MP⚡BUS®
◈BACnet®

Characterised control valve (CCV) with sensor-operated flow rate or power control, power and energy-monitoring function, 2-way, internal thread (Energy Valve), with emergency control function

- **Nominal voltage AC/DC 24 V**
- **Control Modulating**
- **For closed cold and warm water systems**
- **For modulating control of air-handling and heating systems on the water side**
- **Ethernet 10/100 Mbit/s, TCP/IP, integrated web server**
- **Communication via BACnet IP, BACnet MS/TP, Belimo MP-Bus or conventional control**
- **Design life SuperCaps: 15 years**
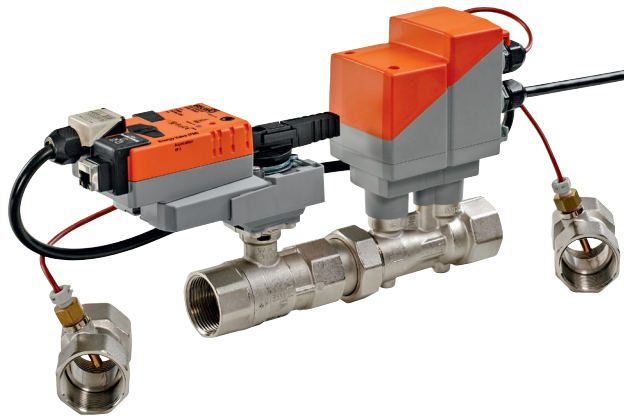
Type overview

Type	DN [ ]	Rp ["]	Vnom [l/s]	Vnom [l/min]	kvs theor. [m³/h]	PN [ ]	n(gl) [ ]
EV015R+KBAC	15	1/2	0.35	21	2.9	16	3.2
EV020R+KBAC	20	3/4	0.65	39	4.9	16	3.2
EV025R+KBAC	25	1	1.15	69	8.6	16	3.2
EV032R+KBAC	32	1 1/4	1.8	108	14.2	16	3.2
EV040R+KBAC	40	1 1/2	2.5	150	21.3	16	3.2
EV050R+KBAC	50	2	4.8	288	32.0	16	3.2

kvs theor.: Theoretical kvs value for pressure drop calculation

Technical data

Electrical data	Nominal voltage	AC/DC 24 V
	Nominal voltage frequency	50/60 Hz
	Nominal voltage range	AC 19.2...28.8 V / DC 21.6...28.8 V
	Power consumption in operation	15 W
	Power consumption in rest position	6.5 W
	Power consumption for wire sizing	26 VA
	Connection supply / control	Cable 1 m, 6 x 0.75 mm²
	Connection control Ethernet	RJ45 socket
	Parallel operation	Yes (note the performance data)
Functional data	Torque motor	20 Nm
	Communicative control	BACnet Application Specific Controller (B-ASC) BACnet IP, BACnet MS/TP (Details see seperate document "PICS") MP-Bus (Details see separate document "Data-Pool Values")
	Positioning signal Y	DC 0...10 V
	Operating range Y	DC 2...10 V
	Operating range Y variable	DC 0.5...10 V
	Position feedback U	DC 2...10 V
	Position feedback U variable	DC 0...10 V DC 0.5...10 V
	Setting emergency setting position (POP)	NC / NO or adjustable 0...100% (POP rotary button)
	Running time emergency control position	35 s / 90°
	Sound power level motor	45 dB(A)
	Sound power level emergency control position	61 dB(A)
	Adjustable flow rate Vmax	30...100% of Vnom
	Control accuracy	±10% (of 25...100% Vnom)
	Control accuracy note	±6% (of 25...100% Vnom) at 20°C / Glykol 0% vol.
	Configuration	via integrated web server / ZTH EU

Characterised control valve (CCV) with sensor-operated flow rate or power control, power and energy-monitoring function, 2-way, internal thread (Energy Valve), with emergency control function

BELIMO®

Technical data

Functional data	Media	Cold and warm water, water with glycol up to max. 50% vol.
	Medium temperature	-10...120°C
	Permissible pressure ps	1600 kPa
	Closing pressure Δps	1400 kPa
	Differential pressure Δpmax	350 kPa
	Differential pressure note	200 kPa for low-noise operation
	Flow characteristic	equal percentage (VDI/VDE 2178), optimised in the opening range (switchable to linear)
	Leakage rate	Leakage rate A, air-bubble-tight (EN 12266-1)
	Pipe connectors	Internal thread according to ISO 7-1
	Installation position	Upright to horizontal (in relation to the stem)
	Maintenance	Maintenance-free
	Manual override	Gear disengagement with push-button
Flow measurement	Measuring principle	Ultrasonic volumetric flow measurement
	Measuring accuracy	±6% (of 25...100% Vnom)
	Measuring accuracy note	±2% (of 25...100% Vnom) at 20°C / Glykol 0% vol.
	Min. flow measurement	1% of Vnom
Temperature measurement	Measuring accuracy of the absolute temperature	± 0.6°C @ 60°C (PT1000 EN60751 Class B)
	Measuring accuracy of temperature difference	±0.23 K @ ΔT = 20 K
	Resolution	0.05°C
Safety	Protection class IEC/EN	III Safety extra-low voltage
	Degree of protection IEC/EN	IP54 (for use of protective cap or grommet for RJ45 socket)
	EMC	CE according to 2004/108/EC
	Mode of operation	Type 1.AA
	Rated impulse voltage supply / control	0.8 kV
	Control pollution degree	3
	Ambient temperature	-30...50°C
	Non-operating temperature	-40...80°C
	Ambient humidity	95% r.h., non-condensing
Materials	Housing	Brass body
	Measuring pipe	Brass body nickel-plated
	Closing element	Stainless steel
	Stem	Stainless steel
	Stem seal	O-ring EPDM
	Immersion sleeve	Brass
	T-Piece	Brass body nickel-plated
Terms	Abbreviations	POP = Power off position / emergency setting position

Safety notes

⚠️

- This device has been designed for use in stationary heating, ventilation and air conditioning systems and must not be used outside the specified field of application, especially in aircraft or in any other airborne means of transport.
- Only authorised specialists may carry out installation. All applicable legal or institutional installation regulations must be complied during installation.
- The connection between the control valve and the measuring tube should not be separated.
- The device contains electrical and electronic components and must not be disposed of as household refuse. All locally valid regulations and requirements must be observed.

Characterised control valve (CCV) with sensor-operated flow rate or power control, power and energy-monitoring function, 2-way, internal thread (Energy Valve), with emergency control function

BELIMO®

Product features

Principle of operation

The final controlling device is comprised of four components: characterised control valve (CCV), measuring pipe with volumetric flow sensor, temperature sensors and the actuator itself. The adjusted maximum flow ($\dot{V}$max) is assigned to the maximum positioning signal (typically 10 V / 100%). Alternatively, the positioning signal can be assigned to the valve opening angle or to the power required on the heat exchanger (see power control). The final controlling device can be controlled communicative or analogue. The medium is detected by the sensor in the measuring pipe and is applied as the flow value. The measured value is balanced with the setpoint. The actuator corrects the deviation by changing the valve position. The angle of rotation α varies according to the differential pressure through the final controlling element (see flow rate curves). TEST
With the supply voltage the integrated condensors will be charged.
Interrupting the supply voltage causes the valve to be moved to the selected emergency setting position (POP) by means of stored electrical energy.

Flow rate curves
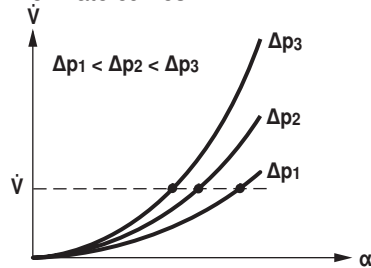
Pre-charging time (start up)

The capacitor actuators require a pre-charging time. This time is used for charging the capacitors up to a usable voltage level. This ensures that, in the event of an electricity interruption, the actuator can move at any time from its current position into the preset emergency setting position (POP). The duration of the pre-charging time depends mainly on how long the power was interrupted.

Typical pre-charging time

	[d]			
	0	**1**	**2**	**7**	**≥10**
[s]	6	9	11	16	20
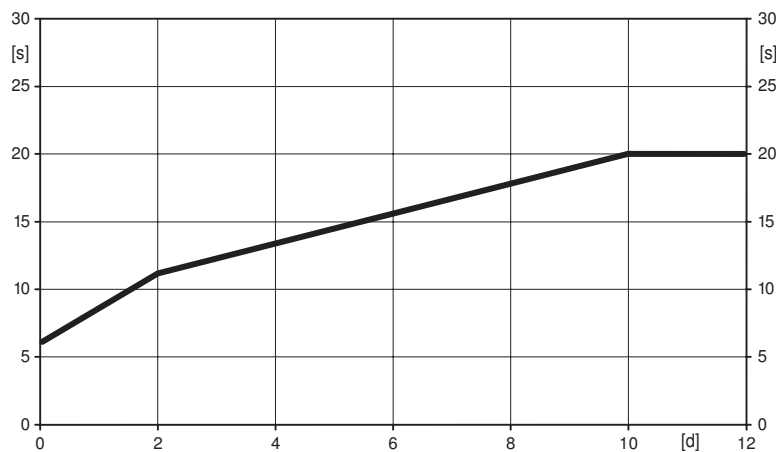
[d] = Electricity interruption in days
[s] = Pre-charging time in seconds

Delivery condition (capacitors)

The actuator is completely discharged after delivery from the factory, which is why the actuator requires approximately 20 s pre-charging time before initial commissioning in order to bring the capacitors up to the required voltage level.

Emergency setting position (POP) rotary knob

The «Emergency setting position» rotary knob can be used to adjust the desired emergency setting position (POP) between 0 and 100% in 10% increments. The rotary knob allways refers to the adapted angle of rotation range. In the event of an electricity interruption, the actuator will move into the selected emergency setting position (POP).

Product features

Transmission behaviour HE

Heat exchanger transmission behaviour
Depending on the construction, temperature spread, medium and hydraulic circuit, the power Q is not proportional to the water volumetric flow $\dot{V}$ (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). This is achieved by means of an equal-percentage valve characteristic curve (Curve 3).
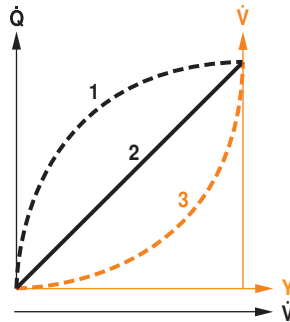
Power control

Alternatively, the positioning signal Y can be assigned to the output power required on the heat exchanger.
Depending on the water temperature and air conditions, the Energy Valve ensures the amount of water required $\dot{V}$ to achieve the desired power.

Maximum controllable power on heat exchanger in power control mode:

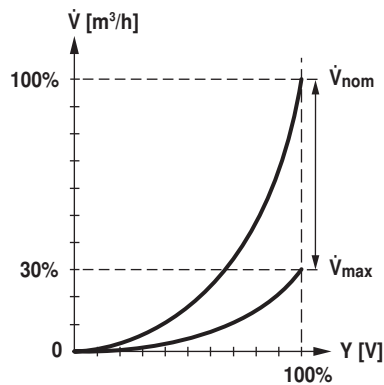| DN 15	30 kW
DN 20	60 kW
DN 25	100 kW
DN 32	160 kW
DN 40	210 kW
DN 50	410 kW

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.

Definition

$\dot{V}$nom is the maximum possible flow.

$\dot{V}$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 30% and 100% of $\dot{V}$nom.

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

Characterised control valve (CCV) with sensor-operated flow rate or power control, power and energy-monitoring function, 2-way, internal thread (Energy Valve), with emergency control function

Product features

Definition

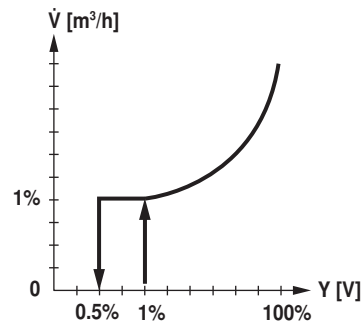Qmax is the set maximum power output on the heat exchanger (in power control mode)
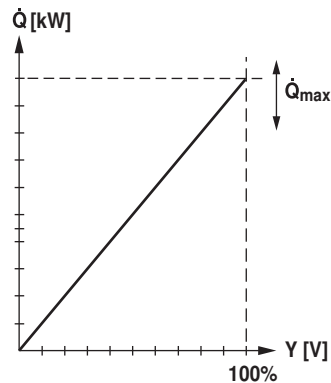
Creep flow suppression

Given the very low flow speed in the opening point, this can no longer be measured by the sensor within the required tolerance. This range is overridden electronically.

Opening valve
The valve remains closed until the volumetric flow required by the positioning signal Y corresponds to 1% of $\dot{V}$nom. 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 1% of $\dot{V}$nom. Once the level falls below this value, the flow rate is maintained at 1% 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.

EV..R+KBAC

Characterised control valve (CCV) with sensor-operated flow rate or power control, power and energy-monitoring function, 2-way, internal thread (Energy Valve), with emergency control function

BELIMO®

Product features

Communication

The parameterisation can be carried out through the integrated web server (RJ45 connection to the web browser) or by communicative means.
Additional information regarding the integrated web server can be found in the separate documentation.
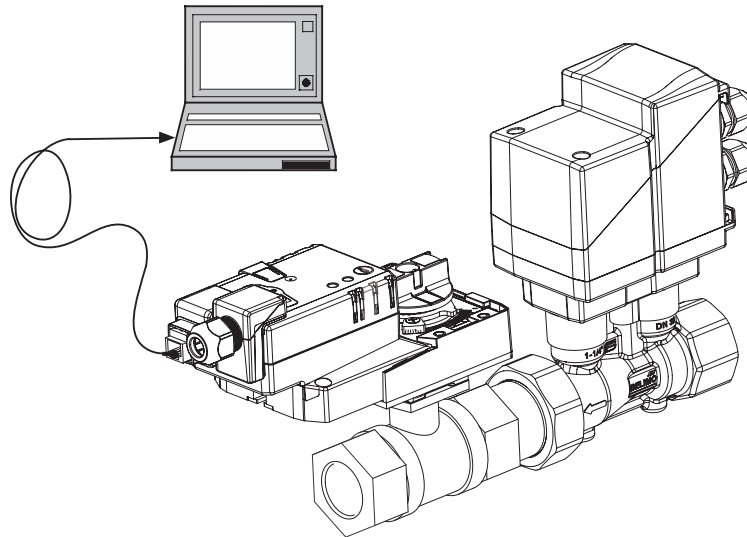
"Peer to Peer" connection
http://belimo.local:8080
The Notebook must be set to "DHCP".
Make sure that only one network connection is active.

Standard IP address:
http://192.168.0.10:8080
Static IP address

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

Positioning signal inversion

This can be inverted in cases of control with an analogue positioning signal. The inversion causes the reversal of the standard behaviour, i.e. at a positioning signal of 0%, regulation is to V̇max or Qmax, and the valve is closed at a positioning signal of 100%.

Hydraulic balancing

Via the integrated web server, the maximum flow rate (equivalent to 100% requirement) can be adjusted on the device itself, simply and reliably, in a few steps. If the device is integrated in the management system, then the balancing can be handled directly by the management system.

Delta-T manager

If a heating or cooling register is operated with a differential temperature that is too low and thus with a flow rate that is too high, this will not result in an increased power output. Nevertheless, heating or cooling machines must provide the energy at a lower degree of effectiveness. Pumps circulate too much water and increase energy consumption unnecessarily.
With the aid of the Energy Valve, it is simple to discover that operation is being carried out at a differential temperature that is too low, resulting in the inefficient use of energy. Necessary setting adjustments can now be carried out quickly and easily at any time. The integrated differential temperature control offers the user in addition the possibility of defining a low limit value. The Energy Valve limits the flow rate automatically to prevent the level from falling below this value.
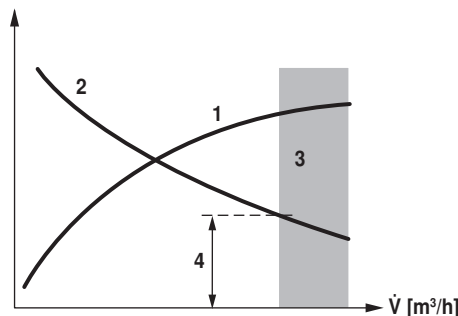
Power output of the heating or cooling registers 1
Differential temperature between supply and return 2
Loss zone (heating or cooling register saturation) 3
Adjustable minimum differential temperature 4

Product features

Combination analogue - communicative	The integrated web server, BACnet IP, BACnet MS/TP or MP-Bus can be used for the communicative position feedback with conventional control by means of an analogue positioning signal. When the combination of positioning signal Y and communicative position feedback is used, it is imperative to ensure that the communicative path is used solely for data transfer from the Energy Valve to the higher-level management system. If the setpoint value is transferred communicatively via bus to the Energy Valve, then the analogue control will be automatically deactivated. This deactivation can be reversed by disconnecting the Energy Valve from the power supply.
Power and energy monitoring function	The final controlling device is equipped with two temperature sensors. A sensor (T2) must be installed at the valve and the second sensor (T1) must be installed on-site on the other side of the water circulation. The two sensors are enclosed with the system already wired. The sensors are used to record the medium temperature of the supply and return lines of the consumer (heating/cooling coil). 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 control with push-button possible - temporary. The gear is disengaged and the actuator decoupled for as long as the button is pressed.
High functional reliability	The actuator is overload protected, requires no limit switches and automatically stops when the end stop is reached.
Home position	The first time the supply voltage is switched on, i.e. at the time of commissioning, the actuator carries out an adaption, which is when the operating range and position feedback adjust themselves to the mechanical setting range. After this process the actuator moves into the required position in order to ensure the flow rate defined by the positioning signal.

Accessories

	Description	Type
Electrical accessories	Connecting cable 5 m, A+B: RJ12 6/6, To ZTH/ZIP-USB-MP	ZK1-GEN

	Description	Type
Service Tools	Service Tool, for MF/MP/Modbus/LonWorks actuators and VAV-Controller	ZTH EU

EV..R+KBAC

Characterised control valve (CCV) with sensor-operated flow rate or power control, power and energy-monitoring function, 2-way, internal thread (Energy Valve), with emergency control function
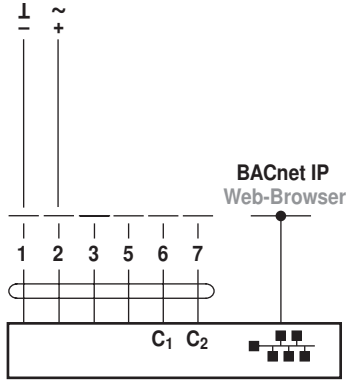
BELIMO

Electrical installation

⚠️ | **Notes** | • Connection via safety isolating transformer.
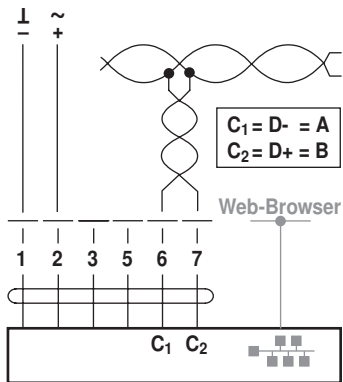• Parallel connection of other actuators possible. Observe the performance data.

Wiring diagrams

BACnet IP

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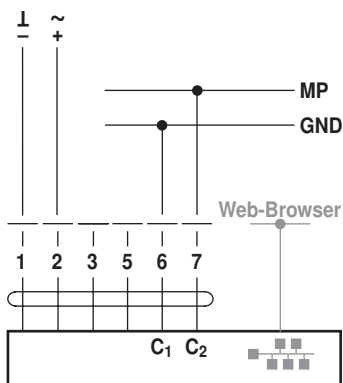1 = black
2 = red
3 = white
5 = orange
6 = pink
7 = grey

BACnet MS/TP

$C_1 = D- = A$
$C_2 = D+ = B$

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

MP-Bus

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

EV..R+KBAC

Characterised control valve (CCV) with sensor-operated flow rate or power control, power and energy-monitoring function, 2-way, internal thread (Energy Valve), with emergency control function

BELIMO®

Electrical installation

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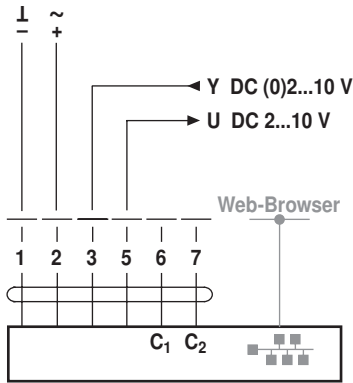
Cable colours:
1 = black
2 = red
3 = white
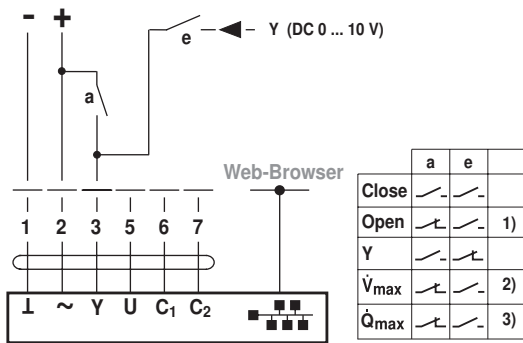5 = orange
6 = pink
7 = grey

Connection of a notebook for parameterisation and manual control via RJ45.

Optional connection via RJ45 (direct connection Notebook / connection via Intranet or Internet) for access to the integrated web server
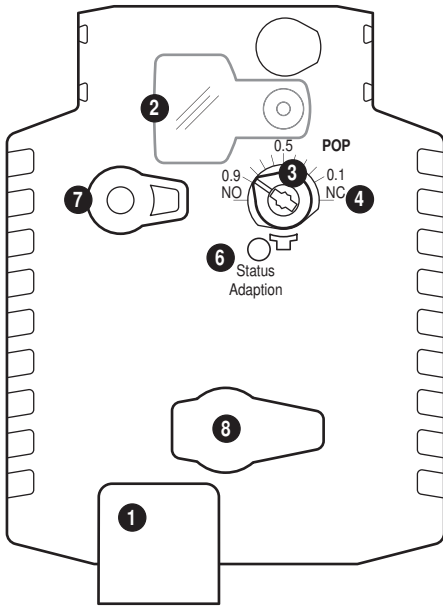
Functions

Functions for actuators with specific parameters (Parametrisation with PC-Tool necessary)

Override control and limiting with DC 24 V with relay contacts (only with conventional control)

	a	e	
Close			
Open			1)
Y			
V̇max			2)
Q̇max			3)

1) Position control
2) Flow control
3) Power control

Characterised control valve (CCV) with sensor-operated flow rate or power control, power and energy-monitoring function, 2-way, internal thread (Energy Valve), with emergency control function

BELIMO

Operating controls and indicators

1 **LED display green**

Off:	No power supply or wiring errors
On:	In operation
Flickering:	Internal communication (Valve/Sensor)

2 **Cover, POP button**

3 **POP button**

4 **Scale for manual adjustment**

6 **Push-button and LED display yellow**

On:	Adaptation process active
Flashing:	POP function active
Off:	Not in operation, pre-charging time SuperCap, fault SuperCap
Press button:	Triggers angle of rotation adaptation, followed by standard mode

7 **Gear disengagement button**

Press button:	Gear disengages, motor stops, manual override possible
Release button:	Gear engages, followed by standard mode

8 **Service plug**

For connecting the ZTH

Emergency position (POP) setting

A – AB
100%

A – AB
0%

A – AB
0...100%
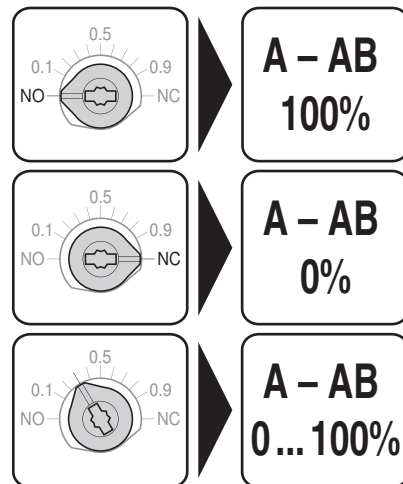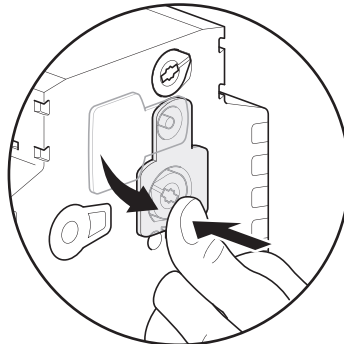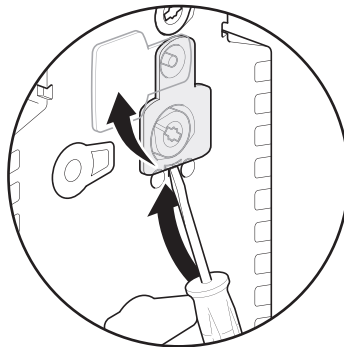
Installation notes

Recommended installation positions

The ball valve can be installed upright to horizontal. The ball valve may not be installed in a hanging position, i.e. with the stem pointing downwards.
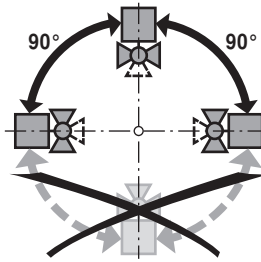
Mounting position in the return

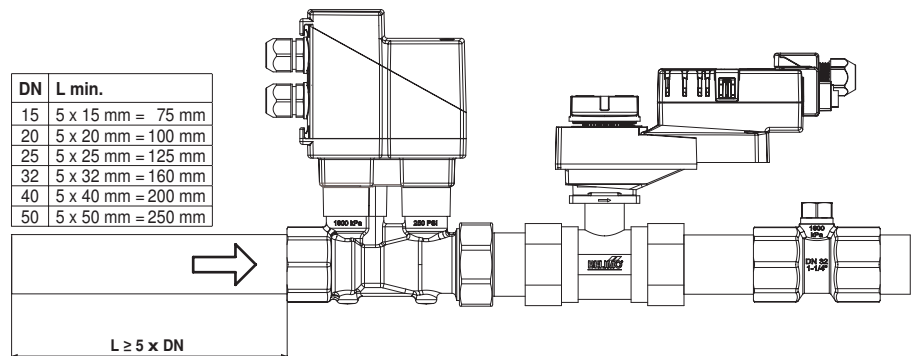Installation in the return is recommended.

Water quality requirements

The water quality requirements specified in VDI 2035 must be adhered to.
Belimo valves are regulating devices. For the valves to function correctly in the long term, they must be kept free from particle debris (e.g. welding beads during installation work). The installation of suitable strainer is recommended.

Maintenance

Ball valves, rotary actuators and sensors are maintenance-free.

In the event of any service work on the final controlling device, it is essential to isolate the rotary actuator from the power supply (by unplugging the electrical cable). 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 be returned to service until the ball valve and the rotary actuator have been properly reassembled in accordance with the instructions and the pipeline has been refilled in the proper manner.

Flow direction

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.

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 5x DN.

DN	L min.
15	5 x 15 mm = 75 mm
20	5 x 20 mm = 100 mm
25	5 x 25 mm = 125 mm
32	5 x 32 mm = 160 mm
40	5 x 40 mm = 200 mm
50	5 x 50 mm = 250 mm

L ≥ 5 x DN

Installation notes

**Installation of immersion sleeve and temperature sensor**

The valve is equipped with two fully-wired temperature sensors.
• T2: This sensor is installed on site near the valve unit.
• T1: This sensor is installed on site ahead of the consumer (valve in the return line) or after the consumer (valve in the supply line).

Two T-pieces for installation of the temperature sensors in the pipelines are included in the shipment.

Note
The cables between valve unit and temperature sensors may not be either shortened or lengthened.

~ 0.8 m

~ 3.0 m
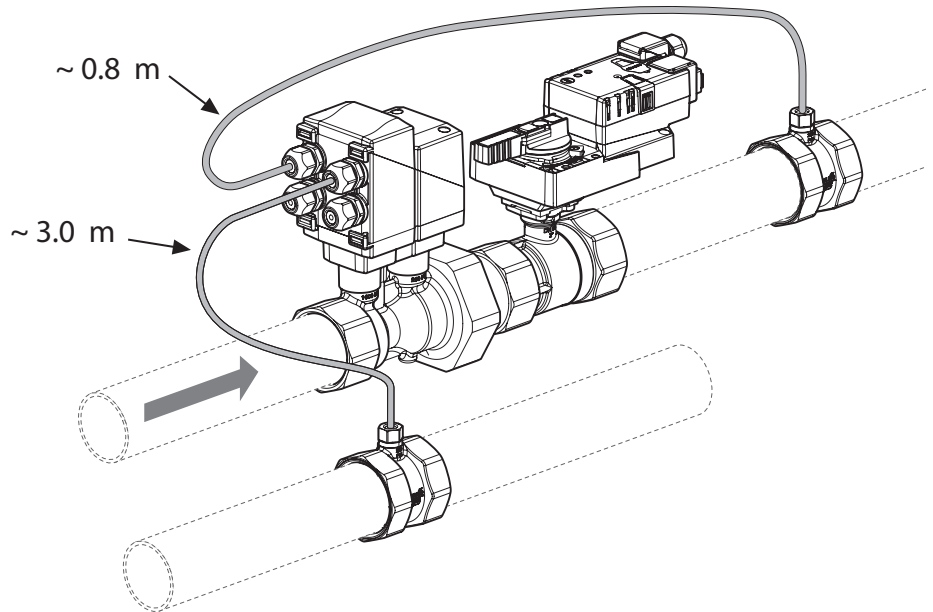
General notes

Valve selection

The valve is determined using the maximum required flow rate $\dot{V}max$.
A calculation of the kvs value is not required.
$\dot{V}max$ = 30…100% of $\dot{V}nom$
If no hydraulic data are available, then the same valve DN can be selected as the heat exchanger nominal diameter.

Minimum differential pressure (pressure drop)

The minimum required differential pressure (pressure drop through the valve) for achieving the desired volumetric flow $\dot{V}max$ can be calculated with the aid of the theoretical kvs value (see type overview) and the below-mentioned formula. The calculated value is dependent on the required maximum volumetric flow $\dot{V}max$. Higher differential pressures are compensated for automatically by the valve.

Formula

$$\Delta p_{min} = 100 \times \left(\frac{\dot{V}_{max}}{k_{vs\ theor.}} \right)^2$$

Δp_{min}: kPa
$\dot{V}_{max}$: m³/h
$k_{vs\ theor.}$: m³/h

Example (DN25 with the desired maximum flow rate = 50% $\dot{V}nom$)
EV025R+KBAC
kvs theor. = 8.6 m³/h
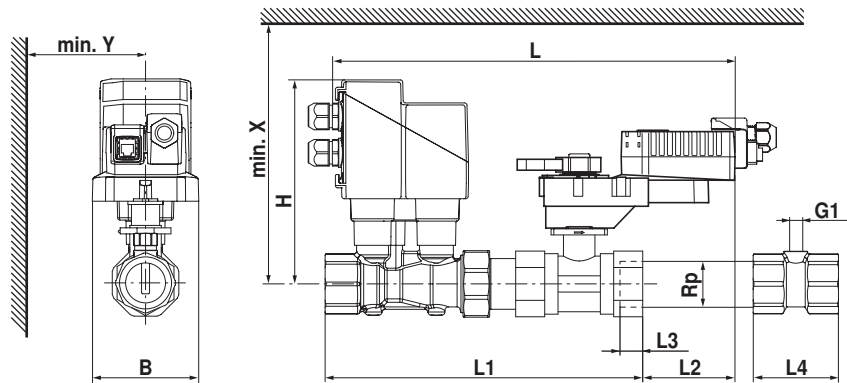$\dot{V}nom$ = 69 l/min
50% * 69 l/min = 34.5 l/min = 2.07 m³/h

$$\Delta p_{min} = 100 \times \left(\frac{\dot{V}_{max}}{k_{vs\ theor.}} \right)^2 = 100 \times \left(\frac{2.07\ m^3/h}{8.6\ m^3/h} \right)^2 = 6\ kPa$$

Characterised control valve (CCV) with sensor-operated flow rate or power control, power and energy-monitoring function, 2-way, internal thread (Energy Valve), with emergency control function

BELIMO®

Dimensions / Weight

Dimensional drawings

Type	DN	Rp	L	L1	L2	L3	B	H	G1	L4
	[ ]	[“]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]
EV015R+KBAC	15	1/2	331	192	128	13	75	160	G1/4”	53
EV020R+KBAC	20	3/4	348	211	123	14	75	162	G1/4”	57
EV025R+KBAC	25	1	344	230	116	16	75	165	G1/4”	65
EV032R+KBAC	32	1 1/4	359	255	110	19	75	168	G1/4”	71
EV040R+KBAC	40	1 1/2	361	267	106	19	75	172	G1/4”	71
EV050R+KBAC	50	2	381	288	100	22	75	177	G1/4”	80

Type	X	Y	Weight approx.
	[mm]	[mm]	[kg]
EV015R+KBAC	230	77	1.6
EV020R+KBAC	232	77	1.9
EV025R+KBAC	235	77	2.1
EV032R+KBAC	238	77	2.9
EV040R+KBAC	242	77	3.4
EV050R+KBAC	247	77	5.0

Further documentation

- Overview MP Cooperation Partners
- Tool Connection Guide
- General notes for project planning
- Instruction Webserver Belimo Energy Valve
- Description Data-Pool Values
- Description Protocol Implementation Conformance Statement PICS