BELIMO

Technical data sheet VRU-M1R-BAC

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. Field of application: technical building equipment, HVAC systems

- Application: Room pressure control in comfort and sensitive areas
- Functional Range Differential Pressure -0.3...0.3 inch WC [-75...75 Pa]
- suitable for ...-VST actuator
- Control modulating, communicative, Hybrid
- Communication via BACnet MS/TP, Modbus RTU, Belimo MP-Bus or analog control

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
	Transformer sizing	2 VA plus connected VST actuator
	Transformer sizing note	Imax 20 A @ 5 ms, incl. actuator
	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
Data bus communication	Communicative control	BACnet MS/TP Modbus RTU MP-Bus
	Number of nodes	BACnet / Modbus see interface description MP-Bus max. 8
Functional data	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 Options: Δp / 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)
	Configuration	via Belimo Assistant App / PC-Tool
Measuring data	Measuring principle	Belimo M1R, diaphragm sensor
	Installation position	position-independent, no zeroing necessary
	Functional Range Differential Pressure	-0.3...0.3 inch WC [-75...75 Pa]
	Accuracy Differential Pressure	±0.001 inch WC [±0.25 Pa]
	Burst pressure	±28 inch WC [±7 kPa]
	Condition Measuring Air	32...122°F [0...50°C] / 5...95% RH, non-condensing
	Pressure tube connection	Nipple diameter 0.2" [5.3 mm] for pressure tube (3/16" [5 mm] inner diameter)
Safety data	Protection class IEC/EN	III, Safety Extra-Low Voltage (SELV)
	Protection class UL	II, reinforced insulation
	Power source UL	Class 2 Supply

Safety data	Degree of protection IEC/EN	IP42
	Degree of protection NEMA/UL	NEMA 1
	Enclosure	UL Enclosure Type 1
	EMC	CE according to 2014/30/EU
	Certification IEC/EN	IEC/EN 60730-1
	Certification UL	cULus according to UL60730-1, UL2043, CAN/CSA E60730-1
	Agency Listing	Listed to UL 2043 - suitable for use in air plenums per Section 300.22(C) of the NEC and Section 602 of the IMC
	Mode of operation	Type 1
	Rated impulse voltage supply / control	0.8 kV
	Pollution degree	2
	Ambient temperature	32...122°F [0...50°C]
	Storage temperature	-40...176°F [-40...80°C]
	Ambient humidity	Max. 95% RH, non-condensing
	Servicing	maintenance-free
Weight	Weight	0.66 lb [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.
- Only authorized 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 (analogue 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: 0.02...0.3 inch WC [5...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 (analogue or bus).

P'nom

OEM specific calibration parameters: 0.02...0.3 inch WC [5...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

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 analog 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.

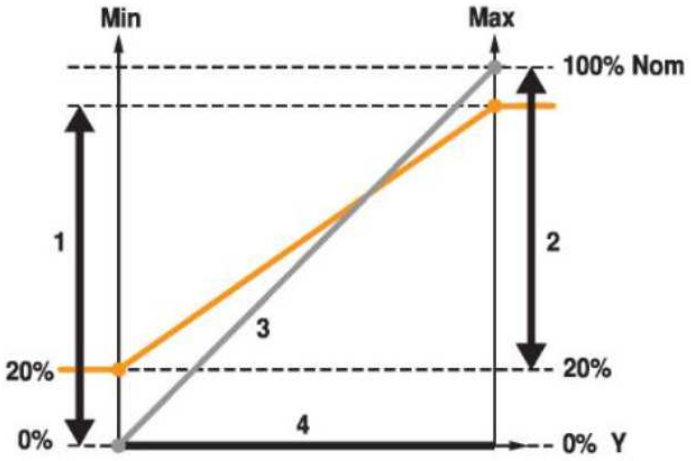
MP-Bus application Compatibility mode: Standard / VRP-M

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
Adjustment range Min 1
Adjustment 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

Electrical accessories

Description	Type
Dummy plug for VST connector plug, Multipack 25 pcs.	ZG-VRU01

Service tools

Description	Type
Service Tool, with ZIP-USB function, for programmable and communicative Belimo actuators, VAV controller and HVAC performance devices	ZTH EU
Belimo PC-Tool, Software for adjustments and diagnostics	MFT-P
Belimo Assistant App, Smartphone app for easy commissioning, parametrising and maintenance	Belimo Assistant App
Converter Bluetooth / NFC	ZIP-BT-NFC

Complete functions ZIP-BT-NFC as of production date 2019-10-15

Electrical installation

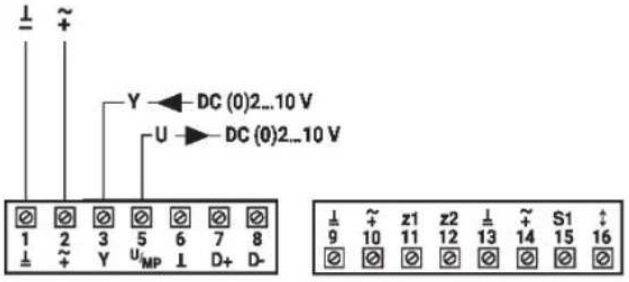
Supply from isolating transformer.

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)



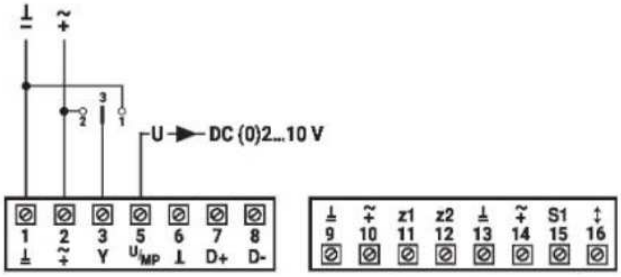
Priority rule - Analog VAV control (a)

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

(see override control z1/z2)

Override command 'damper CLOSE' over reference signal Y (in Mode 2...10 V):
< 0.3 V = damper CLOSE
> 0.3...2 V = V'min
2...10 V = V'min...V'max

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



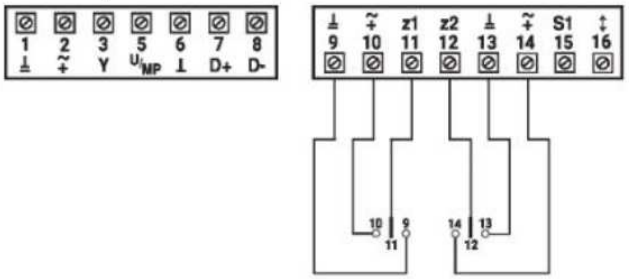
Priority rule - Analogue CAV step control (b)

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

(see override comtrol 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

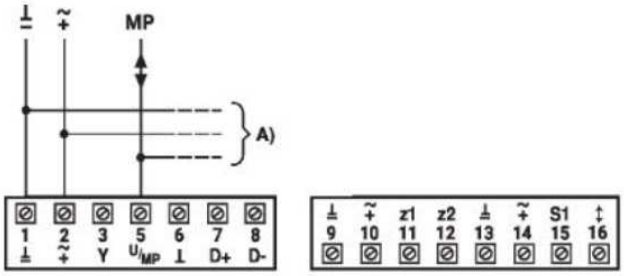
Override control z2
Contact 12-13 = Damper CLOSED
Contact 12-14 = MAX

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

Functions

Functions with specific parameters (NFC)

MP-Bus

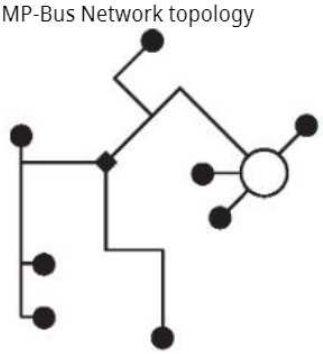


Priority rule MP-Bus control (c)

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

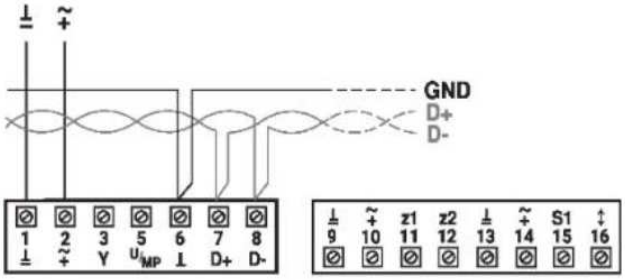
A) additional MP-Bus nodes (max. 8)

MP-Bus Network topology



There are no restrictions for the network topology (star, ring, 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

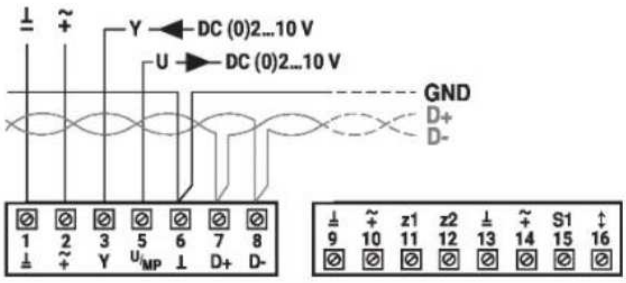
BACnet MS/TP / Modbus RTU



Priority rule BACnet/Modbus control (d)

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

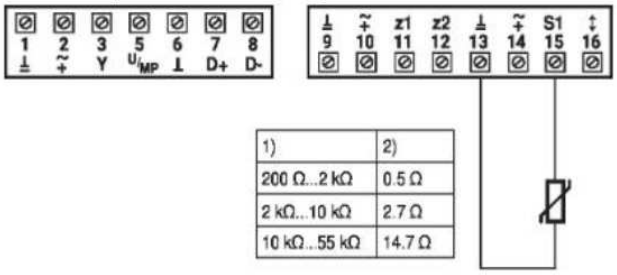
BACnet MS/TP / Modbus RTU with analog setpoint (hybrid mode)



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

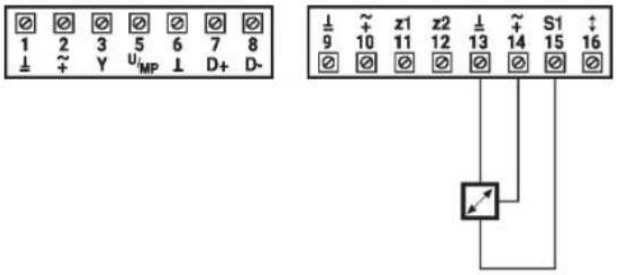
Connection passive sensor (bus operation)



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

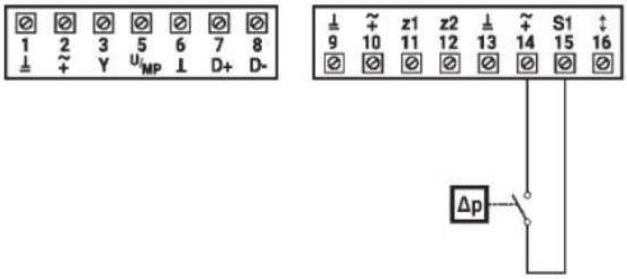
1) Resistance range
2) Resolution
Compensation of the measured value is recommended
Suitable for Ni1000 and Pt1000
Corresponding Belimo sensors 01DT-..

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

Operating data

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
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 ON: Function activated Quick ON: Activated with VAV fast running actuators	(X)	X X	r	r	r	
Designation	String	Model designation damper (OEM, 16 Z.)	X	X	r	r	–	
Setpoint	Δp: Pa (ZTH: %)	Show live data	X	X	X	X	X	
Actual value	Δp: Pa (ZTH: %)	Show live data	X	X	X	X	X	
Damper position	0...100%	Show live data	X		X	X	X	
Override control	Auto/min./max./nom OPEN/CLOSE/Motor stop	Temporary override function (Tool override)	X 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		
Diagnosis – Evaluation	**Status**							
Actuator	OK/not connected/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/de-energised		X	X	X			
Operating time	h	Device connected to supply	X	X	X	X		
Active time	h	Device in motion	X		X	X		
Software Version		VRU - Firmware Version	X	X	X	X		

Availability: VAV-Universal components incl. replacement devices are only available from manufacturers of VAV units (OEM).
Authorisations: [E – Expert Mode] – Functionally relevant settings are only accessible via the Expert Mode 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		Tool			Authorisation
			Room pressure	Room pressure cascade affecting VAV	Assistant app	PC-Tool	ZTH EU	Expert/OEM
VAV unit/Duct pressure control damper – 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 serial number	X		r	–	–	
Direction of rotation	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	–	O
Configuration – Project specific settings								
Position	Text string	Plant designation (64 Z./ZTH 16 Z.)	X	X	r/w	r/w	r	
max.	Pa (ZTH: %)	Δp step max. >P'min...100% P'nom	X	X	r/w	r/w	r/w	
min.	Pa (ZTH: %)	Δp step min. >0...100% P'nom	X	X	r/w	r/w	r/w	
Room-pressure mode	Overpressure/Negative pressure	Room operating mode aseptic (+)/ septic (-)	X	X	r/w	r/w	–	E
Application area	Extract air/Supply air	Mounting location for – Control butterfly valve or – 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 the room-pressure cascade ON: Function activated Quick ON: Activated with VAV fast runner	(X)	X 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 Mode] – Functionally relevant settings are only accessible via the Expert Mode of the Belimo Assistant App.

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E Only visible in Expert Mode

Bus parameter

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
Configuration – Communication								
Bus protocol	BACnet MS/TP/Modbus/MP [2]		X X	X –	r	r	r	E
Bus protocol	BACnet MS/TP							
MAC address	0...127		X	X	r/w	–	–	E
Baud rate	9600/.../115200		X	X	r/w	–	–	E
Terminating resistor	OFF/ON		X	X	r/w	–	–	E
Instance number	0...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
Baud rate	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 PP	PP (MP OFF)/MP1...8 PP (MP OFF)	X	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 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:

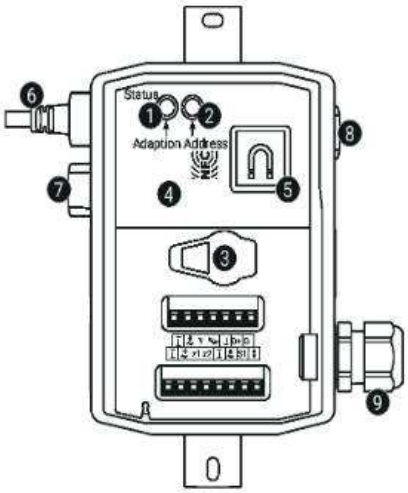
[O – OEM, Manufacturer Mode] – VRU controllers are calibrated and parameterised by the unit manufacturer according to the application and project. These settings can only be changed by the manufacturer.

[E – Expert Mode] – Functionally relevant settings are only accessible via the Expert Mode 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 parametrisation and service tools

4 NFC interface
Belimo Assistant App, over NFC interface (Android) 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 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 the factory by the VAV unit manufacturer, the actuator is 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, cable diameter 5...10 mm

Depending on the connection situation, the cable gland can be inserted in one of the M16x1.5 openings.

Removing the actuator:

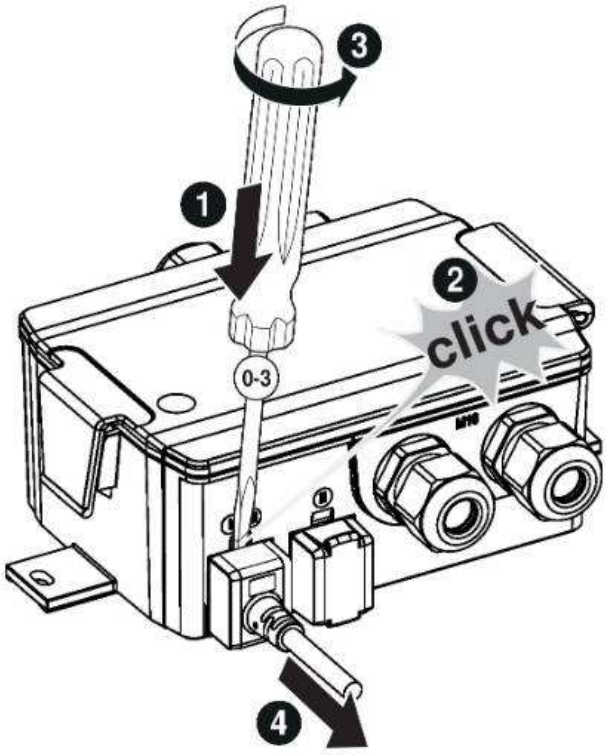
The connecting cable of the VST damper actuator can be removed from the VRU controller using a screwdriver (size 0...3) as shown in the illustration.

Application without actuator:

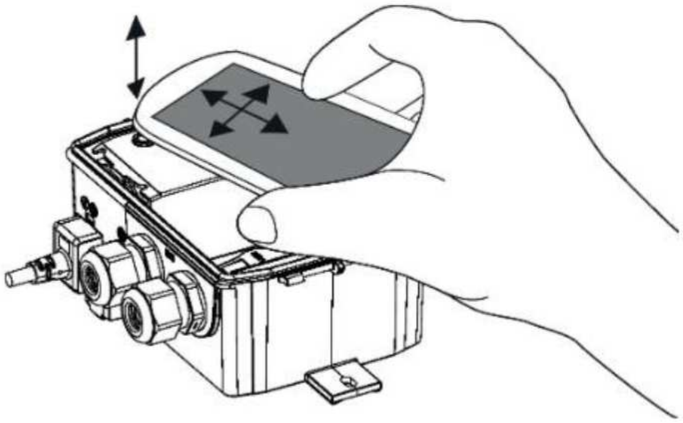
The unused connection socket (I)(M) can be sealed with a dummy plug ZG-VRU01, available as an accessory.

Replacing the actuator:

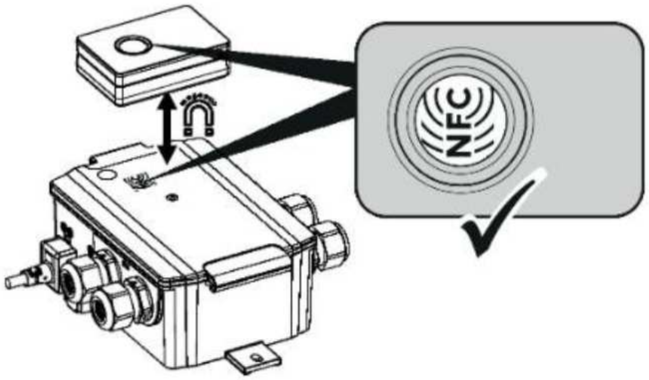
If the VST actuator is replaced during operation, the 24 V supply to the VRU controller must be briefly interrupted. This causes the corresponding actuator driver to be read in.

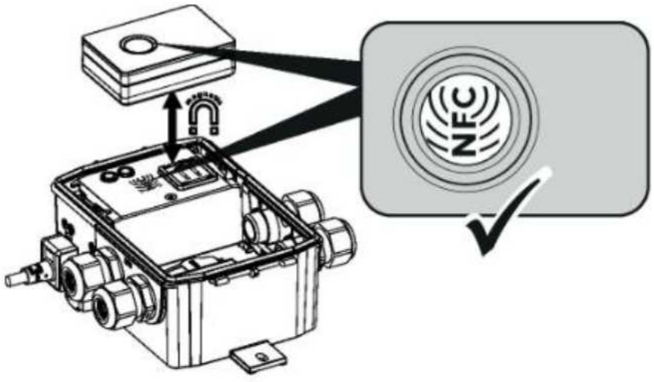


NFC connection



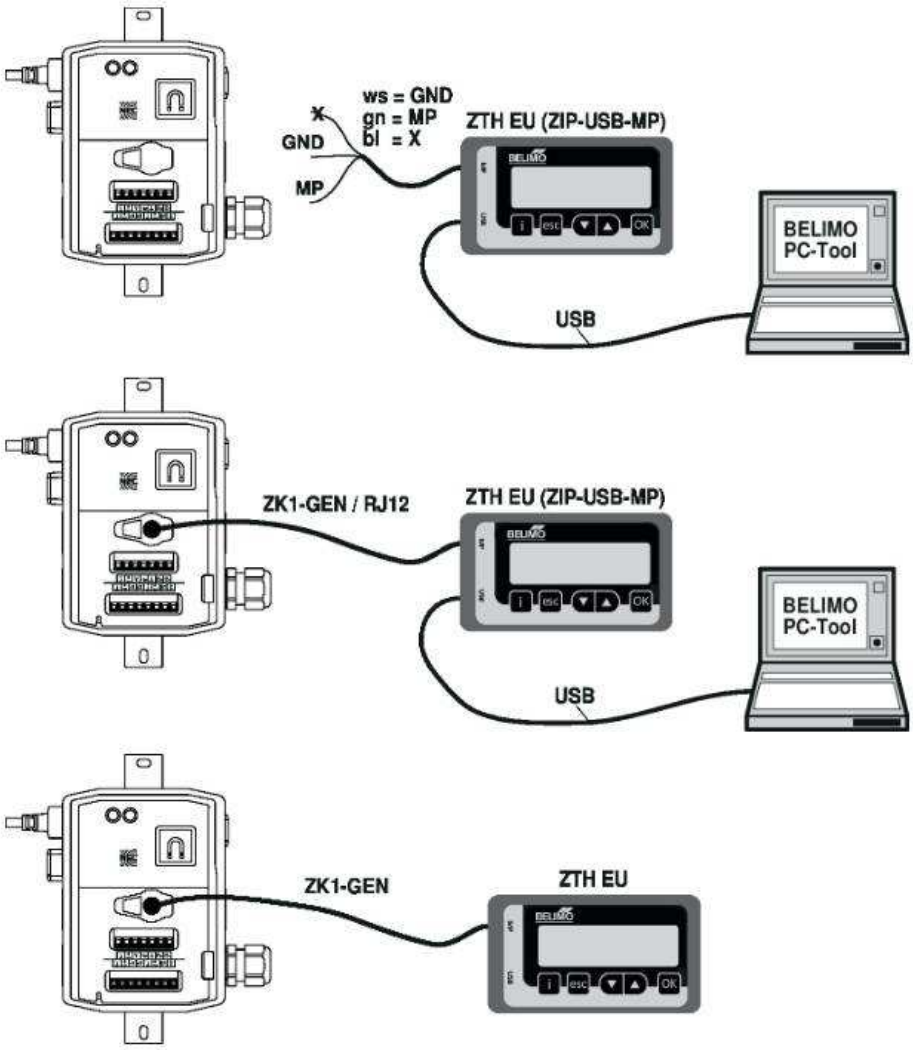
Converter ZIP-BT-NFC



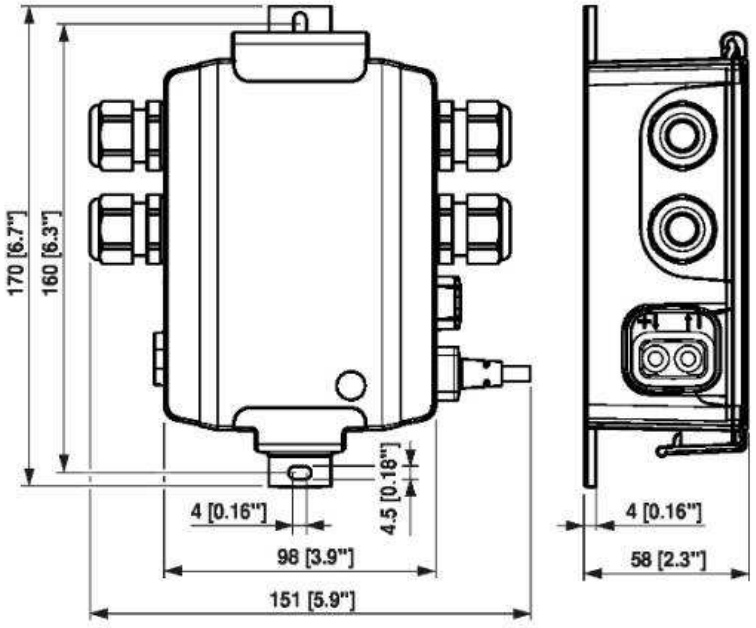


Service tools connection

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



Dimensions



Further documentation

- Volumetric flow and pressure control from Belimo, product range overview
- Data sheets for VST-actuators
- VAV-Universal application description
- Tool connections
- Modbus Interface description
- Description Data-Pool Values
- BACnet Interface description
- Introduction to MP-Bus Technology
- Overview MP Cooperation Partners