BELIMO VAV-Control
for pressure independent volume control

In co-operation with the Original Equipment Manufacturers BELIMO offers:

- Standard velocity control, ex-stock for single and dual duct systems with varying air quantities.
- Wide control range for variable or constant volume with high precision and stability. Independent of system pressure fluctuations.
- Simple adjustment of the desired volume.
- No room pressure problems because of accurate sequence control of supply and exhaust air.
- Parallel running of various controllers with different control ranges is possible.
- Can be controlled by all commonly used temperature controllers with 0...10 V DC or 0...20 V phase cut signals.
- Compatible with building automation systems.
- Output signal indicating actual volume.
- Override control ('closed'; \( V_{\min} ; V_{\max} \)) by the use of on-off interlocks e.g. for morning warm-up.
- Low maintenance system with high life expectancy.

Manufacturers who offer the BELIMO VAV-Control system:
BELIMO VAV-Control system

The BELIMO VAV-Control system is a control device for air velocity control. The actual value sensed by the velocity sensor is compared with the set value entered by the operator. The deviation of both values is the basis for the control action of the controller. It is also the basis for the control action of the damper actuator. The actual value measured by the pressure sensor is compared with the set value entered at the front panel. The deviation of both values is the basis for the control action of the controller. The actual value measured by the temperature sensor is compared with the set value entered at the front panel. The deviation of both values is the basis for the control action of the controller. The controller can be reset between the preset limits.

Selection

BELIMO VAV-Control has to be installed and adjusted by the VAV box manufacturer. The O.E.M. guarantees the optimal functioning of the control package i.e.

- Velocity sensor
- Right measuring position
- Mechanical and electrical adjustment of measurement during commissioning
- Adjustment of the nominal value
- Adjustment of the control range
- Controller
- Calibration of the nominal value
- Adjustment of the control range
- Adjustment of the control range
- Damper actuator
- Selection of right actuator type
- Pressure transducer
- Selection of control range
- Controller
- Controller
- Controller
- Controller
- By using the BELIMO VAV-Control, the O.E.M. is able to manufacture a standard VAV box which can be used for all types of applications.

Example of a Selection Diagram

Example: Wanted: VAV box for a max. volume

V_{\text{max}} = 1100 m^3/h

V_{\text{min}} = 450 m^3/h

Selection:

- Type A adjustment: \( V_{\text{max}} = 50 \%
- Type B adjustment: \( V_{\text{max}} = 40 \%

The adjustment of \( V_{\text{min}} \) is always a percentage of the adjusted \( V_{\text{max}} \).

\[ V_{\text{min}} = \frac{V_{\text{min}}}{V_{\text{max}}} \times 100 \%
\]

For type B & C: \( V_{\text{min}} = 41 \%

Products no longer available
Technical data

Controller VR1 with velocity sensor

<table>
<thead>
<tr>
<th>Power supply</th>
<th>24 VAC + 15% – 10% (50…60 Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power consumption</td>
<td>2.5 W</td>
</tr>
<tr>
<td>Electrical connections</td>
<td>terminals</td>
</tr>
<tr>
<td>Control signal</td>
<td>terminal 3, terminal 4</td>
</tr>
<tr>
<td>Input impedance</td>
<td>100 kΩ, 8 kΩ</td>
</tr>
<tr>
<td>Operational range (V_{min}–V_{max})</td>
<td>1.5…9.5 VDC, 2…10 V phase cut</td>
</tr>
<tr>
<td>Control power</td>
<td>1 mW, 50 mW</td>
</tr>
<tr>
<td>Adjustment ranges V_{min}</td>
<td>30…100% of nominal value</td>
</tr>
<tr>
<td>V_{max}</td>
<td>0…80% of V_{max} setting</td>
</tr>
<tr>
<td>Output signal</td>
<td>1.5…9.5 VDC (≠ 0…100% V_{nominal})</td>
</tr>
<tr>
<td>Method of protection</td>
<td>IP42 (in accordance with European standards)</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>0…50°C (32…122°F)</td>
</tr>
</tbody>
</table>

Velocity sensor

| Measuring range           | 0.3…15 m/s (60…2950 ft/min) |
| Accuracy                  | ±3% of the velocity corresponding to the nominal air volume |
| Time constant             | < 5 s                        |
| Temperature compensation  | 10…40°C (50…104°F)           |

Damper actuator SM 24-I

| Power supply              | 24 VAC ± 20% (50…60 Hz) |
| Control signal            | from controller VR       |
| Power consumption         | 2 W                      |
| Cable / transformer       | 6 kV                     |
| Torque at rated voltage   | min 10 Nm, min 2 Nm      |
| Method of protection      | IP 54, IP 40             |
| Suppression level         | VDE level N              |
| Direction of rotation     | reversible with switch A/B |
| Sound power level         | max. 40 dB (A)           |
| Running time < 90°        | approx 200 s             |

Actual value output for indication and exhaust air control

BELIMO VAV-Control controllers have an output for the actual value signal which can be employed for:

- showing the air flow on a direct-reading instrument
- as a control signal for controlling the exhaust air
- as feedback in a computerised control and supervisory system

The output signal is a minimum (1.5 VDC) when the air velocity is 0 and a maximum (9.5 VDC) at the nominal air velocity.

The control signal and the change in the operational range of the controller have no influence on the actual value signal.

Constant Volume-Control V_{min}

![Diagram of Constant Volume-Control V_{min}]

Parallel connection of several motors is possible.

With a 24 VAC supply only to the VR1, the VAV-Control system maintains the volume, which is adjustable at the V_{min} potentiometer.

Constant Volume-Control V_{max}

![Diagram of Constant Volume-Control V_{max}]

Contact open: V_{min}
Contact closed: V_{max}

Terminal 3 or 4

Parallel connection of several motors is possible.

If one of the two control signal inputs is bridged to the phase of the power supply (terminal 2), the volume adjusted at the V_{max} potentiometer is held constant. With a changeover switch it is possible to obtain a 2-volume V_{min}–V_{max} control.
Changing the air velocity set point (changing the air flow) by means of a temperature controller

The BELIMO VAV-Control System is a pure volume control system, i.e. the basic idea is (like in pneumatic systems) to have a compatible velocity control system supplied by the box manufacturer. Temperature control being provided by the controls manufacturer.

This is possible because the VR1 has two inputs for the most commonly used control signals: 0...10 V DC respectively 0...20 V phase cut.

The control signal w (terminal 3: 1.5...9.50 V DC; terminal 4: 2...10 V phase cut) is used to vary the volume progressively between the preset limits $V_{\text{min}}$ and $V_{\text{max}}$.

For energy efficient variable volume systems it is possible to provide override controls such as ‘closed’, $V_{\text{max}}$, $V_{\text{min}}$ and ‘damper open’.

Parallel operation and sequence control

Without difficulty it is possible to connect two or more VR1 control sets with varying operational ranges to one controller output. It is therefore possible to control supply and exhaust air in a single room or a zone from only one temperature controller.

For building automation systems it is therefore possible to save controller outputs because only one output per room is necessary. Using this basic parallel connection it is easily possible to master the volume balance of an air conditioning system.
A constant positive or negative pressure in a room can be obtained by controlling in sequence supply and exhaust air by using the actual value output of the supply controller VI 1 as a control signal for the exhaust air controller. The slave controller is always following the master controller at a predetermined adjustable ratio.

Override control

To guarantee an energy efficient operation of an AC-System, override positions such as ‘damper closed’, ‘open’, \( V_{\text{min}} \), \( V_{\text{max}} \) are necessary. With the BELIMO VAV-Control System these functions are easily obtainable by changing the wiring. The following functions can be combined at will and can be used for constant or variable volume control systems.

**Complete shut off, override control ‘closed’**

By interrupting the 24 V AC supply to the controller VI 1 the control signal to the actuator is also interrupted, the actuator closes the damper. The actuator needs a constant 24 V AC supply. This additional supply can be connected over the unmarked spare terminal of the VI 1.

**Min. volume \( V_{\text{min}} \)**

By interrupting the control signal to the controller VI 1 the preset volume \( V_{\text{min}} \) is automatically maintained. This can be achieved i.e. by a window, door-contact, or a manual/automatic switch occupied/unoccupied.

**Max. volume \( V_{\text{max}} \)**

If one of the two control inputs are bridged to the 24 V phase (terminal 2) the BELIMO VAV-Control system maintains the preset volume \( V_{\text{max}} \). A modulating control signal at the second input has no further influence. The override position \( V_{\text{max}} \) is used i.e. for morning warm-up.

For economical reasons it is not advisable to maintain this kind of override position for too long a period. (Use an event timer).
Application Hints

BELIMO VAV-Control does not need a minimum pressure. However, the specific resistance of the VAV-device should be taken into consideration.
For energy and noise reasons, it is advisable to reduce the system pressure by using Vortex dampers or reducing the speed of the fans.
This way it is possible to reduce the static pressure ahead of the VAV boxes if the total volume requirement is small.
For parallel or sequence operation of supply and exhaust air velocity controllers, it is advisable to use a separate static pressure control for supply and exhaust fans, to avoid problems under partial load conditions.
The usual filters of an air handling unit should be sufficient for dust protection of velocity sensors.
If there is a lot of dust in the conditioned room, the use of corresponding exhaust air filters will be necessary. For air contaminated with tacky particles, the velocity sensors can not be used.
The optimal positioning of the velocity sensor has been tested by the unit manufacturers. It is therefore essential, that the position of the sensor is not altered. It is also important to follow the manufacturers instructions regarding airflow to the unit.
The unit manufacturer will ensure that maintenance or repair work can easily be carried out.

For certain special functions (i.e. fire protection) it is necessary to open the damper completely.
This override position can lead to an uncontrolled volume situation in an AC system, since the control function of the VAV-Control system is no longer in operation.

BELIMO®
Automation

GB BELIMO Automation (UK) Ltd.
Maple Industrial Estate
Maple Way, GB-Feltham
Middlesex, TW13 7AW
Tel. (01) 844 2202
Telefax (01) 844 01 67

CH BELIMO Automation AG
Dorfstrasse 41
CH-8712 Stäfa
Tel. (01) 926 51 12
Telex 875 165 bell ch
Telefax (01) 926 69 86

AUS Swissmech. Equipment Pty. Ltd.
+NZ P.O. Box 90, Cheltenham,
Victoria 3192, Australia
Tel. (03) 5 55 04 77
Telex 37 554 sme
Telefax 03-555-0878