Adaptive VAV control system for sensitive working areas

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## Overview of the system

**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
  - CLOSED / \( V_{\text{min}} / V_{\text{mid}} / V_{\text{max}} / \) OPEN
  - CLOSED / \( P_{\text{min}} / P_{\text{max}} / \) Motor stop / OPEN

**Bus integration**

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

---

### 1 Controller platform

**VRP-M**

<table>
<thead>
<tr>
<th>VAV / CAV</th>
<th>STP (STP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>AC/DC 24 V</td>
</tr>
<tr>
<td>Reference variable control</td>
<td>0 / 2 ... 10 V, 0 / 4 ... 20 mA</td>
</tr>
<tr>
<td>Feedback, actual value</td>
<td>Volumetric flow 0 / 2 ... 10 V, ( \Delta p ) 0 / 2 ... 10 V</td>
</tr>
<tr>
<td>Tools</td>
<td>PC-Tool VRP-M module, Service-Tool ZTH-GEN</td>
</tr>
<tr>
<td>Optimiser-compatible</td>
<td>●</td>
</tr>
<tr>
<td>Suitable gateways</td>
<td>UK24LON, UK24EIB, UK24MOD, UK24BAC</td>
</tr>
<tr>
<td>Suitable MP-masters</td>
<td>DDC systems from Belimo MP partners, COU24-A-MP</td>
</tr>
</tbody>
</table>

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### 2 Pressure sensors

<table>
<thead>
<tr>
<th>VFP-100</th>
<th>VFP-300</th>
<th>VFP-600</th>
<th>VFD3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring principle</td>
<td>static</td>
<td>static</td>
<td>static</td>
</tr>
<tr>
<td>Pressure range</td>
<td>0 ... 100 Pa</td>
<td>0 ... 300 Pa</td>
<td>0 ... 600 Pa</td>
</tr>
<tr>
<td>Comfort zone</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dusty air</td>
<td>Dusty to very dusty 2)</td>
<td>dusty 2)</td>
<td></td>
</tr>
<tr>
<td>Corrosive media</td>
<td>Corrosive air 3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection</td>
<td>Integrated cable/plug unit, suitable for VRP-M</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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### 3 Damper actuators

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Standard</td>
<td>Fast runners</td>
<td>Fast runners</td>
</tr>
<tr>
<td>Torque</td>
<td>10 Nm</td>
<td>4 Nm</td>
<td>8 Nm</td>
</tr>
<tr>
<td>Running time</td>
<td>110 ... 150 s</td>
<td>2.5 s</td>
<td>4 s</td>
</tr>
<tr>
<td>Emergency function</td>
<td>OPEN or CLOSED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection</td>
<td>Integrated cable/plug unit, suitable for VRP-M</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

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
- Pressure-independent VAV and CAV systems, e.g. in laboratories
- Fast-running VAV and CAV applications, e.g. in digestors or generally for extracting contaminated or slightly aggressive air in closed rooms

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

Controller

Adaptive VRP-M digital PID volumetric flow controller for VAV applications  

Sensors

Sensors with static differential pressure measurement for all applications 1)
- VFP-100, measuring range 0 ... 100 Pa
- VFP-300, measuring range 0 ... 300 Pa
- VFP-600, measuring range 0 ... 600 Pa

Sensor with dynamic differential pressure measurement for comfort applications
- VFD3, adjustable measuring range 0 ... 100 / 300 / 600 Pa

Actuators

- Standard actuator NM24A-V-ST
- Fast runners LMQ24A-SRV-ST and NMQ24A-SRV-ST
- Spring-return actuator with emergency setting function SF24A-V-ST

Brief description

Application
This ready-to-connect system solution is an efficient control system for pressure-independent, standard and fast-running volumetric flow applications.

Field of application
The VAV system is used for the regulated supplying and extraction of contaminated or slightly aggressive air 1) in enclosed spaces:
- Exhaust air systems for laboratory workplaces 1)
- Laboratories in chemical and pharmaceutical plants 1)
- Hospital plants 1)

In conjunction with the fast running actuators LMQ24A-SRV-ST and NMQ24A-SRV-ST, the system is particularly suitable for laboratory applications for the suctioning off of contaminated air 1):

The VRP-M system with standard actuators is compatible with Fan Optimiser COU24-A-MP. The use of VRP-M with fast running actuators is not permitted for the optimiser function!

Function
The differential pressure at the static pressure sensor is converted into an actual volumetric flow signal with a linear throughflow and serves as the actual value for the self-adaptive PID-VAV controller.

The actual volumetric flow signal (0 ... 100% \( \dot{V}_{\text{nom}} \)) can be tapped on the VRP-M as an analogue signal.

1) Air compatibility test essential (see «Technical data» for the VFP-...-sensors, page 23).
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 LMQ24A-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 characteristics

<table>
<thead>
<tr>
<th>Control characteristics</th>
<th>Adaptive, digital PID VAV 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>In addition to standardised VAV and CAV applications, the VRP-M system solution is also suitable for fast running applications such as those required in laboratories. 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 unit manufacturer (see «System components», page 3).</td>
</tr>
<tr>
<td>VAV – variable volumetric flow</td>
<td>Variable air volume applications based on a modulating reference variable, e.g. supplied by a DDC controller, room temperature controller or bus operation. The reference signal for the $V_{min}$ ... $V_{max}$ operating range can be set as follows: DC 0 ... 10 V / DC 2 ... 10 V or bus operation</td>
</tr>
<tr>
<td>CAV – constant volumetric flow</td>
<td>Constant air volume applications with operating modes: CLOSED / $V_{min}$ / $V_{mid}$ / $V_{max}$ / 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. The VRP-M system with standard actuators is compatible with Fan Optimiser COU24-A-MP. See System documentation COU24-A-MP.</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 volumetric flow controller for VRP-M system solutions
- For pressure-independent VAV and CAV systems
- Control: 0 ... 10 / 2 ... 10 V or MP bus
- Diagnostic socket for Service or PC-Tool

### Technical data

#### Electrical data

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<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>Dimensioning</td>
<td>2.6 VA (incl. Sensor VF.., without damper actuator)</td>
</tr>
</tbody>
</table>

#### Functional data

<table>
<thead>
<tr>
<th>Reference signal w (terminal 3)</th>
<th>Input impedance &gt;200 kΩ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range: V_{min} ... V_{max}</td>
<td>DC 0 ... 10 / 2 ... 10 V or</td>
</tr>
<tr>
<td>Actual value, volumetric flow U5 (terminal 5)</td>
<td>DC 0 ... 10 / 2 ... 10 V, max. 5 mA</td>
</tr>
<tr>
<td>OPEN operating mode – z1 (terminal 6)</td>
<td>OPEN, input impedance &gt;300 kΩ</td>
</tr>
<tr>
<td>CAV operating modes z2 (terminal 7)</td>
<td>CLOSED / V_{min} / V_{mid} / V_{max}</td>
</tr>
</tbody>
</table>

#### Control characteristics

- PID, adaptive
- Control tolerance ±5% of V_{nom}

#### LEDs display

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

#### MP bus function (terminal 4) 3)

- MP 1 ... 8 (classic operation: PP)

#### Address in bus operation

- Adjusted with VRP-M-Tool and address push-button

#### 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 ... 90% r.h., non-condensing (EN 60730-1)

#### Dimensions / Weight

- Dimensions See «Dimensions» on page 35
- Weight Approx. 250 g (without sensor)

---

1) See «Creep flow limitation and minimum setting limit», page 10
2) Not available with DC 24 V supply
3) 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-independent variable (VAV) and constant (CAV) volumetric flow controls.

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

Electrical connections

Front panel

Connecting terminals 1 ... 7
Supply and control

Tab connection Damper actuator

Tab connection Pressure sensor

Service/PC-Tool diagnostic socket

Assignment of connecting terminals 1 ... 7

AC 24 V
DC 24 V

VAV reference signal \( V_{\text{min}} \ldots V_{\text{max}} \)

PP/MP communication

Volumetric flow actual value 0 ... 100\% \( V_{\text{nom}} \)

OPEN operating mode

CAV CLOSED operating mode \( V_{\text{min}} \ldots V_{\text{mid}} \ldots V_{\text{max}} \)

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>– Device defective</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flashing:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– With Set push-button pressed down for MP addressing</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>– Volumetric flow &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>– Volumetric flow &lt; setpoint = damper opens or is open</td>
</tr>
</tbody>
</table>

\( \Delta p > 0 \) Yellow LED

Zero offset pressure sensor VFP-..

(for procedure, see page 9)

Set Push-button for assigning the MP address in bus operation

(for procedure, see page 22)
Electrical installation

**Wiring diagrams: VAV 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 ... 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 18 to 20 for a functional description

**Version overview, Release Note - VRP-M system solution**

Up-to-date information about compatibility, versions and functions can be found at www.belimo.eu
Electrical installation (continued)

Wiring diagrams: CAV operation

Example 1:

Example 2:

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 functional description

* Function not available with DC 24 V supply.
Commissioning

Prerequisites

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

- The system solution is mounted on the VAV 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 $\Delta p$ @ $V_{\text{nom}}$ value of the VAV unit
- 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 $V_{\text{min}}$ / $V_{\text{max}}$ 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 is to be performed after each adjustment of the damper angle of rotation limitation, particularly in plants which are operated with a fan optimiser function.

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.

DIP switch Position | Pressure range | Remarks
--- | --- | ---
0 ... 100 Pa | Default setting
0 ... 300 Pa | Differential pressure measurement up to 500 Pa
0 ... 600 Pa | Cannot be used with the VRP-M
–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.
Nominal volumetric flow $V_{\text{nom}}$

$V_{\text{nom}}$ corresponds to the maximum volumetric flow of the VAV unit at which the pressure drop and noise are still within the permissible operating conditions. The $V_{\text{nom}}$ values are specified and programmed permanently by the unit manufacturer.

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

### Creep flow limitation

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

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. The operating range is physically limited owing to the dynamic behaviour of the differential pressure sensor in this area and the flow pattern of the fluid being pumped.

**Sensor** | **Pressure range** | **Limitation**
---|---|---
VFP-100 | 0 ... 100 Pa | 1 Pa
VFP-300 | 0 ... 300 Pa | 3 Pa
VFP-600 | 0 ... 600 Pa | 6 Pa
VFD3 | 0 ... 100 Pa | 1 Pa
| 0 ... 300 Pa | 3 Pa
| 0 ... 600 Pa | 6 Pa

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

Oversized VAV units can make it harder to regulate the lowermost pressure value range. The manufacturer will specify the lowest permissible volumetric flow for the units, usually corresponding to a pressure value of approximately 5 ... 12 Pa. Functional restrictions in this range can be avoided by complying with the unit manufacturer’s volumetric flow adjustment.

**Start point**

**End point**

Setting $[V_{\text{min}}]$

Setting $[V_{\text{max}}]$

1. Creep flow limitation <2 Pa
2. Unit manufacturer’s minimum setting limit
Functions

Control tolerance
The maximum permissible control tolerance is defined as a percentage of the nominal volumetric flow $V_{nom}$. If the control deviation exceeds or undershoots this tolerance, the actuator is adjusted so that the actual volumetric flow corresponds to the required setpoint.

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

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

VAV operating volumetric flow
In variable operation, the pressure is specified by means of the reference signal in the range $V_{min} ... V_{max}$.

- $V_{max}$ forms the upper limit value as a function of the nominal volumetric flow.
- $V_{min}$ forms the lower limit value as a function of $V_{nom}$.

Adjustment range $30 ... 100\%$ of $V_{nom}$.

Adjustment range $0 ... 100\%$ of $V_{nom}$.

Voltage level

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

For override control in VAV 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).

CAV operating modes

Five operating modes are available for step mode:

- Shut-off operation – Damper CLOSED: The damper is moved into the CLOSED position in a defined manner.
- Operating modes $V_{min}$ / $V_{mid}$ / $V_{max}$: The VRP-M permanently regulates the selected volumetric flow.
- Flushing operation – damper OPEN: The damper can be opened for maximum ventilation, in which case volumetric flow control is deactivated!

The operating mode control signals are connected to inputs 6 (z1) and 7 (z2). If signals appear at these two inputs simultaneously, input 6 (z1) for the OPEN function takes priority.
Adaptive volumetric flow controller

Functions (continued)

If necessary, the VAV \( V_{\text{min}} \) ... \( V_{\text{max}} \) range can be overridden by fixed operating modes in VAV applications.

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 \( V_{\text{min}} / V_{\text{mid}} / V_{\text{max}} \): The VRP-M permanently regulates the selected volumetric flow.
- Flushing operation – damper OPEN: The damper can be opened for maximum ventilation, in which case volumetric flow 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 / ( V_{\text{min}} / V_{\text{mid}} / V_{\text{max}} )</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>( V_{\text{min}} ) ... ( V_{\text{max}} )</td>
</tr>
</tbody>
</table>

Notes

- \( V_{\text{mid}} \): All inputs (3 / 6 / 7) open.
- \( V_{\text{mid}} \) not available with DC 24 V supply.

Note

\( V_{\text{mid}} \) is not available with DC 24 V supply.
System configuration

Unit manufacturer’s settings

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

- **Function**: Volumetric flow
- **Sensor**: The pressure sensor type is specified to enable the pressure range to be adapted.
- **Actuator**: The actuator type is specified for the adaptation of the running time characteristics.
- **Density**: Density adjustment to the environment.
- **Height**: Height above sea level for density calculation.

**Control – reference signal w, actual volumetric flow signal U5**

The reference signal \( w \) and the volumetric flow actual value signal \( U_5 \) are adapted to the MCR system.

Selection DC 0...10 V / DC 2...10 V / adjustable (sequence matching in the 0...10 V range)

**Calibration – \( V_{\text{nom}} \)**

The \( V_{\text{nom}} \) values are specified and permanently programmed by the unit manufacturer. With the setting of the \( V_{\text{nom}} \), every VRP-M system solution is optimally adapted to the VAV unit used. \( V_{\text{nom}} \) corresponds to the maximum volumetric flow of the VAV unit at which the pressure drop and noise are still within the permissible operating conditions. The \( V_{\text{nom}} \) setting is specified by the unit manufacturer.

**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 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!
PC-Tool VRP-M module – operating data setting

Adjustments on the system with PC-Tool

The VRP-M module enables, if needed, the adjustment of the operating data ($V_{\text{min}}$, $V_{\text{mid}}$, $V_{\text{max}}$ 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).

VRP-M module
Service tab

1 Identification
2 Operating volumetric flow settings
3 System designation entry
4 Volumetric flow

Operating volumetric flow settings

These parameters are used to set the VAV unit to the air volumes required for the respective application. The settings are based on the air volumes calculated by the planning engineer and can either be preset by the VAV unit manufacturer or adjusted on the system using the VRP-M module.

$V_{\text{max}}$ Adjustment range 30 ... 100% of $V_{\text{nom}}$
Upper volumetric flow limit

$V_{\text{min}}$ Adjustment range 0 ... 100% of $V_{\text{nom}}$
Lower volumetric flow limit

$V_{\text{nom}}$ Control range $x \cdot \text{...} 100\%$ of $V_{\text{nom}}$

Shut-off operation (CLOSED) via $V_{\text{min}}$ setting
If a shut-off function is required in VAV operation, it can be achieved with the setting $V_{\text{min}}$ 0%

$V_{\text{mid}}$ Range 0 ...100% of the range $V_{\text{min}}$ ... $V_{\text{max}}$
An intermediate position $V_{\text{mid}}$ is available for constant volume applications (CAV) to facilitate finer steps.

$V_{\text{nom}}$ settings below the control range
$V_{\text{min}}$ values below the start value displayed in the range can be set, e.g. for VAV units 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

Adaptive volumetric flow controller

PC-Tool VRP-M module – Operating data settings (continued)

VRP-M module
Expert tab

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

2 Control
- Individual setting
  - Reference signal \( w \)
  - Volumetric flow actual value signal \( U_5 \)

3 VRP-M system information
- VRP-M version and calibration value setting
- Volumetric flow function
- Sensor type
- Actuator type

4 Ambient conditions
- Height above sea level
- Density

Mode setting
Options: 0... 10 V / 2...10 V / individual setting
The mode setting acts on the reference signal \( w \) and the volumetric flow actual value signal \( U_5 \). 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 volumetric flow actual value signal \( U_5 \) to the MCR system directly on the control system. The reference signal \( w \) and the volumetric flow actual value signal \( U_5 \) can be set to different values (e.g. reference signal \( w \): 2 ... 10 V / actual value signal \( U_5 \): 0 ... 10 V).

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

Actual value signal \( [U_5] \) / display range 0 ... 100% \( V_{\text{nom}} \)
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: large e.g. 1822 m, for St. Moritz, Switzerland
- Temperature of medium: medium Mean value, e.g. 19°C
- Humid medium: negligible Average, e.g. 45% r.h.

All relevant parameters can be entered through the «Ambient conditions» adjustment marker in the Expert tab. The following values are required for calculating the density and the correction value for the VFD3 signal:
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**

![Diagram of conventional operation and connection via service socket]

**Connection in control cabinet**

![Diagram of connection in control cabinet]

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

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></td>
</tr>
</tbody>
</table>

ZTH-GEN connection in MP bus system:
The MP connection should be separated from the MP bus while the ZTH-GEN is operating.

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></td>
</tr>
</tbody>
</table>

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.

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.
**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 Vx.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 Vx.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>EPIV unit</td>
<td>m³/h / l/min / gpm</td>
<td>Valves</td>
<td></td>
</tr>
<tr>
<td>Supply ... AC ... V VHW: ... %</td>
<td></td>
<td></td>
<td>Display of the current AC 24 V supply voltage, with direct connection to terminals (ZK2-GEN)</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>PICCV function</td>
<td>0 / 1</td>
<td>Valves Belimo US</td>
<td>Enable PICCV Wizard function</td>
</tr>
<tr>
<td>Expert Mode</td>
<td>0 / 1</td>
<td>VAV</td>
<td>Enable VAV settings: Switching mode, set Vmin / Vmax to original values (call up OEM setting)</td>
</tr>
<tr>
<td>Advanced Mode</td>
<td>0 / 1</td>
<td>VAV</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
      - Type
        - Designation
      - Type
        - Firmware
      - Type
        - Serial number

- **Data, settings**
  - Volume: 125 m³/h
  - Setpoint: 124 m³/h
  - Δp: 164 Pa
  - Position: 65%
  - Step: >Auto<
  - Mode
    - – new
      - 0 ... 10 V
    - – new
      - 2 ... 10 V

- **Option, range**
  - Auto / Open / Closed / Vmax / Vmin / Stop
  - 0 ... 10 / 2 ... 10 V

- **Vmin**
  - 10 m³/h
  - – new: 25 m³/h

- **Vmax**
  - 250 m³/h
  - – new: 200 m³/h

- **Vnom**
  - 250 m³/h

- **Address**
  - PP
  - – new: MP4
  - PP / MP1 / MP2 / MP3 ... MP8
Bus operation

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 over 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 opened 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

**Damper position (starting with VRP-M Version V3.x)**
(nvoAbsAngle – absolute actuator position in angular degrees (°))
The feedback signal, i.e. the network variable nvoAbsAngle, is not available for applications with NM24-V-ST actuators (old actuator generation).

**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 mode independently of the VAV control loop. The sensor signal is connected to the reference value input that is not used in MP bus mode (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 volumetric flow to the fixed selected value in the range $V_{\text{min}}$ ... $V_{\text{max}}$.

If needed, the VAV range $V_{\text{min}}$ ... $V_{\text{max}}$ can be overridden in bus operation by fixed operating modes (control inputs $z1$ and $z2$).

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 $\dot{V}_{\text{mid}}$ / $\dot{V}_{\text{max}}$: The VRP-M permanently moves the selected volumetric flow.
- Flushing operation – damper OPEN: The damper can be opened for maximum ventilation, in which case the volumetric flow control is deactivated.
**Operating volumetric flow setting** $V_{\text{min}} / V_{\text{max}}$

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

<table>
<thead>
<tr>
<th>Function</th>
<th>Volumetric flow</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{\text{nom}}$</td>
<td>Nominal</td>
<td>OEM-specific value, depending on the application and the VAV unit type</td>
</tr>
<tr>
<td>$V_{\text{max}}$</td>
<td>Maximum</td>
<td>30 ... 100% of $V_{\text{nom}}$</td>
</tr>
<tr>
<td>$V_{\text{min}}$</td>
<td>Minimum</td>
<td>0 * ... 100% of $V_{\text{nom}}$</td>
</tr>
</tbody>
</table>

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

**Open operating volumetric flow setting**

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

This operating setting allows the limitation of the volumetric flow to be adjusted without altering the parameters on the VAV 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 z1</td>
<td>1</td>
<td>OPEN</td>
</tr>
<tr>
<td>7 z2</td>
<td>2</td>
<td>CLOSED / $V_{\text{mid}} / V_{\text{max}}$</td>
</tr>
<tr>
<td>3</td>
<td>MP override function 1 OPEN 2 CLOSED 3 $V_{\text{max}}$ 4 $V_{\text{min}}$ 5 $V_{\text{mid}}$ 6 $V_{\text{nom}}$ 7</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>MP setpoint 0 ... 100% = $V_{\text{min}}$ ... $V_{\text{max}}$</td>
<td></td>
</tr>
</tbody>
</table>

**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.

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

---

**Note**

$V_{\text{nom}}$ is not available with DC 24 V supply.

**Open operating volumetric flow setting**

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

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The VRP-M starts with its MP initial status (setpoint 0%, corresponding to the $V_{\text{min}}$ setting) if a power failure occurs in the intervening period.
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 through 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 7

MP bus signal cable length
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 NMV-D2-MP 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)
Technical data sheet

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

Type overview

<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 15V (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 orientation: 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
- Switching differential: Max. 0.1% of final value
- Temperature sensitivity: See «Type overview»
- Measuring range: t = +10 ... 40 °C (reference temperature t₀ = 25 °C)

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

<table>
<thead>
<tr>
<th>Product features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Application</strong></td>
</tr>
</tbody>
</table>

**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. |
Dynamic pressure value sensor for room ventilation applications in the comfort zone
- Adjustment range:
  adjustable with DIP switch in the range between 0 ... 100 / 300 / 600 Pa
- Cable connection with plug, suitable for VAV-Universal VRP-M

### 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 15...24 V</td>
</tr>
<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 Operation</td>
<td>0.35 W</td>
</tr>
<tr>
<td>Power consumption Dimensioning</td>
<td>0.75 VA</td>
</tr>
<tr>
<td>Connection</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>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type, principle of operation</td>
<td>$\Delta p$ 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>
<tr>
<td>Safety</td>
<td></td>
</tr>
<tr>
<td>Protection class</td>
<td>III Safety-extra-low voltage</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP40</td>
</tr>
<tr>
<td>EMC</td>
<td>CE according to 2004/108/EC</td>
</tr>
<tr>
<td>Principle of operation</td>
<td>Type 1</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>0 ... +50°C</td>
</tr>
<tr>
<td>Non-operating temperature</td>
<td>−20 ... +60 °C</td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>0 ... 95% r.h., non-condensating</td>
</tr>
<tr>
<td>Dimensions / Weight</td>
<td>See «Dimensions» on page 35</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 170 g</td>
</tr>
</tbody>
</table>

### 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.
<table>
<thead>
<tr>
<th>Product features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Application</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Principle of operation</strong></td>
</tr>
</tbody>
</table>

**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 $-20 \ldots 100$ 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

**Limitation**
The use of VRP-M with fast running actuators is not permitted for the optimiser function!

### Technical data

#### Electrical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>AC/DC 24 V (from VRP-M controller)</td>
</tr>
<tr>
<td>Power consumption</td>
<td>13 W @ nominal torque</td>
</tr>
<tr>
<td>Operation</td>
<td>1.5 W</td>
</tr>
<tr>
<td>Rest position</td>
<td>23 VA</td>
</tr>
<tr>
<td>Dimensioning</td>
<td></td>
</tr>
<tr>
<td>Connection</td>
<td>0.5 m cable with 6-pin plug (suitable for VRP-M)</td>
</tr>
</tbody>
</table>

#### Functional data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque (nominal torque)</td>
<td>Min. 4 Nm @ nominal voltage</td>
</tr>
<tr>
<td>Direction of rotation</td>
<td>As an option with switch 0 / 1</td>
</tr>
<tr>
<td>Direction of motion at Y = 0V</td>
<td>In switch position 0 or 1</td>
</tr>
<tr>
<td>Angle of rotation</td>
<td>max. 95°&lt;sup&gt;o&lt;/sup&gt;, mechanical end stops adjustable</td>
</tr>
<tr>
<td>Running time</td>
<td>2.5 s / 90°&lt;sup&gt;o&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sound power level</td>
<td>52 dB (A)</td>
</tr>
<tr>
<td>Position indication</td>
<td>Mechanical, plug-in</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 in all mounting positions</td>
</tr>
<tr>
<td>EMC</td>
<td>CE according to 2004/108/EC</td>
</tr>
<tr>
<td>Principle of operation</td>
<td>Type 1 (EN 60730-1)</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 (EN 60730-1)</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. 810 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 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**
Fast-running damper actuator for VRP-M system solution
• Torque 8 Nm
• Running time 4 s

Technical data

<table>
<thead>
<tr>
<th>Technical data</th>
<th>Electrical data</th>
<th>Functional data</th>
<th>Safety</th>
<th>Dimensions / Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Supply</td>
<td>Power consumption</td>
<td>Functional data</td>
<td>Dimensions / Weight</td>
</tr>
<tr>
<td></td>
<td>AC/DC 24 V (from VRP-M controller)</td>
<td>Operation</td>
<td>Torque (nominal torque)</td>
<td>See «Dimensions» on page 35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rest position</td>
<td>Min. 8 Nm @ nominal voltage</td>
<td>Weight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimensioning</td>
<td>Direction of rotation</td>
<td>Approx. 930 g</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>As an option with switch 0 / 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Direction of motion for Y = 0 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>In switch position 0 / 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Angle of rotation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>max. 95°, mechanical end stops adjustable</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Running time</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 s / 90°&lt;2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sound power level</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>52 dB (A)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Position indication</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>mechanical, plug-in</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connection</td>
<td>Connection</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.5 m cable with 6-pin plug (suitable for VRP-M)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>Protection class</td>
<td>Degree of protection</td>
<td>EMC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III Safety extra-low voltage</td>
<td>IP54 in all mounting positions</td>
<td>CE according to 2004/108/EC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Principle of operation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type 1 (EN 60730-1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ambient temperature</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>−30 ... +50° C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non-operating temperature</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>−40 ... +80° C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ambient humidity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>95% r.h., non-condensing (EN 60730-1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maintenance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maintenance-free</td>
<td></td>
</tr>
<tr>
<td>Dimensions / Weight</td>
<td>Dimensions</td>
<td></td>
<td>Weight</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Approx. 930 g</td>
<td></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).
## Technical data

### Electrical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</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>Operation: 3.5 W @ nominal torque</td>
</tr>
<tr>
<td></td>
<td>Rest position: 1.25 W</td>
</tr>
<tr>
<td></td>
<td>Dimensioning: 6 VA</td>
</tr>
<tr>
<td>Connection</td>
<td>0.5 m cable with 6-pin plug (suitable for VRP-M)</td>
</tr>
</tbody>
</table>

### Functional data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque (nominal torque)</td>
<td>Min. 10 Nm @ nominal voltage</td>
</tr>
<tr>
<td>Position accuracy</td>
<td>±5%</td>
</tr>
<tr>
<td>Direction of rotation</td>
<td>As an option with switch 0 / 1</td>
</tr>
<tr>
<td>Direction of motion at Y = 2V</td>
<td>In switch position 0 or 1</td>
</tr>
<tr>
<td>Angle of rotation</td>
<td>max. 95°&lt;sup&gt;–&lt;/sup&gt; Mechanical end stops adjustable</td>
</tr>
<tr>
<td>Running time</td>
<td>150 s</td>
</tr>
<tr>
<td>Sound power level</td>
<td>max. 35 dB (A)</td>
</tr>
<tr>
<td>Position indication</td>
<td>mechanical, plug-in</td>
</tr>
</tbody>
</table>

### Safety

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</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 in all mounting positions</td>
</tr>
<tr>
<td>EMC</td>
<td>CE according to 2004/108/EC</td>
</tr>
<tr>
<td>Principle of operation</td>
<td>Type 1 (EN 60730-1)</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 (EN 60730-1)</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Maintenance-free</td>
</tr>
</tbody>
</table>

### Dimensions / Weight

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>See «Dimensions» on page 35</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 710 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.
- 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.
NM24A-V-ST

Damper actuator for VRP-M system solution

Product features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple direct mounting</td>
<td>Simple direct mounting on the damper spindle with a universal spindle clamp, supplied with a universal mounting bracket to prevent the actuator from rotating.</td>
</tr>
<tr>
<td>Manual override</td>
<td>Manual override with self-resetting push-button possible (gear disengagement for as long as the button is pressed).</td>
</tr>
<tr>
<td>Adjustable angle of rotation</td>
<td>Adjustable angle of rotation with mechanical end stops.</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>Description</th>
<th>Data sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical accessories</td>
<td></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: 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

#### 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>Motor: Min. 20 Nm @ nominal voltage</td>
</tr>
<tr>
<td></td>
<td>Spring-return: Min. 20 Nm</td>
</tr>
<tr>
<td>Position accuracy</td>
<td>±5%</td>
</tr>
<tr>
<td>Direction of rotation</td>
<td>Motor: as an option with switch L / R</td>
</tr>
<tr>
<td></td>
<td>Spring-return: As an option by installation L / R</td>
</tr>
<tr>
<td>Direction of rotation for Y = 0 V</td>
<td>in switch position 1 / 0</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>Motor: ≤150 s / 90°&lt;sup&gt;-3&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Spring-return: ≤20 s @ –20 °C ... 50°C / max. 60 s @ –30°C</td>
</tr>
<tr>
<td>Sound power level</td>
<td>Motor: ≤40 dB (A) @ 150 s running time</td>
</tr>
<tr>
<td></td>
<td>Spring-return: ≤62 dB (A)</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>
</tbody>
</table>

#### Principle of operation

- Type 1.AA

#### Rated current voltage

- 0.8 kV

#### Control pollution degree

- 3

#### Ambient temperature

- –30 °C ... +50 °C

#### Non-operating temperature

- –40 °C ... +80 °C

#### Ambient humidity

- 95% r.h., non-condensing

#### Maintenance

- Maintenance-free

#### 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>
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>Type</th>
<th>Description</th>
<th>Data sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical accessories</td>
<td>Auxiliary switch S2A-F</td>
<td></td>
</tr>
<tr>
<td>Mechanical accessories</td>
<td>Various accessories (spindle clamps, shaft extensions, etc.)</td>
<td>T2 - Z-SM..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. **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: Adaptation 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>ØT</th>
<th>ØI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥40</td>
<td>8 ... 26.7</td>
<td>≥8 ≤26.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥20</td>
<td>8 ... 20</td>
<td>≥8 ≤20</td>
<td></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>ØT</th>
<th>ØI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥42</td>
<td>8 ... 26.7</td>
<td>≥8 ≤26.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥20</td>
<td>8 ... 20</td>
<td>≥8 ≤20</td>
<td></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>ØT</th>
<th>ØI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥40</td>
<td>8 ... 26.7</td>
<td>≥8 ≤26.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥20</td>
<td>8 ... 20</td>
<td>≥8 ≤20</td>
<td></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>ØT</th>
<th>ØI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥85</td>
<td>10 ... 22</td>
<td>10 14 ... 25.4</td>
<td></td>
</tr>
</tbody>
</table>

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

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

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