A

2

3a

1   2   1

3b

4

5

3 1
2 4

M18: 130 Nm
M20: 190 Nm

3 7 1
6   5
2 8 4

DN	L [1]	G	L_T
65 ... 400	≤30 mm	½"	≥15 mm

[1] DN 65 = 30 mm

≥ 5 × DN

AC 24 V / DC 24 V

Y DC 0 ... 10 V
U DC 0 ... 10 V

Web-Browser

C_1 C_2

90°   90°

BACnet IP

TCP/IP

C_1 C_2

BACnet MS/TP

C_1 = D–	= A
C_2 = D+	= B

Web-Browser

C_1 C_2

MP-Bus

MP
GND

Web-Browser

C_1 C_2