Adaptive VAV control system for sensitive working areas

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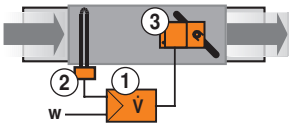
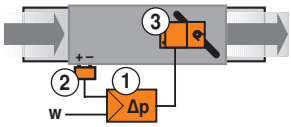
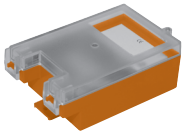
Application

	VAV / CAV	STP (pressure)
		
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	●	
Modulating control	●	
Local override functions	CLOSED / $\dot{V}_{min}$ / $\dot{V}_{mid}$ / $\dot{V}_{max}$ / OPEN	CLOSED / P_{min} / P_{max} / Motor stop / OPEN
Bus integration	MP bus (MP partner systems), LonWorks, KNX, Modbus, BACnet, COU24-A-MP	

① Controller platform



	VRP-M	
	VAV / CAV	**STP**
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	Δp 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	

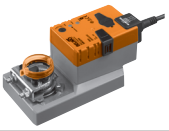
② Pressure sensors



	VFP-100	VFP-300	VFP-600	VFD3
Measuring principle	static	static	static	dynamic
Pressure range	0 ... 100 Pa	0 ... 300 Pa	0 ... 600 Pa	selectable 0 ... 100 / 300 / 600 Pa 5)
Comfort zone	●			
Dusty air	Dusty to very dusty 2)			dusty 2)
Corrosive media	Corrosive air 3)			4)
Connection	Integrated cable/plug unit, suitable for VRP-M			

③ Damper actuators






	NM24A-V-ST	LMQ24A-SRV-ST	NMQ24A-SRV-ST	SF24A-V-ST
Function	Standard	Fast runners	Fast runners	Spring-return
Torque	10 Nm	4 Nm	8 Nm	20 Nm
Running time	110 ... 150 s	2.5 s	4 s	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.

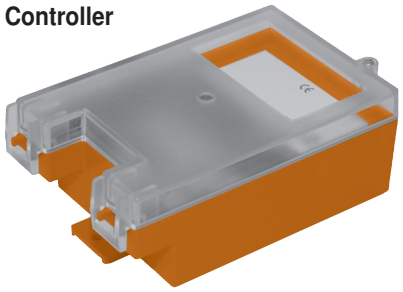
Ready-to-connect system solution for
- **Pressure-independent VAV and CAV systems, e.g. in laboratories**
- **Fast-running VAV and CAV applications, e.g. in digestors or generally for extracting contaminated or slightly aggressive air in closed rooms**

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**

System components

Controller

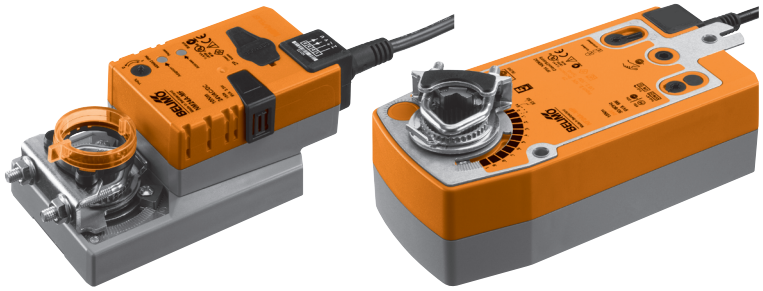


Adaptive VRP-M digital PID volumetric flow controller for VAV applications Pages 5 ... 22

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 Pages 23 ... 24
Sensor with dynamic differential pressure measurement for comfort applications
– VFD3, adjustable measuring range 0 ... 100 / 300 / 600 Pa Pages 25 ... 26

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 Pages 27 ... 34

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!

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

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% $\dot{V}_{nom}$) can be tapped on the VRP-M as an analogue signal.

Brief description

(continued)

The actual value x is compared with the setpoint w set on the VAV controller and the connected damper actuator is connected according to the resulting control deviation.
The VRP-M controller can be controlled according to its application as a CAV constant controller ($\dot{V}_{min}$ / $\dot{V}_{max}$) or a VAV controller via the reference value input w with a modulating 0 … 10 / 2 … 10 V signal in the range from $\dot{V}_{min}$ … $\dot{V}_{max}$. Control inputs with OPEN/CLOSE/$\dot{V}_{mid}$ functions are available for special applications.
The VRP-M can be integrated into 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 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.**

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

System characteristics

Control characteristics — Adaptive, digital PID VAV controller (see «System components», page 3).

Pressure measurement — Belimo pressure sensors (see «System components», page 3).

Damper actuators — Belimo VAV damper actuators (see «System components», page 3).

Optimally matched components — 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).

VAV – variable volumetric flow — 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 $\dot{V}_{min}$ ... $\dot{V}_{max}$ operating range can be set as follows:
DC 0 ... 10 V / DC 2 ... 10 V or bus operation

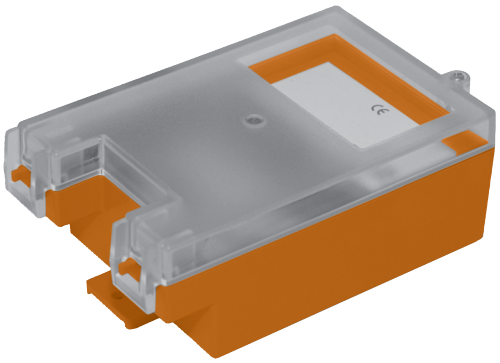
CAV – constant volumetric flow — Constant air volume applications with operating modes:
CLOSED / $\dot{V}_{min}$ / $\dot{V}_{mid}$ / $\dot{V}_{max}$ / OPEN (bus operation)

Bus function — 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.

Diagnostics tool — PC-Tool VRP-M module, ZTH-GEN, can be plugged into the VRP-M or via external cable connection.

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	Nominal voltage	AC 24 V, 50/60 Hz DC 24 V
	Nominal voltage range	AC ±20% / DC ±10%
	Power consumption Operation	1.1 W (incl. Sensor VF.., without damper actuator)
	Dimensioning	2.6 VA (incl. Sensor VF.., without damper actuator)
	Connection Actuator	Plug, 6-pin
	Pressure sensor	Plug, 4-pin
	Terminals 1 ... 7	7-pin screw terminals, 0.5 mm^2 ... 1.5 mm^2
	VRP-M-Tool	Plug, 3-pin
Functional data	Reference signal w (terminal 3) Range: $\dot{V}_{min}$ ... $\dot{V}_{max}$	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) Range 0 ... 100% $\dot{V}_{nom}$	DC 0 ... 10 / 2 ... 10 V, max. 5 mA
	OPEN operating mode – z1 (terminal 6)	OPEN, input impedance >300 kΩ
	CAV operating modes z2 (terminal 7)	CLOSED / $\dot{V}_{min}$ / $\dot{V}_{mid}$ / $\dot{V}_{max}$ Contact current <1 mA
	Control characteristics	PID, adaptive
	Control tolerance	±5% of $\dot{V}_{nom}$
	Ranges $\dot{V}_{nom}$	Nominal volumetric flow (manufacturer-dependent)
	$\dot{V}_{max}$	30 ... 100% of $\dot{V}_{nom}$
	$\dot{V}_{min}$ [1]	0 ... 100% of $\dot{V}_{nom}$
	$\dot{V}_{mid}$ (intermediate position) [2]	0 ... 100% of $\dot{V}_{min}$ ... $\dot{V}_{max}$
	LED display	AC/DC 24 V supply Pressure too high/too low, zero VFP-..sensor
	MP bus function (terminal 4) [3] Address in bus operation Functionality	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)

[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.**

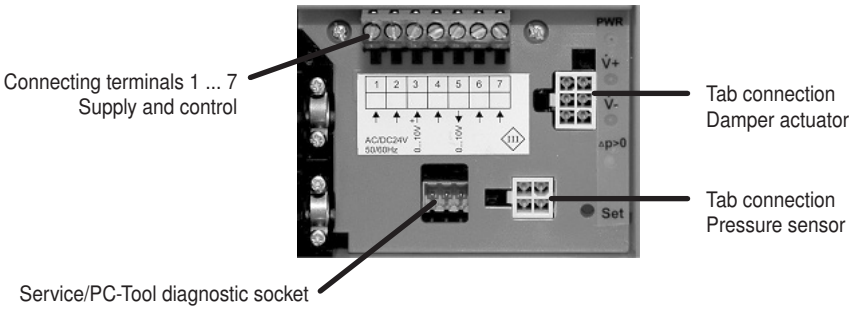
Application

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.

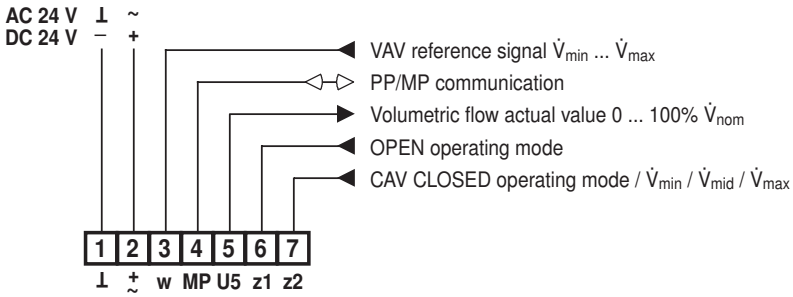
For more information, see «VRP-M system description», pages 3 ... 4

Electrical connections

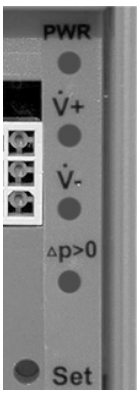
Front panel



Assignment of connecting terminals 1 ... 7



LED display and address push-button



PWR	Green LED	LED on: – Supply AC/DC 24 V OK – Device ready for operation	LED off: – Supply failure – Device defective
	Flashing	– With Set push-button pressed down for MP addressing	
V̇+	Red LED	LED on: – Volumetric flow > setpoint = damper closes or is closed	
V̇–	Red LED	LED on: – Volumetric flow < setpoint = damper opens or is open	
Δp > 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)	

Version overview, Release Note - VRP-M system solution

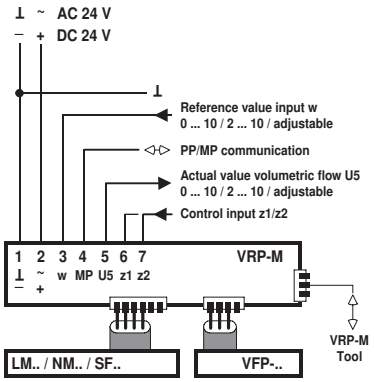
Up-to-date information about compatibility, versions and functions can be found at www.belimo.eu

Electrical installation

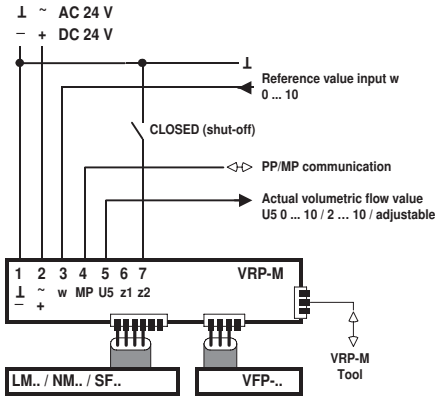
Wiring diagrams: VAV operation

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

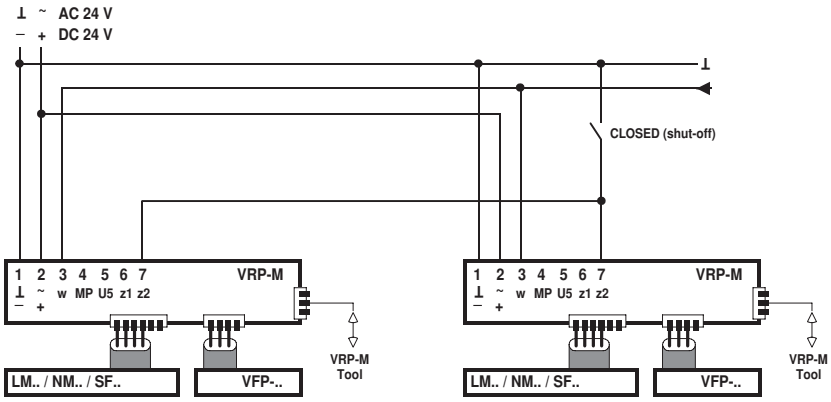
Example 1:
With analogue reference signal



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

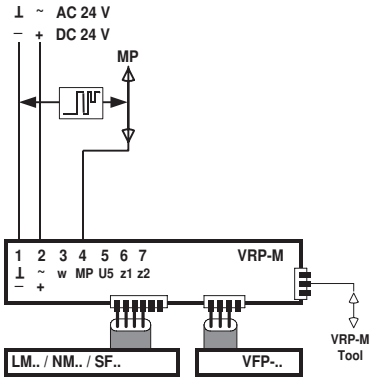


Example 3:
DC 0 ... 10 V with shut-off / parallel control

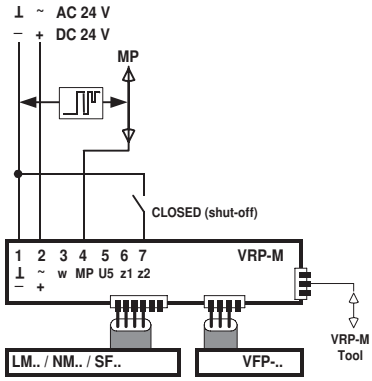


Notes
- Supply via safety isolating transformer!
- We recommend routing connections 1, 2 (AC/DC 24 V) and 4 (MP signal) to accessible terminals (floor distributor, control cabinet, etc.), in order to simplify access with the VRP-M-Tool for diagnostic and service work.

Example 4:
With bus control



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



Bus operation:
See pages 18 to 20 for a functional description

Electrical installation *(continued)*

Wiring diagrams: CAV operation

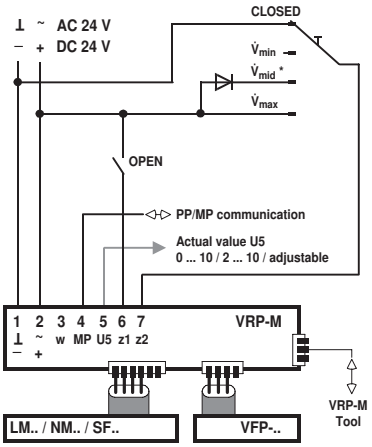
Notes

– 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 functional description

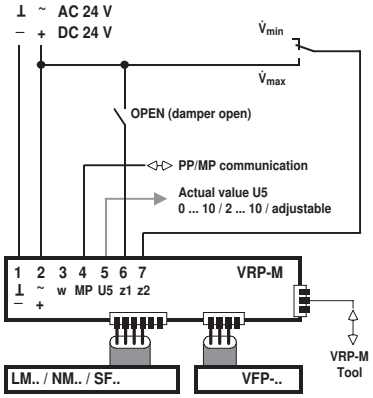
Example 1:



* Function not available with DC 24 V supply.

Example 2:

$\dot{V}_{min}$ – $\dot{V}_{max}$ – OPEN



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 Δp @ $\dot{V}_{nom}$ 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 $\dot{V}_{min}$ / $\dot{V}_{max}$ 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 a angle of rotation adaptation be carried out after every adjustment of the angle of rotation limitation

Note
Fast runner damper actuators LMQ24A-SRV-ST and NMQ24A-SRV-ST
Once the push button gear disengagement key is pressed, a synchronisation is carried out, i.e. the actuator moves CLOSED and returns to the setpoint position.

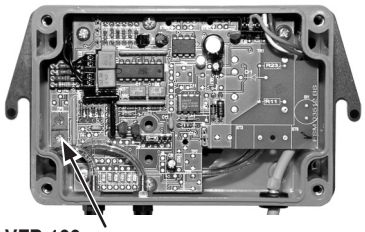
Procedure:

- Switch on the 24 V supply
- Press the «Adaption» push-button (actuator travels CLOSED … OPEN … setpoint position)

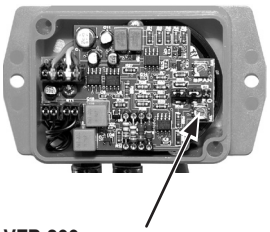
Static pressure sensor VFP-.. Zero offset

- 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 or
  rotate it back until the voltage U5 is <0.04 V / 2.04 V (Mode = 0 ... 10 V / 2 ... 10 V)
- Connect the hose connections to the sensor: observe + / – setting!

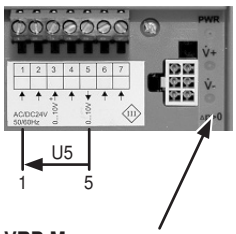
Note
Static pressure sensors VFP-..
In the event of a mounting orientation that deviates from the perpendicular position, it is mandatory that a zero offset be carried out.



VFP-100 Zero potentiometer



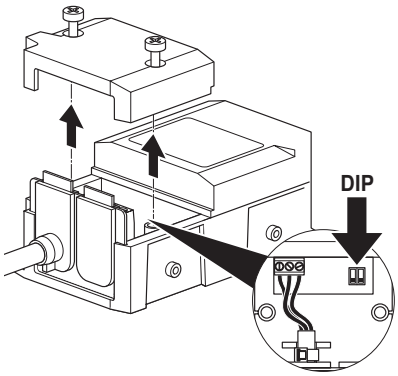
VFP-300
VFP-600 Zero potentiometer



VRP-M LED Δp > 0

Dynamic pressure sensor VFD3 Pressure range setting

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



DIP switch Position	Pressure range	Remarks
	0 ... 100 Pa	
	0 ... 300 Pa	Default setting
	0 ... 600 Pa	Differential pressure measurement up to 500 Pa
	–20 ... 100 Pa	Cannot be used with the VRP-M

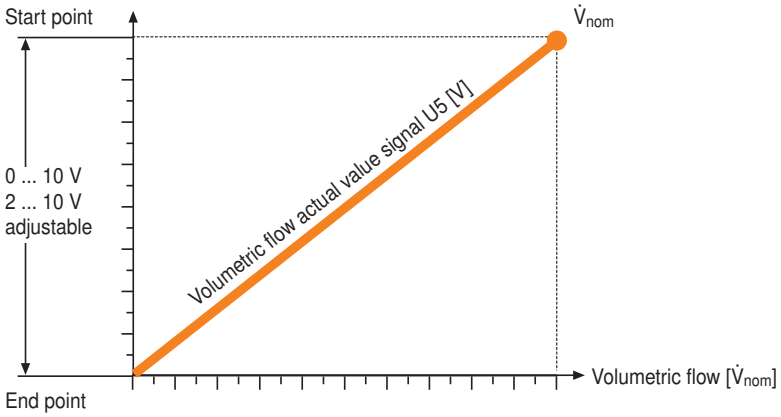
Note
Dynamic pressure sensor VFD3
The pressure range of the VFD3 is set in the factory by the manufacturer of the VAV unit and configured accordingly in the VRP-M. It is mandatory that an adjustment of the pressure range requires an adaptation in the VRP-M configuration.
The pressure range –20 ... 100 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 volumetric flow $\dot{V}_{nom}$

$\dot{V}_{nom}$ 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 $\dot{V}_{nom}$ values are specified and programmed permanently by the unit manufacturer.
The volumetric flow actual value signal U5 is always in reference to the $\dot{V}_{nom}$. For this reason, changes in the operating volumetric flow setting $\dot{V}_{min}$ and $\dot{V}_{max}$ have no influence on the U5 V signal



Creep flow limitation
Minimum setting limit $\dot{V}_{min}$

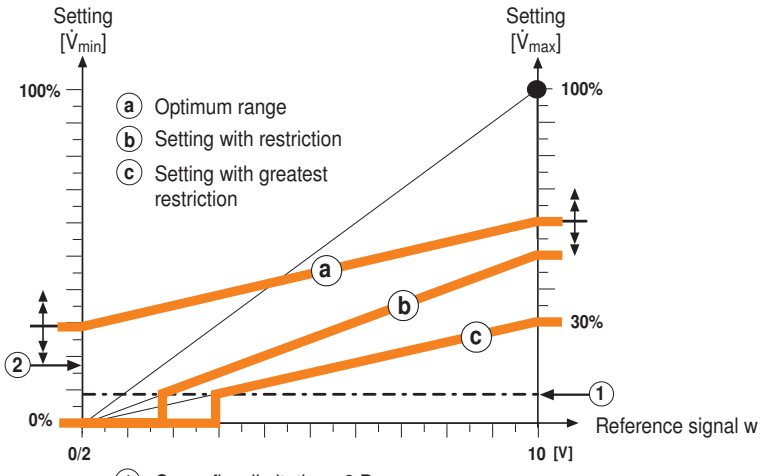
Creep flow limitation (1)

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. 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.



1 Creep flow limitation <2 Pa
2 Unit manufacturer's minimum setting limit

Functions

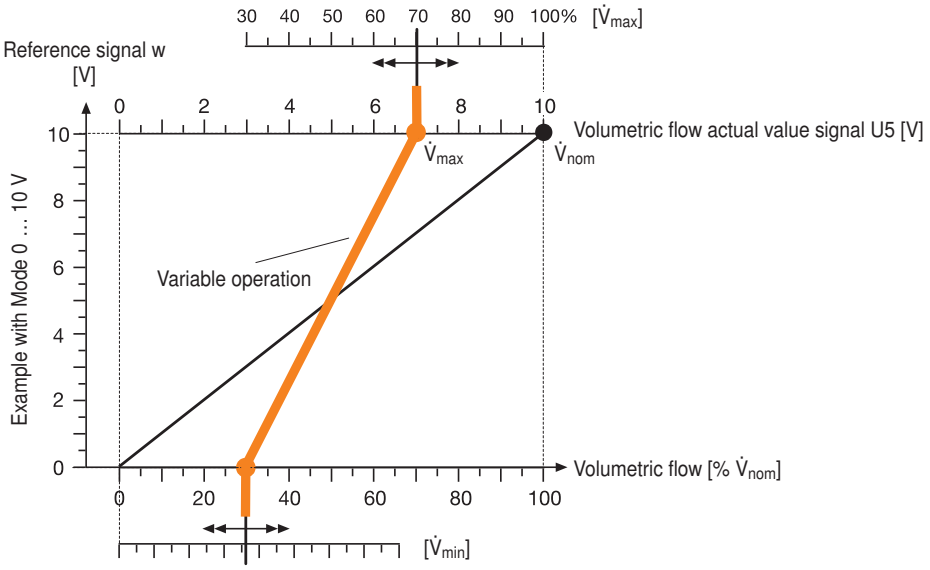
(continued)

Control tolerance

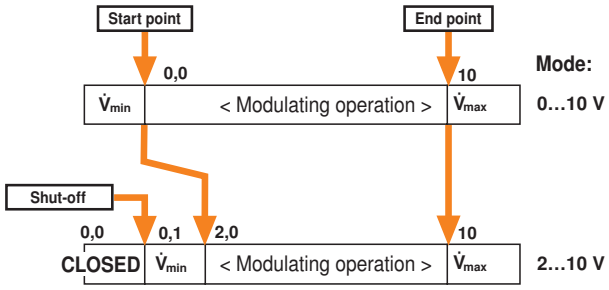
The maximum permissible control tolerance is defined as a percentage of the nominal volumetric flow $\dot{V}_{nom}$. If the control deviation exceeds or undershoots this tolerance, the actuator is adjusted so that the actual volumetric flow corresponds to the required setpoint.
Control tolerance: ±5% of $\dot{V}_{nom}$
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
Setting $\dot{V}_{min}$ ... $\dot{V}_{max}$

In variable operation, the pressure is specified by means of the reference signal in the range $\dot{V}_{min}$ ... $\dot{V}_{max}$.
– $\dot{V}_{max}$ forms the upper limit value as a function of the nominal volumetric flow.
Adjustment range 30 ... 100% of $\dot{V}_{nom}$.
– $\dot{V}_{min}$ forms the lower limit value as a function of $\dot{V}_{nom}$.
Adjustment range 0 ... 100% of $\dot{V}_{nom}$.



Voltage level



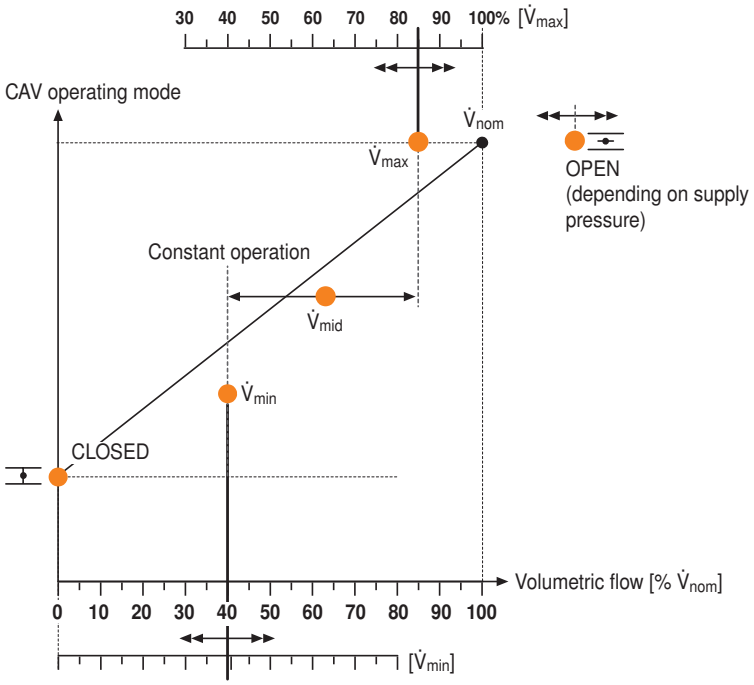
In 2 … 10 V mode, it is possible to achieve shut-off operation (damper CLOSED) by lowering the reference signal to 0.0 V.

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
CLOSED / $\dot{V}_{min}$ / $\dot{V}_{mid}$ / $\dot{V}_{max}$ / OPEN

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 $\dot{V}_{min}$ / $\dot{V}_{mid}$ / $\dot{V}_{max}$: 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.

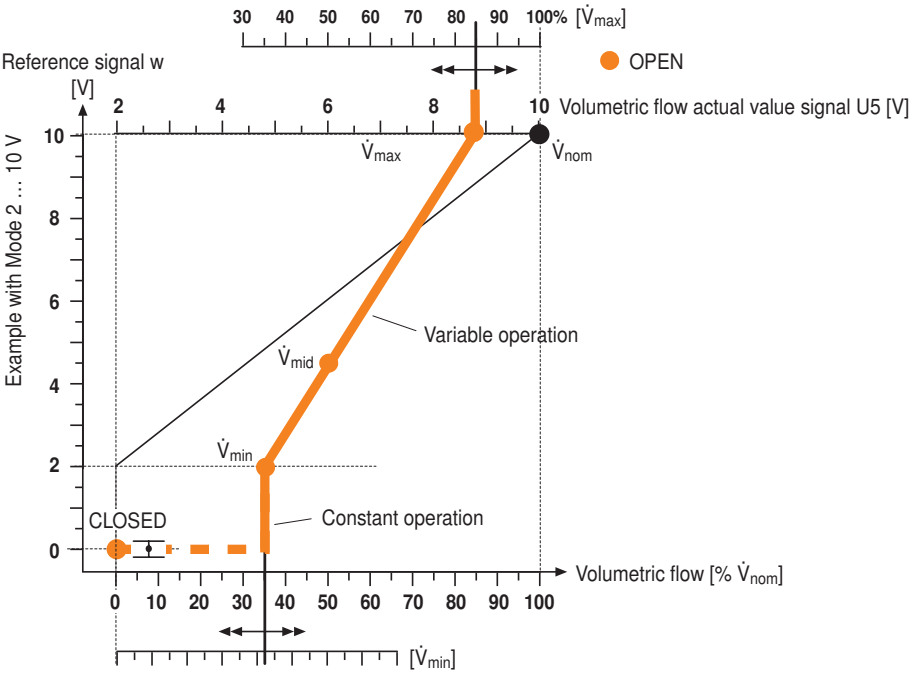
Functions *(continued)*



Note
$\dot{V}_{mid}$ is not available with DC 24 V supply.

VAV operation with override
CLOSED / $\dot{V}_{min}$ / $\dot{V}_{mid}$ / $\dot{V}_{max}$ / OPEN

If necessary, the VAV $\dot{V}_{min}$ ... $\dot{V}_{max}$ 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 $\dot{V}_{min}$ / $\dot{V}_{mid}$ / $\dot{V}_{max}$: 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!



Notes
– $\dot{V}_{min}$: All inputs (3 / 6 / 7) open.
– $\dot{V}_{mid}$ not available with DC 24 V supply.

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.

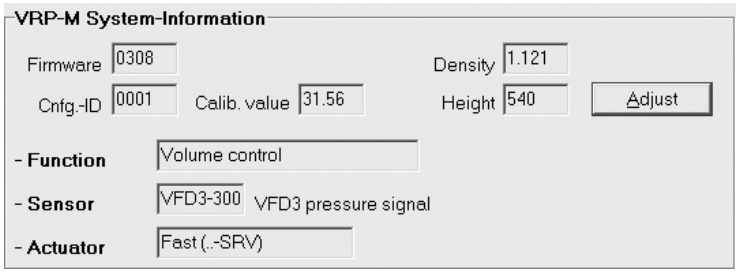
Terminal		Priority	Function
6	z1	1	OPEN
7	z2	2	CLOSED / $\dot{V}_{min}$ / $\dot{V}_{mid}$ / $\dot{V}_{max}$
3	w	3	$\dot{V}_{min}$ … $\dot{V}_{max}$

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:

VRP-M-Tool
Expert tab
System information



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

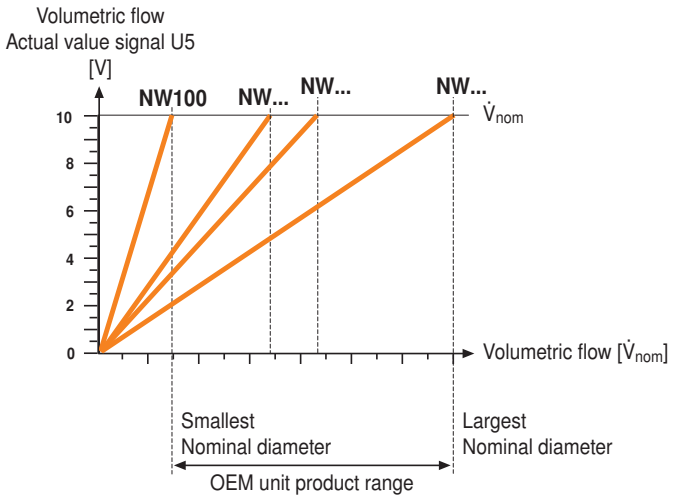
Height above sea level for density calculation.

Control – reference signal w, actual volumetric flow signal U5

The reference signal w and the volumetric flow actual value signal U5 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 – $\dot{V}_{nom}$

The $\dot{V}_{nom}$ values are specified and permanently programmed by the unit manufacturer.
With the setting of the $\dot{V}_{nom}$, every VRP-M system solution is optimally adapted to the VAV unit used. $\dot{V}_{nom}$ 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 $\dot{V}_{nom}$ 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.

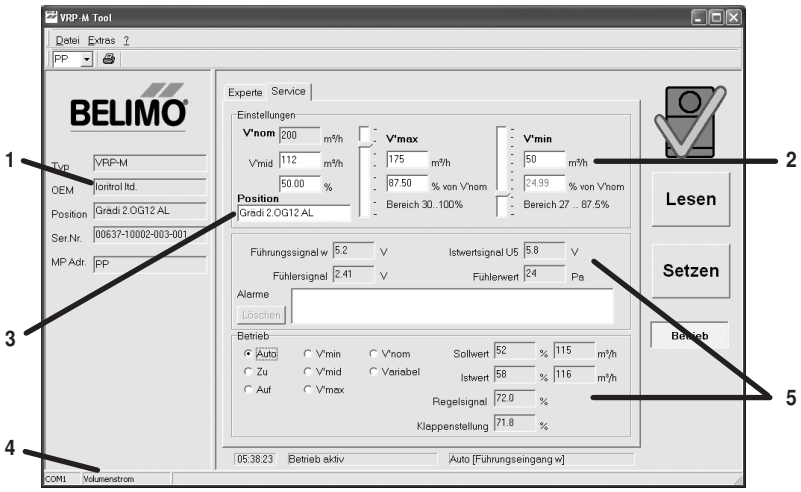
Note
The equipment configuration and settings form part of the unit manufacturer's system solution (OEM) and are not allowed to be modified without the OEM's prior authorisation. All changes are liable to disrupt operation and cause damage to the system or injury to persons!

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 ($\dot{V}_{min}$, $\dot{V}_{mid}$, $\dot{V}_{max}$ 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

5 Checking – Operation:
Reference signal display
Pressure value [Pascal]
Setpoint / actual value display [m³/h, l/s]
Operating mode selection:
– AUTO / CLOSED / OPEN
– $\dot{V}_{min}$ / $\dot{V}_{mid}$ / $\dot{V}_{max}$ / $\dot{V}_{nom}$
– Variable setpoint ($\dot{V}_{min}$ ... $\dot{V}_{max}$)

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.

$\dot{V}_{max}$ Adjustment range 30 ... 100% of $\dot{V}_{nom}$
Upper volumetric flow limit

$\dot{V}_{min}$ Adjustment range 0 ... 100% of $\dot{V}_{nom}$
Control range x * ...100% of $\dot{V}_{nom}$
Lower volumetric flow limit

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

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

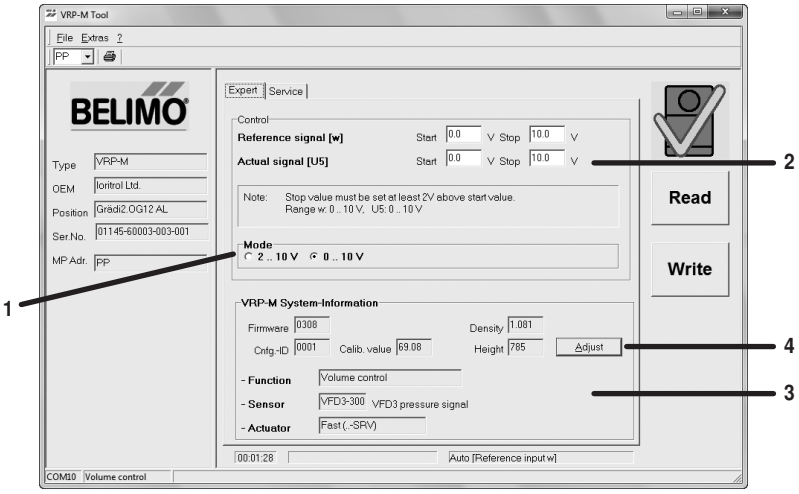
* $\dot{V}_{min}$ settings below the control range
$\dot{V}_{min}$ values below the start value displayed in the range can be set, e.g. for VAV units with shut-off function

System designation entry

Input field (16 characters) for specific system designations, e.g. MCR address, system name, item number in diagram, etc.

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 U5

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 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 volumetric flow actual value signal U5 to the MCR system directly on the control system.
The reference signal w and the volumetric flow 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 $\dot{V}_{min}$ ... $\dot{V}_{max}$

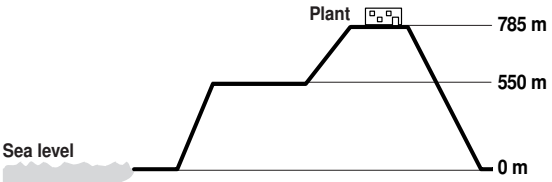
Start point: DC 0.0 ... 8 V
Stop point: DC 2.0 ... 10 V

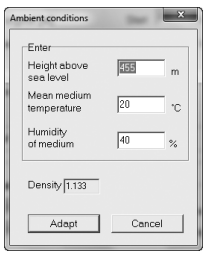
Actual value signal [U5] / display range 0 ... 100% $\dot{V}_{nom}$

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.





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:

	Correction influence	**Typical setting value**
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.

PC-Tool VRP-M module – Availability

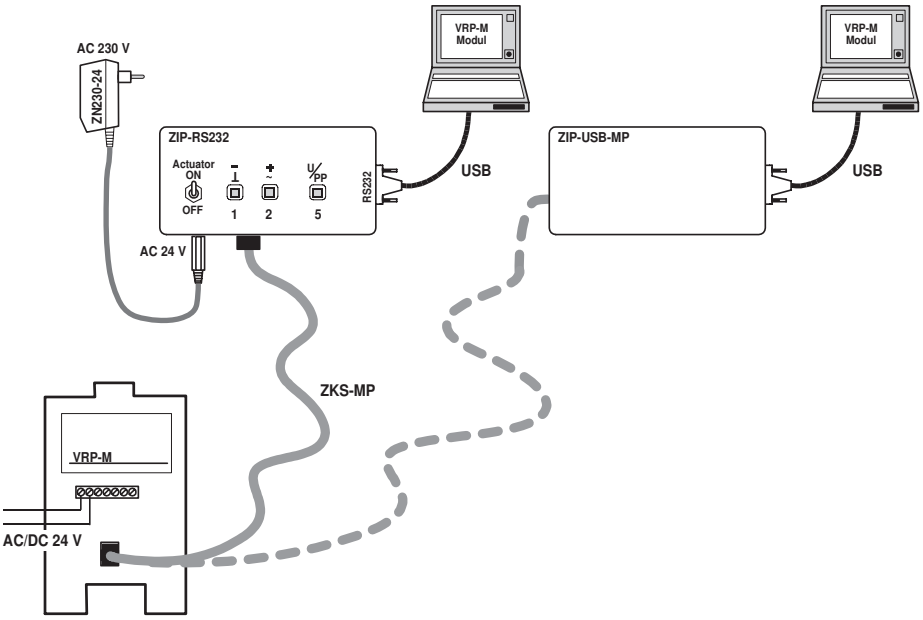
The current version of the PC-Tool or the VRP-M module, respectively, and the associated documentation can be downloaded from www.belimo.eu.

PC-Tool connection

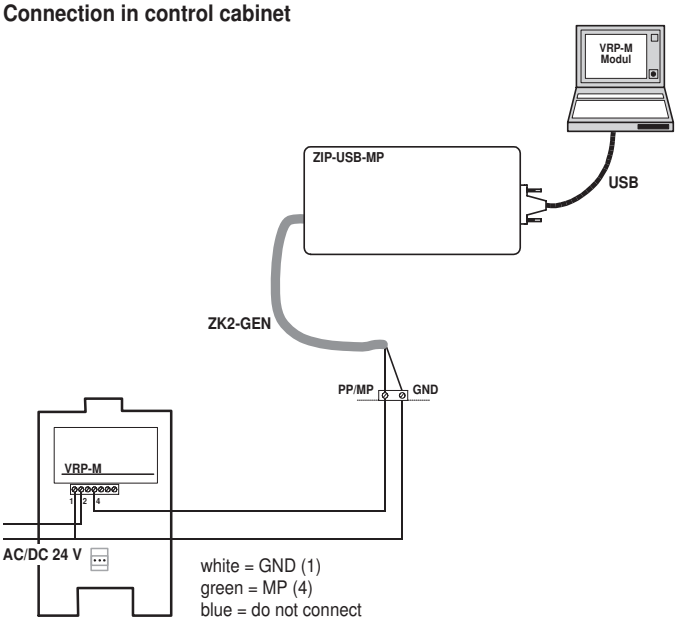
The PC-Tool required for settings and servicing can be connected either directly to the 3-pin service socket on the VRP-M controller or via the MP connection (terminal 4). A level converter ZIP-USB-MP or ZIP-RS232 is required for communication.

Conventional operation (PP)

Connection via service socket



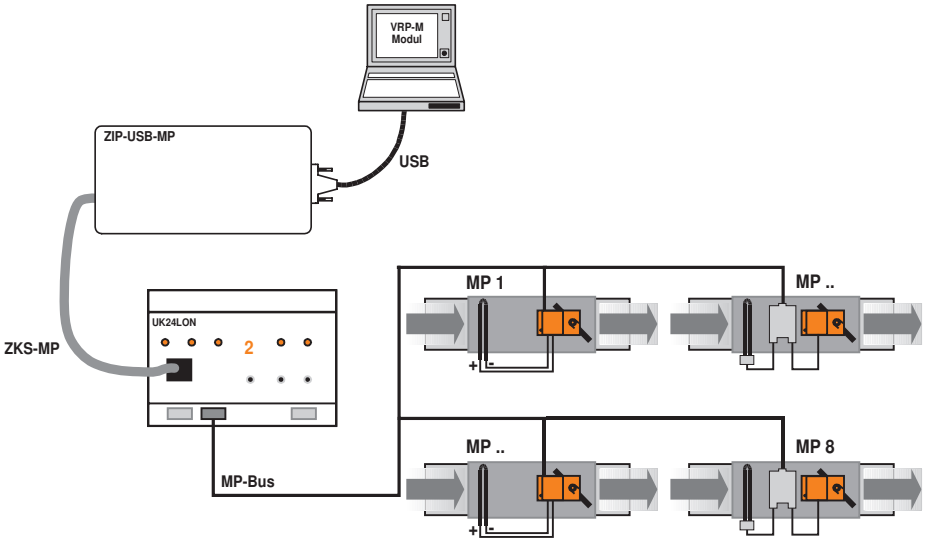
Connection in control cabinet



PC-Tool connection

MP bus mode

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...

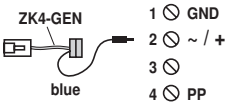
Service-Tool ZTH-GEN

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

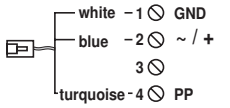
The ZTH-GEN is supplied via the actuator/VAV controller. The connection is set up
- directly at the Service socket of the actuator/VAV controller or
- via the PP/MP connection, e.g. connection socket, in the control cabinet, room controller CR24

Local connection via service socket

Connection to	Cable type	Connection
VRP-M	ZK4-GEN	

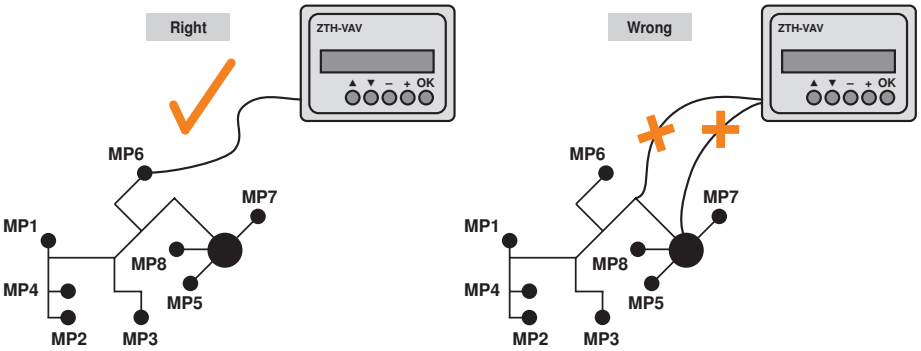
ZTH-GEN connection in MP bus system:
The MP connection should be separated from the MP bus while the ZTH-GEN is operating.

Direction connection to terminals

Connection to	Cable type	Connection
VRP-M	ZK2-GEN	

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.

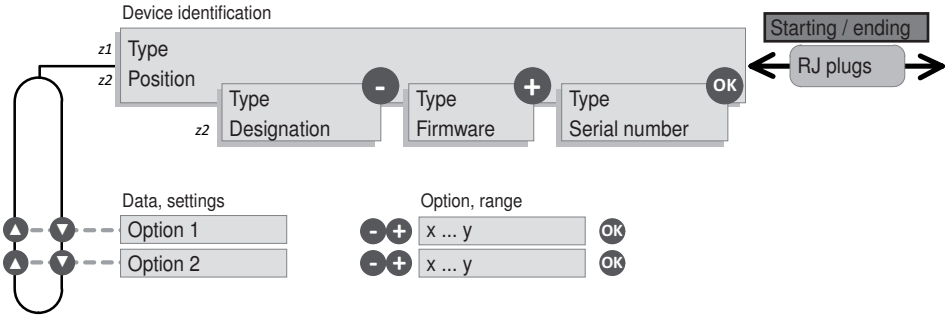
Connection in the MP bus system



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.

Configuration

Start Configuration

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

2. Configuration menu display appears

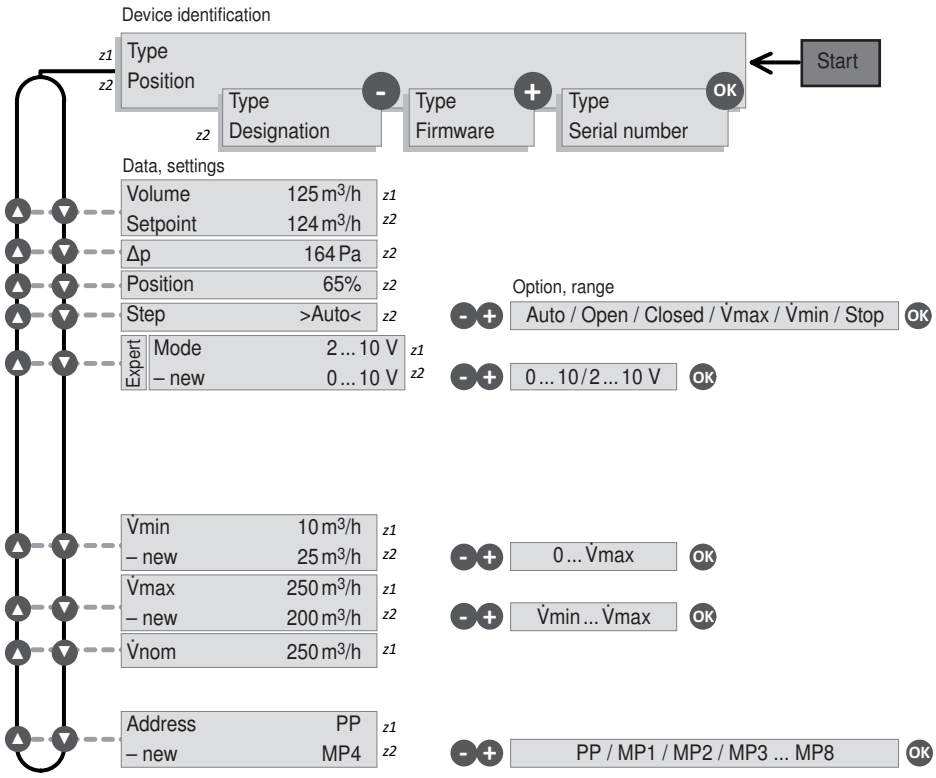
Configuration menu

Option / Display	Setting	Product range	Explanation
HW Version Vx.x FW Version Vx.x			Display of the current hardware and firmware version of the ZTH-GEN
Text	German / **English**	-	
VAV unit	**m³/h** / l/s / cfm	VAV	
EPIV unit	m³/h / **l/min** / gpm	Valves	
Supply. ... AC … V VHW: … %			Display of the current AC 24 V supply voltage, with direct connection to terminals (ZK2-GEN)
Start MP tester	OK	-	MP bus diagnostics tool for system integrators. The MP tester is not a component part of this documentation.
PICCV function	**0** / 1	Valves	Belimo US Enable PICCV Wizard function
Expert Mode [1]	**0** / 1	VAV [3]	Enable VAV settings: – Switching mode, – set V̇min / V̇max to original values (call up OEM setting)
Advanced Mode [2]	**0** / 1	VAV [3] Fire protection	Enable settings: – VAV: Direction of rotation, – BF-Top: Adaption
Exit Configuration	OK		

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



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

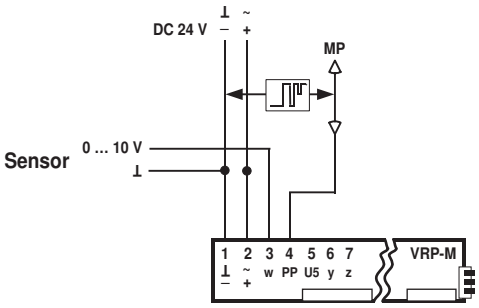
The cycle time of the MP bus must be noted when integrating setpoints and actual values. It is typically 2…8 s, depending on the number of connected bus users and integrated sensors.
The local VRP-M control function is not affected by the cycle time. The cycle time of the MP bus must always be taken 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

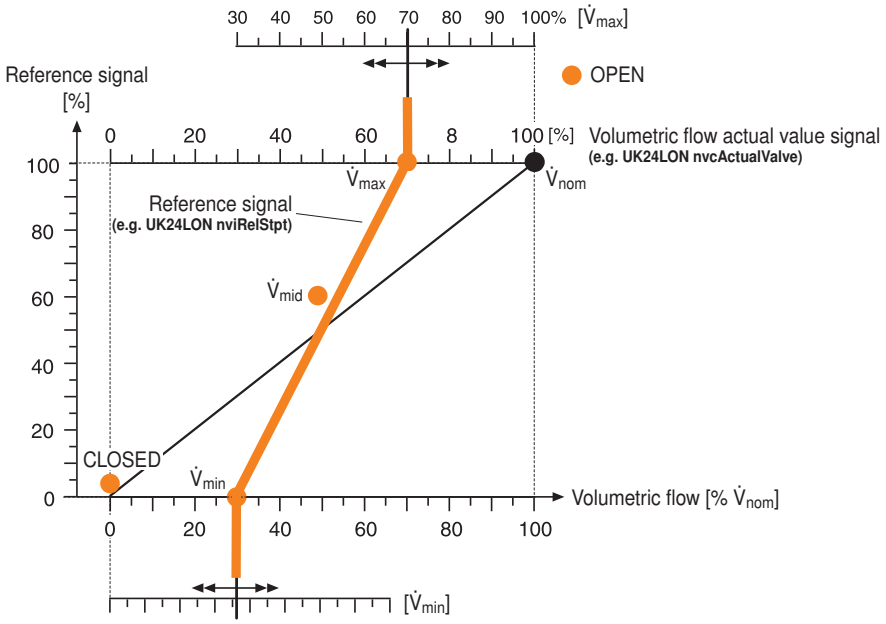
Integration of switches, passive resistance sensors

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 $\dot{V}_{min}$ ... $\dot{V}_{max}$.
If needed, the VAV range $\dot{V}_{min}$ ... $\dot{V}_{max}$ 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 $\dot{V}_{mid}$ / $\dot{V}_{max}$: 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.

Bus operation *(continued)*



Note
$\dot{V}_{mid}$ is not available with DC 24 V supply.

Operating volumetric flow setting $\dot{V}_{min}$ / $\dot{V}_{max}$

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

Function	Volumetric flow	Range
$\dot{V}_{nom}$	Nominal	OEM-specific value, depending on the application and the VAV unit type
$\dot{V}_{max}$	Maximum	30 ... 100% of $\dot{V}_{nom}$
$\dot{V}_{min}$	Minimum	0 * ... 100% of $\dot{V}_{nom}$

* The minimum volumetric flow adjustment $\dot{V}_{min}$ 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 $\dot{V}_{min}$ / $\dot{V}_{max}$ setting can be open if necessary, i.e. with a setting of $\dot{V}_{min}$ 0% / $\dot{V}_{max}$ 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.

Terminal		Priority	Function
6	z1	1	OPEN
7	z2	2	CLOSED / $\dot{V}_{mid}$ / $\dot{V}_{max}$
		3	MP override function 1 OPEN 2 CLOSED 3 $\dot{V}_{max}$ 4 $\dot{V}_{min}$ 5 $\dot{V}_{mid}$ 6 – 7 $\dot{V}_{nom}$
		4	MP setpoint 0 ... 100% = $\dot{V}_{min}$ ... $\dot{V}_{max}$

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

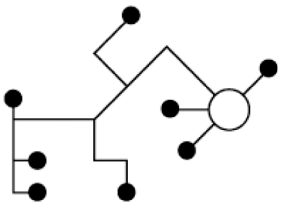
Initial setpoint after power failure

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

MP bus

Topology

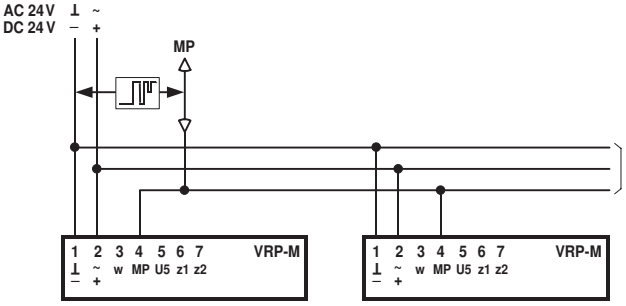
The cables of up to eight actuators can be laid in a freely definable topology. The following topologies are permitted: star, ring, tree or mixed forms.



Up to 8 MP bus users

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.



Additional MP bus users

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.

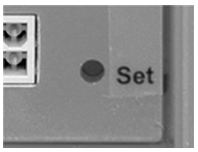
For more information about planning and installation, see www.belimo.com

- 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)

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**

VFP-100

VFP-300
VFP-600

Type overview

Type	Measuring ranges	Overload protection	Temperature sensitivity of zero	Weight
VFP-100	0 ... 100 Pa	max. 500 Pa	±0.1% / K	Approx. 500 g
VFP-300	0 ... 300 Pa	Max. 1500 Pa	±0.05% / K	Approx. 280 g
VFP-600	0 ... 600 Pa	Max. 3000 Pa	±0.05% / K	Approx. 280 g

Technical data

Electrical data	Supply Connection	DC 15V (from VRP-M controller) 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 Zero Measuring range	See «Type overview» t = +10 ... 40°C (reference temperature t0 = 25°C)
	Mounting orientation	Upright (nipple on bottom or side)
	Position dependency	Max. ±4.5 Pa With 90° rotation◁ around horizontal spindle
	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.**

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.
The pressure sensors are used for static differential pressure measurement with pick-up devices 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.

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	Nominal voltage	AC 24 V, 50/60 Hz / DC 15…24 V
	Nominal voltage range	AC 19.2 … 28.8 V / DC 13.5 … 28.8 V
	Power consumption Operation	0.35 W
	Dimensioning	0.75 VA
	Connection	Pre-mounted 1 m cable with 4-pin plug, compatible with VRP-M
Functional data	Type, principle of operation	Δp sensor with dynamic measurement principle
	Range of use, measuring medium	Outside air/exhaust air in the comfort zone with sensor-compatible media
	Medium temperature	0 ... 50°C
	Humidity of the medium	5 ... 95% r.h., non-condensating
	Materials in contact with medium	Glass, epoxy resin, PA, TPE
	Connection for pressure hoses	Hose nipple Ø 6 mm, with + and – connection designation
	Adjustment range	Can be selected with DIP switch: 0 … 100 Pa 0 … 300 Pa (default setting) 0 … 600 Pa –20 … 100 Pa (cannot be used with the VRP-M)
	Accuracy	±1 Pa in the pressure range –20 … 20 Pa ±5% in the pressure range 20 … 500 Pa
	Zero	<±1%, no balancing required
	Loading capacity	±5000 Pa
	Installation position	Any, no reset necessary
	Response time	<50 ms (<100 ms after Power-Up)
	Output signal	0 ... 10 V, max. load 1 mA
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.

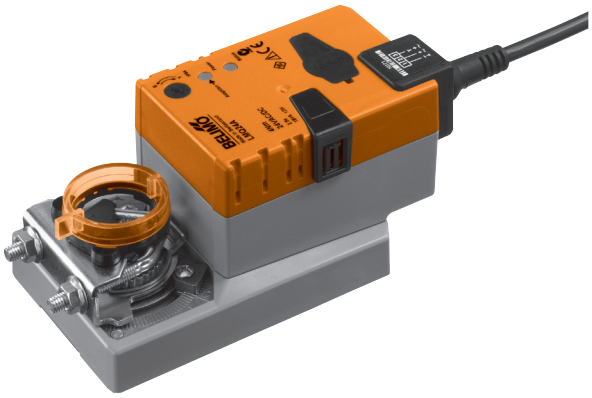
Note

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**



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

Technical data

Electrical data	Supply		AC/DC 24 V (from VRP-M controller)
	Power consumption	Operation	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

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).

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.

Pos. direction of rotation switch	Home position
0 Y = 0	ccw Left end stop
1 Y = 0	cw Right end stop

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.

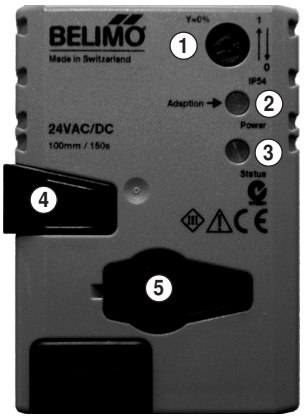
High functional reliability

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

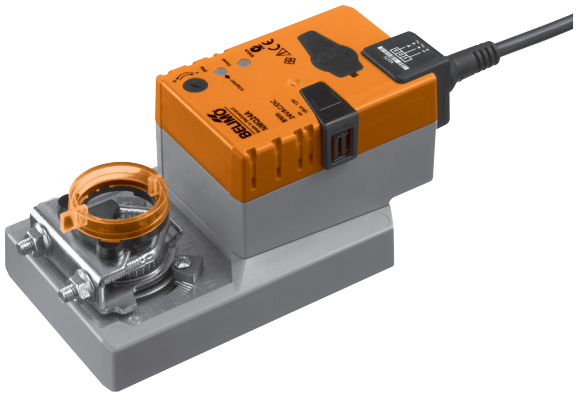
② **Push-button and LED display green**
Off: No power supply or fault
Illuminated: Operation
Press key: Initiates angle of rotation adaptation, followed by standard mode

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**

Fast-running damper actuator for VRP-M system solution
- **Torque 8 Nm**
- **Running time 4 s**



Technical data

Electrical data	Supply		AC/DC 24 V (from VRP-M controller)
	Power consumption	Operation	12 W @ nominal torque
		Rest position	1.5 W
		Dimensioning	18 VA
	Connection		0.5 m cable with 6-pin plug (suitable for VRP-M)
Functional data	Torque (nominal torque)		Min. 8 Nm @ nominal voltage
	Direction of rotation		As an option with switch 0 / 1
	Direction of motion for Y = 0 V		In switch position 0 or 1
	Angle of rotation		max. 95°, mechanical end stops adjustable
	Running time		4 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. 930 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 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.**

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

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).

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.

Pos. direction of rotation switch	Home position
0 / 1: Y = 0, ccw	Left end stop
0 / 1: Y = 0, cw	Right end stop

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.

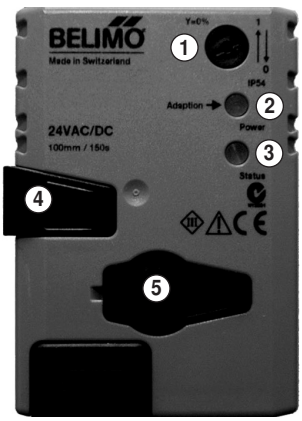
High functional reliability

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

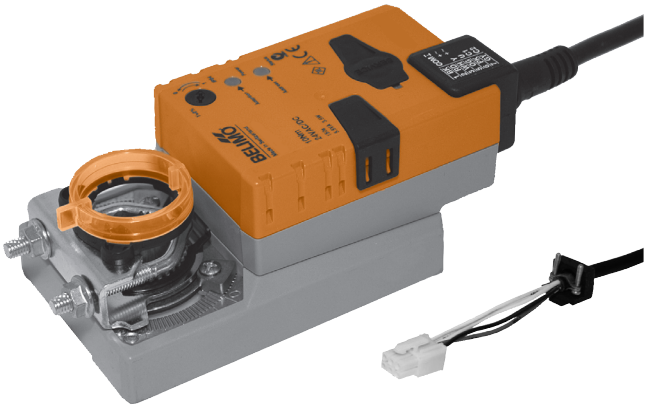
③ **Push-button and LED display yellow**
Off: Standard mode
Illuminated: Adaption or synchronisation process active
Press key: No function

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**

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° Mechanical end stops adjustable
	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 override with self-resetting push-button possible (gear disengagement 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

	Description	Data sheet
Electrical accessories	Auxiliary switch S..A..	T2 - S..A..
	Feedback potentiometer P..A..	T2 - P..A..
Mechanical accessories	Shaft extension AV6-20	T2 - Z-NM..A..

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**

Spring-return actuator with emergency setting function for VAV and CAV units in ventilation and air conditioning systems for building services installations

- **Torque 20 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	8.5 W @ nominal torque
		Rest position	3.5 W
		Dimensioning	11 VA
	Connection		1 m cable with 6-pin plug (compatible with VRP-M)
Functional data	Torque	Motor	Min. 20 Nm @ nominal voltage
		Spring-return	Min. 20 Nm
	Position accuracy		±5%
	Direction of rotation	Motor	as an option with switch ↷ / ↶
		Spring-return	As an option by installation L / R
	Direction of rotation for Y = 0 V		in switch position 1 ↷ or 0 ↶
	Manual override		With hand crank and interlocking switch
	Angle of rotation		max. 95° ∢ (can be limited by adjustable mechanical stop)
	Running time	Motor	≤150 s / 90° ∢
		Spring-return	≤20 s @ –20 ... 50 °C / max. 60 s @ –30 °C
	Sound power level	Motor	≤40 dB (A) @ 150 s running time
		Spring-return	≤62 dB (A)
	Service life		Min. 60,000 emergency settings
Safety	Protection class		**III** Safety extra-low voltage
	Degree of protection		IP54
	EMC		CE according to 2004/108/EC
	Certification		Certified in accordance with IEC/EN 60730-1 and IEC/EN 60730-2-14
	Principle of operation		Type 1.AA
	Rated current voltage		0.8 kV
	Control pollution degree		3
	Ambient temperature		–30 ... +50 °C
	Non-operating temperature		–40 ... +80 °C
	Ambient humidity		95% r.h., non-condensing
	Maintenance		Maintenance-free
Dimensions / Weight	Dimensions		See «Dimensions» on page 35
	Weight		Approx. 2.3 kg

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

Principle of operation
The actuator is controlled by the Belimo VRP-M controller and travels to the position defined by the control signal.

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.

Adjustable angle of rotation
Adjustable angle of rotation with mechanical end stop.

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.

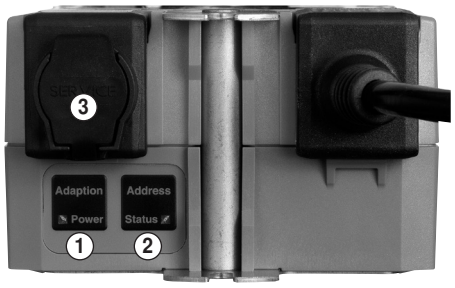
Accessories

	Description	Data sheet
Electrical accessories	Auxiliary switch S2A-F	
Mechanical accessories	Various accessories (spindle clamps, shaft extensions, etc.)	T2 - Z-SM..A..

Electrical installation

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

Display and operating elements



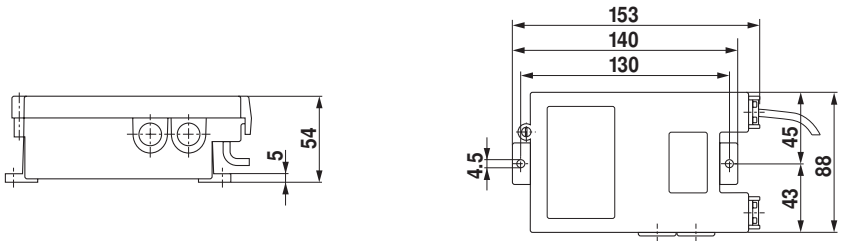
① **Membrane key and LED display green**
Off: No power supply or fault
Illuminated: Operation
Press key: Initiates angle of rotation adaptation, followed by standard mode

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

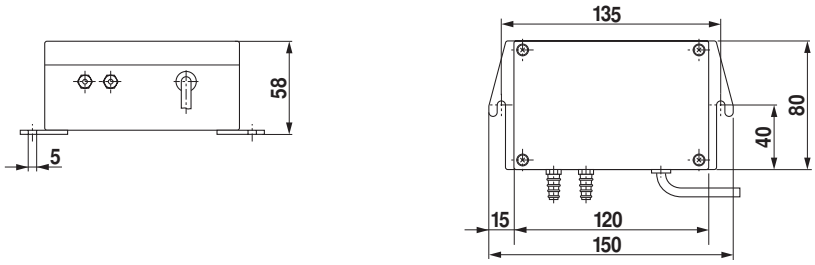
③ **Communication (PC-Tool, ZTH-GEN) is blocked for this actuator type**

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

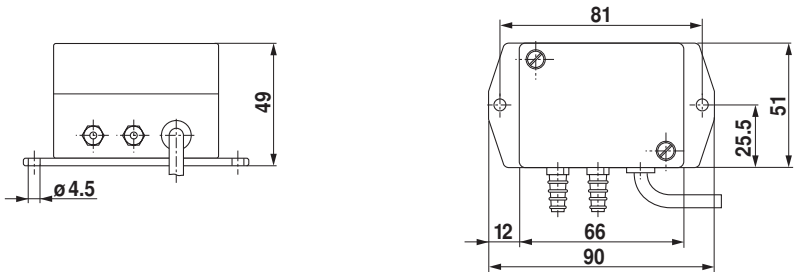
Dimensional drawings of VRP-M controller



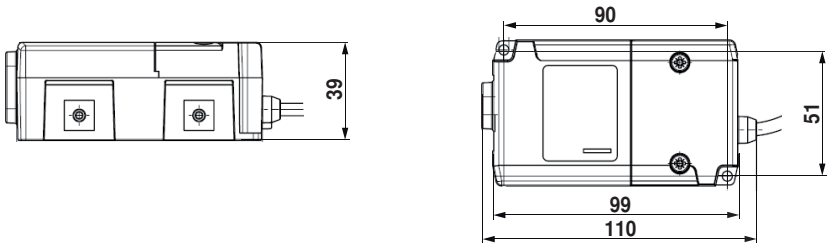
Dimensional drawings of VFP-100 sensor



Dimensional drawings of VFP-300 and VFP-600 sensors



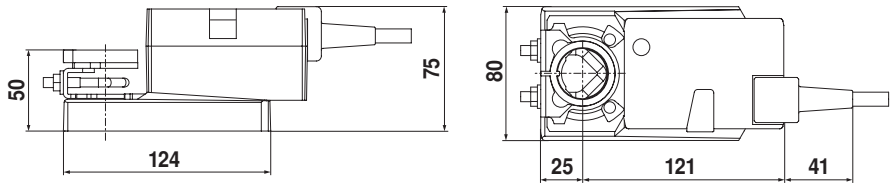
Dimensional drawings of VFD3



Dimensional drawings LMQ24A-SRV-ST

Damper spindle	Length			
	≥40	8 ... 26.7	≥8	≤26.7
*	≥20	8 ... 20	≥8	≤20

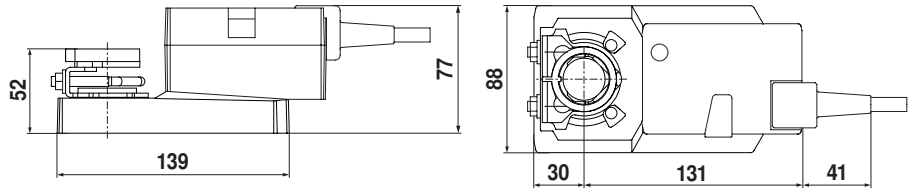
* Option (Accessory K-NA)



Dimensional drawings NMQ24A-SRV-ST

Damper spindle	Length			
	≥42	8 ... 26.7	≥8	≤26.7
*	≥20	8 ... 20	≥8	≤20

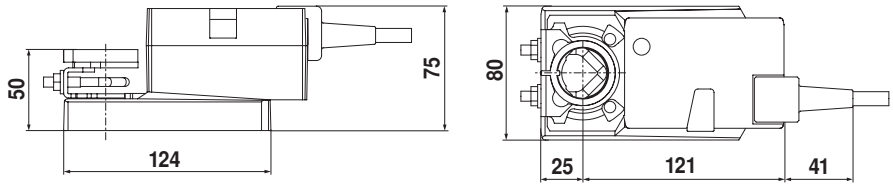
* Option (Accessory K-SA)



Dimensional drawings NM24A-V-ST

Damper spindle	Length			
	≥40	8 ... 26.7	≥8	≤26.7
*	≥20	8 ... 20	≥8	≤20

* Option (Accessory K-NA)



Dimensional drawings SF24A-V-ST

Variant 1a:

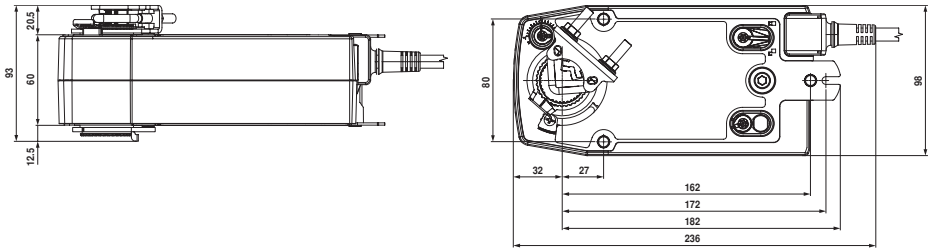
¾"-spindle clamp (with insertion part) EU Standard

Damper spindle	Length			
	≥85	10...22	10	14...25.4
	≥15			

Variant 1b:

1"-spindle clamp (without insertion part) EU Standard

Damper spindle	Length		
	≥85	19...25.4 (26.7)	12...18
	≥15		



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