Characterised control valve with sensor-operated flow control, 2-way, Internal thread, PN 25 (EPIV)
- Nominal voltage AC/DC 24 V
- Control modulating, communicative
- For closed cold and warm water systems
- For modulating control of air-handling and heating systems on the water side
- Communication via Belimo MP-Bus or conventional control
- Conversion of active sensor signals and switching contacts

### Type overview

<table>
<thead>
<tr>
<th>Type</th>
<th>DN</th>
<th>Rp</th>
<th>V’nom</th>
<th>V’nom</th>
<th>V’nom</th>
<th>kvs theor.</th>
<th>PN</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP015R+MP</td>
<td>15</td>
<td>1/2</td>
<td>0.35</td>
<td>21</td>
<td>1.26</td>
<td>2.9</td>
<td>25</td>
</tr>
<tr>
<td>EP020R+MP</td>
<td>20</td>
<td>3/4</td>
<td>0.65</td>
<td>39</td>
<td>2.34</td>
<td>4.9</td>
<td>25</td>
</tr>
<tr>
<td>EP025R+MP</td>
<td>25</td>
<td>1</td>
<td>1.15</td>
<td>69</td>
<td>4.14</td>
<td>8.6</td>
<td>25</td>
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<tr>
<td>EP032R+MP</td>
<td>32</td>
<td>1 1/4</td>
<td>1.8</td>
<td>108</td>
<td>6.48</td>
<td>14.2</td>
<td>25</td>
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<tr>
<td>EP040R+MP</td>
<td>40</td>
<td>1 1/2</td>
<td>2.5</td>
<td>150</td>
<td>9</td>
<td>21.3</td>
<td>25</td>
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<tr>
<td>EP050R+MP</td>
<td>50</td>
<td>2</td>
<td>4.8</td>
<td>288</td>
<td>17.28</td>
<td>32.0</td>
<td>25</td>
</tr>
</tbody>
</table>

**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: 3.5 W (DN 15...25), 4.5 W (DN 32...50)
- Power consumption in rest position: 1.3 W (DN 15...25), 1.4 W (DN 32...50)
- Power consumption for wire sizing: 6 VA (DN 15...25), 7 VA (DN 32...50)
- Connection supply / control: Cable 1 m, 4 x 0.75 mm²
- Parallel operation: Yes (note the performance data)

#### Functional data
- Torque motor: 5Nm (DN 15...25), 10Nm (DN 32...40), 20Nm (DN 50)
- Communicative control: MP-Bus
- Operating range Y: 2...10 V
- Input Impedance: 100 kΩ
- Operating range Y variable: Start point 0.5...24 V, End point 8.5...32 V
- Options positioning signal: Modulating (DC 0...32 V)
- Position feedback U: 2...10 V
- Position feedback U note: Max. 1 mA
- Position feedback U variable: Start point 0.5...8 V, End point 2...10 V
- Sound power level Motor: 45 dB(A)
- Adjustable flow rate V’max: 30...100% of Vnom
- Control accuracy: ±5% (of 25...100% V’nom) @ 20°C / Glycol 0% vol.
- Control accuracy note: ±10% (of 25...100% V’nom) @ -10...120°C / Glycol 0...50% vol.
- Min. controllable flow: 1% of V’nom
- Fluid: Cold and warm water, water with glycol up to max. 50% vol.
- Fluid temperature: -10...120°C
- Fluid temperature note: At a fluid temperature of -10...2°C, a stem heating or a valve neck extension is recommended.

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Functional data
- Close-off pressure $\Delta p_{\text{fs}}$: 1400 kPa
- Differential pressure $\Delta p_{\text{max}}$: 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: air-bubble tight, leakage rate A (EN 12266-1)
- Pipe connection: Internal thread according to ISO 7-1
- Installation position: upright to horizontal (in relation to the stem)
- Servicing: maintenance-free
- Manual override: with push-button, can be locked

Flow measurement
- Measuring principle: Ultrasonic volumetric flow measurement
- Measuring accuracy flow: ±2% (of 25...100% $V'_{\text{nom}}$) @ 20°C / Glycol 0% vol.
- Measuring accuracy flow note: ±6% (of 25...100% $V'_{\text{nom}}$) @ -10...120°C / Glycol 0...50% vol.
- Min. flow measurement: 0.5% of $V'_{\text{nom}}$

Safety
- Protection class: IEC/EN III Safety Extra-Low Voltage (SELV)
- Degree of protection: IEC/EN IP54
- EMC: CE according to 2014/30/EU
- Mode of operation: Type 1
- Rated impulse voltage supply / control: 0.8 kV
- Control pollution degree: 3
- Ambient temperature: -30...50°C
- Storage temperature: -40...80°C
- Ambient humidity: Max. 95% r.H., non-condensing

Materials
- Flow measuring pipe: Brass body nickel-plated
- Closing element: Stainless steel
- Stem seal: EPDM O-ring

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.
- Outdoor application: only possible in case that no (sea) water, snow, ice, insolation or aggressive gases interfere directly with the actuator and that is ensured that the ambient conditions remain at any time within the thresholds according to the data sheet.
- Only authorised specialists may carry out installation. All applicable legal or institutional installation regulations must be complied during installation.
- 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.

Product features
Mode of operation
The HVAC performance device is comprised of three components: characterised control valve (CCV), measuring pipe with volumetric flow sensor and the actuator itself. The adjusted maximum flow ($V'_{\text{max}}$) is assigned to the maximum positioning signal (typically 10 V / 100%). The final controlling device can be controlled communicative or analogue. The fluid 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 $\alpha$ varies according to the differential pressure through the final controlling element (see volumetric flow curves).
Transmission behaviour HE

Heat exchanger transmission behaviour
Depending on the construction, temperature spread, fluid characteristics and hydraulic circuit, the power $Q$ is not proportional to the water volumetric flow $V$ (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).
**Control characteristics**

The fluid velocity is measured in the measuring component (sensor electronics) and converted to a flow rate signal. The positioning signal $Y$ corresponds to the power $Q$ via the exchanger, the volumetric flow is regulated in the EPIV. The control signal $Y$ is converted into an equal-percentage characteristic curve and provided with the $V^{\text{max}}$ value as the new reference variable $w$. The momentary control deviation forms the positioning signal $Y_1$ for the actuator.

The specially configured control parameters in connection with the precise flow rate 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). As an alternative, $U_5$ can be used for displaying the valve opening angle. It is always in reference to the respective $V^{\text{nom}}$, i.e. if $V^{\text{max}}$ is e.g. 50% of $V^{\text{nom}}$, then $Y = 10 \text{ V}$, $U_5 = 5 \text{ V}$.

1. Standard equal percentage $V^{\text{max}} = V^{\text{nom}} / 2$. Effect $V^{\text{max}} < V^{\text{nom}}$

Block diagram
**Product features**

**Definition**
Flow control

V’nom is the maximum possible flow.

V’max is the maximum flow rate which has been set with the greatest positioning signal. V’max can be set between 30% and 100% of V’nom.

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**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 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 V’nom. Once the level falls below this value, the flow rate is maintained at 1% of V’nom. If the level falls below the flow rate of 0.5% of V’nom required by the reference variable Y, then the valve will close.

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**Converter for sensors**
Connection option for a sensor (active sensor or switching contact). The MP actuator serves as an analogue/digital converter for the transmission of the sensor signal via MP-Bus to the higher level system.

**Parametrisable actuators**
The factory settings cover the most common applications. Single parameters can be modified with the Belimo Service Tools MFT-P or ZTH EU.

**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 V’max, and the valve is closed at a positioning signal of 100%.

**Hydraulic balancing**
With the Belimo tools, the maximum flow rate (equivalent to 100% requirement) can be adjusted on-site, 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.

**Manual override**
Manual override with push-button possible (the gear is disengaged for as long as the button 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.
## Accessories

### Gateways

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gateway MP zu BACnet MS/TP</td>
<td>UK24BAC</td>
</tr>
<tr>
<td>Gateway MP to Modbus RTU</td>
<td>UK24MOD</td>
</tr>
<tr>
<td>Gateway MP to KNX</td>
<td>UK24EIB</td>
</tr>
</tbody>
</table>

### Electrical accessories

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection cable 5 m, A: RJ11 6/4 ZTH EU, B: 6-pin for connection to</td>
<td>ZK1-GEN</td>
</tr>
<tr>
<td>service socket</td>
<td></td>
</tr>
<tr>
<td>Connection cable 5 m, A: RJ11 6/4 ZTH EU, B: free wire end for connection</td>
<td>ZK2-GEN</td>
</tr>
<tr>
<td>to MP/PP terminal</td>
<td></td>
</tr>
<tr>
<td>Connecting board MP-Bus for wiring boxes EXT-WR-FP...-MP</td>
<td>ZFP2-MP</td>
</tr>
<tr>
<td>MP-Bus power supply for MP actuators</td>
<td>ZN230-24MP</td>
</tr>
</tbody>
</table>

### Mechanical accessories

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe connector for ball valve DN 15 Rp 1/2”</td>
<td>ZR2315</td>
</tr>
<tr>
<td>Pipe connector for ball valve DN 20 Rp 3/4”</td>
<td>ZR2320</td>
</tr>
<tr>
<td>Pipe connector for ball valve DN 25 Rp 1”</td>
<td>ZR2325</td>
</tr>
<tr>
<td>Pipe connector for ball valve DN 32 Rp 1 1/4”</td>
<td>ZR2332</td>
</tr>
<tr>
<td>Pipe connector for ball valve DN 40 Rp 1 1/2”</td>
<td>ZR2340</td>
</tr>
<tr>
<td>Pipe connector for ball valve DN 50 Rp 2”</td>
<td>ZR2350</td>
</tr>
<tr>
<td>Valve neck extension for ball valve DN15…50</td>
<td>ZR-EXT-01</td>
</tr>
</tbody>
</table>

### Service Tools

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Tool, with ZIP-USB function, for parametrisable and communicative</td>
<td>ZTH EU</td>
</tr>
<tr>
<td>Belimo actuators / VAV controller and HVAC performance devices</td>
<td></td>
</tr>
<tr>
<td>Belimo PC-Tool, Software for adjustments and diagnostics</td>
<td>MFT-P</td>
</tr>
<tr>
<td>Adapter for Service-Tool ZTH</td>
<td>MFT-C</td>
</tr>
</tbody>
</table>

## Electrical installation

### Notes

- Connection via safety isolating transformer.
- Parallel connection of other actuators possible. Observe the performance data.

### Wiring diagrams

#### AC/DC 24 V, modulating

![Wiring diagram for AC/DC 24 V, modulating]

Cable colours:

1 = black
2 = red
3 = white
5 = orange

#### Operation on the MP-Bus

![Wiring diagram for Operation on the MP-Bus]

Cable colours:

1 = black
2 = red
3 = white
5 = orange
Functions when operated on MP-Bus

Connection on the MP-Bus

[Diagram showing connection on the MP-Bus]

MP-Bus Network topology

[Diagram showing network topology]

There are no restrictions for the network topology (star, ring, tree or mixed forms are permitted).
Supply and communication in one and the same 3-wire cable
• no shielding or twisting necessary
• no terminating resistors required

Connection of active sensors

[Diagram showing connection of active sensors]

Connection of external switching contact

[Diagram showing connection of external switching contact]

Functions for devices with specific parameters (Parametrisation necessary)

Override control and limiting with AC 24 V with relay contacts

[Diagram showing override control and limiting with AC 24 V]

Override control and limiting with DC 24 V with relay contacts

[Diagram showing override control and limiting with DC 24 V]

Control 3-point

[Diagram showing control 3-point]

Position control: 90° = 100s
Flow control: Vmax = 100s

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Operating controls and indicators

2 Push-button and LED display green
- Off: No power supply or malfunction
- On: In operation
- Press button: Triggers angle of rotation adaptation, followed by standard mode

3 Push-button and LED display yellow
- Off: Standard mode without MP bus
- Flickering: MP communication active
- On: Adaptation or synchronising process active
- Press button: Confirmation of the addressing

4 Gear disengagement button
- Press button: Gear disengages, motor stops, manual override possible
- Release button: Gear engages, synchronisation starts, followed by standard mode

5 Service plug
- For connecting parameterisation and service tools

Check power supply connection
- 2 Off and 3 On Possible wiring error in power supply

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 a suitable strainer is recommended.

Servicing
Ball valves, rotary actuators and sensors are maintenance-free. Before any service work on the final controlling device is carried out, it is essential to isolate the rotary actuator from the power supply (by unplugging the electrical cable if necessary). Any pumps in the part of the piping system concerned must also be switched off and the appropriate slide valves closed (allow all components to cool down first if necessary and always 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 correctly reassembled in accordance with the instructions and the pipeline has been refilled by professionally trained personnel.

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.
Installation notes

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 flow sensor. Its dimensions should be at least 5x DN.

<table>
<thead>
<tr>
<th>DN</th>
<th>L min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>5 x 15 mm = 75 mm</td>
</tr>
<tr>
<td>20</td>
<td>5 x 20 mm = 100 mm</td>
</tr>
<tr>
<td>25</td>
<td>5 x 25 mm = 125 mm</td>
</tr>
<tr>
<td>32</td>
<td>5 x 32 mm = 160 mm</td>
</tr>
<tr>
<td>40</td>
<td>5 x 40 mm = 200 mm</td>
</tr>
<tr>
<td>50</td>
<td>5 x 50 mm = 250 mm</td>
</tr>
</tbody>
</table>

Split installation

The valve-actuator combination may be mounted separately from the flow sensor. The direction of flow must be observed.

General notes

Valve selection

The valve is determined using the maximum required flow rate V’max. A calculation of the kvs value is not required.

V’max = 30…100% of 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 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 V’max. Higher differential pressures are compensated for automatically by the valve.

Formula

\[ \Delta p_{\text{min}} = 100 \times \left( \frac{V'_{\text{max}}}{k\text{vs }_{\text{theor.}}} \right)^2 \]

\[ \Delta p_{\text{min}} : \text{kPa} \]

\[ V'_{\text{max}} : \text{m}^3/\text{h} \]

\[ k\text{vs }_{\text{theor.}} : \text{m}^3/\text{h} \]

Example (DN25 with the desired maximum flow rate = 50% Vnom)

EP025R+MP

kvs theor. = 8.6 m³/h

Vnom = 69 l/min

50% * 69 l/min = 34.5 l/min = 2.07 m³/h

\[ \Delta p_{\text{min}} = 100 \times \left( \frac{2.07 \text{ m}^3/\text{h}}{8.6 \text{ m}^3/\text{h}} \right)^2 = 6 \text{ kPa} \]

Behaviour with sensor failure

In case of a flow sensor error, the EPIV will switch from flow control to position control. Once the error disappears, the EPIV will switch back to the normal control setting.
Service

Service Tools connection

The actuator can be parametrised by ZTH EU via the service socket. For an extended parametrisation the PC tool can be connected.

Connection ZTH EU / PC-Tool

Dimensions / Weight

Dimensions drawings

<table>
<thead>
<tr>
<th>Type</th>
<th>DN</th>
<th>Rp</th>
<th>L</th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>B</th>
<th>H</th>
<th>X</th>
<th>Y</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td>EP015R+MP</td>
<td>15</td>
<td>1/2</td>
<td>275</td>
<td>192</td>
<td>81</td>
<td>13</td>
<td>75</td>
<td>125</td>
<td>195</td>
<td>77</td>
<td>1.4 kg</td>
</tr>
<tr>
<td>EP020R+MP</td>
<td>20</td>
<td>3/4</td>
<td>291</td>
<td>211</td>
<td>75</td>
<td>14</td>
<td>75</td>
<td>125</td>
<td>195</td>
<td>77</td>
<td>1.7 kg</td>
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<tr>
<td>EP025R+MP</td>
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<td>1</td>
<td>295</td>
<td>230</td>
<td>71</td>
<td>16</td>
<td>75</td>
<td>127</td>
<td>197</td>
<td>77</td>
<td>2.3 kg</td>
</tr>
<tr>
<td>EP032R+MP</td>
<td>32</td>
<td>1 1/4</td>
<td>323</td>
<td>255</td>
<td>68</td>
<td>19</td>
<td>85</td>
<td>131</td>
<td>201</td>
<td>77</td>
<td>2.6 kg</td>
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<tr>
<td>EP040R+MP</td>
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<td>1 1/2</td>
<td>325</td>
<td>267</td>
<td>65</td>
<td>19</td>
<td>85</td>
<td>141</td>
<td>211</td>
<td>77</td>
<td>3.4 kg</td>
</tr>
<tr>
<td>EP050R+MP</td>
<td>50</td>
<td>2</td>
<td>343</td>
<td>288</td>
<td>69</td>
<td>22</td>
<td>95</td>
<td>142</td>
<td>212</td>
<td>77</td>
<td>5.1 kg</td>
</tr>
</tbody>
</table>

Further documentation

- Overview MP Cooperation Partners
- Tool connections
- Introduction to MP-Bus Technology
- General notes for project planning