Adaptive control system for pressure applications (STP)

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Dimensions

| Dimensions | 35    |
### Application

| Supply/exhaust air systems | ● |
| Extraction systems | ● |
| Duct/section pressure | ● |

### Actuator variants

- Standard actuator or fast runner
- Spring-return actuator with emergency position OPEN or CLOSED (see Damper actuators)

### Sensor variants

- Static or dynamic (see Pressure sensors)

### Optimiser function for energy-efficient fan control

1)  Stage control
2)  Modulating control
3)  Local override functions

#### Bus integration

- MP bus (MP partner systems), LonWorks, KNX, Modbus, BACnet, COU24-A-MP

#### Controller platform

- VRP-M

#### Supply

- AC/DC 24 V

#### Reference variable control

- 0 / 2 ... 10 V, 0 / 4 ... 20 mA

#### Feedback, actual value

- Volumetric flow 0 / 2 ... 10 V
- $\Delta p$ 0 / 2 ... 10 V

#### Tools

- PC-Tool VRP-M module, Service-Tool ZTH-GEN

#### Optimiser-compatible

- ●

#### Suitable gateways

- UK24LON, UK24EIB, UK24MOD, UK24BAC

#### Suitable MP-masters

- DDC systems from Belimo MP partners, COU24-A-MP

### Pressure sensors

- **VFP-100**
  - Measuring principle: static
  - Pressure range: 0 ... 100 Pa
  - Comfort zone: Dusty

- **VFP-300**
  - Measuring principle: static
  - Pressure range: 0 ... 300 Pa
  - Comfort zone: Dusty to very dusty

- **VFP-600**
  - Measuring principle: static
  - Pressure range: 0 ... 600 Pa
  - Comfort zone: Dusty

- **VFD3**
  - Measuring principle: dynamic
  - Pressure range: selectable 0 ... 100 / 300 / 600 Pa
  - Comfort zone: Dusty

#### Connection

- Integrated cable/plug unit, suitable for VRP-M

### Damper actuators

- **NM24A-V-ST**
  - Function: Standard
  - Torque: 10 Nm
  - Running time: 110 ... 150 s
  - Emergency function: OPEN

- **LMQ24A-SRV-ST**
  - Function: Fast runners
  - Torque: 4 Nm
  - Running time: 2.5 s

- **NMQ24A-SRV-ST**
  - Function: Fast runners
  - Torque: 8 Nm
  - Running time: 4 s

- **SF24A-V-ST**
  - Function: Spring-return
  - Torque: 20 Nm
  - Running time: 150 s
  - Emergency function: OPEN or CLOSED

#### Connection

- Integrated cable/plug unit, suitable for VRP-M

---

1) Limitation: Optimiser function requires actuator with standard running time, fast runners are not permitted.
2) Independent of the sensor type, the pick-up device (unit component) must be tested at cyclical intervals and be cleaned as needed.
3) The VAV unit (pick-up device, etc.) must be selected in accordance with the medium. The compatibility of the sensor materials is to be tested (see Technical data VFP-.. and VFD3).
4) Compatible with duct cleaning agent and duct disinfecting agent.
5) Differential pressure measurement up to 500 Pa.
Ready-to-connect system solution for section and duct pressure applications with standard and fast running VAV actuators

Control:
DC 2 ... 10 V / 0 ... 10 V or bus

Integration in
• DDC controller with MP interface
• EIB-Konnex, Modbus and BACnet systems
• LONWORKS® systems
• Diagnostic socket for Service and PC-Tool

Brief description

Application
The ready-to-connect system solution forms an efficient control system for positive/negative pressure control circuits in section or duct applications.

Field of application
In-house applications with neutral, contaminated or slightly aggressive air (air compatibility test essential, see «Technical data» for the VFP-..-sensors, page 23).

Function
The pressure difference on the static pressure sensor serves as an actual value x for the adaptive PID pressure controller. This signal (0 ... 100 % $P_{nom}$) can be tapped at the VRP-M STP controller connection U5 as an analogue signal. Switching the negative/positive pressure controllers is done by assigning the pressure sensor connections accordingly. The actual value $x$ is compared with the setpoint $w$ set on the pressure controller and the connected actuator is actuated according to the resulting system deviation.

The VRP-M STP controller can be actuated according to the function either as a constant controller ($P_{min}$ / $P_{max}$) or via the reference value input $w$ with a 0 ... 10 / 2 ... 10 V modulating signal, in the range $P_{min}$ ... $P_{max}$. For special applications, there are control inputs available with the functions OPEN / CLOSED / Motor stop.

The VRP-M STP can be integrated in an MP system via the MP bus connection.
Safety notes

- The VRP-M system solution is not allowed to be used outside the specified field of application, especially in aircraft or in any other airborne means of transport.
- Only components explicitly approved for this purpose by Belimo are allowed to be used for the VRP-M system solution.
- The equipment configuration and settings form part of the unit manufacturer’s system solution (OEM) and are not allowed to be modified without the OEM’s prior authorisation. All changes are liable to disrupt operation and cause damage to the system or injury to persons!
- Attention must be paid to the following during the planning phase and before the VRP-M system solution is operated:
  - The compatibility of the pressure sensors with the medium to be controlled must be tested,
  - The specifications supplied by the damper manufacturer (design, place of installation) must be consulted and
  - The local technical regulations must be observed.
- Applications with fast running actuator LMG24A-SRV-ST or NMQ24A-SRV-ST: The actuator moves first to the top, then to the bottom spindle end stops when the supply voltage is switched on for the first time or after pressing the «Adaption» push-button. It then moves into the position required by the system. The VRP-M control function is inoperative during this procedure.
- If the VRP-M solution is operated in a bus system, the cycle times of the MP bus and the higher-level system must be taken into account.
- The damper manufacturer (OEM) is responsible for ensuring that the VRP-M-system solution is installed and set correctly as well as for overall precision. If replacement devices are ordered, they are configured by the OEM at the factory according to the installed system. The VRP-M system solution is sold exclusively via the OEM channel for this reason.

System description

System characteristics

<table>
<thead>
<tr>
<th>Control characteristics</th>
<th>Adaptive, digital PID pressure controller (see «System components», page 3).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure measurement</td>
<td>Belimo pressure sensors (see «System components», page 3).</td>
</tr>
<tr>
<td>Damper actuators</td>
<td>Belimo VAV damper actuators (see «System components», page 3).</td>
</tr>
<tr>
<td>Optimally matched components</td>
<td>The solution comprises the components optimally matched with one another that are therefore only permitted to be used in the controller-sensor-actuator combinations specified by Belimo and selected by the damper manufacturer (see «System components», page 3).</td>
</tr>
<tr>
<td>STP – Variable pressure range</td>
<td>Variable pressure range by means of a modulating reference variable, e.g. supplied by a DDC controller or bus operation, The reference signal for the ( P_{min} ) ... ( P_{max} ) operating range can be set as follows: DC 2 ... 10 / 0 ... 10 V or bus operation</td>
</tr>
<tr>
<td>STP – Constant pressure</td>
<td>Constant pressure applications with operating modes (relays, switching contacts). The following operating modes are available: CLOSED / ( P_{min} ) / ( P_{max} ) / Motor stop / OPEN / Bus operation</td>
</tr>
<tr>
<td>Bus function</td>
<td>Up to eight Belimo MP devices (VRP-M / VAV-Compact / damper actuator / valve) can be connected via the MP bus and integrated into the following systems: – DDC controller with integrated MP bus protocol – EIB-Konnex-System with Gateway UK24EIB – LONWORKS® system with Gateway UK24LON – Modbus system with Gateway UK24MOD – BACnet system with Gateway UK24BAC See «Bus system», pages 20 to 22.</td>
</tr>
<tr>
<td>Diagnostics tool</td>
<td>PC-Tool VRP-M module, ZTH-GEN, can be plugged into the VRP-M or via external cable connection.</td>
</tr>
</tbody>
</table>
Adaptive digital PID pressure controller for VRP-M system solutions

- Control: 0 ... 10 / 2 ... 10 V or MP bus
- Diagnostic socket for Service or PC-Tool

## Technical data sheet

### Technical data

#### Electrical data

<table>
<thead>
<tr>
<th>Nominal voltage</th>
<th>AC 24 V, 50/60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage range</td>
<td>AC ±20% / DC ±10%</td>
</tr>
<tr>
<td>Power consumption</td>
<td>1.1 W (incl. Sensor VF.., without damper actuator)</td>
</tr>
<tr>
<td></td>
<td>2.6 VA (incl. Sensor VF.., without damper actuator)</td>
</tr>
</tbody>
</table>

#### Connection

<table>
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<tr>
<th>Actuator</th>
<th>Plug, 6-pin</th>
</tr>
</thead>
<tbody>
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<td>Pressure sensor</td>
<td>Plug, 4-pin</td>
</tr>
<tr>
<td>Terminals 1 ... 7</td>
<td>7-pin screw terminals, 0.5 mm² ... 1.5 mm²</td>
</tr>
<tr>
<td>VRP-M-Tool</td>
<td>Plug, 3-pin</td>
</tr>
</tbody>
</table>

#### Functional data

**Reference signal w (terminal 3)**
- Input impedance >200 kΩ
- DC 0 ... 10 / 2 ... 10 V or
- 0 ... 20 / 4 ... 20 mA (with 500 Ω resistance)

**Actual value, volumetric flow U5 (terminal 5)**
- DC 0 ... 10 / 2 ... 10 V, max. 5 mA

**OPEN operating mode – z1 (terminal 6)**
- OPEN, input impedance >300 kΩ
- Contact current <1 mA

**CAV operating modes z2 (terminal 7)**
- CLOSED / P min / Motor stop / P max

**Control characteristics**
- PID, adaptive

**Control tolerance**
- ±5% of V nom

**Ranges**
- P nom
- P max
- P min 1)

**LED display**
- AC/DC 24 V supply
- Pressure too high/too low, zero VFP-..sensor

**MP bus function (terminal 4)**
- MP 1 ... 8 (classic operation: PP)
- Adjustable with VRP-M-Tool and address push-button
- Slave

**Operation / service**
- VRP-M-Tool

#### Safety

**Protection class**
- III Safety extra-low voltage

**Degree of protection**
- IP42

**EMC**
- CE according to 2004/108/EC

**Principle of operation**
- Type 1 (EN 60730-1)

**Ambient temperature**
- 0 ... ±50 °C

**Non-operating temperature**
- −20 ... +80 °C

**Ambient humidity**
- 5 ... 95% r.h., non-condensing (EN 60730-1)

**Maintenance**
- Maintenance-free

#### Dimensions / Weight

**Dimensions**
- See «Dimensions» on page 35

**Weight**
- Approx. 250 g (without sensor)

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1) See «Creep flow limitation and minimum setting limit», page 10
2) See «Bus operation», pages 20 to 22
Safety notes

- The controller is not allowed to be used outside the specified field of application, especially not in aircraft or in any other airborne means of transport.
- The device does not contain any parts that can be replaced or repaired by the user.
- The manufacturer of the unit (OEM) is responsible for ensuring that the VRP-M-controller is installed and set correctly as well as for the overall precision of the unit. If replacement devices are ordered, they are configured by the OEM at the factory according to the installed system. The VRP-M controller is sold exclusively via the OEM channel for this reason.
- 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.

Application

Together with a VFP-.. / VFD3 pressure sensor and a damper actuator, the VRP-M forms a control system for pressure controls.

For more information, see «VRP-M system description», pages 3 and 4

Electrical connections

Front panel

Assignment of connecting terminals 1 ... 7

<table>
<thead>
<tr>
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<th>Supply and control</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Tab connection Damper actuator</td>
<td></td>
</tr>
<tr>
<td>Tab connection Pressure sensor</td>
<td></td>
</tr>
<tr>
<td>Service/PC-Tool diagnostic socket</td>
<td></td>
</tr>
</tbody>
</table>

LED display and address push-button

<table>
<thead>
<tr>
<th>PWR</th>
<th>Green LED</th>
<th>LED on:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>– Supply AC/DC 24 V OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Device ready for operation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LED off:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Supply failure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Device defective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>V+</th>
<th>Red LED</th>
<th>LED on:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>– Pressure &gt; setpoint = damper closes or is closed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>V−</th>
<th>Red LED</th>
<th>LED on:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>– Pressure &lt; setpoint = damper opens or is open</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Δp &gt; 0</th>
<th>Yellow LED</th>
<th>Zero offset pressure sensor VFP-..</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(for procedure, see page 9)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set</th>
<th>Push-button for assigning the MP address in bus operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(for procedure, see page 22)</td>
</tr>
</tbody>
</table>
Electrical installation

Wiring diagrams STP

Modulating operation

Example 1:
With analogue reference signal

Example 2:
DC 0...10 V with shut-off (CLOSED)

Example 3:
DC 0...10 V with shut-off / parallel control

Example 4:
With bus control

Example 5:
Typical application: MP with shut-off (CLOSED)

Conventional operation:
Functional description such as control priority
See pages 11 and 12

Notes
– Supply via safety isolating transformer!
– We recommend routing connections 1, 2 (AC/DC 24 V) and 4 (MP signal) to accessible terminals (floor distributor, control cabinet, etc.), in order to simplify access with the VRP-M-Tool for diagnostic and service work.

Bus operation:
See pages 20 to 22 for a functional description
Adaptive pressure controller

Electrical installation (continued)

Wiring diagrams STP
Constant pressure operation

Notes
– Supply via safety isolating transformer!
– We recommend routing connections 1, 2 (AC/DC 24 V), 4 (MP signal) and 5 (UF signal) to accessible terminals (floor distributor, control cabinet, etc.), in order to simplify access with the VRP-M-Tool for diagnostic and service work.

See pages 10 and 11 for a description of function 4, 3, 2, 1 VRP-M MP w ~ T + _

5

6

7

U5 z1 z2

VFP-..LM.. / NM.. / SF..

VRP-M Tool

* Function not available with DC 24 V supply.
Commissioning

Prerequisites

The following has been accomplished by the unit manufacturer for the system solution:

- Mounting on the damper unit
- The static pressure sensor has been balanced to the zero point offset or the pressure range of the dynamic pressure sensor has been adjusted, respectively
- The VRP-M has been correctly calibrated and parameterised to the $\Delta p$ @ $V_{nom}$ value of the application
- The electrical connection has been made and checked
- 24 V supply and control have been made ready for operation
- The ventilators have been put into operation

Procedure

- Test the electrical connection
- Check the zero offset with static pressure sensor or the pressure range setting with dynamic pressure sensor, respectively
- Check the damper mobility
- Test the damper angle of rotation setting, correcting it if necessary, and carry out an angle of rotation adaptation
- Check the $P_{min}$ / $P_{max}$ setting, correcting it if necessary
- Test the supply pressure (supply/exhaust air ventilator in operation and balanced)
- Test the control signal setting, adjusting it if necessary

Damper actuator angle of rotation adaptation

An angle of rotation adaptation must be carried out after each adjustment of the damper angle or rotation limitation.

In the case of fast runner damper actuators LMQ24A-SRV-ST and NMQ24A-SRV-ST, it is mandatory that an angle of rotation adaptation be carried out after every adjustment of the angle of rotation limitation.

Procedure:

- Switch on the 24 V supply
- Press the «Adaption» push-button (actuator travels CLOSED … OPEN … setpoint position)
- Disconnect both (!) hose connections from the sensor
- Remove the cover of the sensor housing
- Rotate the zero potentiometer inside the VFP-.. until the LED in the VRP-M \([p > 0]\) lights up
- Rotate it back until the LED just gets off
- Connect the hose connections to the sensor: observe + / – setting!

Static pressure sensor VFP-...

Zero offset

Note

Static pressure sensors VFP-...
In the event of a mounting orientation that deviates from the perpendicular position, it is mandatory that a zero offset be carried out.

Dynamic pressure sensor VFD3

Pressure range setting

The DIP switches for adjusting the pressure range are located under the VFD3 housing cover.

Note

Dynamic pressure sensor VFD3
The pressure range of the VFD3 is set in the factory by the manufacturer of the VAV unit and configured accordingly in the VRP-M. It is mandatory that an adjustment of the pressure range requires an adaptation in the VRP-M configuration.

The pressure range –20 ... 100 Pa cannot be used with the VRP-M.

If necessary, the setting of the DIP switches can be sealed with a compatible lacquer. It is recommended for purposes of documenting the setting that the selected pressure range be marked on the housing cover with a waterproof felt-tip pen.

The VFD3 is not equipped with an external zero adjustment.
**Functions**

**Nominal pressure $P_{\text{nom}}$**

$P_{\text{nom}}$ corresponds to the highest possible pressure setting of the application within the permissible operating conditions. The $P_{\text{nom}}$ values are specified and are programmed permanently by the damper manufacturer.

The actual value signal U5 is always in reference to the $P_{\text{nom}}$. For this reason, changes in the operating pressure setting $P_{\text{min}}$ and $P_{\text{max}}$ have no influence on the U5 V signal.

---

**Creep flow limitation**

**Minimum setting limit $P_{\text{min}}$**

Creep flow limitation (1)

This function suppresses differential pressure signals in the zero region. Thanks to this limitation, undefined actuator movements in the effective pressure range of 1 ... 6 Pa are prevented.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Pressure range</th>
<th>Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>VFP-100</td>
<td>0 ... 100 Pa</td>
<td>1 Pa</td>
</tr>
<tr>
<td>VFP-300</td>
<td>0 ... 300 Pa</td>
<td>3 Pa</td>
</tr>
<tr>
<td>VFP-600</td>
<td>0 ... 600 Pa</td>
<td>6 Pa</td>
</tr>
<tr>
<td>VFD3</td>
<td>0 ... 100 Pa</td>
<td>1 Pa</td>
</tr>
<tr>
<td></td>
<td>0 ... 300 Pa</td>
<td>3 Pa</td>
</tr>
<tr>
<td></td>
<td>0 ... 600 Pa</td>
<td>6 Pa</td>
</tr>
</tbody>
</table>

**Unit manufacturer’s minimum setting limit (2)**

An oversized damper can make it harder to regulate the lowermost pressure range. The lowest permissible pressure is specified by the manufacturer, which is approximately equivalent to 5 ... 12 Pa. Functional restrictions in this range can be avoided by complying with the unit manufacturer’s specified setting.

---

![Diagram](image-url)
Functions (continued)

Control tolerance
The maximum permissible control tolerance is defined as a percentage of the nominal pressure $P_{\text{nom}}$. If the system deviation exceeds or undershoots this tolerance, the actuator is adjusted so that the actual value corresponds to the required setpoint.

Control tolerance: $\pm 5\%$ of $P_{\text{nom}}$

The two LEDs [+p] and [-p] will show the following when the maximum control tolerance is exceeded or undershot or when the actuator in movement must be corrected by the deviation:
- LED [+p]: actual value > (setpoint + control tolerance) = damper closes
- LED [-p]: actual value < (setpoint + control tolerance) = damper opens

STP – operating pressure $P_{\text{min}} / P_{\text{max}}$ setting
In variable operation, the pressure is specified by means of the reference signal in the range $P_{\text{min}} \ldots P_{\text{max}}$.
- $P_{\text{max}}$ forms the upper limit value as a function of the nominal pressure. Range 30 ...100% of $P_{\text{nom}}$.
- $P_{\text{min}}$ forms the lower limit value as a function of $P_{\text{nom}}$. Range 0 ...100% of $P_{\text{nom}}$.

Voltage level

Example with Mode 0 ... 10 V

In mode 2 ... 10 V, it is possible to achieve shut-off mode (damper CLOSED) by lowering the reference signal to 0.0V.

For override control in STP operation, e.g. CLOSED or OPEN, the reference signal $w$ (Input 3) can be overridden by wiring the control inputs 6 (z1) and 7 (z2).

In mode 0 ... 10 V, the reference signal $w$ must be between 0.0V and 10.0V.

In mode 2 ... 10 V, the reference signal $w$ must be between 0.1V and 10.0V and is capable of achieving shut-off mode.

STP operating modes
CLOSED / $P_{\text{min}}$ / Motor stop / $P_{\text{max}}$ / OPEN

Notes
Motor stop stage is not available with the DC 24 V supply.
**Functions** (continued)

---

### STP – modulating operation with override

**CLOSED / \( P_{\text{min}} \) / \( P_{\text{max}} \) / OPEN**

If necessary, the modulating \( P_{\text{min}} \) ... \( P_{\text{max}} \) range can be overridden by fixed operating modes.

The following operating modes are available:

- **Shut-off operation, Damper CLOSED**: The damper is moved into the CLOSED position in a defined manner.
- **Operating modes \( P_{\text{min}} \) / \( P_{\text{max}} \)**: The VRP-M permanently regulates the selected pressure.
- **Motor stop**
- **Damper OPEN**: The damper can be opened for maximum ventilation, in which case the pressure control is deactivated!

---

### Priorities for reference value input 3 (w) and control inputs 6 (z₁) / 7 (z₂)

If several signals appear simultaneously, they are processed according to the following priorities.

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Priority</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1</td>
<td>OPEN</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>CLOSED / Motor stop / ( P_{\text{max}} )</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>( P_{\text{min}} ) ... ( P_{\text{max}} )</td>
</tr>
</tbody>
</table>

---

**Notes**

- \( P_{\text{min}} \): All inputs (3 / 6 / 7) open
- Motor stop is not available with the DC 24 V supply.
**System configuration**

**Settings by damper manufacturer (OEM)**

The system solution selected by the manufacturer is mounted by the latter on the damper and configured according to the system requirements (as stated in the order). This configuration comprises the following settings:

- **Function** Pressure (VRP-M STP)
- **Sensor** The pressure sensor type is specified to enable the pressure range to be adapted.
- **Actuator** The actuator type is specified to enable the running time characteristics to be adapted.

**Control – reference signal w, actual value signal U5**

The reference signal w and the actual value signal U5 are set to the MCR system. Selection DC 0...10 V / DC 2...10 V / adjustable (sequence matching in the 0...10 V range)

**Setting – \( P_{nom} \)**

The \( P_{nom} \) values are specified and programmed permanently by the damper manufacturer. With the setting of \( P_{nom} \), every VRP-M system solution is optimally adapted to the application. \( P_{nom} \) is equivalent to the highest possible pressure within the permissible operating conditions.

**Replacement orders**

If replacement devices are ordered, they must be parameterised beforehand by the OEM at the factory according to the installed system. The VRP-M is sold exclusively via the OEM channel for this reason.

**Note**

The equipment configuration and settings form part of the damper manufacturer’s system solution (OEM) and are not allowed to be modified without prior authorisation. All changes are liable to disrupt operation and cause damage to the system or injury to persons!
The VRP-M module enables, if needed, the adjustment of the operating data ($P_{\min}$, $P_{\max}$ settings) and of the reference signals (Setting mode – Voltage range) to the requirements at the plant. The PC-Tool adapter must be connected to the diagnostics socket on the VRP-M or to the MP connection routed to the terminals for this purpose (see pages 16 ... 17).

**Adjustments on the system with PC-Tool**

**3 System designation entry**

**4 Pressure**

**5 Checking – Operation:**

- Reference signal display
- Pressure [Pa]
- Setpoint / actual value [Pa]
- Operating mode selection:
  - AUTO / CLOSED / OPEN
  - $P_{\min}$ / $P_{\max}$ / Motor stop / $P_{\text{nom}}$
  - Variable setpoint ($P_{\min}$ ... $P_{\max}$)

**Settings - pressure stages**

With these parameters, the pressure stages required for the corresponding application are set. The settings are based on the pressure values calculated by the planning engineer and can either be preset by the manufacturer or adjusted on the system using the VRP-M module.

- $P_{\max}$ Range 30 ...100% of $P_{\text{nom}}$
- Upper pressure value
- $P_{\min}$ Range 0 ...100% of $P_{\text{nom}}$
- Control range $x \times ...100\%$ of $P_{\text{nom}}$
- Lower pressure value
- Shut-off operation (CLOSED) via $P_{\min}$ setting
  
  If a shut-off function is required in modulating operation, it can be achieved with the setting $P_{\min}$ 0%

* $P_{\min}$ settings below the control range
* $P_{\min}$ values below the start value displayed in the range can be set, e.g. for dampers with shut-off function

**System designation entry**

Input field (16 characters) for specific system designations, e.g. MCR address, system name, item number in diagram, etc.
VRP-M module – Operating data settings (continued)

1 Mode setting:
- Standard 0 ... 10 / 2 ... 10 V

2 Control
   Individual setting
   - Reference signal w
   - Actual value signal U5

Variable settings are entered in the «Control» field above.

3 VRP-M system information
   - VRP-M version
   - Function pressure [VRP-M STP]
   - Sensor type
   - Actuator type

4 Ambient conditions (VFD3)
   - Height above sea level

Mode setting
Options: 0 ... 10 V / 2 ... 10 V / individual setting
The mode setting acts on the reference signal w and the actual value signal U5.
Variable settings are displayed here and can also be reset by selecting 2 ... 10 / 0 ... 10 V.
Variable settings are entered in the «Control» field above.

Control Variable setting
It is sometimes essential to adapt the reference signal w or the actual value signal U5 to the
MCR system directly on the control system.
The reference signal w and the actual value signal U5 can be set to different values (e.g.
reference signal w: 2 ... 10 V / actual value signal U5: 0 ... 10 V).

Reference signal [w] / operating range \( P_{\text{min}} \ldots P_{\text{max}} \)
Start point: DC 0.0 ... 8 V
Stop point: DC 2.0 ... 10 V

Actual value signal [U5] / display range 0 ... 100% \( P_{\text{nom}} \)
Start point: DC 0.0 ... 8 V
Stop point: DC 2.0 ... 10 V

Ambient conditions
With this function, the VRP-M solution and the VFD3 sensor can be adjusted to the geographical
environment of the plant.

Height above sea level as a relevant parameter can be entered as a corrective value for the
VFD3 signal through the «Ambient conditions» adjustment marker in the Expert tab:
**VRP-M**

**Adaptive pressure controller**

---

**PC-Tool VRP-M module – Availability**

The current version of the PC-Tool or the VRP-M module, respectively, and the associated documentation can be downloaded from www.belimo.eu.

---

**PC-Tool connection**

The PC-Tool required for settings and servicing can be connected either directly to the 3-pin service socket on the VRP-M controller or via the MP connection (terminal 4). A level converter ZIP-USB-MP or ZIP-RS232 is required for communication.

**Conventional operation (PP)**

**Connection via service socket**

**Connection in control cabinet**

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**Connection via service socket**

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**Conventional operation (PP)**

**Connection via service socket**

**Connection in control cabinet**
Adaptive pressure controller

PC-Tool connection

**MP bus operation**

The PC-Tool can only be connected via the bus master during MP bus operation because otherwise two MP masters would be connected on the same MP bus. This means the local connection to the VRP-M is not permitted to be operating at the same time as the MP master.

---

**Notes**

- The service plug integrated in the VRP-M is not available with bus operation.
- The MP bus cannot be used to transmit open and closed-loop control functions if it is also used to connect the PC-Tool.

Workaround: Undo MP bus (terminal 4) and use local MP plug or tool connection on the UK24...
Service-Tool ZTH-GEN

Service-Tool for parameterisable and communicative Belimo actuators and VAV controllers. Local connection via service socket on the device or remote control via MP/PP connection.

Connection and supply

The ZTH-GEN is supplied via the actuator/VAV controller. The connection is set up
• directly at the Service socket of the actuator/VAV controller or
• via the PP/MP connection, e.g. connection socket, in the control cabinet, room controller CR24

Local connection via service socket

<table>
<thead>
<tr>
<th>Connection to</th>
<th>Cable type</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRP-M</td>
<td>ZK4-GEN</td>
<td>ZTH-GEN connection in MP bus system: The MP connection should be disconnected from the MP bus while the ZTH-GEN is operating.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Direction connection to terminals

<table>
<thead>
<tr>
<th>Connection to</th>
<th>Cable type</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRP-M</td>
<td>ZK2-GEN</td>
<td>VAV-Universal actuators: The V actuators NM24A-S-ST, LMQ24A-SRV-ST and NMQ24A-SRV-ST, suitable for the VAV universal controller VRP-M (STP), have a tool connection, but are not tool-capable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Connection in the MP bus system

Direct connection to the MP bus or MP master is not possible with the ZTH-GEN. Solution: Use the service socket on the VAV controller or temporarily disconnect the MP connection of the MP device from the MP bus and connect the ZTH-GEN to the MP connection.

Menu structure, handling

The operating menu can be run through from both sides ▼▲.

Starting / ending

The connection to the actuator/VAV controller is started by plugging in the RJ plug and terminated by unplugging it.
# Adaptive pressure controller

## Configuration

### Start Configuration

1. Press the key (OK) while simultaneously plugging in the connecting cable.

2. Configuration menu display appears.

### Configuration menu

<table>
<thead>
<tr>
<th>Option / Display</th>
<th>Setting</th>
<th>Product range</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HW Version V.x</td>
<td></td>
<td></td>
<td>Display of the current hardware and firmware version of the ZTH-GEN</td>
</tr>
<tr>
<td>FW Version V.x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text</td>
<td>German / English</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAV unit</td>
<td>m³/h / l/s / cfm</td>
<td>VAV</td>
<td></td>
</tr>
<tr>
<td>EPV unit</td>
<td>m³/h / l/min / gpm</td>
<td>Valves</td>
<td>Display of the current AC 24V supply voltage, with direct connection to terminals (ZK2-GEN)</td>
</tr>
<tr>
<td>Supply. ...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC ... V VHW: ... %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start MP tester</td>
<td>OK</td>
<td></td>
<td>MP bus diagnostics tool for system integrators. The MP tester is not a component part of this documentation.</td>
</tr>
<tr>
<td>PICCCV function</td>
<td>0 / 1</td>
<td>Valves</td>
<td>Belimo US Enable PICCCV Wizard function</td>
</tr>
<tr>
<td>Expert Mode 1)</td>
<td>0 / 1</td>
<td>VAV 3)</td>
<td>Enable VAV settings: – Switching mode, – Set Vmin / Vmax to original values (call up OEM setting)</td>
</tr>
<tr>
<td>Advanced Mode 2)</td>
<td>0 / 1</td>
<td>VAV 3)</td>
<td>Enable settings: – VAV: Direction of rotation, – BF-Top: Adaptation</td>
</tr>
<tr>
<td>Exit Configuration</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Activate options 1) and 2) only as needed and with the respective know-how; the adjustment of the respective parameters requires special expertise.

3) only for VAV-Compact

## Functions for VAV product range

### Menu tree

- **Device identification**
  - Type
  - Position
  - Data, settings
    - Δp
    - Setpoint
  - Type
    - Designation
  - Type
    - Firmware
  - Type
    - Serial number

- **Option, range**
  - Mode
    - new
  - Step
    - Auto
  - Option, range
    - 0 ... Pmax
    - Pmin ... Pmax

- **Address**
  - new
  - PP
  - MP4

- **Pmin**
  - new
  - 100 Pa
  - 95 Pa

- **Pmax**
  - new
  - 145 Pa
  - 140 Pa

- **Pnom**
  - 175 Pa

- **Start**
The VRP-M system solution can be interconnected with other Belimo MP actuators (damper actuators, valve actuators, VAV-Compact controllers, VRP-M system solutions) thanks to the integrated communication principle via the Belimo MP bus. The maximum of eight Belimo MP devices are supplied with a digital control signal by the higher-level bus master and then move to the position dictated by this signal.

The switching from conventional to bus mode takes place automatically, as soon as an MP address (1...8) is assigned to the MP actuator.

The Belimo MP devices can be integrated in the following systems:
- LONWORKS®: The variables of Functional Profile 8110 can be used in conjunction with the Belimo UK24LON interface.
- EIB-Konnex: In connection with the Belimo UK24EIB interface
- DDC controller with an integrated MP bus protocol: Available from several manufacturers

**MP bus cycle time**

The cycle time of the MP bus must be noted when integrating setpoints and actual values. It is typically 2...8 s, depending on the number of connected bus users and integrated sensors.

The local VRP-M control function is not affected by the cycle time. The cycle time of the MP bus must always be taken into account, however, when selecting setpoints via the MP bus.

**Principle of operation**

**Sensor integration (starting with VRP-M version V3.x)**

The VRP-M can be connected to an additional active 0 ... 10 V signal in MP bus operation independently of the control loop. The sensor signal is connected to the reference value input that is not used in MP bus operation (connection 3).

The VRP-M acts in this capacity as an analogue/digital converter for the transmission of the sensor signal to the higher-level system. This must know the physical address (which sensor at which MP device) and be able to interpret the respective sensor signal.

**Active sensor connection**

Active 0 ... 10 V sensors for open and closed-loop control functions in the higher-level system, such as moisture or CO2 sensors. The cycle time must be taken into account in the implementation!

Reference signal w setting if an active sensor is connected: 0 ... 10 V

**Integration of switches, passive resistance sensors**

The VRP-M only supports active sensors with a 0 ... 10 V output; i.e. no switches or passive sensors (resistance elements) can be integrated.

**Principle of VRP-M in bus operation**

In bus operation, the VRP-M controller receives its reference signal from the higher-level control system and adjusts the pressure to the specified value in the range $P_{\text{min}} ... P_{\text{max}}$.

If needed, the VAV range $P_{\text{min}} ... P_{\text{max}}$ can be overridden in bus operation by fixed operating modes (control inputs $z_1$ and $z_2$).

The following operating modes are available:
- Shut-off operation, Damper CLOSED: The damper is moved into the CLOSED position in a defined manner.
- Operating mode $P_{\text{max}}$: the VRP-M adjusts the set pressure.
- Motor stop
- Flushing mode – Damper OPEN: The damper can be opened for maximum ventilation, in which case the pressure control is deactivated.
Bus operation (continued)

**Pressure setting \( P_{\text{min}} / P_{\text{max}} \)**

The setpoint selected over the MP bus is resolved by means of the \( P_{\text{min}} \) and \( P_{\text{max}} \) settings on the VRP-M.

<table>
<thead>
<tr>
<th>Function</th>
<th>Volumetric flow</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>( P_{\text{nom}} )</td>
<td>nominal</td>
<td>OEM-specific value, depending on the application</td>
</tr>
<tr>
<td>( P_{\text{max}} )</td>
<td>maximum</td>
<td>30 ... 100% of ( P_{\text{nom}} )</td>
</tr>
<tr>
<td>( P_{\text{min}} )</td>
<td>minimum</td>
<td>0 (^{o}) ... 100% of ( P_{\text{nom}} )</td>
</tr>
</tbody>
</table>

* The minimum pressure setting \( P_{\text{min}} \) is dependent on the setting used, or is influenced by the creep flow limitation, respectively (see the function: «Creep flow limitation / Minimum setting limit»).

**Open pressure setting**

The \( P_{\text{min}} / P_{\text{max}} \) setting can be open if necessary, i.e. with a setting of \( P_{\text{min}} \) 0% / \( P_{\text{max}} \) 100%. In this case, the pressure must be limited in the higher-level system.

This operating setting allows the limitation of the pressure to be adjusted without altering the parameters on the pressure controller.

Responsibility for the limiting function passes from the unit manufacturer to the system supplier or integrator.

**Bus signal priorities (MP setpoint) and control inputs 6 (z1) / 7 (z2)**

If several signals appear simultaneously, they are processed according to the following table of priorities.

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Priority</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1</td>
<td>OPEN</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>CLOSED / Motor stop / ( P_{\text{max}} )</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>MP override function</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>OPEN</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>CLOSED</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>( P_{\text{max}} )</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>( P_{\text{min}} )</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Motor stop</td>
</tr>
<tr>
<td></td>
<td>6 –</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>( P_{\text{nom}} )</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>MP setpoint 0 ... 100% = ( P_{\text{min}} ) ... ( P_{\text{max}} )</td>
</tr>
</tbody>
</table>

**Note**

Note the speed of the MP bus!

**Bus fail function**

The VRP-M saves the current setpoint, i.e. the last setpoint to have been received from a bus master (VRP-M-Tool, UK24LON). If the MP network fails, the connected VRP-M detects this and retains this setpoint until it receives a new one from the MP master.

**Last setpoint**

Initial setpoint after power failure

The VRP-M starts with its MP initial status (setpoint 0%, corresponding to the \( P_{\text{min}} \) setting) if a power failure occurs in the intervening period.
VRP-M
Adaptive pressure controller

MP bus

Topology
The cables of up to eight actuators can be laid in a freely definable topology. The following
topologies are permitted: star, ring, tree or mixed forms.

Connection
The network consists of a 3-pin connection (MP communication and 24 V supply). Neither
special cables nor terminating resistors are required. Power can be supplied either over the bus
cable or from a local power supply.

Network
Up to eight MP actuators can be connected in a network (VAV-Compact, VRP-M etc.).

Supply with AC or DC voltage
Nominal voltage AC 24 V, 50/60 Hz, DC 24 V
Power supply range AC 19.2 ... 28.8 V, DC 21.6 ... 26.4 V
Dimensioning See «Technical data», page 5

Length of MP bus cable
The cable lengths are limited:
– By the sum of the performance data of the connected devices, e.g. VAV controllers, actuators
– By the type of supply (AC 24 V or DC 24 V)
– By the cable cross-section.

For more information about planning and installation, see www.belimo.com
– VAV-Compact products information
  Bus and communication systems section

Addressing
If the VRP-M system solution is integrated in a bus system, each connected VRP-M must be
assigned an MP address in the range 1 ... 8.

Procedure
– Start the addressing procedure on the MP bus master VRP-M-Tool, UK24LON etc.
– For the procedure, see the documentation of the bus master used
– Procedure with VRP-M-Tool:
  a) Select Addressing via serial number
     Enter the serial number of the VRP-M (sticker on the VRP-M, display in the VRP-M-Tool)
  b) Select addressing with acknowledgement on the VRP-M
     Acknowledge the selected address by pressing the Set key on the desired VRP-M. If the Set
     key is pressed, then the Power LED will flash (green)
Static differential pressure sensors for neutral to slightly aggressive gases
• Measuring range, type-dependent, 0 ... 100 / 300 / 600 Pa
• Cable connection with plug suitable for VAV-Universal VRP-M

Overview of types

<table>
<thead>
<tr>
<th>Type</th>
<th>Measuring ranges</th>
<th>Overload protection</th>
<th>Temperature sensitivity of zero</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>VFP-100</td>
<td>0 ... 100 Pa</td>
<td>Max. 500 Pa</td>
<td>±0.1% / K</td>
<td>Approx. 500 g</td>
</tr>
<tr>
<td>VFP-300</td>
<td>0 ... 300 Pa</td>
<td>Max. 1500 Pa</td>
<td>±0.05% / K</td>
<td>Approx. 280 g</td>
</tr>
<tr>
<td>VFP-600</td>
<td>0 ... 600 Pa</td>
<td>Max. 3000 Pa</td>
<td>±0.05% / K</td>
<td>Approx. 280 g</td>
</tr>
</tbody>
</table>

Technical data

Electrical data
Supply: DC 15 V (from VRP-M controller)
Connection: 1 m cable with 4-pin plug (suitable for VRP-M)

Functional data
Type, principle of operation: Pressure measurement by means of diaphragm (static, inductive)
Measuring range: See «Type overview»
Overload protection: See «Type overview»
Measuring medium: Neutral to slightly aggressive gases
Parts in contact with medium: Ni, Al, CuBe, PU
Linearity: ±1% of final value (FS)
Switching differential: Max. 0.1% of final value
Temperature sensitivity: See «Type overview»
Measuring range: t = +10 ... 40°C (reference temperature t0 = 25°C)
Mounting position: Upright (nipple on bottom or side)
Position dependency: Max. ±4.5 Pa
Connection for pressure hoses: Hose nipple for hose with 4 ... 6 mm interior diameter

Safety
Protection class: III Safety extra-low voltage
Degree of protection: IP42
EMC: CE according to 2004/108/EC
Principle of operation: Type 1 (EN 60730-1)
Ambient temperature: 0 ... +50°C
Non-operating temperature: −10 ... +70°C
Ambient humidity: 5 ... 95% r.h., non-condensing (EN 60730-1)
Maintenance: Maintenance-free

Dimensions / Weight
Dimensions: See «Dimensions» on page 35
Weight: See «Type overview»

Safety notes
• The pressure sensors must not 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.
• Legal regulations and regulations issued by authorities must be observed during installation.
• The devices do not contain any parts that can be replaced or repaired by the user.
• The devices contain electrical and electronic components and are not allowed to be disposed of as household refuse. All locally valid regulations and requirements must be observed.
# Static pressure value sensors

## Product features

| Application | Together with a VRP-M controller and a Belimo damper actuator, the VFP-.. static pressure sensors form a control system for pressure-independent variable (VAV) and constant (CAV) volumetric flow controls or for duct pressure controls (STP). The pressure sensors are used for static differential pressure measurement with differential pressure sensors installed in air ducts. They can also be used with contaminated or mildly aggressive air 1). Their robust design makes them ideal for installation in laboratories, clean room systems and industrial applications. |
| Principle of operation | A high-quality metal diaphragm is used in the sensor. The measured pressure produces a corresponding diaphragm stroke, which is detected inductively and converted to a pressure-linearised output signal. The measuring signal is influenced by the mounting position due to the dead weight of the diaphragm. The sensor is calibrated in vertical position at the factory, although it can, if necessary, e.g. if installed in another position, be readjusted at the utilisation site. The temperature is compensated to reduce drift to a minimum. The wear-free, inductive measurement method guarantees maintenance-free operation.  

1) See «Technical data», page 23  
For zero offset and more information, see «System description», page 9 |

## Electrical installation

The ready-to-connect sensor unit is connected to the VRP-M controller with the 4-pin plug.
## Technical data

### Electrical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>AC 24 V, 50/60 Hz / DC 15…24 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage range</td>
<td>AC 19.2 … 28.8 V / DC 13.5 … 28.8 V</td>
</tr>
<tr>
<td>Power consumption</td>
<td>0.35 W</td>
</tr>
<tr>
<td>Operation</td>
<td>0.75 VA</td>
</tr>
<tr>
<td>Dimensioning</td>
<td>Pre-mounted 1 m cable with 4-pin plug, compatible with VRP-M</td>
</tr>
</tbody>
</table>

### Functional data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type, principle of operation</td>
<td>Δp sensor with dynamic measurement principle</td>
</tr>
<tr>
<td>Range of use, measuring medium</td>
<td>Outside air/exhaust air in the comfort zone with sensor-compatible media</td>
</tr>
<tr>
<td>Medium temperature</td>
<td>0 ... 50°C</td>
</tr>
<tr>
<td>Humidity of the medium</td>
<td>5 ... 95% r.h., non-condensating</td>
</tr>
<tr>
<td>Materials in contact with medium</td>
<td>Glass, epoxy resin, PA, TPE</td>
</tr>
<tr>
<td>Connection for pressure hoses</td>
<td>Hose nipple Ø 6 mm, with + and – connection designation</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>Can be selected with DIP switch:</td>
</tr>
<tr>
<td></td>
<td>0 … 100 Pa</td>
</tr>
<tr>
<td></td>
<td>0 … 300 Pa (default setting)</td>
</tr>
<tr>
<td></td>
<td>0 … 600 Pa</td>
</tr>
<tr>
<td></td>
<td>–20 … 100 Pa (cannot be used with the VRP-M)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±1 Pa in the pressure range −20 … 20 Pa</td>
</tr>
<tr>
<td></td>
<td>±5% in the pressure range 20 … 500 Pa</td>
</tr>
<tr>
<td>Zero</td>
<td>&lt;±1%, no balancing required</td>
</tr>
<tr>
<td>Loading capacity</td>
<td>±5000 Pa</td>
</tr>
<tr>
<td>Installation position</td>
<td>Any, no reset necessary</td>
</tr>
<tr>
<td>Response time</td>
<td>&lt;50 ms (&lt;100 ms after Power-Up)</td>
</tr>
<tr>
<td>Output signal</td>
<td>0 ... 10 V, max. load 1 mA</td>
</tr>
</tbody>
</table>

### Safety

| Protection class              | III Safety extra-low voltage                                               |
| Degree of protection         | IP40                                                                         |
| EMC                           | CE according to 2004/108/EC                                                 |
| Principle of operation       | Type 1                                                                       |
| Rated current voltage        | 0.8 kV                                                                       |
| Control pollution degree     | 3                                                                            |
| Ambient temperature          | 0 … +50°C                                                                    |
| Non-operating temperature    | –20 … +60°C                                                                  |
| Ambient humidity             | 0 … 95% r.h., non-condensating                                              |

### Dimensions / Weight

| Dimensions (H x W x D)        | See «Dimensions» on page 35                                                 |
| Weight                        | Approx. 170 g                                                                |

### Note

A setting of 0 … 600 Pa can be measured differential pressures up to 500 Pa.

## Safety notes

- The pressure sensors must not 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. Legal regulations and regulations issued by authorities must be observed during installation.
- The devices contain electrical and electronic components and are not allowed to be disposed of as household refuse. All locally valid regulations and requirements must be observed.
## Product features

| Application | Recording of Δp values in conventional heating, ventilation and air conditioning room ventilation comfort applications, e.g.:
| - Negative and positive pressure in the duct system with reference to the ambient pressure
| - Volumetric flow of supply air/exhaust air in combination with Belimo VAV universal controller VRP-M |

| Principle of operation | The integrated maintenance-free D3 pressure value sensor functions in accordance with the dynamic measurement principle. The differential pressure Δp present at the sensor is available at the analogue output as 0 ... 10 V value. |

### Note

**Dynamic pressure sensor VFD3**

The pressure range of the VFD3 is set in the factory by the manufacturer of the VAV unit and configured accordingly in the VRP-M. It is mandatory that an adjustment of the pressure range requires an adaptation in the VRP-M configuration. The pressure range –20 ... 100 Pa cannot be used with the VRP-M.
Fast-running damper actuator for VRP-M system solution
- Torque 4 Nm
- Running time 2.5 s

**Technical data**

| **Supply** | AC/DC 24 V (from VRP-M controller) |
| **Power consumption** | 13 W @ nominal torque |
| **Rest position** | 1.5 W |
| **Dimensioning** | 23 VA |
| **Connection** | 0.5 m cable with 6-pin plug (suitable for VRP-M) |

**Functional data**

- **Torque (nominal torque)**: Min. 4 Nm @ nominal voltage
- **Direction of rotation**: As an option with switch 0 / 1
- **Direction of motion at Y = 0V**: In switch position 0 or 1
- **Angle of rotation**: max. 95°, mechanical end stops adjustable
- **Running time**: 2.5 s / 90°<
- **Sound power level**: 52 dB (A)
- **Position indication**: Mechanical, plug-in

**Safety**

- **Protection class**: III Safety extra-low voltage
- **Degree of protection**: IP54 in all mounting positions
- **EMC**: CE according to 2004/108/EC
- **Principle of operation**: Type 1 (EN 60730-1)
- **Ambient temperature**: –30 ... +50°C
- **Non-operating temperature**: –40 ... +80°C
- **Ambient humidity**: 95% r.h., non-condensing (EN 60730-1)
- **Maintenance**: Maintenance-free

**Dimensions / Weight**

- **Dimensions**: See «Dimensions» on page 35
- **Weight**: Approx. 810 g

**Safety notes**

- The actuator 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.
- Legal regulations and 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 cable must not be removed from the device.
- Self adaptation is necessary when the system is commissioned and after each adjustment of the angle of rotation (press the adaptation push-button).
- When calculating the torque required, the specifications supplied by the damper manufacturers (cross-section, construction, place of installation), and the ventilation conditions must be observed.
- The device contains electrical and electronic components and is not allowed to be disposed of as household refuse. All locally valid regulations and requirements must be observed.
**Product features**

**Simple direct mounting**
Simple direct mounting on the damper spindle with a universal spindle clamp; a universal mounting bracket is enclosed to prevent the actuator from rotating.

**Manual override**
Manual override with self-resetting push-button. The position calculation is synchronised in order to prevent deviations as a result of manual override. This synchronisation acts at the same time as a simple functional check (see below «Synchronisation»).

**Adjustable angle of rotation**
The angle of rotation is adapted to the available setting range by the manufacturer of the damper by means of integrated, mechanical end stops.
Permissible range: 63 ... 100%.

**Adaption – Adaptation to the available angle of rotation**
This function detects the upper and lower spindle end stops and stores them in the actuator. The running time and the operating range are adapted to the available angle of rotation. Detection of the mechanical end stops enables a gentle approach to the end position and protects the actuator and damper mechanisms. The actuator moves first to the top, then to the bottom spindle end stops when the supply voltage is switched on for the first time, i.e. at the time of commissioning or after pressing the «Adaption» key.

**Home position**
Actuation of the «Gear disengagement» key causes the actuator to move to home position. This function is performed by the actuator, even when the supply voltage is restored, if the «Gear disengagement» key was pressed during the electricity interruption.

**Functional check**
An extremely simple functional check of the dampers is possible: The gearbox can be disengaged simply by pressing the «gear disengagement» key on the housing. As long as the key remains pressed, the damper can be operated manually.

**High functional reliability**
The actuators are overload-proof, require no limit switches and automatically stop when the end stop is reached.

**Electrical installation**
The ready-to-connect actuator unit is connected to the VRP-M controller with the 6-pin plug.

**Display and operating elements**

1. **Direction of rotation switch**
   Switching over: Direction of rotation changes

2. **Push-button and LED display green**
   Off: No power supply or fault
   Illuminated: Operation
   Press key: Initiates angle of rotation adaptation, followed by standard mode

3. **Push-button and LED display yellow**
   Off: Standard mode
   Illuminated: Adaption or synchronisation process active
   Press key: No function

4. **Gear disengagement key**
   Press key: Gearbox disengaged, motor stops, manual override possible
   Release key: Gearbox engaged, synchronisation starts, followed by standard mode

5. **Communication (PC-Tool, ZTH-GEN) is blocked for this actuator type**
**Technical data sheet**

**Technical data**

<table>
<thead>
<tr>
<th><strong>Electrical data</strong></th>
<th></th>
<th><strong>Functional data</strong></th>
<th></th>
<th><strong>Safety</strong></th>
<th><strong>Dimensions / Weight</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>AC/DC 24 V (from VRP-M controller)</td>
<td>Torque (nominal torque)</td>
<td>Min. 8 Nm @ nominal voltage</td>
<td>Protection class</td>
<td>III Safety extra-low voltage</td>
</tr>
<tr>
<td>Power consumption</td>
<td>12 W @ nominal torque</td>
<td>Direction of rotation</td>
<td>As an option with switch 0 / 1</td>
<td>Degree of protection</td>
<td>IP54 in all mounting positions</td>
</tr>
<tr>
<td>Operation</td>
<td>1.5 W</td>
<td>Direction of motion for Y = 0 V</td>
<td>In switch position 0 or 1</td>
<td>EMC</td>
<td>CE according to 2004/108/EC</td>
</tr>
<tr>
<td>Rest position</td>
<td>18 VA</td>
<td>Angle of rotation</td>
<td>max. 95°&lt;sup&gt;∞&lt;/sup&gt;, mechanical end stops adjustable</td>
<td>Principle of operation</td>
<td>Type 1 (EN 60730-1)</td>
</tr>
<tr>
<td>Dimensioning</td>
<td></td>
<td>Running time</td>
<td>4 s / 90°&lt;sup&gt;∞&lt;/sup&gt;</td>
<td>Ambient temperature</td>
<td>-30 ... +50°C</td>
</tr>
<tr>
<td>Connection</td>
<td>0.5 m cable with 6-pin plug (suitable for VRP-M)</td>
<td>Sound power level</td>
<td>52 dB (A)</td>
<td>Non-operating temperature</td>
<td>-40 ... +80°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Position indication</td>
<td>mechanical, plug-in</td>
<td>Ambient humidity</td>
<td>95% r.h., non-condensing (EN 60730-1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Maintenance</td>
<td>Maintenance-free</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dimensions</td>
<td>See «Dimensions» on page 35</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Weight</td>
<td>Approx. 930 g</td>
</tr>
</tbody>
</table>

**Safety notes**

- The actuator 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. Legal regulations and 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 cable must not be removed from the device.
- Self adaption is necessary when the system is commissioned and after each adjustment of the angle of rotation (press the Adaption push-button once).
- When calculating the torque required, the specifications supplied by the damper manufacturers (cross-section, construction, place of installation), and the ventilation conditions must be observed.
- The device contains electrical and electronic components and is not allowed to be disposed of as household refuse. All locally valid regulations and requirements must be observed.
# Fast-running damper actuator for VRP-M system solution

## Product features

### Simple direct mounting

Simple direct mounting on the damper spindle with a universal spindle clamp; a universal mounting bracket is enclosed to prevent the actuator from rotating.

### Manual override

Manual override with self-resetting push-button. The position calculation is synchronised in order to prevent deviations as a result of manual override. This synchronisation acts at the same time as a simple functional check (see below «Synchronisation»).

### Adjustable angle of rotation

The angle of rotation is adapted to the available setting range by the manufacturer of the damper by means of integrated, mechanical end stops. Permissible range: 63 ... 100%.

**Adaption – Adaptation to the available angle of rotation**

This function detects the upper and lower spindle end stops and stores them in the actuator. The running time and the operating range are adapted to the available angle of rotation. Detection of the mechanical end stops enables a gentle approach to the end position and protects the actuator and damper mechanisms. The actuator moves first to the top, then to the bottom spindle end stops when the supply voltage is switched on for the first time, i.e. at the time of commissioning or after pressing the «Adaption» key.

### Home position

Actuation of the «Gear disengagement» key causes the actuator to move to home position. This function is performed by the actuator, even when the supply voltage is restored, if the «Gear disengagement» key was pressed during the electricity interruption.

After this procedure, the actuator then moves into the position defined by the system.

### Functional check

An extremely simple functional check of the dampers is possible: The gearbox can be disengaged simply by pressing the «gear disengagement» key on the housing. As long as the key remains pressed, the damper can be operated manually.

### High functional reliability

The actuators are overload-proof, require no limit switches and automatically stop when the end stop is reached.

## Electrical installation

The ready-to-connect actuator unit is connected to the VRP-M controller with the 6-pin plug.

## Display and operating elements

1. **Direction of rotation switch**
   - Switching over: Direction of rotation changes

2. **Push-button and LED display green**
   - Off: No power supply or fault
   - Illuminated: Operation
   - Press key: Initiates angle of rotation adaptation, followed by standard mode

3. **Push-button and LED display yellow**
   - Off: Standard mode
   - Illuminated: Adaption or synchronisation process active
   - Press key: No function

4. **Gear disengagement key**
   - Press key: Gearbox disengaged, motor stops, manual override possible
   - Release key: Gearbox engaged, synchronisation starts, followed by standard mode

5. **Communication (PC-Tool, ZTH-GEN) is blocked for this actuator type**

---

**Caution!**

An adaption must be carried out when the system is commissioned or whenever the end stops for angle of rotation limiting are adjusted (press the «Adaption» push-button once).
Damper actuator for VRP-M system solution
• Torque 10 Nm
• Running time 150 s

Technical data

### Electrical data
- **Nominal voltage**: AC 24 V, 50/60 Hz / DC 24 V (from VRP-M)
- **Power consumption**
  - Operation: 3.5 W @ nominal torque
  - Rest position: 1.25 W
  - Dimensioning: 6 VA
- **Connection**: 0.5 m cable with 6-pin plug (suitable for VRP-M)

### Functional data
- **Torque (nominal torque)**: Min. 10 Nm @ nominal voltage
- **Position accuracy**: ±5%
- **Direction of rotation**: As an option with switch 0 / 1
- **Direction of motion at Y = 2V**: In switch position 0 or 1
- **Angle of rotation**: max. 95°
- **Running time**: 150 s
- **Sound power level**: max. 35 dB (A)
- **Position indication**: mechanical, plug-in

### Safety
- **Protection class**: III Safety extra-low voltage
- **Degree of protection**: IP54 in all mounting positions
- **EMC**: CE according to 2004/108/EC
- **Principle of operation**: Type 1 (EN 60730-1)
- **Ambient temperature**: −30 ... +50 °C
- **Non-operating temperature**: −40 ... +80 °C
- **Ambient humidity**: 95% r.h., non-condensing (EN 60730-1)
- **Maintenance**: Maintenance-free

### Dimensions / Weight
- **Dimensions**: See «Dimensions» on page 35
- **Weight**: Approx. 710 g

### Safety notes
- The actuator 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.
- Legal regulations and 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 cable must not be removed from the device.
- When the required torque is calculated, the cross section, design and installation site as well as the air flow conditions must be observed.
- The device contains electrical and electronic components and is not allowed to be disposed of as household refuse. All locally valid regulations and requirements must be observed.
**Product features**

**Simple direct mounting** Simple direct mounting on the damper spindle with a universal spindle clamp, supplied with a universal mounting bracket to prevent the actuator from rotating.

**Manual override** Manual operation with self-resetting pushbutton possible (the gear is disengaged for as long as the button is pressed).

**Adjustable angle of rotation** Adjustable angle of rotation with mechanical end stops.

**Adaption** Angle-of-rotation sensing and adaptation of the control range. Triggered by pressing a button on the actuator, with LEDs for status display.

**High functional reliability** The actuator is overload protected, requires no limit switches and automatically stops when the end stop is reached.

**Accessories**

<table>
<thead>
<tr>
<th>Description</th>
<th>Data sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical accessories</td>
<td></td>
</tr>
<tr>
<td>Auxiliary switch S..A.</td>
<td>T2 - S..A.</td>
</tr>
<tr>
<td>Feedback potentiometer P..A.</td>
<td>T2 - P..A.</td>
</tr>
<tr>
<td>Mechanical accessories</td>
<td></td>
</tr>
<tr>
<td>Shaft extension AV6-20</td>
<td>T2 - Z-NM..A..</td>
</tr>
</tbody>
</table>

**Electrical installation**

The ready-to-connect actuator unit is connected to the VRP-M controller with the 6-pin plug.

**Display and operating elements**

1. **Direction of rotation switch**
   - Switching over: Direction of rotation changes

2. **Push-button and LED display green**
   - Off: No power supply or fault
   - Illuminated: Operation
   - Press key: Switches on angle of rotation adaptation followed by standard mode

3. **Push-button and LED display yellow**
   - Off: Standard mode
   - Illuminated: Adaption or synchronising process active
   - Press key: No function

4. **Gear disengagement key**
   - Press key: Gear disengaged, motor stops, manual override possible
   - Release key: Gear engaged, synchronisation starts, followed by standard mode

5. **Communication (PC-Tool, ZTH-GEN) is blocked for this actuator type**
### Technical data

#### Electrical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage</td>
<td>AC 24 V, 50/60 Hz / DC 24 V (from VRP-M)</td>
</tr>
<tr>
<td>Power consumption</td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>8.5 W @ nominal torque</td>
</tr>
<tr>
<td>Rest position</td>
<td>3.5 W</td>
</tr>
<tr>
<td>Dimensioning</td>
<td>11 VA</td>
</tr>
</tbody>
</table>

#### Functional data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque</td>
<td>Min. 20 Nm @ nominal voltage</td>
</tr>
<tr>
<td>Motor</td>
<td>Min. 20 Nm</td>
</tr>
<tr>
<td>Spring-return</td>
<td></td>
</tr>
<tr>
<td>Position accuracy</td>
<td>±5%</td>
</tr>
<tr>
<td>Direction of rotation</td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td>As an option with switch L/R</td>
</tr>
<tr>
<td>Spring-return</td>
<td>As an option by installation L/R</td>
</tr>
<tr>
<td>Direction of rotation for Y = 0 V</td>
<td>in switch position L/R or R</td>
</tr>
<tr>
<td>Manual override</td>
<td>With hand crank and interlocking switch</td>
</tr>
<tr>
<td>Angle of rotation</td>
<td>Max. 95° (can be limited by adjustable mechanical stop)</td>
</tr>
<tr>
<td>Running time</td>
<td>≤150 s / 90°-4</td>
</tr>
<tr>
<td>Motor</td>
<td>≤20 s @ –20 ... 50°C / max. 60 s @ –30°C</td>
</tr>
<tr>
<td>Spring-return</td>
<td></td>
</tr>
<tr>
<td>Sound power level</td>
<td>≤40 dB (A) @ 150 s running time</td>
</tr>
<tr>
<td>Motor</td>
<td>≤62 dB (A)</td>
</tr>
<tr>
<td>Spring-return</td>
<td></td>
</tr>
<tr>
<td>Service life</td>
<td>Min. 60,000 emergency settings</td>
</tr>
</tbody>
</table>

#### Safety

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection class</td>
<td>III Safety extra-low voltage</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP54</td>
</tr>
<tr>
<td>EMC</td>
<td>CE according to 2004/108/EC</td>
</tr>
<tr>
<td>Certification</td>
<td>Certified in accordance with IEC/EN 60730-1 and IEC/EN 60730-2-14</td>
</tr>
<tr>
<td>Principle of operation</td>
<td>Type 1.AA</td>
</tr>
<tr>
<td>Rated current voltage</td>
<td>0.8 kV</td>
</tr>
<tr>
<td>Control pollution degree</td>
<td>3</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>–30 ... +50°C</td>
</tr>
<tr>
<td>Non-operating temperature</td>
<td>–40 ... +80°C</td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>95% r.h., non-condensing</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Maintenance-free</td>
</tr>
</tbody>
</table>

#### Dimensions / Weight

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>See «Dimensions» on page 35</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 2.3 kg</td>
</tr>
</tbody>
</table>
Spring-return actuator for VRP-M system solution

Safety notes

- The actuator 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.
- Legal regulations and 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 cable must not be removed from the device.
- The device contains electrical and electronic components and is not allowed to be disposed of as household refuse. All locally valid regulations and requirements must be observed.

Product features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle of operation</td>
<td>The actuator is controlled by the Belimo VRP-M controller and travels to the position defined by the control signal.</td>
</tr>
<tr>
<td>Simple direct mounting</td>
<td>Simple direct mounting on the damper spindle with a universal spindle clamp; a universal mounting bracket is enclosed to prevent the actuator from rotating.</td>
</tr>
<tr>
<td>Adjustable angle of rotation</td>
<td>Adjustable angle of rotation with mechanical end stop.</td>
</tr>
<tr>
<td>Adaption</td>
<td>Angle-of-rotation sensing and adaptation of the control range. Triggered by pressing a button on the actuator, with LEDs for status display.</td>
</tr>
<tr>
<td>High functional reliability</td>
<td>The actuator is overload protected, requires no limit switches and automatically stops when the end stop is reached.</td>
</tr>
</tbody>
</table>

Accessories

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Data sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical accessories</td>
<td>Auxiliary switch S2A-F</td>
<td>T2 - Z-SM..A..</td>
</tr>
<tr>
<td>Mechanical accessories</td>
<td>Various accessories (spindle clamps, shaft extensions, etc.)</td>
<td></td>
</tr>
</tbody>
</table>

Electrical installation

The ready-to-connect actuator unit is connected to the VRP-M controller with the 6-pin plug.

Display and operating elements

1. Membrane key and LED display green
   - Off: No power supply or fault
   - Illuminated: Operation
   - Press key: Initiates angle of rotation adaptation, followed by standard mode

2. Membrane key and LED display yellow
   - Off: Standard mode
   - Illuminated: Adaption or synchronisation process active
   - Press key: No function

3. Communication (PC-Tool, ZTH-GEN) is blocked for this actuator type

Operating elements

The elements manual override, locking switch and direction of rotation switch are available on both sides.
Dimensions

Dimensional drawings of VRP-M controller

Dimensional drawings of VFP-100 sensor

Dimensional drawings of VFP-300 and VFP-600 sensors

Dimensional drawings of VFD3

Dimensional drawings LMQ24A-SRV-ST

<table>
<thead>
<tr>
<th>Damper spindle</th>
<th>Length</th>
<th>Ø</th>
<th>T</th>
<th>Ø</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥40</td>
<td>8...26.7</td>
<td>≥8</td>
<td>≤26.7</td>
</tr>
<tr>
<td></td>
<td>≥20</td>
<td>8...20</td>
<td>≥8</td>
<td>≤20</td>
</tr>
</tbody>
</table>

* Option (Accessory K-NA)

Dimensional drawings NMQ24A-SRV-ST

<table>
<thead>
<tr>
<th>Damper spindle</th>
<th>Length</th>
<th>Ø</th>
<th>T</th>
<th>Ø</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥42</td>
<td>8...26.7</td>
<td>≥8</td>
<td>≤26.7</td>
</tr>
<tr>
<td></td>
<td>≥20</td>
<td>8...20</td>
<td>≥8</td>
<td>≤20</td>
</tr>
</tbody>
</table>

* Option (Accessory K-SA)

Dimensional drawings NM24A-V-ST

<table>
<thead>
<tr>
<th>Damper spindle</th>
<th>Length</th>
<th>Ø</th>
<th>T</th>
<th>Ø</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥40</td>
<td>8...26.7</td>
<td>≥8</td>
<td>≤26.7</td>
</tr>
<tr>
<td></td>
<td>≥20</td>
<td>8...20</td>
<td>≥8</td>
<td>≤20</td>
</tr>
</tbody>
</table>

* Option (Accessory K-NA)

Dimensional drawings SF24A-V-ST

**Variant 1a:** 3/8"-spindle clamp (with insertion part) EU Standard

<table>
<thead>
<tr>
<th>Damper spindle</th>
<th>Length</th>
<th>Ø</th>
<th>T</th>
<th>Ø</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥85</td>
<td>10...22</td>
<td>10</td>
<td>14...25.4</td>
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</table>

**Variant 1b:** 1"-spindle clamp (without insertion part) EU Standard

<table>
<thead>
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<th>Damper spindle</th>
<th>Length</th>
<th>Ø</th>
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<tbody>
<tr>
<td></td>
<td>≥85</td>
<td>19...25.4 (26.7)</td>
</tr>
<tr>
<td></td>
<td>≥15</td>
<td>12...18</td>
</tr>
</tbody>
</table>
**All inclusive.**

**5 years Guarantee**

**Worldwide present**

**Complete assortment from a single source**

**Examined Quality**

**Short delivery time**

**Comprehensive support**

---

### Headquarters

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Fax +41 (0)43 843 62 68  
info@belimo.ch  
www.belimo.com

### Subsidiaries, Representatives and Agencies

<table>
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