# BELIMO®

VAV-Universal, modular control solution with integrated Δp sensor for polluted media. Can be combined with damper actuator optimally suited to the room pressure application. Application field: technical building equipment, HVAC systems

• Application: Room pressure control in comfort and sensitive areas
• Functional range differential pressure -75...75 Pa
• suitable for ...-VST actuator
• Control modulating, communicative, hybrid
• Communication via BACnet MS/TP, Modbus RTU, Belimo MP-Bus or conventional control

ASHRAE BACnet™
Modbus
MP/BUS®
NFC

## Technical data

| | | |
|---|---|---|
| **Electrical data** | 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 | Imax 20 A @ 5 ms |
| | Connection supply / control | Terminals 2.5 mm² |
| | Sensor input S1 | Connection of external sensor (passive / active / switch) |
| | Actuator Connection (I) (M) | AC/DC 24 V, PP-Link for VST actuator |
| **Functional data** | Communicative control | BACnet MS/TP<br>Modbus RTU<br>MP-Bus |
| | Operating range Y | 2...10 V |
| | Input Impedance | 100 kΩ |
| | Operating range Y variable | 0.5...10 V |
| | Position feedback U note | Max. 0.5 mA<br>Options: Δp / Position |
| | Position feedback U variable | 0...10 V<br>Start point 0...8 V<br>End point 2...10 V |
| | Override control | z1 motor stop / damper OPEN (AC/DC 24 V)<br>z2 damper CLOSE / MAX (AC/DC 24 V) |
| | Parametrisation | via Belimo Assistant App / PC-Tool |
| **Measuring data** | Measuring principle | Belimo M1R, membrane sensor |
| | Installation position | position-independent, no zeroing necessary |
| | Functional range differential pressure | -75...75 Pa |
| | Burst pressure | ±7 kPa |
| | Condition measuring air | 0...50°C / 5...95% r.H., non-condensing |
| | Pressure hose connection | Nipple diameter 5.3 mm for pressure hose (5 mm inner diameter) |
| **Safety data** | 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 |

| | | |
|---|---|---|
| **Weight** | Weight | 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-M1R-BAC is used in the comfort area as well as in sensitive working areas with contaminated media for room pressure applications.

Pressure measurement

The integrated M1R differential pressure sensor is suitable for detecting very small pressure differences. The maintenance-free sensor technology enables a wide range of applications in the HVAC comfort area: office, hotel, etc. and in sensitive work areas: hospital rooms, clean rooms, etc.

Actuators

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

Control function

Room pressure control (RP) and room pressure cascade control (RPC), description see application library

**Application room pressure control (RP)**

Room pressure control (RP) for rooms with switchable or variable Δp value P'min...P'max via a continuous command variable (analog or bus).

Application A) - with non-critical room leakage rate

Rooms with non-critical leakage rates / overflows, room pressure controller acting on supply or extract air dampers.

Application B) - with low room leakage rate

Rooms with low leakage rates / overflows, room pressure controller acting on bypass damper mounted parallel to the VAV unit.

Description see application library

P'nom

OEM specific calibration parameters: 0...75 Pa

P'max

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

P'min

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

Room pressure mode

Switchable: negative / positive pressure via Belimo Assistant App or BACnet/Modbus

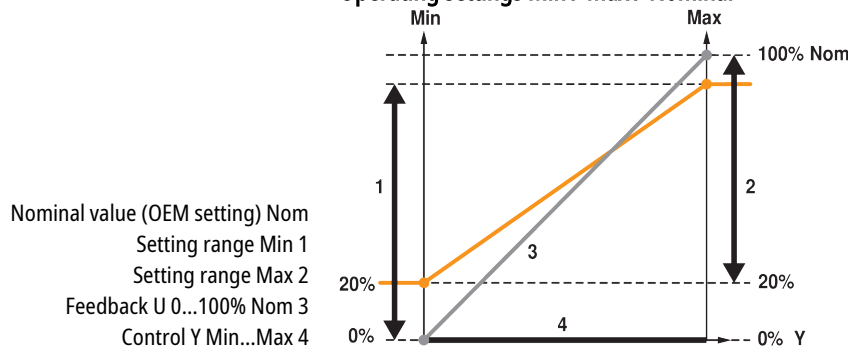| | |
|---|---|
| **Application room pressure cascade control (RPC)** | Room pressure cascade control (RPC) for rooms with low leakage rates / overflows acting on volume flow controller, with switchable or variable Δp value P'min...P'max via a continuous command variable (analog or bus). |
| | P'nom<br>OEM specific calibration parameters: 0...75 Pa |
| | P'max<br>Maximum operating pressure, adjustable 20...100% of P'nom |
| | P'min<br>Minimum operating pressure, adjustable 0...100% of P'nom |
| | Room pressure mode<br>Switchable: negative / positive pressure via Belimo Assistant App or BACnet/Modbus |
| **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: Standard / VRP-M** | The VRU-..-BAC is based on the new Belimo MP data pool model. |
| | 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** | see application library |

**Operating settings Min / Max / Nominal**

Nominal value (OEM setting) Nom
Setting range Min 1
Setting range Max 2
Feedback U 0...100% Nom 3
Control Y Min...Max 4



| | |
|---|---|
| **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. |

## Accessories

| 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

⚠ Connection via safety 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.

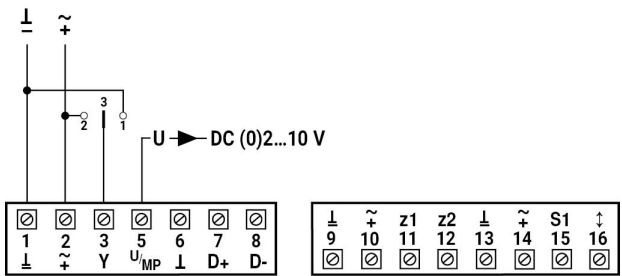### Wiring diagrams

AC/DC 24 V, modulating (VAV)



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



AC/DC 24 V, override control z1/z2
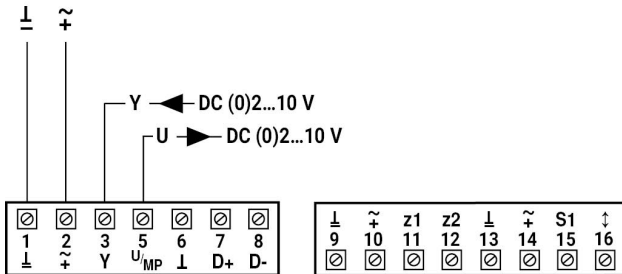


**Priority rule - Analog VAV-control (a)**

1. z1
2. z2
3. a) adaption
   b) synchronisation
4. Y-modulating: Min...Max

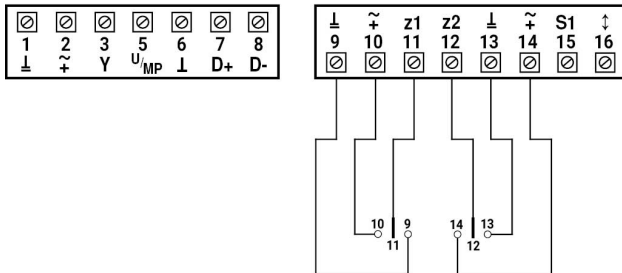(see override control z1/z2)

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

1. z1
2. z2
3. a) adaption
   b) synchronisation
4. Y-steps: Close-Min-Max

(see override comtrol z1/z2)

Contact 2-3 = MAX
3 uncoated = MIN
Contact 1-3 = CLOSE (Mode 2...10 V)
              MIN (Mode 0...10 V)

**Override control z1**

Contact 11-9 = Motor STOP
Contact 11-10 = Damper OPEN

**Override control z2**

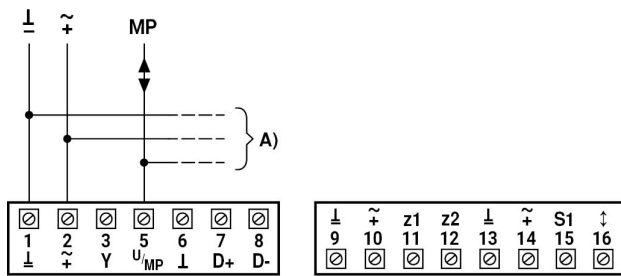Contact 12-13 = Damper CLOSED
Contact 12-14 = MAX

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

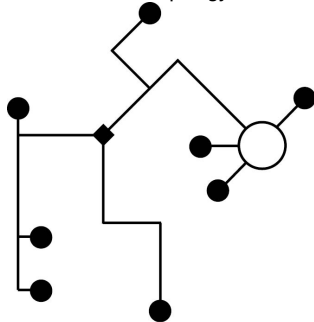## Functions for actuators with specific parameters (Parametrisation necessary)
MP-Bus



### 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
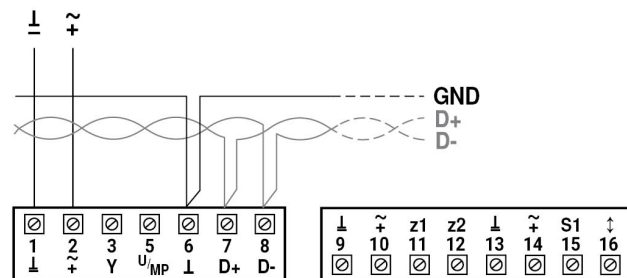7. Bus setpoint: Min…Max

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

MP-Bus Network topology



There are no restrictions for the network topology (star, ring, tree or mixed forms are permitted).
Supply and communication in one and the same 3-wire cable
• no shielding or twisting necessary
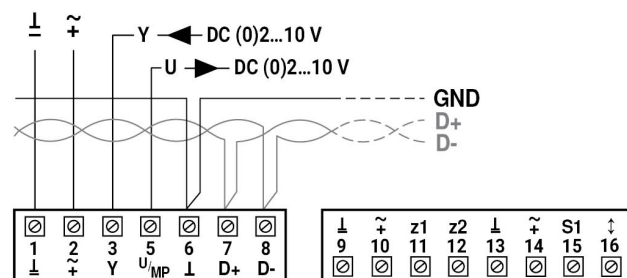• no terminating resistors required

BACnet MS/TP / Modbus RTU



### Priority rule BACnet/Modbus control (d)
1. z1
2. z2
3. Bus Watchdog
4. a) adaption
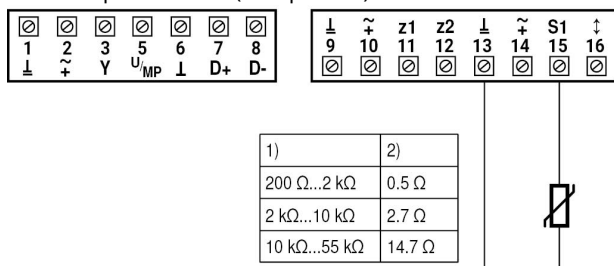   b) synchronisation
5. Bus override
6. Bus setpoint: Min…Max

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



### Priority rule BACnet/Modbus hybrid mode (e)
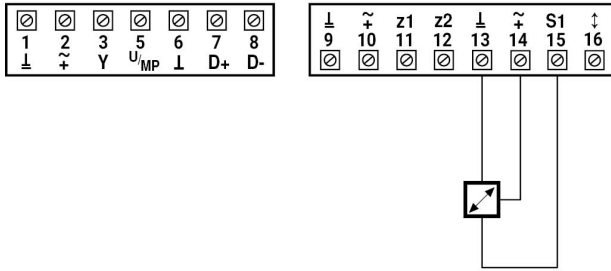1. z1
2. z2
3. Bus Watchdog
4. a) adaption
   b) synchronisation
5. Bus override
6. Y-step: Actuator CLOSE / MIN / MAX
7. Bus setpoint: Min…Max

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)
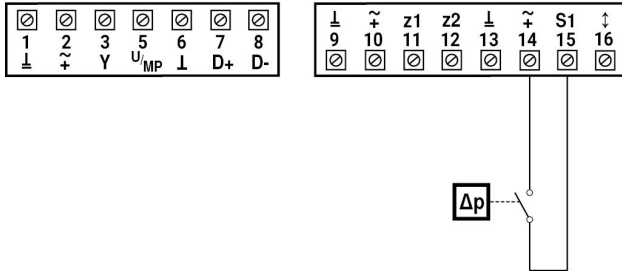


Requirements switching contact:
The switch must be capable of
switching a current of 10 mA @ 24 V
cleanly.
Example:
- dP sensor
- window contact

**Parameter and tool overview**

# Operating data

| Parameter/function | Unit/value | Function/description/(area) | Application | | Tool | | | Authori-sation |
|---|---|---|---|---|---|---|---|---|
| | | | Room pressure | Room pressure cascade affecting VAV | Assistant app | PC-Tool | ZTH EU | Expert/OEM |
| **Overview** | | | | | | | | |
| Position | String | Plant designation (64 Z./ZTH 10 Z.) | X | X | r | r | r | |
| Series number | xxxxx-xxxxx-xxx-xxx | Series number VRU | X | | r | r | r | |
| Voltage source | 24 V/- | | X | X | r | | | |
| Type | VRU-M1R-BAC | | X | X | r | r | r | |
| Application | Room pressure | Application setting | X | | r | r | r | |
| Room pressure cascade | OFF/ON/Quick ON | OFF<br>ON: Function activated<br>Quick ON: Activated with VAV fast running actuators | (X) | X<br>X | r | r | r | |
| Designation | String | Model designation damper (OEM,16 Z.) | X | X | r | r | – | |
| Setpoint | Δp: Pa (ZTH: %) | Display live data | X | X | X | X | X | |
| Actual value | Δp: Pa (ZTH: %) | Display live data | X | X | X | X | X | |
| Damper position | 0…100% | Display live data | X | | X | X | X | |
| Override control | Auto/MIN/MAX/Nom OPEN/CLOSE/motor stop | Temporary override function (Tool override) | X<br>X | (X) | X | X | | |
| Actuator | Adaption, synchronisation | Trigger adaption, synchronisation | X | | X | X | | E |
| Transmit setting data | | System documentation | X | X | X | X | | |
| Save setting data | | Save setting in file | X | X | | X | | |
| Trend display | Setpoint, actual value, damper position | Commissioning, validation, service | X | | X | X | | |
| Trend display | Setpoint, actual value | Commissioning, validation, service | | X | X | X | | |
| Transmit trend data | | Commissioning, validation, service | X | X | X | X | | |
| **Diagnosis – evaluation** | **Status** | | | | | | | |
| Actuator | OK/Gear disengaged/Actuator blocked/Setting range extended | | X | | | | | |
| Sensor | OK/Δp sensor incorrectly connected/measuring value outside measuring range/Δp sensor error | | X | X | | | | |
| Room pressure | OK/Setpoint not reached | | X | X | | | | |
| Bus | OK/Bus watchdog triggered | | X | X | | | | |
| **Diagnosis – installation** | **Unit/value** | **Function/description/(area)** | | | | | | |
| Voltage source | 24 V/deenergised | | X | X | X | | | |
| Operating time | h | Device connected to supply | 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

# Configuration

| Parameter/function | Unit/value | Function/description/(area) | Application Room pressure | Application Room pressure cascade affecting VAV | Tool Assistant app | Tool PC-Tool | Tool ZTH EU | Authorisation Expert/OEM |
|---|---|---|---|---|---|---|---|---|
| **VAV unit/Air duct pressure control butterfly valve - manufacturer parameters (OEM values - not variable)** | | | | | | | | |
| Application | Room pressure | Application setting | X | X | r | r | r | O |
| Designation | Text string | Model designation damper (16 Z.) | X | X | r | r | – | O |
| P'nom | Pa | Nominal value Δp RP [5…75 Pa] | X | X | r | r | r | O |
| SN Actuator | xxxxx-xxxxx-xxx-xxx | Actuator series number | X | | r | – | – | |
| Rotation Direction | CCW/CW | Actuator direction of rotation setting | X | | r/w | r/w | – | E |
| Range of rotation | Adapted/programmed | Actuator adapted/programmed 30…95° | X | | r/w | r/w | – | E |
| Power on behaviour | No action/synch. / Adaption | Actuator power on behaviour | X | | r/w | r/w | – | E |
| NFC interface | ON/OFF | NFC Communication for app access | X | X | r | r | – | O |
| | | | | | | | | |
| **Parametrisation – Project-specific settings** | | | | | | | | |
| Position | Text string | Plant designation (64 Z./ZTH 16 Z.) | X | X | r/w | r/w | r | |
| Max | Pa (PC-Tool/ZTH %) | Δp step max 20…100% P'nom | X | X | r/w | r/w | r/w | |
| Min | Pa (PC-Tool/ZTH %) | Δp step min 0…100% P'nom | X | X | r/w | r/w | r/w | |
| Room pressure mode | Positive pressure/negative pressure | Room operating mode aseptic (+)/septic (-) | X | X | r/w | r/w | – | E |
| Application area | Exhaust air/supply air | Mounting location for<br>- Control damper or<br>- Room pressure cascade: VAV unit with Cascade signal (secondary controller) | X | X | r/w | r/w | – | E |
| Room pressure cascade | OFF/ON/Quick ON | in connection with room pressure cascade<br>ON: Function activated<br>Quick ON: Activated with VAV fast running actuators | (X) | X<br>X | r/w | r/w | – | E |
| Setpoint | Analogue/bus | Analogue and hybrid mode/bus | X | X | r/w | r/w | – | E |
| Reference signal Y | 2…10 V/0…10 V/adjustable | Control setting | X | X | r/w | r/w | – | E |
| Feedback type | Δp/Position | Δp/Damper position | X | | r/w | r/w | – | E |
| Feedback U | 2…10 V/0…10 V/adjustable | Setting U signal | X | | r/w | r/w | – | E |

**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
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–    Tool: Does not support parameter
E    Only visible in Expert Mode

# Bus parameter

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

**Note:**

[1] Refer to instructions: VAV-Universal - MP-Bus existing system: Replace VRP-M with VRU-...-BAC

[2] In the room pressure cascade application, the room pressure controller can not be integrated in the MP-Bus system. MP address setting: PP!

**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
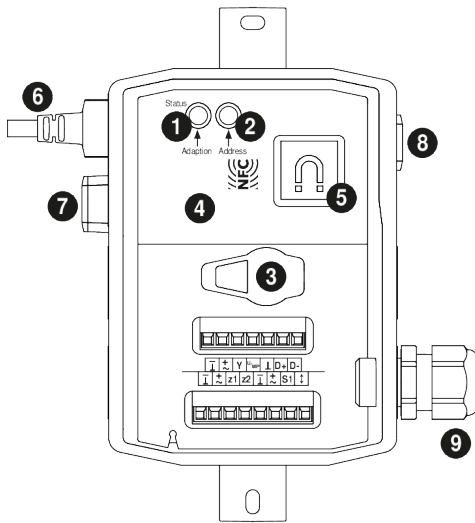
**① Push-button and LED display green**

| | |
|---|---|
| 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 ⓘ ⓜ**

For ...-VST actuator

**⑦ Blind plug ⓘⓘ not used**

**⑧ Connection Δp 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 Δp 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.
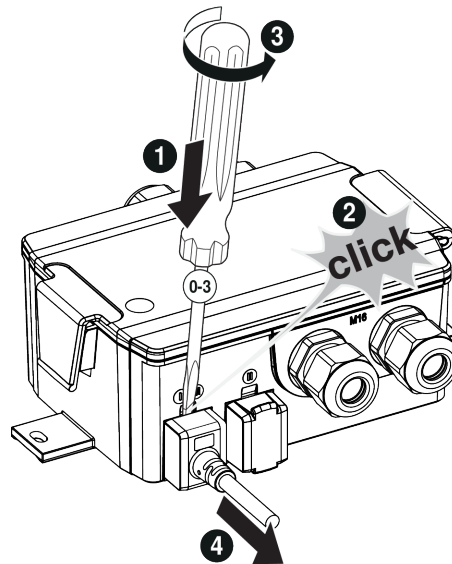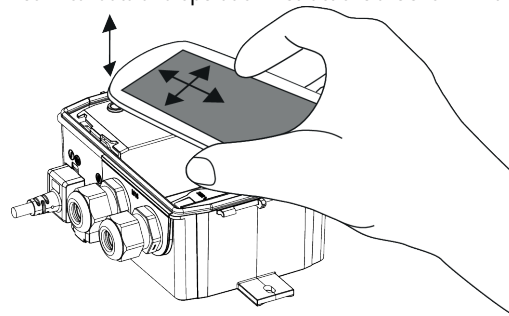
## Service

**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)

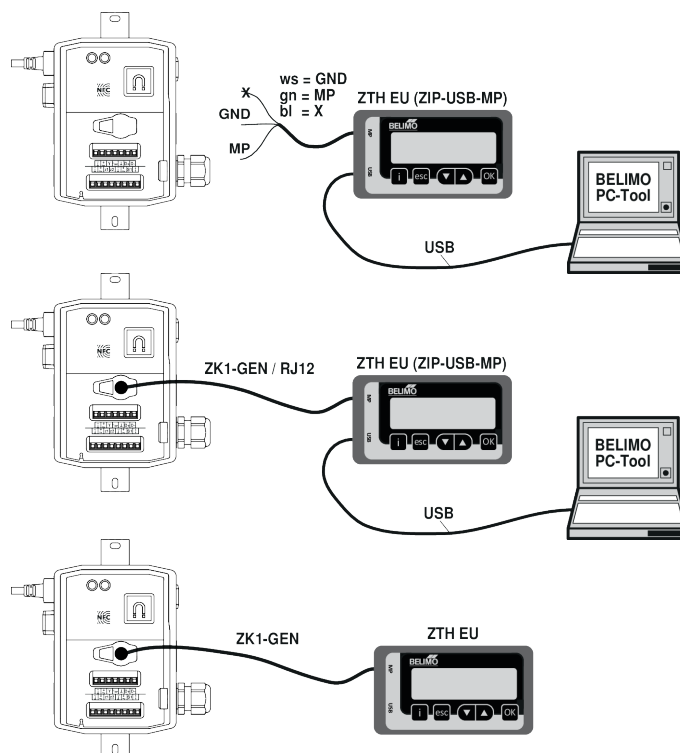Align NFC-capable smartphone on the device so that both NFC antennas are superposed.

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.
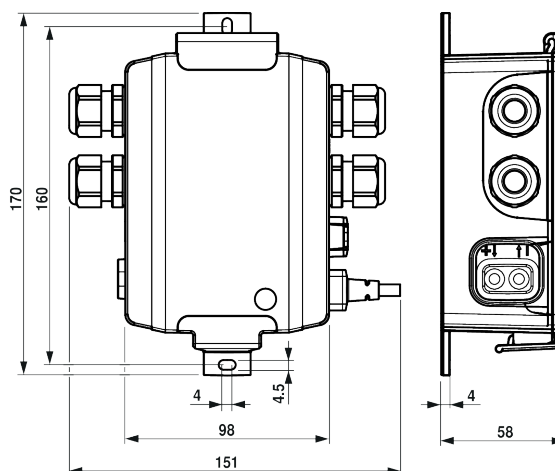


**Converter ZIP-BT-NFC**
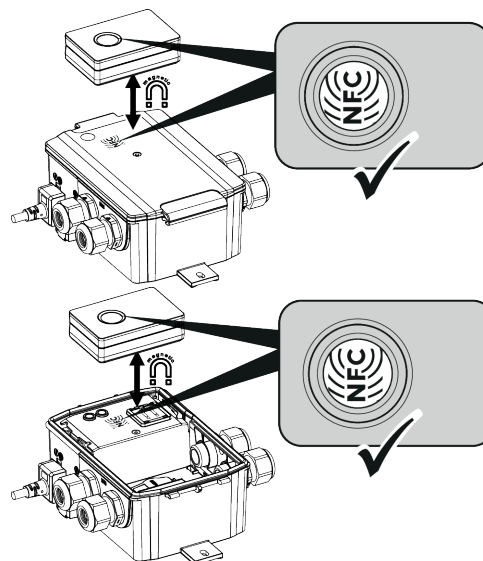


**Service Tools connection**   The device can be configured by ZTH EU via the service socket or by the Belimo Assistant App via NFC.

ws = GND
gn = MP
bl = X

GND

MP

ZTH EU (ZIP-USB-MP)

BELIMO PC-Tool

USB

ZK1-GEN / RJ12

ZTH EU (ZIP-USB-MP)

BELIMO PC-Tool

USB

ZK1-GEN

ZTH EU

## Dimensions

**Dimensional drawings**



170
160
4
4.5
98
151
4
58

## Further documentation

• Data sheets for VST-actuators
• VAV-Universal application description
• Tool connections
• Description Modbus register
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