

VAV-Universal, modular control solution with integrated  $\Delta p$  sensor for polluted media. Can be combined with damper actuator optimally suited to the VAV/pressure duct application. Field of application: technical building equipment, HVAC systems

- Application: VAV/CAV units or duct pressure control in sensitive working areas with contaminated media
- Functional range differential pressure 0...600 Pa
- suitable for ...-VST actuator
- Control modulating, communicative, hybrid
- Communication via BACnet MS/TP, Modbus RTU, Belimo MP-Bus or conventional control



### Technical data

<b>Electrical data</b>	Nominal voltage	AC/DC 24 V
	Nominal voltage frequency	50/60 Hz
	Nominal voltage range	AC 19.2...28.8 V / DC 21.6...28.8 V
	Power consumption in operation	1.5 W
	Power consumption for wire sizing	2 VA plus connected VST actuator
	Power consumption for wire sizing note	$I_{max}$ 20 A @ 5 ms
	Connection supply / control	Terminals 2.5 mm <sup>2</sup>
	Sensor input S1	Connection of external sensor (passive / active / switch)
	Actuator Connection (I) (M)	AC/DC 24 V, PP-Link for VST actuator
<b>Functional data</b>	Communicative control	BACnet MS/TP Modbus RTU MP-Bus
	Operating range Y	2...10 V
	Input Impedance	100 k $\Omega$
	Operating range Y variable	0.5...10 V
	Position feedback U note	Max. 0.5 mA Options: Volume / $\Delta p$ / Position
	Position feedback U variable	0...10 V Start point 0...8 V End point 2...10 V
	Override control	z1 motor stop / damper OPEN (AC/DC 24 V) z2 damper CLOSE / MAX (AC/DC 24 V)
	Parametrisation	via Belimo Assistant App / PC-Tool
<b>Measuring data</b>	Measuring principle	Belimo M1, membrane sensor
	Installation position	position-independent, no zeroing necessary
	Functional range differential pressure	0...600 Pa
	Maximum System pressure	1500 Pa
	Burst pressure	$\pm 7$ kPa
	Height compensation	Adjustment of system height for volumetric flow measurement (range 0...3000 m above sea level)
	Condition measuring air	0...50°C / 5...95% RH, non-condensing
	Pressure hose connection	Nipple diameter 5.3 mm for pressure hose (5 mm inner diameter)
<b>Safety data</b>	Protection class IEC/EN	III Safety Extra-Low Voltage (SELV)
	Degree of protection IEC/EN	IP42
	EMC	CE according to 2014/30/EU
	Certification IEC/EN	IEC/EN 60730-1

Mode of operation	Type 1
Rated impulse voltage supply / control	0.8 kV
Control pollution degree	2
Ambient temperature	0...50°C
Storage temperature	-20...80°C
Ambient humidity	Max. 95% r.H., non-condensing
Servicing	maintenance-free
<b>Weight</b>	<b>Weight</b>
	0.30 kg

**Safety notes**


- The device must not be used outside the specified field of application, especially not in aircraft or in any other airborne means of transport.
- Outdoor applications: only possible if no (sea) water, snow, ice, solar radiation and aggressive gases act directly on the device, and it is guaranteed that the ambient conditions are always within the limit values according to the data sheet.
- Only authorised specialists may carry out installation. All applicable legal or institutional installation regulations must be complied during installation.
- The device may only be opened by lifting the cover. It does not contain any parts that can be replaced or repaired by the user.
- 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.

**Product features**

**Application** The VAV-Universal controller VRU-M1-BAC is used in the comfort zone as well as in sensitive working areas with polluted media. For pressure-independent control of VAV units, for recording a volumetric flow or for controlling duct pressure. See application library for description.

**Pressure measurement**

The integrated M1 differential pressure sensor is also suitable for very small volumetric flows. The maintenance-free sensor technology enables a wide range of applications in the HVAC comfort zone: residential construction, office, hotel etc. and in sensitive working areas: hospital rooms, clean rooms etc.

**Actuators**

For the various applications and damper designs, the VAV unit manufacturer has various actuator variants with running times of 2.5...120 s available.

**Control functions**

Volumetric flow (VAV/CAV), duct pressure (STP) or Position Control (Open-Loop)

**Application Variable Volume flow rate (VAV)** Variable volume flow control in the  $V'_{min}$ ... $V'_{max}$  range, demand-dependent via a modulating reference variable (analogue or bus), e.g. room temperature, CO<sub>2</sub> controller for energy-saving air conditioning of individual rooms or zones.

$V'_{nom}$ ,  $\Delta p$  @  $V'_{nom}$

OEM specific calibration parameters, suitable for the VAV unit

Setting range  $\Delta p$  @  $V'_{nom}$ : 38...500 Pa

$V'_{max}$  / Max

Maximum operating volume flow, adjustable 20...100%  $V'_{nom}$

$V'_{min}$  / Min

Minimum operating volume flow, adjustable 0...100%  $V'_{nom}$

**Application Constant Volume flow rate (CAV)** Constant volume flow control. If required, via step switching (switching contacts) for constant volume flow applications.

Steps: CLOSE / Min / Max / OPEN

**Application Volumetric flow measurement** Measurement of a volumetric flow, e.g. for summation or as setpoint measurement for a common extract air box. Transmitter, without damper actuator

V'nom, Δp @ V'nom

OEM-specific calibration parameters, suitable for the measuring device

Setting range Δp @ V'nom: 38...500 Pa

**Application Position Control (Open-Loop)** Position Control for integration of the VRU...-BAC into an external VAV control loop. Transmitter and actuator unit.

Max

Range: 20...100 % rotation range

Min

Range: 0...100 % rotation range

**Application duct pressure (STP)** Channel or strand pressure control in step operation (switching contacts): CLOSE / P'min / P'max or variable specification of the Δp value P'min...P'max via a continuous command variable (analogue or bus). Lower control limit (STP) 38 Pa

P'nom

OEM specific calibration parameters: 38...500 Pa

P'max

Maximum operating pressure, adjustable 20...100% P'nom

P'min

Minimum operating pressure, adjustable 0...100% P'nom

**Demand Control Ventilation (DCV)** Output of the demand signal (damper position) to the higher-level automation system - DCV function (Fan Optimizer).

**Bus operation** Thanks to the multi-bus functionality of the VRU...-BAC, the VAV universal controllers can be easily integrated into a bus system. The communication interface is defined on the system using the Belimo Assistant App: BACnet MS/TP, Modbus RTU, Belimo MP-Bus.

A hybrid mode is optionally available for BACnet MS/TP and Modbus RTU, bus connection combined with analogue control.

In bus mode, a sensor (0...10 V / passive) can optionally be connected, e.g. a temperature sensor or a switching contact, for integration into the higher-level bus system.

**MP-Bus application Compatibility mode:** The VRU...-BAC is based on the new Belimo MP data pool model.

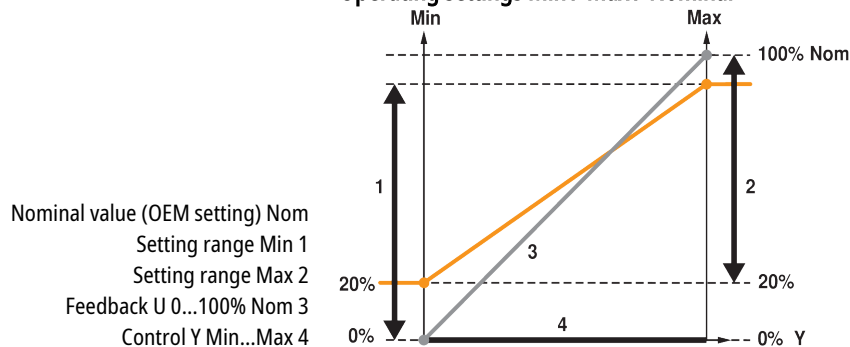
**Standard / VRP-M**

If the VRU...-BAC is used as a VRP-M replacement in an existing MP-Bus system, the VRU...-BAC can be set to the VRP-M function with the compatibility mode parameter. See instructions: VAV-Universal - MP-Bus Existing system: Replace VRP-M with VRU...-BAC.

**Operating settings** Control functions

Volume flow (VAV/CAV), duct pressure (STP - lower control limit 38 Pa) or Position Control (Open-Loop)

**Operating settings Min / Max / Nominal**



**Operating and service tools** Smartphone with Belimo Assistant App - contactless operation via the integrated NFC interface.  
 PC-Tool (ZTH EU) - can be locally plugged into the service socket or remotely via MP connection.

Service tools	Description	Type
	Belimo Assistant App, Smartphone app for easy commissioning, parametrising and maintenance	Belimo Assistant App
	Belimo PC-Tool, Software for adjustments and diagnostics	MFT-P
	Converter Bluetooth / NFC	ZIP-BT-NFC
	Service Tool, with ZIP-USB function, for parametrisable and communicative Belimo actuators, VAV controller and HVAC performance devices	ZTH EU
	Complete functions ZIP-BT-NFC as of production date 2019-10-15	

**Electrical installation**

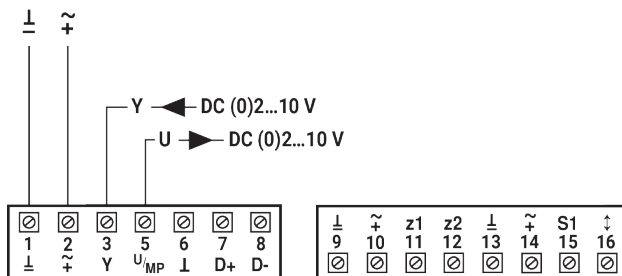
**Supply from isolating transformer.**

The wiring of the line for BACnet MS/TP / Modbus RTU is to be carried out in accordance with applicable RS485 regulations.

**Modbus / BACnet: Supply and communication are not galvanically isolated. Connect earth signal of the devices with one another.**

**Wiring diagrams**

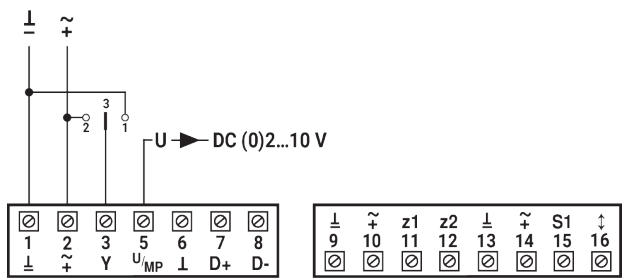
AC/DC 24 V, modulating (VAV)


**Priority rule - Analog VAV control (a)**

1. z1
2. z2
3. a) adaptation  
b) synchronisation
4. Y-modulating: min...max

(see override control z1/z2)

AC/DC 24 V, contactor step control (CAV)


**Priority rule - Analogue CAV step control (b)**

1. z1
2. z2
3. a) adaptation  
b) synchronisation
4. Y-steps: CLOSE-MIN-MAX

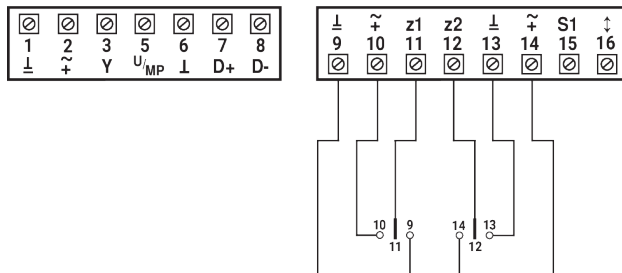
(see override control z1/z2)

Contact 2-3 = MAX

3 uncoated = MIN

 Contact 1-3 = CLOSE (mode 2...10 V)  
MIN (mode 0...10 V)

AC/DC 24 V, override control z1/z2


**Override control z1**

Contact 11-9 = Motor STOP

Contact 11-10 = Damper OPEN

**Override control z2**

Contact 12-13 = Damper CLOSED

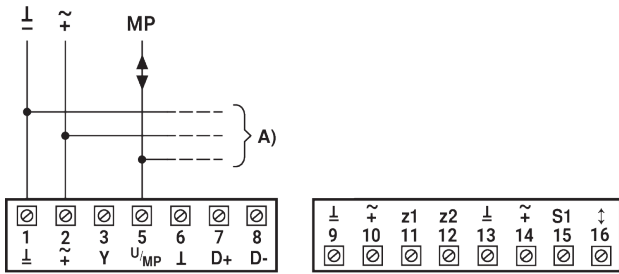
Contact 12-14 = MAX

 11/12 uncoated = priority rule  
a/b/c/d/e

**Functions**

**Functions for actuators with specific parameters (NFC)**

MP-Bus

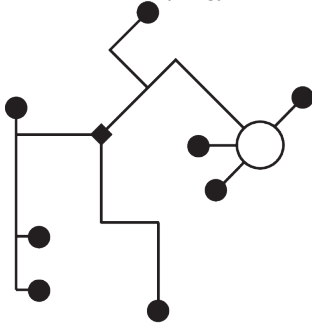


**Priority rule MP-Bus control (c)**

1. z1
2. z2
3. Bus watchdog
4. a) adaptation  
b) synchronisation
5. Y-step: actuator CLOSED / MIN / MAX
6. Bus override
7. Bus setpoint: min...max

A) additional MP-Bus nodes (max. 8)

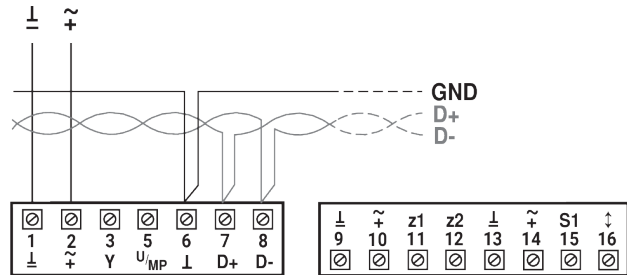
**MP-Bus Network topology**



There are no restrictions for the network topology (star, ring or mixed forms are permitted). Supply and communication in one and the same 3-wire cable

- no shielding or twisting necessary
- no terminating resistors required

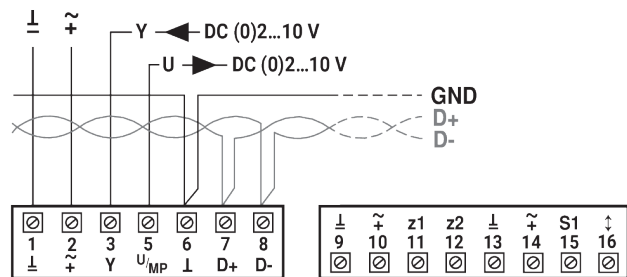
**BACnet MS/TP / Modbus RTU**



**Priority rule BACnet/Modbus control (d)**

1. z1
2. z2
3. Bus watchdog
4. a) adaptation  
b) synchronisation
5. Bus override
6. Bus setpoint: min...max

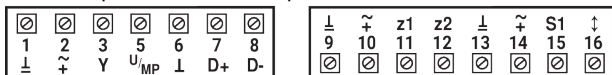
**BACnet MS/TP / Modbus RTU with analog setpoint (hybrid mode)**



**Priority rule BACnet/Modbus hybrid mode (e)**

1. z1
2. z2
3. Bus watchdog
4. a) adaptation  
b) synchronisation
5. Bus override
6. Y-step: actuator CLOSE / MIN / MAX
7. Bus setpoint: min...max

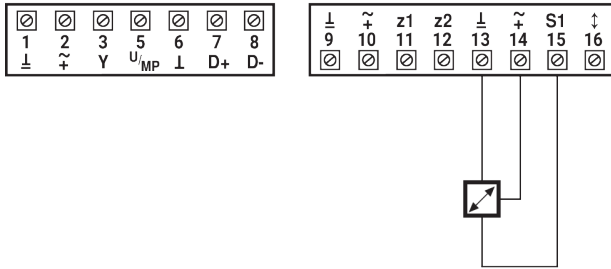
**Connection passive sensor (bus operation)**



1)	2)
200 Ω...2 kΩ	0.5 Ω
2 kΩ...10 kΩ	2.7 Ω
10 kΩ...55 kΩ	14.7 Ω

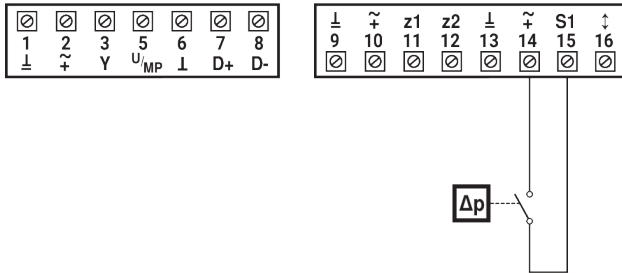
1) Resistance range  
2) Resolution  
Suitable for Ni1000 and Pt1000  
Corresponding Belimo sensors 01DT-..

Connection of active sensor (bus operation)



Possible input voltage range:  
 DC 0...10 V (resolution 5 mV)  
 Example:  
 - Active temperature sensors  
 - setpoint generator  
 - humidity sensor

Connection switching contact (bus operation)



Requirements switching contact:  
 The switch must be capable of  
 switching a current of 10 mA @ 24 V  
 cleanly.  
 Example:  
 - dP sensor  
 - window contact

Parameter and tool overview

## Operating data

Parameter/function	Unit/value	Function/description/(area)	Application				Tool			Authorisation
			VAV/CAV	Vol. measurement	Position control	Air duct pressure	Assistant app	PC-Tool	ZTH EU	Expert/OEM
<b>Overview</b>										
Position	String	Plant designation (64 Z./ZTH 10 Z.)	X	X	X	X	r	r	r	
Series number	xxxxx-xxxxx-xxx-xxx	Series number VRU	X	X	X	X	r	r	r	
Voltage source	24 V/-		X	X	X	X	r			
Type	VRU-M1-BAC		X	X	X	X	r	r	r	
Application	- Volumetric flow - Measure volumetric flow - Air duct pressure	Application setting (OEM setting)	X							
			X	X	X	X	r	r	r	
Control function	VAV-CAV / Position control	Control function (OEM setting)	X		X		r	r	r	
Designation	String	Model designation unit/damper (OEM,16 Z.)	X	X	X	X	r	r	-	
Setpoint	VAV: m <sup>3</sup> /h / l/s / cfm (ZTH: %) Position: % Δp: Pa (ZTH: %)	Display live data dependent on the selected application	X	-	X	X	X	X	X	
Actual value	VAV: m <sup>3</sup> /h / l/s / cfm (ZTH: %) Position: % Δp: Pa (ZTH: %)	Display live data dependent on the selected application	X	X	X	X	X	X	X	
Damper position	0...100%	Display live data	X		X	X	X	X	X	
Override control	Auto/MIN/MAX/ OPEN/CLOSE/Motor stop/ Nom	Temporary override function (Tool override)	X		X	X	X	X		
Actuator	Adaption, synchronisation	Trigger adaption, synchronisation	X		X	X	X	X		E
Transmit setting data		System documentation	X	X	X	X	X	X		
Save setting data		Save setting in file	X	X	X	X		X		
Trend display	Setpoint, actual value, damper position	Commissioning, validation, service	X		X	X	X	X		
Trend display	Actual value (volumetric flow)	Commissioning, validation, service		X			X	X		
Transmit trend data		Commissioning, validation, service	X	X	X	X	X	X		
<b>Diagnosis – Evaluation</b>										
	<b>Status</b>									
Actuator	OK/Gear disengaged/Actuator blocked/Setting range extended/Connected actuator does not match the application		X		X	X	X			
Sensor	OK/Δp sensor incorrectly connected/measuring value outside measuring range/Δp sensor error		X	X	X	X	X			
Pressure	OK/Setpoint not reached		X	X	X	X	X			
Bus	OK/Bus watchdog triggered		X	X	X	X	X			
<b>Diagnosis – Installation</b>										
	<b>Unit/value</b>	<b>Function/description/(area)</b>								
Voltage source	24 V/deenergised		X	X	X	X	X			
Operating time	h	Device connected to supply	X	X	X	X	X			

**Availability:** VAV-Universal components incl. replacement devices are only available from manufacturers of VAV units (OEM).

**Authorisations:** [E-Expert Level] - Functionally relevant settings are only accessible via the Expert Level of the Belimo Assistant App.

**Legend**

- X Application supports function/parameter
- r Tool: read
- w Tool: write
- Tool: Does not support parameter
- E Only visible in Expert Mode

## Parametrisation

Parameter/function	Unit/value	Function/description/(area)	Application				Tool			Authorisation
			VAV/CAV	Vol. measurement	Position control	Air duct pressure	Assistant app	PC-Tool	ZTH EU	Expert/OEM
<b>VAV unit/Air duct pressure control butterfly valve - manufacturer parameters (OEM values - not variable)</b>										
Application	- Volumetric flow - Measure volumetric flow - Air duct pressure	Application setting					r	r	r	O
Designation	Text string	Model designation unit/damper (16 Z.)	X	X	X	X	r	r	-	O
V'nom	m <sup>3</sup> /h/l/s/cfm	Volumetric flow nominal value	X	X	X		r	r	r	O
Δp@V'nom	Pa	Calibration VAV unit [38...500 Pa]	X	X	X		r	r	-	O
P'nom	Pa	Nominal value Δp STP [38...600 Pa]				X	r	r	r	O
SN actuator	xxxxx-xxxxx-xxx-xxx	Actuator series number	X		X	X	r	-	-	
Rotation direction	CCW/CW	Actuator direction of rotation setting	X		X	X	r/w	r/w	-	E
Range of rotation	Adapted/programmed	Actuator adapted/programmed 30...95°	X		X	X	r/w	r/w	-	E
Power on behaviour	No action/synch. / Adaption	Actuator power on behaviour	X		X	X	r/w	r/w	-	E
Suppress damper leakage	OFF/ON	Retrofit application, damper leakage	X				r	r	-	O
NFC interface	ON/OFF	NFC Communication for app access	X	X	X	X	r	r	-	O
<b>Parametrisation – Project-specific settings</b>										
Position	Text string	System designation (64 Z./ZTH 16 Z.)	X	X	X	X	r/w	r/w	r	
Max	m <sup>3</sup> /h/l/s/cfm (PC-Tool/ZTH %) % (Position) Pa (PC-Tool/ZTH %)	Operating volumetric flow 20...100% V'nom Damper position (Pos.Cntrl.) 20...100% Δp step max 20...100% P'nom	X	X	X	X	r/w	r/w	r/w	
Min	m <sup>3</sup> /h/l/s/cfm (PC-Tool/ZTH %) % (Position) Pa (PC-Tool/ZTH %)	Operating volumetric flow 0...100% V'nom Damper position (Pos.Cntrl.) 0...100% Δp step min 0...100% P'nom	X	X	X	X	r/w	r/w	r/w	
Altitude compensation	ON/OFF	Switch function ON/OFF	X	X	X		r/w	r/w	-	E
Altitude of installation	0m	compensated Δp and volumetric flow values to set the altitude of installation (above sea level)	X	X	X		r/w	r/w	-	E
Function	VAV-CAV/Position control	Control function	X		X		r/w	r/w	-	E
Room pressure cascade	OFF/ON	VAV: Secondary circuit room pressure cascade	X				r/w	r/w	-	E
Setpoint	Analogue/bus	Analogue and hybrid mode/bus	X	X	X	X	r/w	r/w	-	E
Setpoint offset	0%	VAV: ±5% compensation ABL unit	X				r/w	r/w	-	E
Reference signal Y	2...10 V/0...10 V/adjustable	Setting for VAV control	X		X	X	r/w	r/w	-	E
Feedback type	Volumetric flow/Δp/Position	VAV: Volume/Δp/Damper position Pressure: Δp/Damper position	X	(X)	X		r/w	r/w	-	E
Feedback U	2...10 V/0...10 V/adjustable	Setting U signal	X	X	X	X	r/w	r/w	-	E

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- Tool: Does not support parameter
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## Bus parameter

Parameter/function	Unit/value	Function/description/(area)	Tool			Authorisation
			Assistant app	PC-Tool	ZTH EU	Expert/OEM
<b>Parametrisation – Communication</b>						
Bus protocol	BACnet MS/TP / Modbus / MP		r/w	–	–	E
Bus protocol	BACnet MS/TP					
MAC address	0...127		r/w	–	–	E
Baudrate	9600 / ... / 115200		r/w	–	–	E
Terminating resistor	OFF/ON		r/w	–	–	E
Instance number	1...4194304		r/w	–	–	E
Device name	VAV Universal	(32 Z.)	r/w	–	–	E
Max master	0...127		r/w	–	–	E
Bus protocol	Modbus RTU					
Address	1...247		r/w	–	–	E
Baudrate	9600 / ... / 115200		r/w	–	–	E
Terminating resistor	OFF/ON		r/w	–	–	E
Parity	1-8-N-2/...E-1/...-O-1/...-N-1		r/w	–	–	E
Bus protocol	MP-Bus					
MP address	PP/MP1...8	PP (MP off)/MP1...8	r/w	r/w	–	E
Bus fail position	0%	0...100% (min...max)	r/w	–	–	E
Compatibility mode	Default/VRP-M <sup>1)</sup>	Default: Belimo MP datapool device VRP-M: VRP-M replacement in existing MP system <sup>1)</sup>	r/w	r/w	–	E

### Note:

<sup>1)</sup> Refer to instructions: VAV-Universal - MP-Bus existing system: Replace VRP-M with VRU-...-BAC

### Availability:

VAV-Universal components incl. replacement devices are only available from manufacturers of VAV units (OEM).

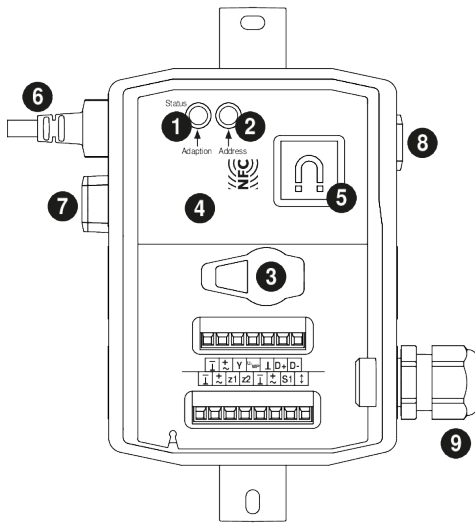
### Authorisations:

[O-OEM, Manufacturer Level] - VRU controllers are calibrated and parameterised by the unit manufacturer according to the application and project. These settings can only be changed by the manufacturer. [E-Expert Level] - Functionally relevant settings are only accessible via the Expert Level of the Belimo Assistant App.

### Legend:

X Application supports function/parameter  
r Tool: read  
w Tool: write  
– Tool: Does not support parameter  
O Access only with OEM authorisation  
E Only visible in Expert Mode

## Operating controls and indicators



- 1 Push-button and LED display green**  
 On: In operation (Power ok)  
 Flashing: Pending status information Belimo Assistant-App  
 Press button: Triggers angle of rotation adaptation, followed by standard mode
- 2 Push-button and LED display yellow**  
 Flashing: MP addressing  
 Press button: Confirmation of the addressing
- 3 Service plug**  
 For connecting parameterisation and service tools
- 4 NFC-Interface**  
 Belimo Assistant App, over NFC interface (Android Phone) or with ZIP-BT-NFC converter for bluetooth connection (iOS and Android Phone)
- 5 Holding plate**  
 For ZIP-BT-NFC (magnet)
- 6 Connection I M**  
 For ...-VST actuator
- 7 Blind plug II not used**
- 8 Connection  $\Delta p$  sensor**  
 6 mm (tube inside diameter 5 mm)
- 9 Cable gland M16**

**Installation notes**
**Installation situation**

Mounting VAV-Universal control equipment:

The VAV-Universal set is assembled on the VAV unit in factory by the VAV unit manufacturer, the actuator connected to the VRU controller, set and calibrated.

Installation of the VAV unit:

The VAV unit must be installed according to the specifications of the VAV unit manufacturer.

Installation specification  $\Delta p$  sensor:

No restrictions, but it must be avoided that any condensation can run into the sensor and remain there.

Accessibility of control equipment:

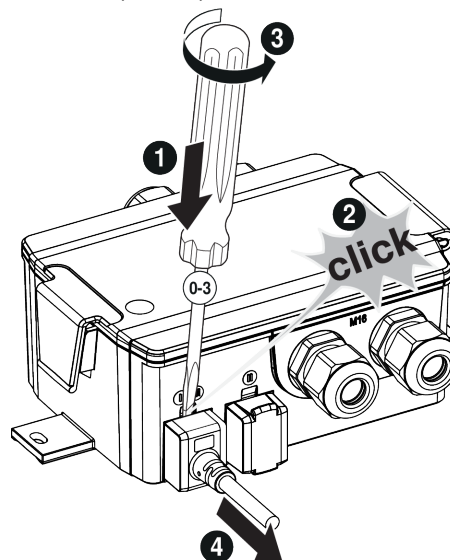
Accessibility to the control equipment must be guaranteed at all times.

Cable gland M16x1.5

Depending on the connection situation, the cable gland can be inserted in one of the 4 M16 openings. (Tightening torque 5 Nm)

Remove actuator cable:

The connecting cable of the VST damper actuator can be removed from the VRU controller using a screwdriver (size 0...3) as shown in the illustration.



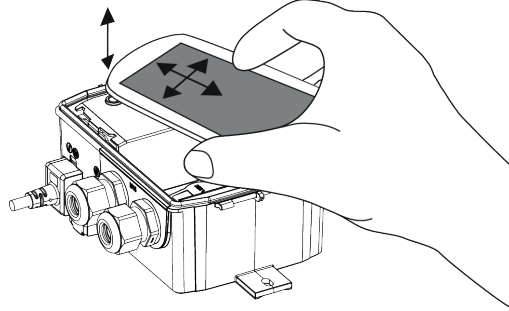
**NFC connection** Belimo devices marked with the NFC logo can be operated with the Belimo Assistant App.

Requirement:

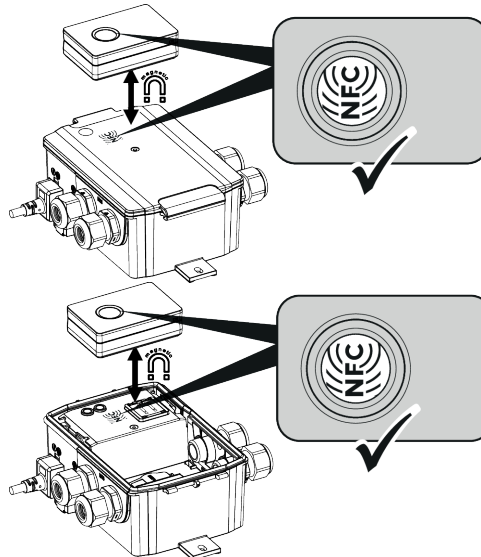
- NFC- or Bluetooth-capable smartphone
- Belimo Assistant App (Google Play & Apple AppStore)

Align NFC-capable smartphone on the device so that both NFC antennas are superposed.

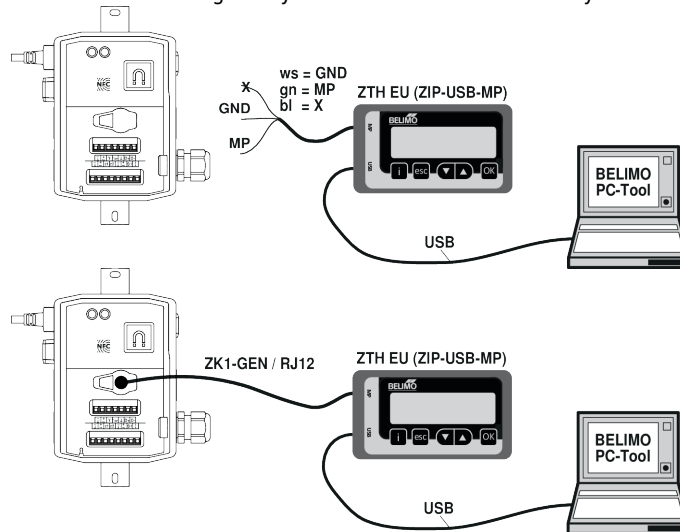
Connect Bluetooth-enabled smartphone via the Bluetooth-to-NFC Converter ZIP-BT-NFC to the device. Technical data and operation instructions are shown in the ZIP-BT-NFC data sheet.

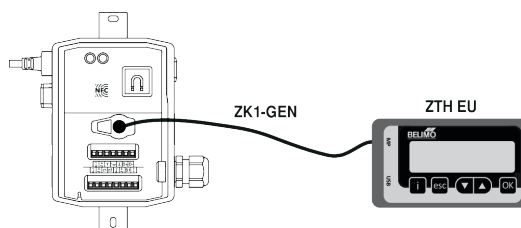


**Converter ZIP-BT-NFC**



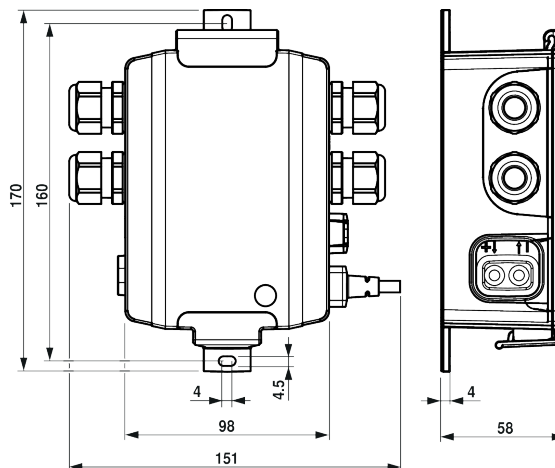
**Service Tools connection** The device can be configured by ZTH EU via the service socket or by the Belimo Assistant App via NFC.





## Dimensions

## Dimensional drawings



## Further documentation

- Data sheets for VST-actuators
- VAV-Universal application description
- Tool connections
- Description Modbus register
- Description Data-Pool Values
- Description Protocol Implementation Conformance Statement PICS
- Introduction to MP-Bus Technology
- Overview MP Cooperation Partners