Product information

Differential pressure control with the Belimo Energy Valve^{TM}

Edition 2026-01/C

BELIMO

Table of contents

BELIMO

Electronic differential pressure control

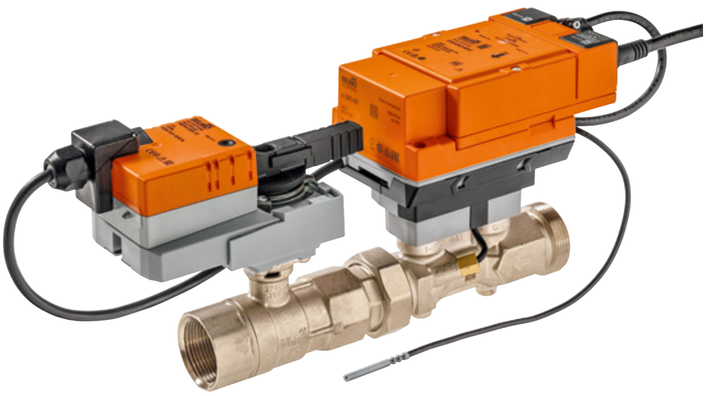
In addition to the control modes position control, flow control and power control, the Belimo Energy Valve™ can also be used as an electronic differential pressure controller. This document provides an overview of electronic differential pressure control. The product documentation of the Energy Valve and the differential pressure sensor used (e.g. data sheet) is also to be taken into account.

For differential pressure control in direct-to-chip cooling applications for data centers, visit belimo.com/datacenters or contact your local Belimo partner.

Products

The differential pressure control mode is available for the following devices with DN 15…50:

- EV..R2+BAC 2-way Belimo Energy Valve™
- EV..R2+KBAC 2-way Belimo Energy Valve™ with fail-safe
- EV..R2+MID 2-way Belimo Energy Valve™ with Thermal Energy Meter (MID/EN 1434)
- Other versions (e.g. IP66/67) upon request



Belimo Energy Valve™

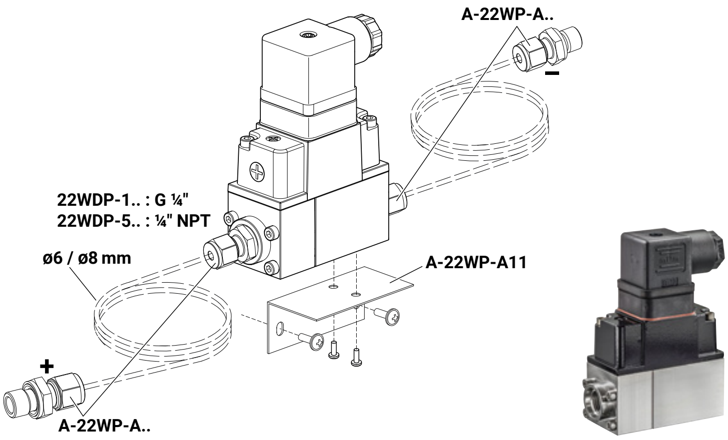
Accessories for the installation of the Energy Valve can be found in the respective product documentation.

Required components for differential pressure control

If the Energy Valve is used to control the differential pressure, a corresponding differential pressure sensor is needed. This is not included in the scope of delivery of the Energy Valve. The 22WDP-11.. and 22PDP-18.. differential pressure sensors are used for differential pressure control. They are available for various measuring ranges and can be obtained from Belimo.

Differential pressure sensor water 22WDP-11.. from Belimo

Active sensor (0...10 V) for differential pressure measurement in HVAC systems. The sensor is suitable for water and water-glycol mixtures. The housing is made of stainless steel and corresponds to IP65 / NEMA 4. This differential pressure sensor measures the differential pressure that is transferred to a diaphragm integrated in the sensor via two impulse lines (capillary tubes) installed onsite.



Differential pressure sensor water – 22WDP-11.. from Belimo

The specifications regarding accuracy and long-term stability listed in the data sheet of the 22WDP-11.. must be observed.

Differential pressure sensor water 22PDP-18.. from Belimo

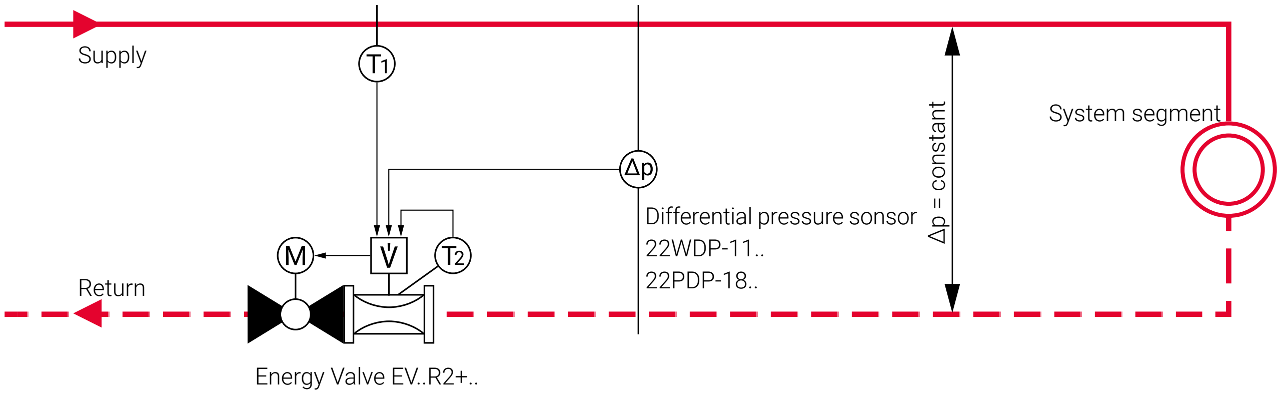
Active sensor (4...20 mA / 0...5 V / 0...10 V) for differential pressure measurement in HVAC systems. The sensor is suitable for water and water-glycol mixtures. IP65 / NEMA 4X rated housing with LCD display. The differential pressure sensor is equipped with two remote pressure transmitters made of stainless steel. They measure the static pressure at the two measuring points. The calculated differential pressure is output and is available as a measured value.

Differential pressure sensor water – 22PDP-18.. from Belimo

The specifications regarding accuracy and long-term stability listed in the data sheet of the 22PDP-18.. must be observed.

Mode of operation

The electronic differential pressure controller is used to maintain the differential pressure (dp) at a constant set value between two points in a hydronic circuit. In addition, it can be used as a flow rate and power limiter.



Differential pressure control with Energy Valve

In this control mode, the Energy Valve does not receive a setpoint from the building management system. The differential pressure sensor connected with the Energy Valve measures the current differential pressure. This value is read out of the Energy Valve and compared with the preset setpoint. If a deviation is detected between the measured value and the setpoint, this is compensated automatically by the logic integrated in the Energy Valve. To accomplish this, the opening angle of the characterised control valve integrated in the Energy Valve is either enlarged or reduced. The following three operating states can occur:

1. Effective differential pressure less than the differential pressure setpoint
To reduce the pressure drop across the Energy Valve and thus increase the differential pressure between the measuring points, the valve is opened further until the setpoint is reached. If the differential pressure on the system side is not sufficiently high, the setpoint may not be reached. In this case, the Energy Valve moves to the maximum opening position of 90°.

2. Effective differential pressure corresponds to the differential pressure setpoint
No action of the Energy Valve. The opening position is retained.

3. Effective differential pressure greater than the differential pressure setpoint
To reduce the differential pressure between the two measuring points, more pressure drop must be generated across the Energy Valve. In this case, the valve opening is reduced until the setpoint or minimum position is reached. The ball valve installed in the Energy Valve is never completely closed during standard differential pressure control mode in order to ensure that changes in the system (change in pump head or flow changes due to controlling consumer valves) can be detected.

For differential pressure control in direct-to-chip cooling applications for data centers, visit belimo.com/datacenters or contact your local Belimo partner.

Additional features

Thanks to the innovative concept involving measurement of the flow and the supply and return temperatures, the calculation of the currently delivered power and the logic integrated in the device, users have a wide range of additional features at their disposal.

Easily adjustable setpoint

The desired setpoint is simple to adjust on the device. Various options are available:

- Belimo Assistant 2, simple communication with the Energy Valve thanks to NFC
- Web server integrated in the Energy Valve, accessible via direct connection or through a network
- Belimo Cloud, value change from anywhere
- Communicative, value change via MP-Bus, Modbus or BACnet

Adjustable flow limitation

A maximum flow V'_{max} can be specified for the Energy Valve. Even if the effective differential pressure is below the setpoint, the Energy Valve does not open further when V'_{max} is reached. This makes it possible to avoid situations in which other parts of the hydronic system have too little energy at their disposal.

Flow limitation adjustment range: V'_{max} = 25...100% von V'_{nom}

Adjustable maximum power

A maximum power Q'_{max} can be specified for the Energy Valve. The valve position is not increased further when the set maximum heating or cooling power is reached. This setting can be used as a simple way to ensure that the controlled system segment is not able draw too much power.

Maximum power adjustment range: Q'_{max} = 1...100% Q'_{nom}

Sensor drift compensation

After a longer operating time, a drift can occur at the differential pressure sensor, which can be compensated for as follows:

1. Close the Energy Valve completely (web server, Belimo Assistant 2, manually)
2. The measured differential pressure is displayed (web server, Belimo Assistant 2)
3. Measure the existing differential pressure at the measuring points (additional system-side measurement connections necessary)
4. Calculate and enter the required offset (web server, Belimo Assistant 2)

Shut-off function

If necessary, the characterised control valve integrated in the Energy Valve can be closed completely (lever, web server (automatic reset after 2 hours), communicative override control). The characterised control valve ensures an air-bubble tight shut-off.

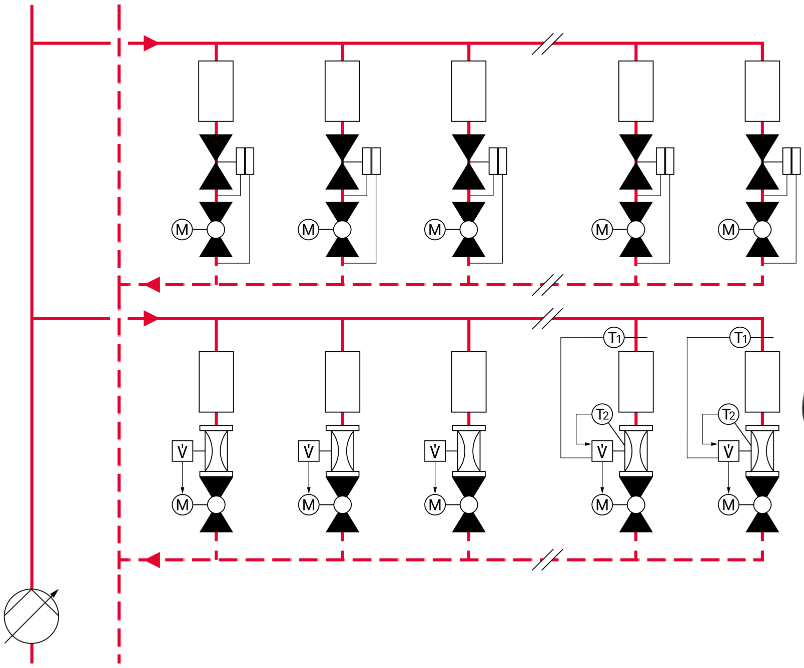
Purpose of use

The best results can be achieved by using a pressure-independent control valve at each consumer. In order to achieve BAC efficiency class "A" according to ISO 52120-1 in the BAC and TBM functions[1)]

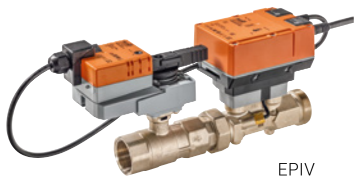
– 1.4.a Heat distribution with hydronic balancing
– 3.4.a Cold distribution with hydronic balancing

dynamic balancing for each emitter is needed.

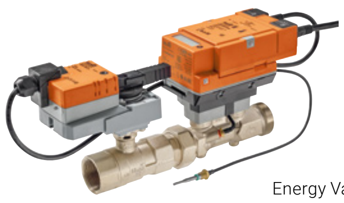
[1)] BAC: Building automation and control
TBM: Technical building management



PIQCV



EPIV

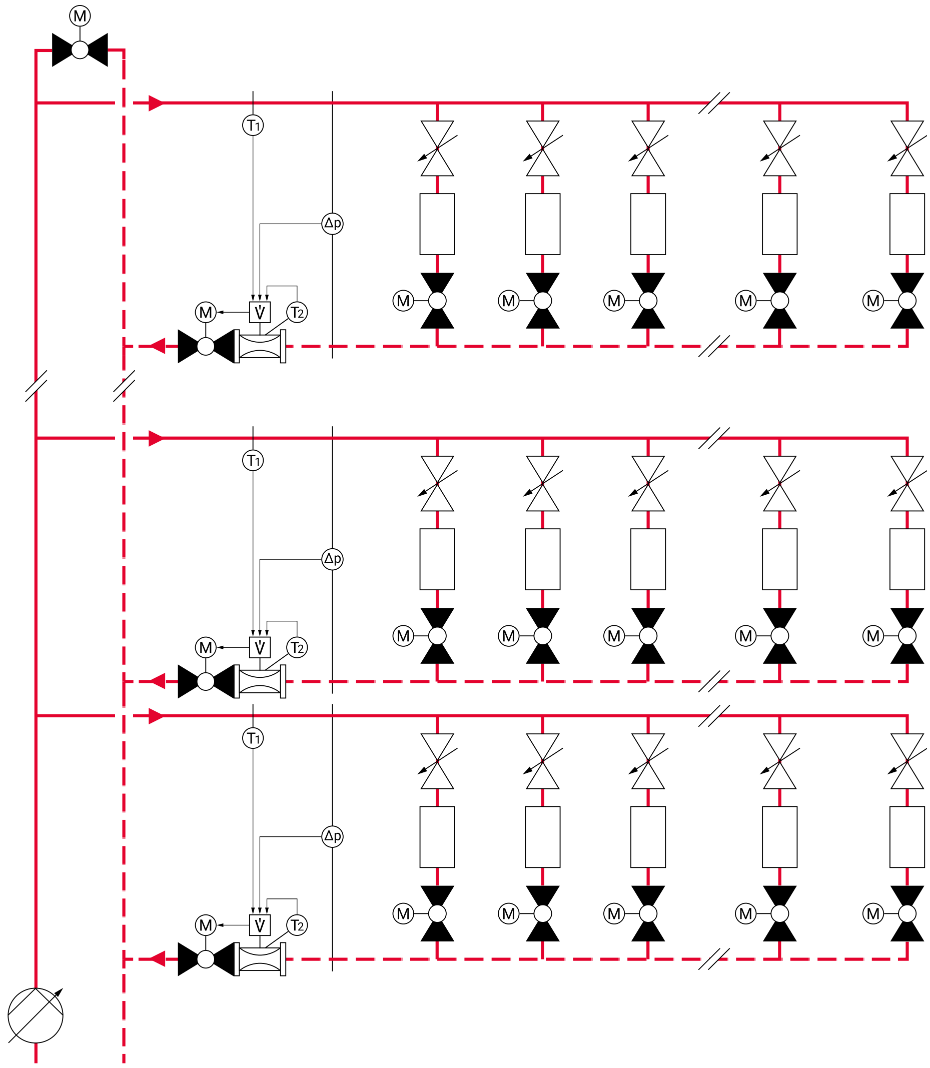


Energy Valve

Perfect pressure-independent control of the individual consumers with PIQCV, EPIV and Energy Valve

The differential pressure control function of the Energy Valve is not required in this application.

However, if the balancing at the individual consumers is only static (class "D"), the various system segments can be dynamically balanced against one another (class "C") by using additional Energy Valves with differential pressure control function. It should be noted that the mutual hydronic influence of the individual consumer branches within the system segment remains.



Dynamic balancing of the system segment (building floor) and static balancing of the consumers

Thanks to the flow measurement of the Energy Valve, the total quantity of water can be calculated and the control valve in the bypass can be controlled as required in order to ensure a minimum quantity of water (pump protection).

Advantages

Keeping the differential pressure in a system segment constant makes it possible to avoid flow noise due to excessive flow rates. Possible losses in comfort and energy wastage due to oversupply are also reduced.

System transparency

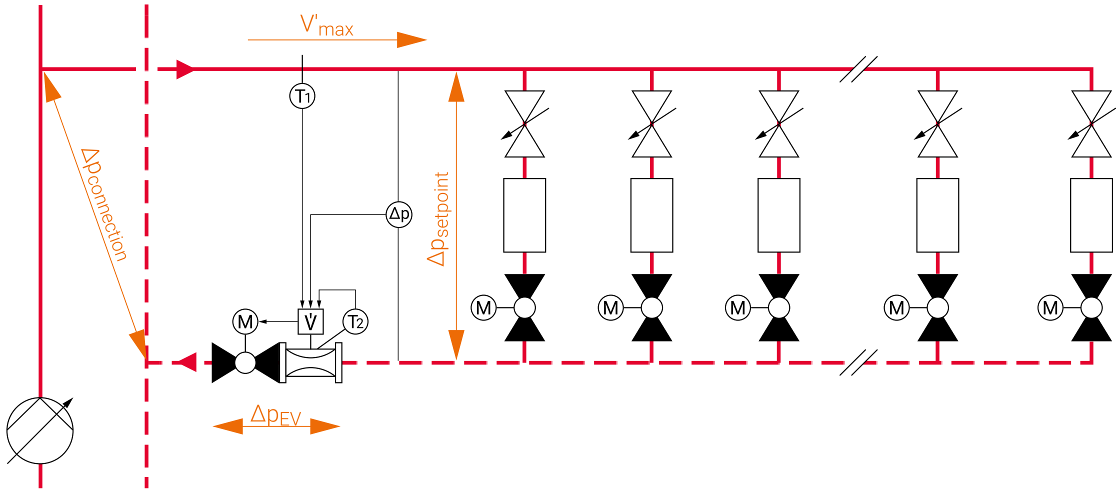
The flow and the supply and return temperature are measured in real time. This enables calculation of current power output and current energy consumption. The Energy Valve thus contributes to system transparency. The saved and readily accessible information (Belimo Assistant 2, web server, Belimo Cloud) enables evaluation and optimisation of the hydronic system. The transparency achieved also greatly simplifies troubleshooting in the hydronic system.

Additional benefits over conventional mechanical differential pressure controllers are achieved by using the electronic differential pressure controller design:

- Eliminates the need to find and adjust the setting position on the differential pressure controller; simple, direct setpoint input
- No access to the differential pressure controller required to change the setpoint; setpoint change possible via MP-Bus, Modbus, BACnet or Belimo Cloud
- No measuring computer required to measure system values; permanent measurement of differential pressure, flow and fluid temperatures and easy data access via communicative interface, Belimo Assistant 2, web server or Belimo Cloud

Sizing

As described in the chapter Functionality, the Energy Valve in differential pressure control mode adjusts its hydronic resistance by changing the valve opening so that the pressure drop across the Energy Valve occurs that is required to achieve the desired differential pressure between the measuring points.



To select a suitable Energy Valve, the required K_V value must be calculated. The sizing is made for nominal flow.

Required specifications:

– Nominal flow V'_{max} in the system segment

– Desired differential pressure $dp_{setpoint}$ between the measuring points

– System differential pressure $dp_{connection}$ between the connection points of the system segment

1. Calculation of the necessary pressure drop across the Energy Valve
   – $dp_{EV} = dp_{connection} - dp_{setpoint}$
   Note: If additional high pressure losses occur between $dp_{connection}$ and $dp_{setpoint}$ (e.g. long pipeline), these must also be taken into account

2. Calculation of the necessary flow coefficient of the Energy Valve K_{vEV}

$$K_{vEV} = \frac{V'_{max}}{\sqrt{\frac{\Delta p_{EV}}{100}}}$$

K_{vEV} [m³/h] / V'_{max} [m³/h] / Δp_{EV} [kPa]

3. Selection of the Energy Valve
   – The previously calculated K_{vEV} must be less than the $K_{vtheor.}$ of the selected type

$K_{vtheor.}$ and V'_{max} for differential pressure control with Energy Valve

Valve type	DN	$K_{vtheor.}$ [m³/h]	V'_{max} *) [l/s]	V'_{max} *) [m³/h]
EV015R2+..	15	3.2	0.105...0.42	0.375...1.5
EV020R2+..	20	5.3	0.173...0.69	0.625...2.5
EV025R2+..	25	8.8	0.243...0.97	0.875...3.5
EV032R2+..	32	14.1	0.418...1.67	1.5...6
EV040R2+..	40	19.2	0.695...2.78	2.5...10
EV050R2+..	50	30.4	1.043...4.17	3.75...15

*) Flow limitation adjustment range

For the best possible control capability, the smallest possible nominal diameter should be selected. V'_{max} must also be considered.

Example: V'_{max} = 9.3 m³/h
$\Delta p_{setpoint}$ = 45 kPa
$\Delta p_{connection}$ = 110 kPa

1. $\Delta p_{EV} = \Delta p_{connection} - \Delta p_{setpoint}$ = 110 kPa – 45 kPa = 65 kPa

2.
$$K_{vEV} = \frac{V'_{max}}{\sqrt{\frac{\Delta p_{EV}}{100}}} = \frac{9.3\ m^3/h}{\sqrt{\frac{65\ kPa}{100}}} = \mathbf{11.5\ m^3/h}$$

3. Selection **EV040R2+..** ($K_{vtheor.}$ = 19.2 m³/h / V'_{max} = 2.5...10 m³/h)

Operating range

In differential pressure control mode, the Energy Valve automatically changes its opening position to achieve the pressure drop required to reach the desired differential pressure setpoint. The flow that occurs is specified by the system segment supplied. The following limitations must be taken into account:

Maximum flow

– The specified V'_{nom} value of the Energy Valve must not be exceeded

V'_{nom} Energy Valve

Valve type	DN	V'_{nom}*) [l/s]	V'_{nom}*) [m³/h]
EV015R2+..	15	0.42	1.5
EV020R2+..	20	0.69	2.5
EV025R2+..	25	0.97	3.5
EV032R2+..	32	1.67	6
EV040R2+..	40	2.78	10
EV050R2+..	50	4.17	15

*) Flow limitation adjustment range

– Maximum flow at which $dp_{setpoint}$ is reached:

$$\text{max. } V' = K_{vtheor.} \cdot \sqrt{\frac{\Delta p_{EV}}{100}}$$

Minimum flow with flow reduction

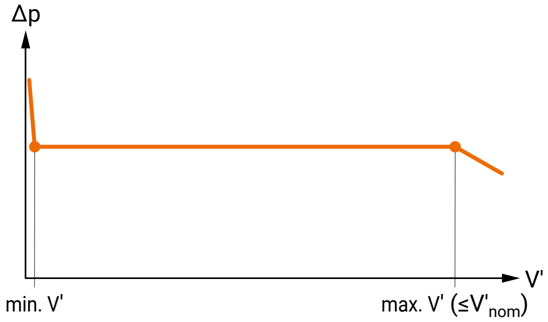
– Reduction of the flow through the control valves in the system segment
– Differential pressure control is carried out up to a minimum flow of 0.7% V'_{nom}

Behaviour when the minimum flow is undercut

– The position of the angle reached at 0.7% of V'_{nom} is retained ("freeze position")

Start-up behaviour after the flow has fallen below the minimum flow

Differential pressure control mode is resumed when a differential pressure is present and one of the following conditions is met:
– The measured flow is higher than 1.2% V'_{nom}
or
– The measured differential pressure is less than 50% of the differential pressure setpoint and a flow of at least 0.2% V'_{nom} is detected



Differential pressure control operating range

Note:
– In differential pressure control mode, the valve is never completely closed
– Instead of the "freeze position" described above, an actuator position of 27% is approached as the starting position for the control mode in the following situations:
  – The valve has been restarted
  – After a voltage interruption
  – The manual override was previously operated
  – Switching from another control mode (e.g. flow control) to differential pressure control mode
  – No differential pressure is present at a flow <0.7% V'_{nom}
– If the flow cannot be measured due to a malfunction in the flow sensor or due to air bubbles in the system, the differential pressure is controlled within the valve opening range from 27% to 100%
– The actuator switches from actuator position 27% to control mode if a differential pressure is present and one of the following conditions is met (both for at least 30 seconds):
  – The measured flow is higher than 0.7% V'_{nom}
  or
  – The measured differential pressure is less than 50% of the differential pressure setpoint and a flow of at least 0.2% V'_{nom} is detected

Differential pressure sensor selection

The following differential pressure sensors can be used:
– Differential pressure sensor 22WDP-11.. from Belimo
– Differential pressure sensor 22PDP-18.. from Belimo

The specifications in the respective sensor data sheets are to be observed. The desired setpoint must be within the possible adjustment range. It is recommended to use a differential pressure sensor with a maximum setpoint that does not deviate too strongly from the desired setpoint. The dead band used must be observed.

For differential pressure control in direct-to-chip cooling applications for data centers, visit belimo.com/datacenters or contact your local Belimo partner.

Selection 22WDP-11..

	Differential pressure sensor specification					
Sensor type	**Measuring range [kPa]**	**Overpressure [kPa]**	**Burst pressure [kPa]**	**Fluid temperature [°C]**	**Possible adjustment range differential pressure setpoint Energy Valve [kPa]**	**Dead band differential pressure control [kPa]**
22WDP-111	0...100	600	2100	−10...80	10...80	+/−4
22WDP-112	0...250	600	2100	−10...80	25...200	+/−10
22WDP-114	0...400	1600	2100	−10...80	40...320	+/−16
22WDP-115	0...600	1600	2100	−10...80	60...400	+/−16

Selection 22PDP-18..

	Differential pressure sensor specification					
Sensor type	**Measuring range [kPa]**	**Permissible operating pressure [kPa]**	**Overpressure [kPa]**	**Burst pressure [kPa]**	**Fluid temperature [°C]**	**Possible adjustment range differential pressure setpointEnergy Valve [kPa]**
22PDP-185	0...500	500	1000	10000	−40...105	10...400
22PDP-186	0...1000	1000	2000	20000	−40...105	10...400
22PDP-189	0...3500	3500	7000	70000	−40...105	28...400

Minimum permissible fluid temperature Energy Valve: −10°C
Maximum permissible operating pressure Energy Valve: 1600 kPa

The measuring range and the differential pressure setpoint that is adjustable on the Energy Valve are dependent in the case of sensor type 22PDP-18.. on the setting that is selected on the differential pressure sensor.

	Possible adjustment range differential pressure setpoint Energy Valve [kPa]			
Sensor type	**Setting Range 1**	**Setting Range 2**	**Setting Range 3**	**Setting Range 4**
22PDP-185	40...400	20...200	10...80	10...40
22PDP-186	–	40...400	16...160	10...80
22PDP-189	–	–	40...400	28...280

	Dead band differential pressure control [kPa]			
Sensor type	**Setting Range 1**	**Setting Range 2**	**Setting Range 3**	**Setting Range 4**
22PDP-185	+/– 16	+/– 10	+/– 4	+/– 4
22PDP-186	–	+/– 16	+/– 8	+/– 4
22PDP-189	–	–	+/– 16	+/– 14

Integration

In differential pressure control mode, the Energy Valve is operated as a stand-alone device without external control signal. Nonetheless, it can be integrated to enable simple access via communicative interface to all operating data and measured values or easily adjust the setpoint. The following communicative interfaces are available in every Energy Valve EV..R2+..:

- MP-Bus
- Modbus TCP, Modbus RTU
- BACnet/IP, BACnet MS/TP

Information regarding communicative integration can be found in the following documents:

- Data sheet Energy Valve
- Installation instructions Energy Valve
- MP-Bus Data-Pool Values
- Modbus interface description
- BACnet interface description

In addition to the communicative interface, the analogue feedback signal U can be used to display **one** of the following measured values:

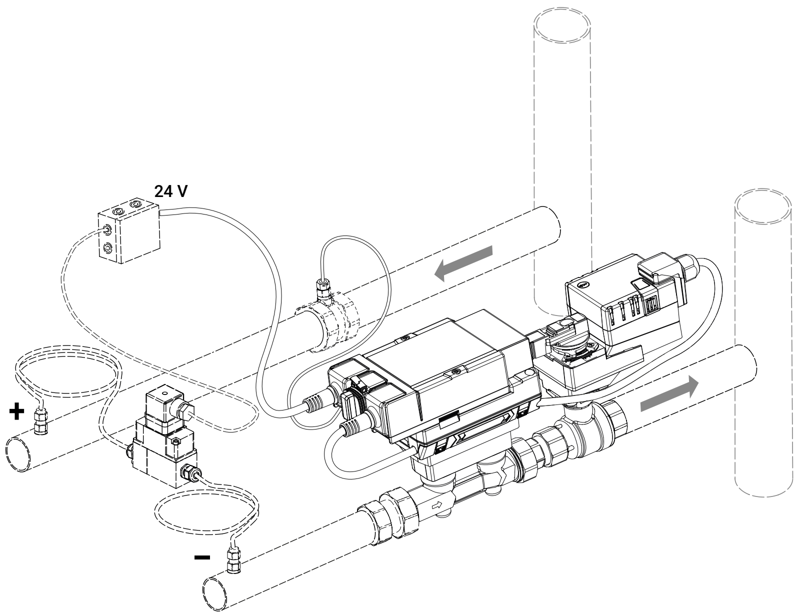
- Differential pressure
- Heating/cooling power [1)]
- Flow
- Actuator position
- Supply temperature
- Return temperature
- Differential temperature

[1)] of the connected system segment

Installation

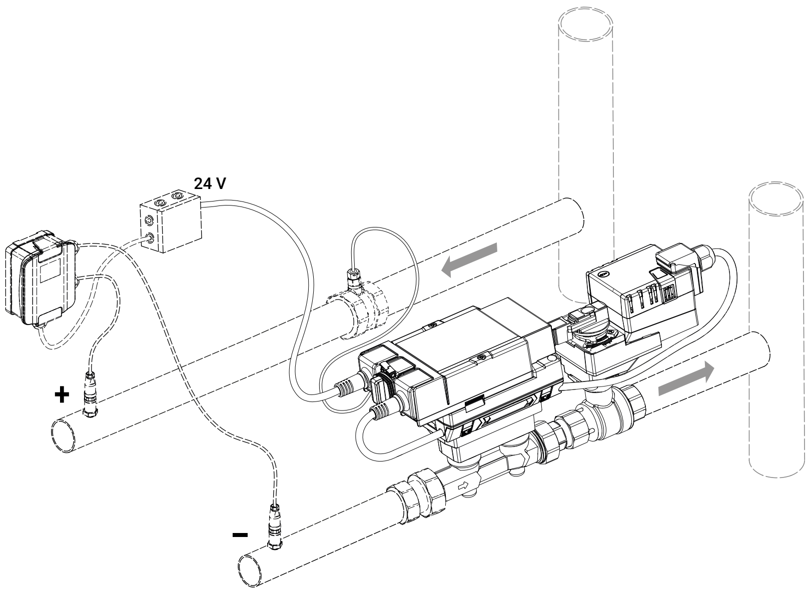
When installing the differential pressure sensor, the corresponding installation instructions are to be observed. The connection of the differential pressure sensor is described in the installation instructions for the Energy Valve.

Installation 22WDP-11..



Installation 22WDP-11..

Installation 22PDP-18..

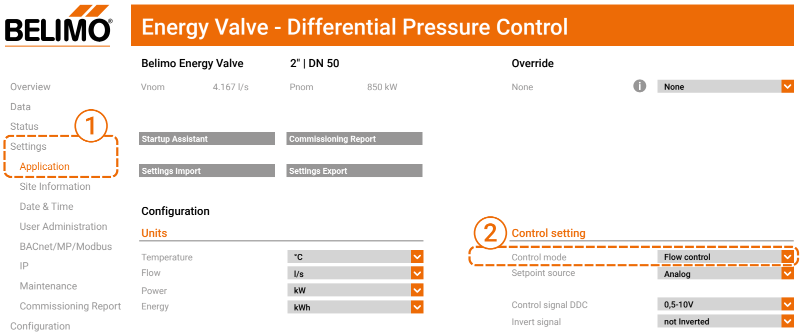


Installation 22PDP-18..

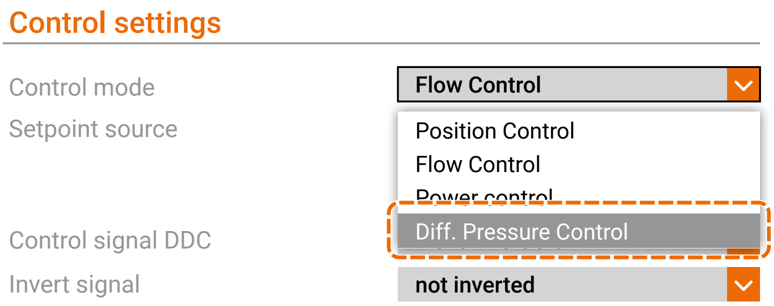
Commissioning / Configuration

Commissioning / Configuration with the web server

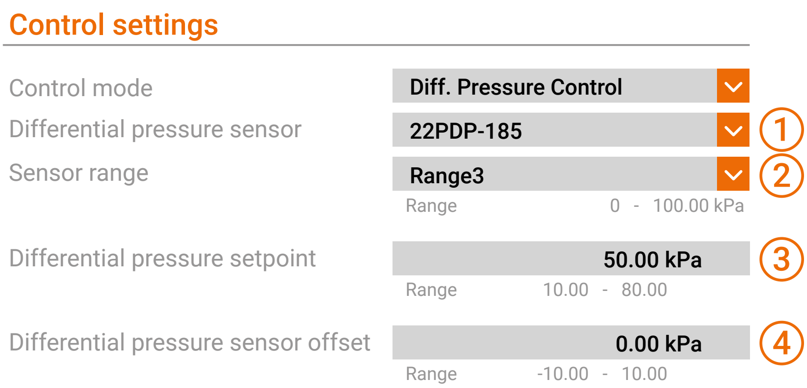
Detailed information regarding the web server can be found in the *Web Server instructions – Belimo Energy Valve™ / Thermal Energy Meter* document. The specific settings for differential pressure control are described in the following.



Web server – changing the control mode (step 1)

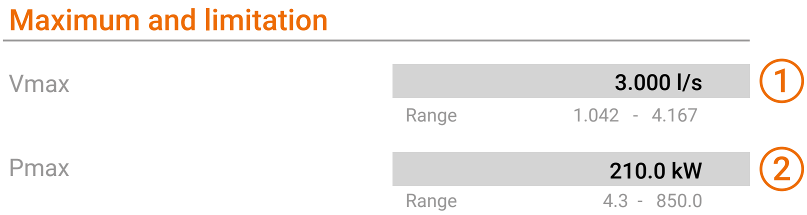


Web server – changing the control mode (step 2)



Web server – differential pressure control setting

1. Selection of the installed differential presure sensor
2. Selection of ranges 1 to 4 for the measuring range set on the 22PDP-18.. (this selection option is not available with the 22WDP-11..)
3. Adjustment of the desired differential pressure setpoint
4. Possibility of correcting sensor drift



Web server – limitation function setting

1. Definition of the maximum flow V'_{max}
   - When the set V'_{max} value is reached, the differential pressure is not increased any further, even if the setpoint has not yet been reached
   - Factory setting $V'_{max} = V'_{nom}$
2. Definition of the maximum heating/cooling power P'_{max} in the corresponding system segment
   - When the maximum power is reached, the differential pressure is not increased any further, even if it falls below the setpoint
   - Factory setting $P'_{max} = P'_{nom}$

If no specific limitations are required, no settings need to be made here.

Commissioning / Configuration with Belimo Assistant 2

The above settings can also be made quickly and intuitively using Belimo Assistant 2.

Configuration with MP-Bus, Modbus or BACnet

The settings can be changed via bus using the corresponding data points.

Configuration via Belimo Cloud

For devices connected to the Belimo Cloud, settings can be made from any location.

Restrictions

- Note that the delta T manager is not available in differential pressure control mode
- Specially configured control parameters ensure stable control quality. However, they are not designed for rapid control processes, i.e. domestic water control
- Series connection of the electronic differential pressure controller with other electronic pressure-independent control valves in flow control or power control is not recommended

All inclusive.

Belimo is the global market leader in the development, production, and sales of field devices for the energy-efficient control of heating, ventilation and air-conditioning systems. The focus of our core business is on damper actuators, control valves, sensors and meters.

Always focusing on customer value, we deliver more than only products. We offer you the complete product range for the regulation and control of HVAC systems from a single source. At the same time, we rely on tested Swiss quality with a five-year warranty. Our worldwide representatives in over 80 countries guarantee short delivery times and comprehensive support through the entire product life. Belimo does indeed include everything.

The “small” Belimo devices have a big impact on comfort, energy efficiency, safety, installation and maintenance.

In short: Small devices, big impact.

- 5-year warranty
- On site around the globe
- Complete product range
- Tested quality
- Short delivery times
- Comprehensive support

EN – 2026-01/C – Subject to technical modifications

BELIMO Automation AG
Brunnenbachstrasse 1, 8340 Hinwil, Switzerland
+41 43 843 61 11, info@belimo.ch, www.belimo.com

BELIMO®