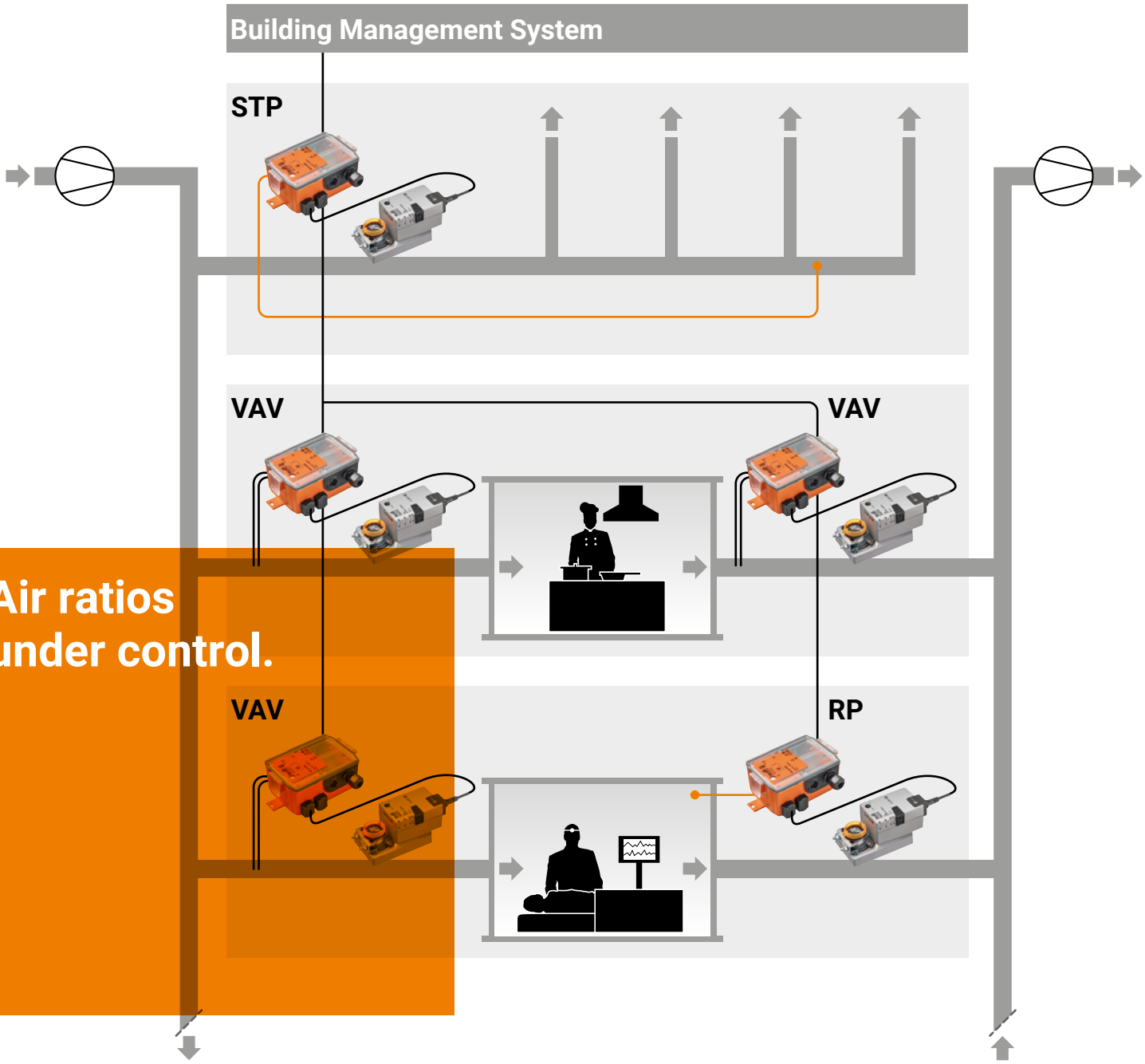


Air ratios under control.

Applications of room and system solutions with VAV-Universal

Edition 2021-05/A

BELIMO

Preface

Thank you for your interest in our products. In this brochure, you will find information on volumetric flow, duct pressure and room-pressure applications with the new VAV-Universal product range from Belimo.

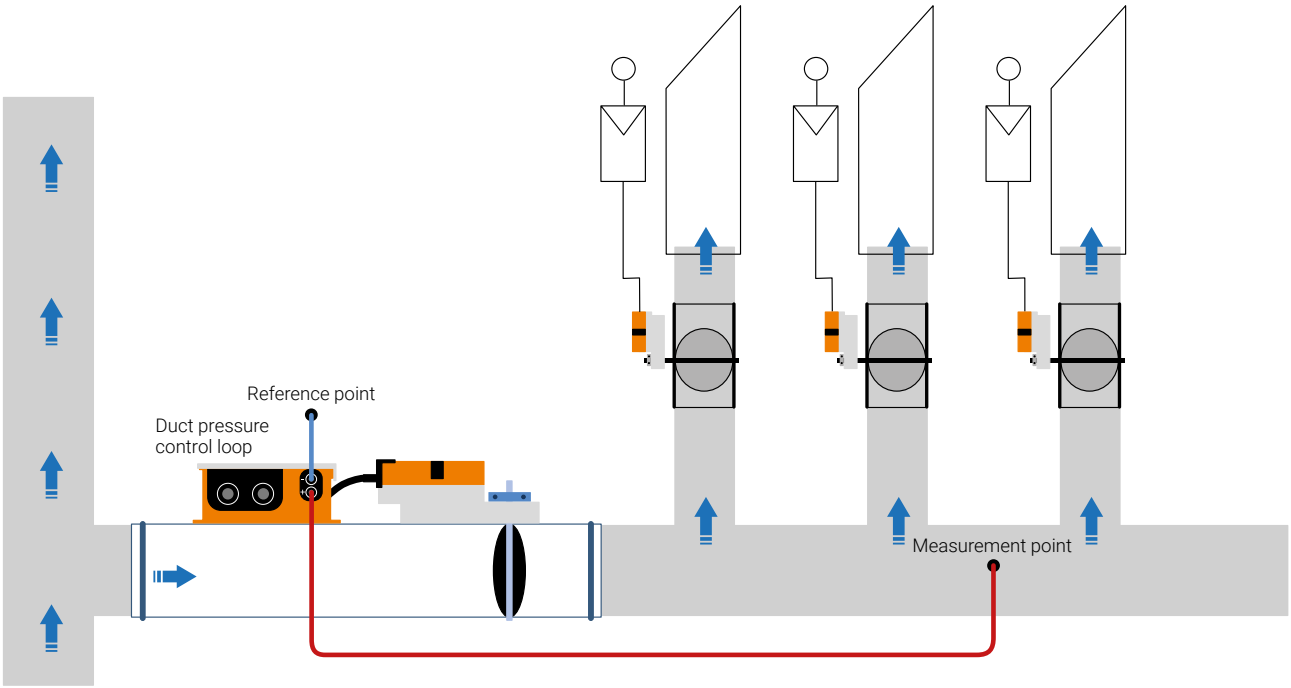
All chapters are structured as follows:

- Brief description
- Principle diagram
- Function diagram
- Device selection
- Diagram
- Parameter and tool overview

The last chapter, starting on page 61, also provides an overview of general principles such as connections, local override controls, sequential versus parallel control, etc.
At www.belimo.com you will find further solutions from Belimo relating to the areas of room and system solutions, bus and system integration, ventilation applications and sensors. Please contact us for more information.

Note
The Belimo VAV product range – VAV-Compact and VAV-Universal components incl. replacement devices – is only available from manufacturers of VAV units (OEM).
Please contact the desired supplier. Your local Belimo representative is happy to help you if necessary.

The diagram shows an example of the principle of one duct (line) pressure control.



Belimo product types

VAV-Universal – maximum flexibility for increased requirements

Ventilation concepts according to DIN EN 15232 require modern, energy-efficient VAV control concepts and ensure operation as required from the fan to the room. Not as much as possible, but as much as necessary.

In addition to the proven VAV-Compact product range, which covers around 90 percent of VAV applications, the modern VAV-Universal product range is now available for special applications. Its modular design, consisting of a VRU controller with integrated high-quality Δp sensor technology, enables the optimum combination of controller and damper motorisation for all VAV, duct pressure and room-pressure applications.

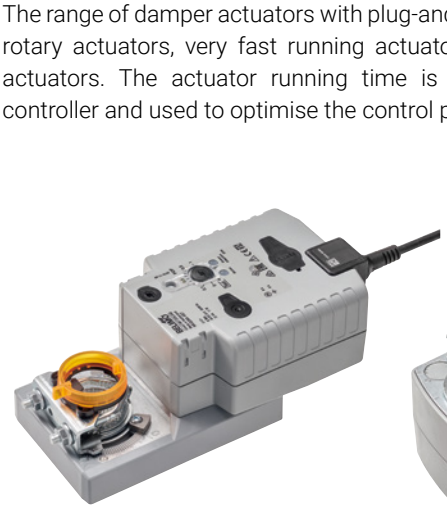
VRU controller sensor unit

The VRU controller sensor unit was developed for use in building technology and is perfectly matched to the VST actuators that belong to the system. Two sensor variants are available: in addition to the well-established, dynamic D3 sensor, the new M1 membrane sensor is also available.

The system supports volumetric flow (VAV), duct pressure (STP) and room-pressure (RP) applications. The control via analogue, BACnet/Modbus, in hybrid mode or MP-Bus is preset with the corresponding tools by the OEM or on the system during system integration. NFC interface, service socket or a PP interface are available for easy tool connection.

VST actuator product range

The range of damper actuators with plug-and-play function includes rotary actuators, very fast running actuators and fail-safe rotary actuators. The actuator running time is detected by the VRU controller and used to optimise the control performance.



Tools for easy commissioning and parametrisation

With the Belimo Assistant App (Android, iOS), actual and setpoint values can be displayed graphically as trend data or parameters adjusted on the system via Bluetooth or NFC. The Belimo PC-Tool is available to system integrators and VAV manufacturers for the production of the VAV unit.

VAV-Compact L/N/SMV-D3-…

The system solution for volumetric flow systems to equip your VAV units for VAV or CAV applications. For analogue control or for direct integration into Modbus, BACnet, KNX or MP-Bus systems.
See www.belimo.eu

Product and function overview

	Function	Characteristic	VRU-D3-BAC	VRU-M1-BAC	VRU-M1R-BAC
Application	VAV/CAV	Volumetric flow	■	■	
	Measure volumetric flow	Volumetric flow	■	■	
	Position Control (Open-Loop)	Volumetric flow	■	■	
	Duct pressure control	Δp	■	■	
	Room-pressure control	Δp			■
	Room-pressure cascade control	Δp Room-pressure volumetric flow control	■ Flow	■ Flow	■ Δp
	Integration in DCV system	Requirement recording via damper position	■	■	■
Control	Modulating	min./max.	■	■	■
	Step mode	min./max.	■	■	■
	Local override – input z1	Motor stop/damper OPEN	■	■	■
	Local override – input z2	Damper CLOSED/max.	■	■	■
	Room-pressure mode +/–	Adjustable via Tool/Modbus/BACnet			
	Control (adjustable with Tool)	0…10 V/2…10 V/variable/bus	■	■	■
		Modbus RTU, incl. hybrid mode	■	■	■
		BACnet MS/TP, incl. hybrid mode	■	■	■
		MP-Bus	■	■	■ [1]
	Feedback (Feedback U5)	0…10 V/2…10 V variable/bus	■	■	■
		Volumetric flow/Δp/position	■	■	Δp
Δp sensor	Measuring principle	D3 - flow (dynamic)	■		
		M1(R) - diaphragm (static)		■	■
	Measuring ranges	Application-dependent (VAV 0…500 Pa)	0...500 Pa	0...600 Pa	–75...75 Pa
	Field of application	Comfort zone	■	■	■
		Polluted air (compatibility test required)		■	■
Actuator	Ready-to-connect connection	Plug-and-play function	■	■	■
	L/N/SM24A-VST	5/10/20 Nm, 120 s, rotary actuator	■	■	■
	L/NMQ24A-VST	4 Nm, 2.4 s/8 Nm, 4 s, very fast running actuator	■	■	■
	NKQ24A-VST	6 Nm, 4 s, very fast running actuator, electrical fail-safe	■	■	■
	N/SF24A-VST LF24-VST	4/10/20 Nm, 120 s, mechanical fail-safe	■	■	■
Tools	Assistant App, NFC	NFC/Bluetooth	■	■	■
	PC-Tool	Default/OEM Manufacturing Tool	■	■	■

Note: VAV-Universal components incl. replacement units are only available from manufacturers of VAV units (OEM).
The components VRD. /VRP.../..-V/..-SRV-ST of the old VAV-Universal product range are not compatible with the VRU./...-VST.
Please contact your Belimo representative for further assistance.

[1] RPC room-pressure cascade controllers cannot be integrated into MP-Bus systems.

Terms

CAV	Constant Air Volume
VAV	Variable Air Volume
DCV	Demand Controlled Ventilation
BMT	Building management technology

DPC	Duct pressure controller
RP	Room-pressure controller
RPC	Room-pressure cascade

cw	Clockwise	direction of rotation
ccw	Anticlockwise	direction of rotation
min.	Operating mode min.	according to the application V'_{min}, P'_{min}, min.
max.	Operating mode max.	according to the application V'_{max}, P'_{max}, max.
P'_{nom} [1)]	Pressure application	Δp control nominal setting[1)]
V'_{nom} [1)]	VAV applications	volumetric flow nominal setting[1)]
$\Delta p@V'_{nom}$ [1)]	VAV applications	calibration unit VAV unit[1)]

[1)] OEM factory setting: fixed setting, values cannot be changed

D3	Δp sensor, D3	– flow sensor (dynamic)
M1(R)	Δp sensor, M1(R)	– diaphragm sensor (static)
VRU…	VAV-Universal controller, Δp sensor unit	
…-VST	VAV-Universal actuator, suitable for the VRU… controller	
VC	VAV-Compact product range, compact solution VAV controller and Δp sensor integrated in actuator	
VU	VAV-Universal product range, modular solution, VAV controller with integrated Δp sensor and external actuator	

MOD	Modbus interface
BAC	BACnet interface
MP	MP-Bus interface
NFC	Chip (Near Field Communication), interface for wireless tool connection

OEM	Original Equipment Manufacturer

Table of contents

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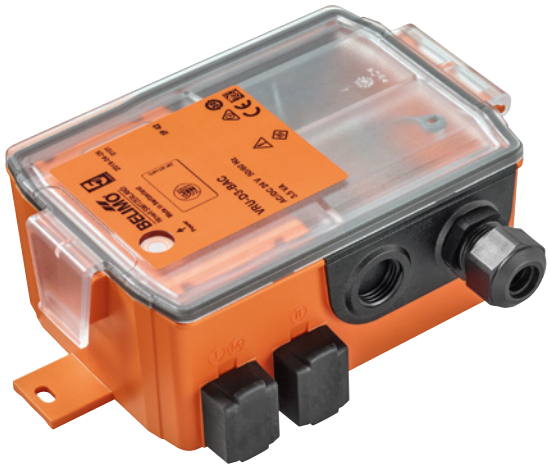
1

Volumetric flow control VAV/CAV

VRU-D3-BAC/VRU-M1-BAC



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Volumetric flow control VAV/CAV

Brief description

– Variable volumetric flow control (VAV) $V'_{min}...V'_{max}$
– Constant volumetric flow control (CAV) Damper CLOSED/V'_{min}/V'_{max} / Damper OPEN

Principle diagram

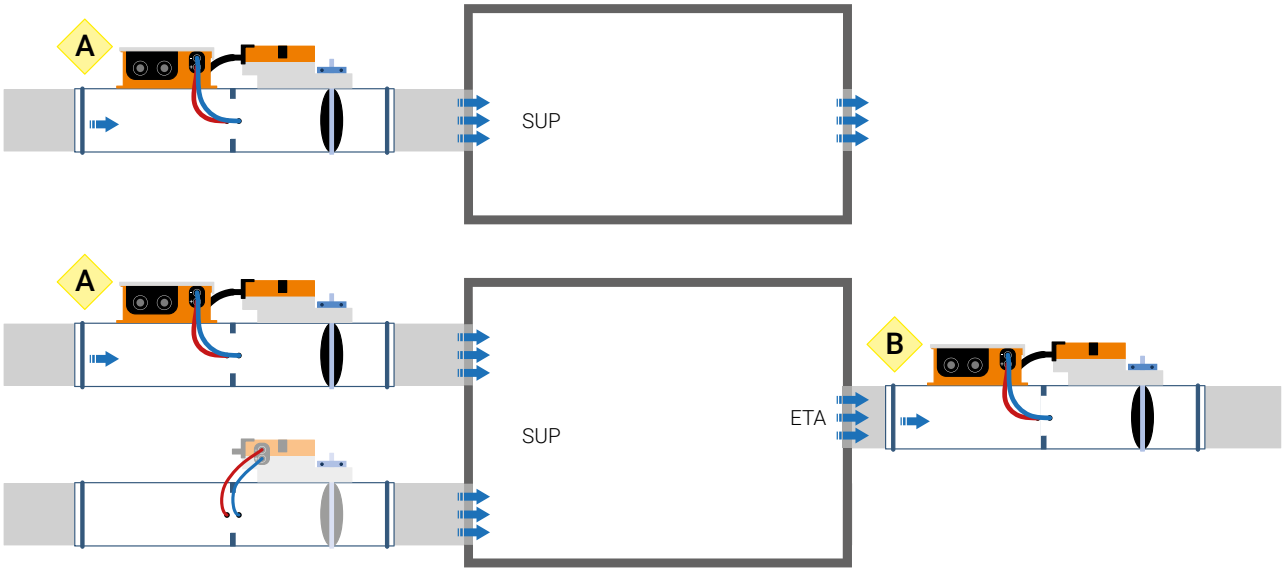


Illustration example

Ventilation system with constant [CAV] and variable air volume [VAV]
– Room and zone applications SUP unit or SUP and ETA unit, in comfort zone
– Extract air/extraction systems for polluted extract air, e.g. kitchen extract air

The VAV-Universal VRU-... control unit controls the volumetric flow specified by the room automation system, e.g. via a room temperature or air quality controller for the downstream zone/room. Pressure fluctuations in the air duct system are detected and automatically corrected.
The following variants are available in combination with the actuator solution optimally suited to the application:
– VRU-D3-BAC for comfort zone
– VRU-M1-BAC for comfort zone and for polluted extract air
The damper position of the VAV unit is available for DCV applications via the selected bus system (Fan Optimiser function).

Control functions

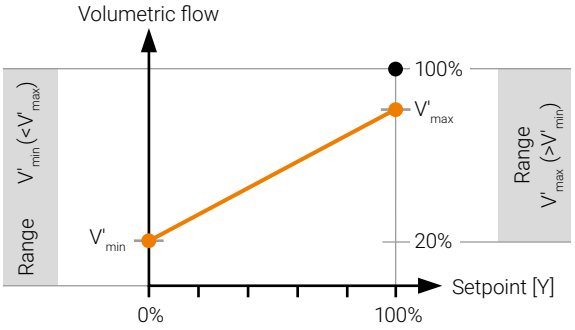
- V'_{min} Minimum air exchange rate, hygiene section, building protection (air humidity etc.)
- V'_{max} Maximum air exchange rate, maximum cooling load, removal of emissions
- V'_{min}...V'_{max} Partial load operation - variable volume operation (VAV)

- Local override (z1/z2) Motor stop, damper OPEN, V'_{max}, damper CLOSED
- Control analogue 0…10 V/2…10 V, Modbus [1], BACnet[1], MP-Bus

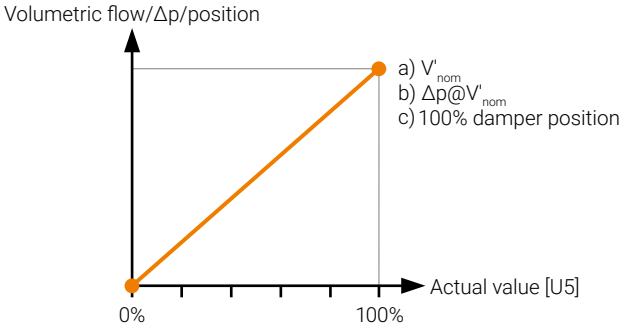
[1] Hybrid mode possible

Function diagram

VAV control: analogue/bus (setpoint)



Feedback U5/bus (actual value)



Device selection

Product type from Belimo	Function	Sensor/actuator characteristic	Field of application	SUP unit	ETA unit
VRU-D3-BAC	VAV/CAV controller	Δp sensor, integrated D3 flow sensor 0...500 Pa	Comfort	■	■
VRU-M1-BAC	VAV/CAV controller	Δp sensor, integrated M1 diaphragm sensor 0...600 Pa	Comfort Polluted air	■	■
L/N/SM24A-VST	Rotary actuator, default	5/10/20 Nm, 120 s	All ranges		
LF/NF/ SM24A-VST	Rotary actuator, mechanical fail-safe	4/10/20 Nm, 120 s, spring 20 s	All ranges		
LMQ24A-VST	Rotary actuator, very fast running	4 Nm, 2.4 s	All ranges		
NMQ24A-VST	Rotary actuator, very fast running	8 Nm, 4 s	All ranges		
NKQ24A-VST	Rotary actuator, very fast running, electrical fail-safe	6 Nm, 4 s	All ranges		

Option VAV-Compact

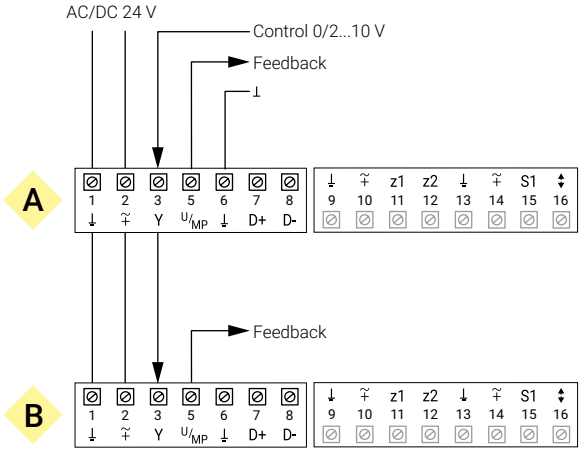
Product type from Belimo	Function	Sensor/actuator characteristic	Field of application	SUP unit	ETA unit
L/N/SMV-D3...	VAV-Compact controller (VAV/CAV)	Δp sensor, integrated D3 flow sensor 0...500 Pa Rotary actuator 5/10/20 Nm, integrated	Comfort	■	■

See www.belimo.eu

Diagram

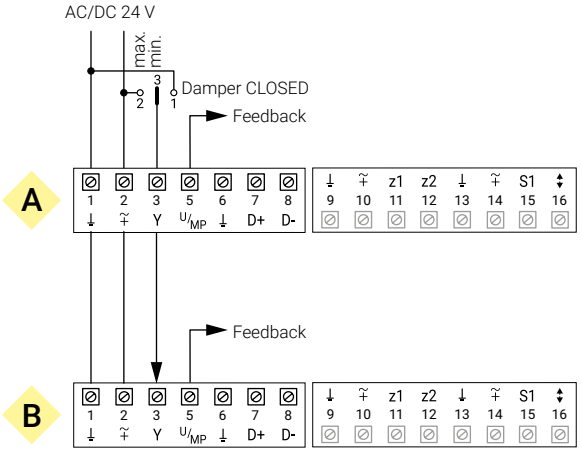
Analogue control [Mode 0...10/2...10 V]

– VAV mode: V'_{min}/V'_{max}

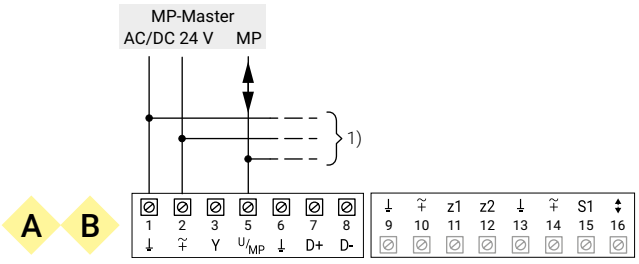


Analogue control [Mode 2...10 V]

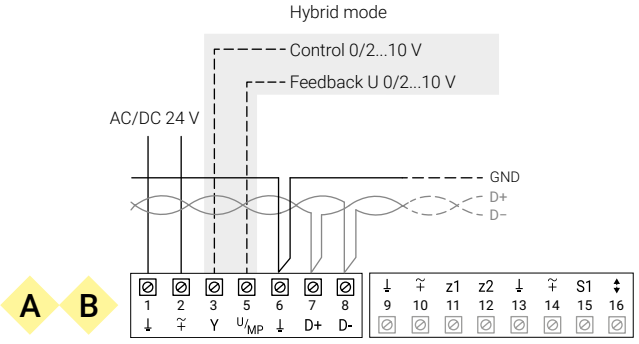
– CAV steps: damper CLOSED/V'_{min}/V'_{max}



MP-Bus



Mode RTU, BACnet MS/TP



[1] Other MP devices (total 8)

Safety requirements

Only authorised specialists may carry out installation. All applicable legal and government agency regulations must be complied with during use. Connection via an isolating transformer.

See VAV-Universal-VRU Product Information: www.belimo.eu

Explanations/notes

– Priority control p. 71
– Connection z1/z2 p. 61
– Sensor integration bus mode p. 61

– VRP-M replacement in existing MP-Bus system:
See separate instructions VAV-Universal-VRU in VRP-M compatibility mode (MP)

Parameter and tool overview for volumetric flow control VAV/CAV

Parameter/function	Unit/value	Function/description/(area)	Application	Tool			Authorisation
			VAV/CAV	Assistant app	PC-Tool	ZTH EU	Expert/OEM
VAV unit – manufacturer parameters (OEM values – not variable)							
Application	Volumetric flow	Application setting	■	r	r	r	O
Designation	Text	Model designation unit/damper (16 Z.)	■	r	r	–	O
V'_{nom}	m^3/h/l/s/cfm	Volumetric flow nominal value	■	r	r	r	O
$\Delta p@V'_{nom}$	Pa	Calibration VAV unit [38…500 Pa]	■	r	r	–	O
SN actuator	xxxxx-xxxxx-xxx-xxx	Actuator serial number	■	r	–	–	
Rotation direction	ccw/cw	Actuator direction of rotation setting	■	r/w	r/w	–	E
Range of rotation	Adapted/programmed	Actuator adapted/programmed 30...95°	■	r/w	r/w	–	E
Power-on behaviour	No action/synch./ adaption	Actuator power-on behaviour	■	r/w	r/w	–	E
Damper leakage suppressed	OFF/ON	Retrofit application, damper leakage	■	r	r	–	O
NFC interface	ON/OFF	NFC Communication for app access	■	r	r	–	O
Parametrisation – Project specific settings							
Position	Text	System designation (64 Z./ZTH 16 Z.)	■	r/w	r/w	r	
V'_{max}	m^3/h/l/s/cfm (ZTH %)	Operating volumetric flow V'_{max} 20…100% V'_{nom}	■	r/w	r/w	r/w	
V'_{min}	m^3/h/l/s/cfm (ZTH %)	Operating volumetric flow V'_{min} 0…100% V'_{nom}	■	r/w	r/w	r/w	
Altitude compensation	ON/OFF	Switch function on/off	■	r/w	r/w	–	E
Altitude of installation	0 m	Compensated Δp and volumetric flow values to set the altitude of installation (above sea level)	■	r/w	r/w	–	E
Control function	VAV/CAV	VAV control, active	■	r/w	r/w	–	E
Room-pressure cascade	OFF	VAV: secondary circuit room pressure cascade	■	r/w	r/w	–	E
Setpoint	Analogue/bus	Analogue and hybrid mode/bus	■	r/w	r/w	–	E
Setpoint offset	0%	VAV: ±5% compensation ABL unit	■	r/w	r/w	–	E
Reference signal Y	2...10 V/0...10 V/adjustable	Setting for VAV control	■	r/w	r/w	–	E
Feedback type	Volumetric flow/Δp/position	Volume/Δp/damper position	■	r/w	r/w	–	E
Feedback U	2...10 V/0...10 V/adjustable	Setting U signal	■	r/w	r/w	–	E

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

Permissions: [O – OEM, manufacturer mode] – VRU controllers are calibrated and parameterised by the unit manufacturer according to the application and the 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
r Tool: read
w Tool: write
– Tool: Does not support parameter
E Only visible in Expert Mode

2

Volumetric flow measurement

VRU-D3-BAC/VRU-M1-BAC

Volumetric flow measurement

Brief description

Volumetric flow measuring device (transmitter) for detecting or monitoring volumetric flow

Principle diagram

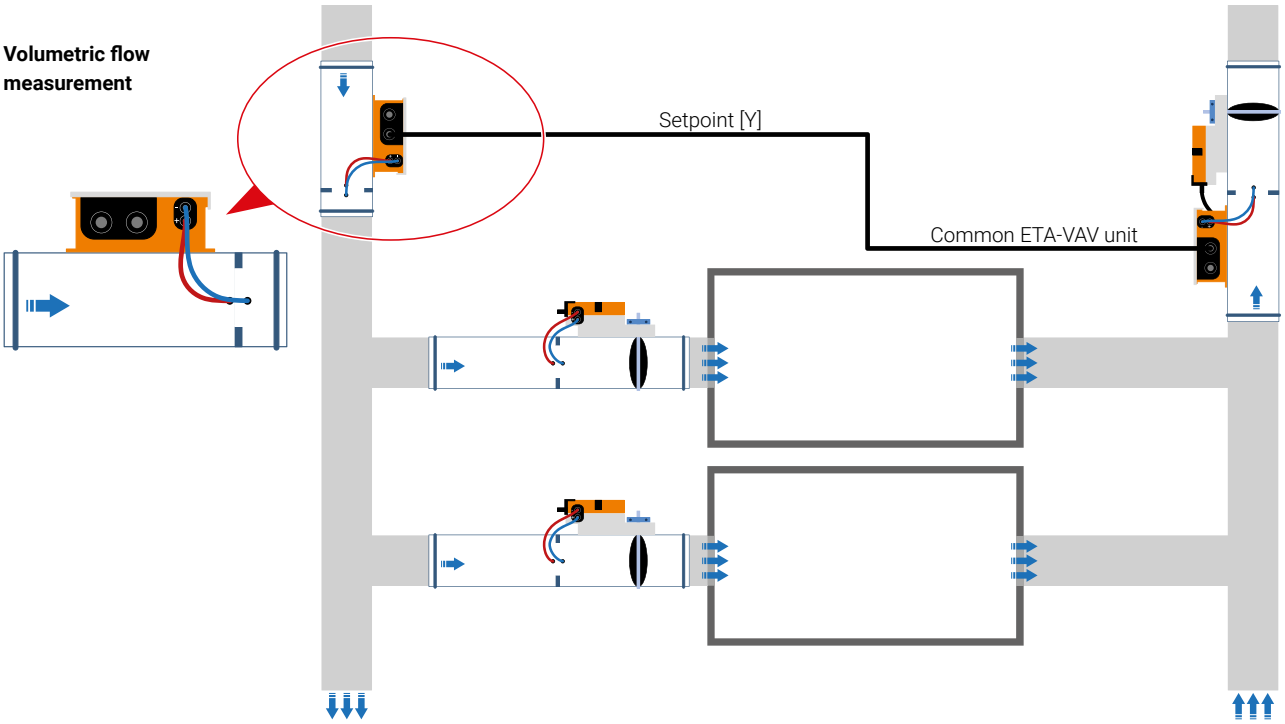
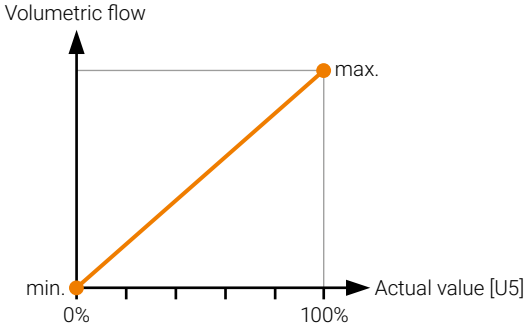


Illustration example

Volumetric flow measuring devices for detecting or monitoring volumetric flow
- In air handling units in comfort zones and for polluted fluid
- E.g. for recording the total supply air for the setpoint specification of a common extract air-side VAV unit
- Display function 0…100% V'_{nom}
- Analogue integration 0…10 V/2…10 V, Modbus, BACnet, MP-Bus

Function diagram

Feedback U5/bus (actual value)



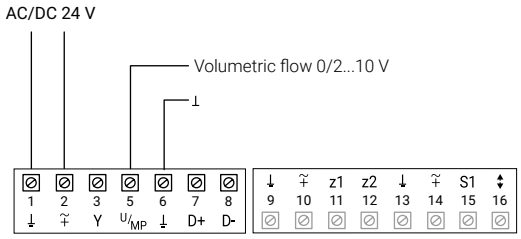
Device selection

Product type from Belimo	Function	Sensor/actuator characteristic	Field of application	SUP unit	ETA unit
VRU-D3-BAC	VAV/CAV controller	Δp sensor, integrated D3 flow sensor 0...500 Pa	Comfort	■	■
VRU-M1-BAC	VAV/CAV controller	Δp sensor, integrated M1 diaphragm sensor 0...600 Pa	Comfort Polluted air	■	■

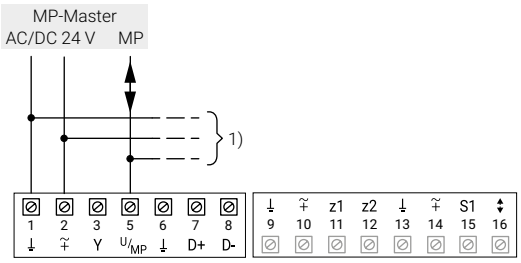
Diagram

Analogue operation [Mode 0...10/2...10 V]

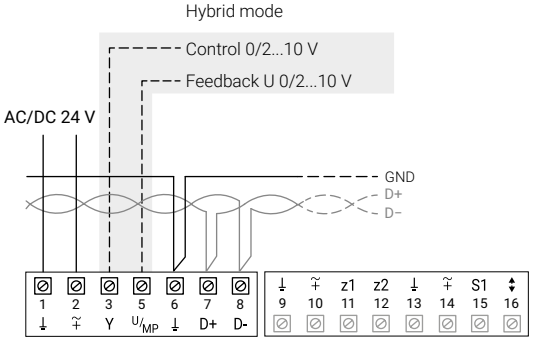
Display V'$_{nom}$



MP-Bus



Mode RTU, BACnet MS/TP



[1] Other MP devices (total 8)

Safety requirements

Only authorised specialists may carry out installation. All applicable legal and government agency regulations must be complied with during use. Connection via an isolating transformer.

See VAV-Universal-VRU Product Information: www.belimo.eu

Explanations/notes

- Priority control p. 71
- Connection z1/z2 p. 61
- Sensor integration bus mode p. 61
- VRP-M replacement in existing MP-Bus system: See separate instructions VAV-Universal-VRU in VRP-M compatibility mode (MP)

Parameter and tool overview for volumetric flow measurement

Parameter/function	Unit/value	Function/description/(area)	Application	Tool			Authorisation
			VAV/CAV	Assistant app	PC-Tool	ZTH EU	Expert/OEM
VAV unit – manufacturer parameters (OEM values – not variable)							
Application	Volumetric flow	Application setting	■	r	r	r	O
Designation	Text	Model designation measuring device (16 Z.)	■	r	r	–	O
V'_{nom}	m^3/h/l/s/cfm	Volumetric flow nominal value	■	r	r	r	O
NFC interface	ON/OFF	NFC Communication for app access	■	r	r	–	O
Parametrisation – Project specific settings							
Position	Text	System designation (64 Z./ZTH 16 Z.)	■	r/w	r/w	r	
Altitude compensation	ON/OFF	Switch function on/off	■	r/w	r/w	–	E
Altitude of installation	0 m	Compensated Δp and volumetric flow values to set the altitude of installation (above sea level)	■	r/w	r/w	–	E
Feedback type	Volumetric flow	Volume	■	r/w	r/w	–	E
Feedback U	2...10 V/0...10 V/adjustable	Setting U signal	■	r/w	r/w	–	E

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

Permissions: [O – OEM, manufacturer mode] – VRU controllers are calibrated and parameterised by the unit manufacturer according to the application and the 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
r Tool: read
w Tool: write
– Tool: Does not support parameter
E Only visible in Expert Mode

3

Position Control (Open-Loop)

VRU-D3-BAC/VRU-M1-BAC

Position Control (Open-Loop)

Brief description

VAV-Universal-VRU-... sensor/actuator in position control mode (Open-Loop, i.e. VAV control function inactive)

– Volumetric flow display 0...100% V'_{nom}
– Damper actuator, control 0...100% range of rotation

Principle diagram

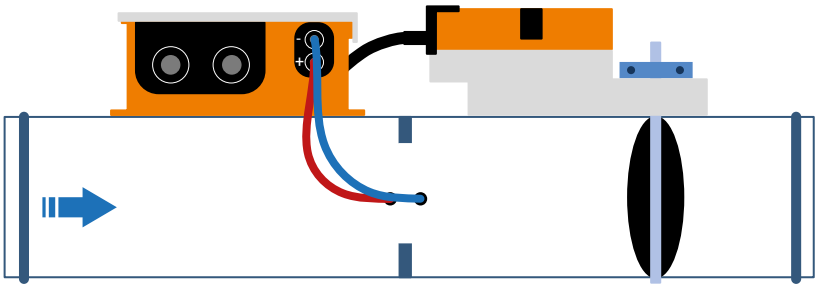


Illustration example

In this application, the VAV-Universal VRU-... functions solely as a sensor and actuator element. Position control mode: volumetric flow/pressure control inactive.

– VRU-D3-BAC for comfort zone
– VRU-M1-BAC for the comfort zone and polluted extract air

Position control function

– Volumetric flow display	0...100% V'_{nom}
– Damper actuator, control	0...100% range of rotation
– Local override (z1/z2)	Motor stop, damper OPEN, damper CLOSED
– Control	analogue 0...10 V/2...10 V, Modbus [1], BACnet [1], MP-Bus

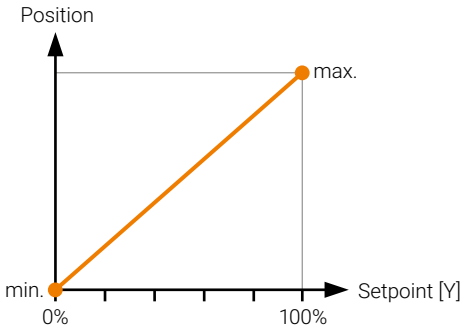
[1] Hybrid mode possible

Application note

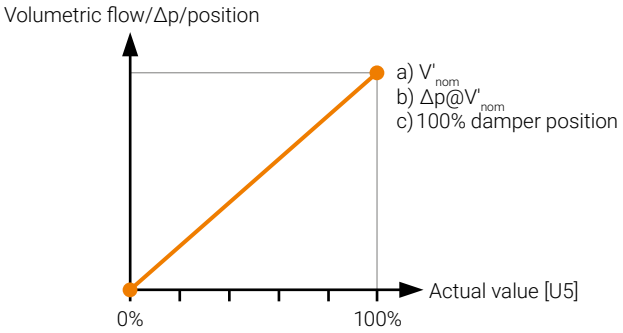
When designing the bus application, the cycle times for reading the actual values and writing the damper position must be taken into account.

Function diagram

Position control: analogue/bus (setpoint)



Feedback U5/bus (actual value)



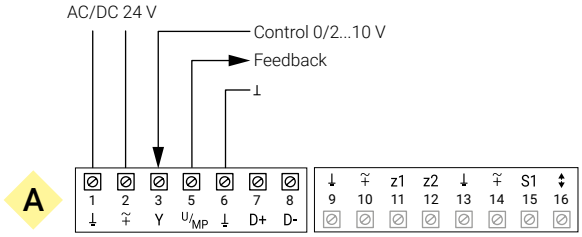
Device selection

Product type from Belimo	Function	Sensor/actuator characteristic	Field of application	SUP unit	ETA unit
VRU-D3-BAC	Position Control (Open-Loop)	Δp sensor, integrated D3 flow sensor 0...500 Pa	Comfort	■	■
VRU-M1-BAC	Position Control (Open-Loop)	Δp sensor, integrated M1 diaphragm sensor 0...600 Pa	Comfort Polluted air	■	■
L/N/SM24A-VST	Rotary actuator, default	5/10/20 Nm, 120 s	All ranges		
LF/NF/SF24A-VST	Rotary actuator, mechanical fail-safe	4/10/20 Nm, 120 s, spring 20 s	All ranges		
LMQ24A-VST	Rotary actuator, very fast running	4 Nm, 2.4 s	All ranges		
NMQ24A-VST	Rotary actuator, very fast running	8 Nm, 4 s	All ranges		
NKQ24A-VST	Rotary actuator, very fast running, electrical fail-safe	6 Nm, 4 s	All ranges		

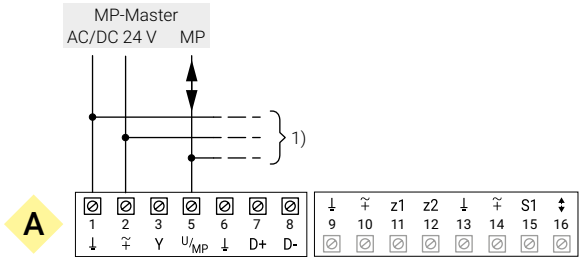
Diagram

Analogue control [Mode 0...10/2...10 V]

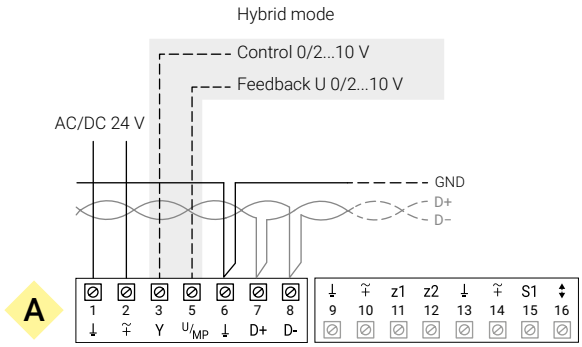
– Modulating control: 0...100% range of rotation



MP-Bus



Mode RTU, BACnet MS/TP



[1] Other MP devices (total 8)

Safety requirements

Only authorised specialists may carry out installation. All applicable legal and government agency regulations must be complied with during use. Connection via an isolating transformer.

See VAV-Universal-VRU Product Information: www.belimo.eu

Explanations/notes

– Priority control	p. 71
– Connection z1/z2	p. 61
– Sensor integration bus mode	p. 61
– VRP-M replacement in existing MP-Bus system:	See separate instructions VAV-Universal-VRU in VRP-M compatibility mode (MP)

Parameter and tool overview for volumetric flow control position control

Parameter/function	Unit/value	Function/description/(area)	Application	Tool			Authorisation
			VAV/CAV	Assistant app	PC-Tool	ZTH EU	Expert/OEM
VAV unit – manufacturer parameters (OEM values – not variable)							
Application	Volumetric flow	Application setting	■	r	r	r	O
Designation	Text	Model designation unit/damper (16 Z.)	■	r	r	–	O
V'_{nom}	m^3/h/l/s/cfm	Volumetric flow nominal value	■	r	r	r	O
$\Delta p@V'_{nom}$	Pa	Calibration VAV unit [38…500 Pa]	■	r	r	–	O
SN actuator	xxxxx-xxxxx-xxx-xxx	Actuator serial number	■	r	–	–	
Rotation direction	ccw/cw	Actuator direction of rotation setting	■	r/w	r/w	–	E
Range of rotation	Adapted/programmed	Actuator adapted/programmed 30...95°	■	r/w	r/w	–	E
Power-on behaviour	No action/synch./ adaptation	Actuator power-on behaviour	■	r/w	r/w	–	E
NFC interface	ON/OFF	NFC Communication for app access	■	r	r	–	O
Parametrisation – Project specific settings							
Position	Text	System designation (64 Z./ZTH 16 Z.)	■	r/w	r/w	r	
max.	%	Damper position 0...100%	■	r/w	r/w	r/w	
min.	%	Damper position 0...100%	■	r/w	r/w	r/w	
Altitude compensation	ON/OFF	Switch function on/off	■	r/w	r/w	–	E
Altitude of installation	0 m	Compensated Δp and volumetric flow values to set the altitude of installation (above sea level)	■	r/w	r/w	–	E
Control function	VAV/CAV	VAV control inactive (Open-Loop)	■	r/w	r/w	–	E
Setpoint	Analogue/bus	Analogue and hybrid mode/bus	■	r/w	r/w	–	E
Reference signal Y	2...10 V/0...10 V/adjustable	Setting for damper control	■	r/w	r/w	–	E
Feedback type	Volumetric flow/Δp/position	Volume/Δp/damper position	■	r/w	r/w	–	E
Feedback U	2...10 V/0...10 V/adjustable	Setting U signal	■	r/w	r/w	–	E

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

Permissions: [O – OEM, manufacturer mode] – VRU controllers are calibrated and parameterised by the unit manufacturer according to the application and the 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
r Tool: read
w Tool: write
– Tool: Does not support parameter
E Only visible in Expert Mode

4

Duct pressure control STP

VRU-D3-BAC/VRU-M1-BAC

Duct pressure control STP

Brief description

Duct/line pressure control
– Variable operation (STP) $P'_{min}...P'_{max}$
– Constant pressure control (STP) P'_{min}/P'_{max}
damper CLOSED/damper OPEN

Principle diagram

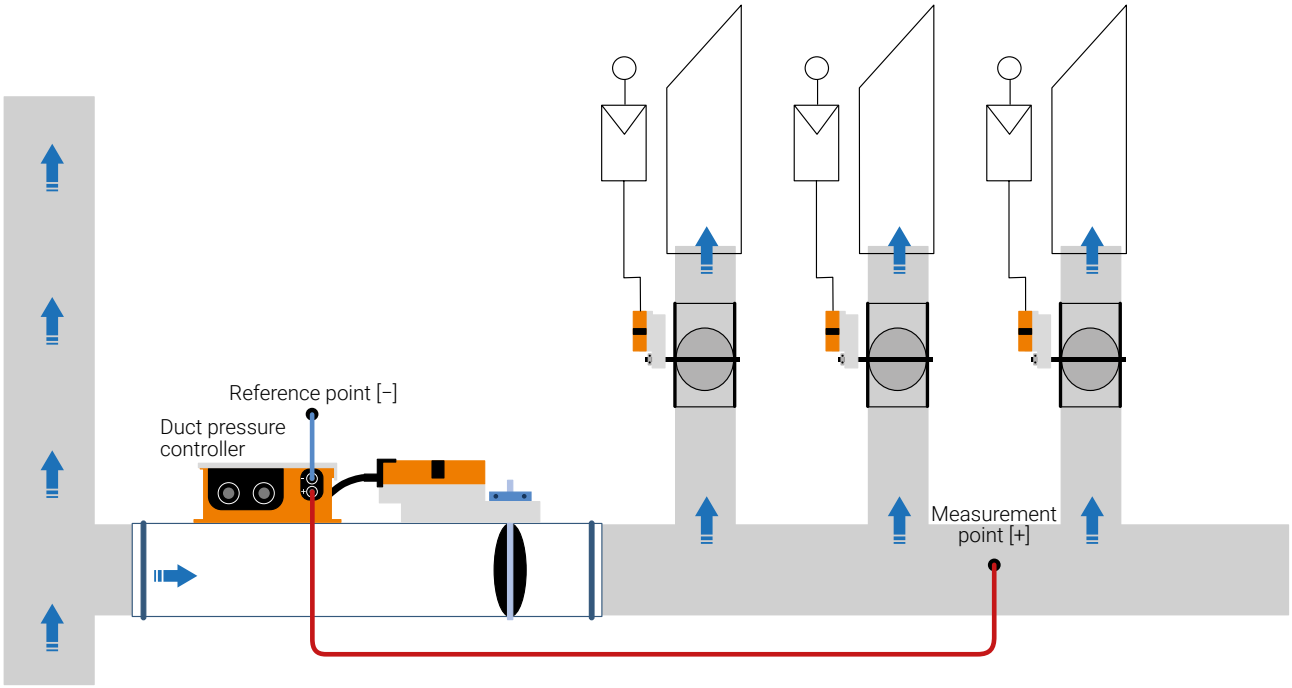


Illustration example

Duct and line pressure control in ventilation systems
– Storey line
– Pre-pressure, control e.g. for active cooling ceiling systems

The VAV-Universal VRU-... control unit controls the duct pressure required for the application. Pressure fluctuations in the air duct system are detected and automatically corrected.
The following variants are available in combination with the actuator solution optimally suited to the application:
– VRU-D3-BAC operating range 38...500 Pa
– VRU-M1-BAC operating range 38...600 Pa
The damper position is available for DCV applications via the selected bus system (Fan Optimiser function).

Control setting, see Commissioning room/duct pressure applications page 73

Control functions

– P'_{min} Pressure level 1
– P'_{max} Pressure level 2
– P'_{min}...P'_{max} Variable operation (STP)

– Local override (z1/z2)
Motor stop, damper OPEN, P'_{max}, damper CLOSED
– Control analogue 0…10 V/2…10 V,
Modbus [1], BACnet [1], MP-Bus

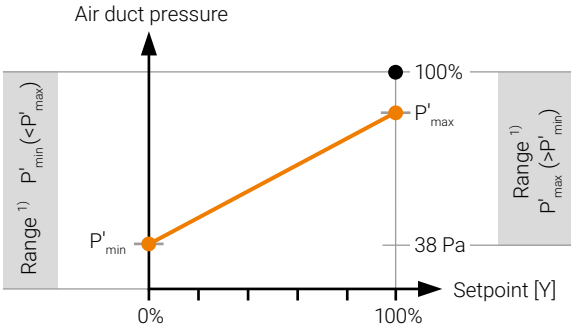
[1] Hybrid mode possible

Max. hose line for D3 sensor (VRU-D3-BAC)
The pressure drop in the measurement signal cable generates a measuring error of maximum 2.5%. Use of the VRU-M1-BAC is recommended for applications with measurement signal cables >20 m.

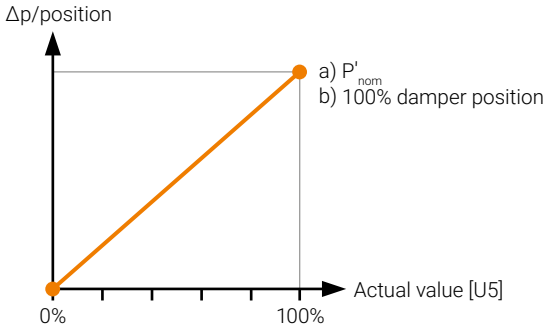
4

Function diagram

Δp control: Y/bus (setpoint)



Feedback U5/bus (actual value)



[1] Note: The control limit/nominal voltage range STP is under revision. (Release: 3rd quarter 2021)

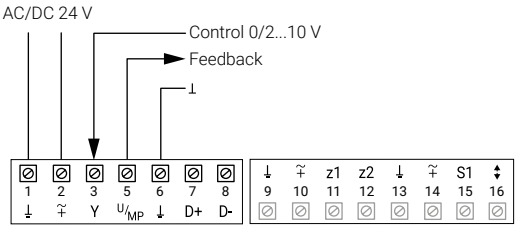
Device selection

Product type from Belimo	Function	Sensor/actuator characteristic	Field of application
VRU-D3-BAC	Duct pressure controller - lower control limit 38 Pa	Δp sensor, integrated D3 flow sensor 0...500 Pa	Comfort
VRU-M1-BAC	Duct pressure controller - lower control limit 38 Pa	Δp sensor, integrated M1 diaphragm sensor 0...600 Pa	Comfort Polluted air
L/N/SM24A-VST	Rotary actuator, default	5/10/20 Nm, 120 s	All ranges
LF/NF/SF24A-VST	Rotary actuator, mechanical fail-safe	4/10/20 Nm, 120 s, spring 20 s	All ranges

Diagram

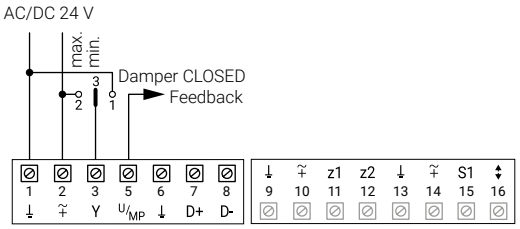
Analogue control [Mode 0...10/2...10 V]

– Modulating operation: P'$_{min}$...P'$_{max}$

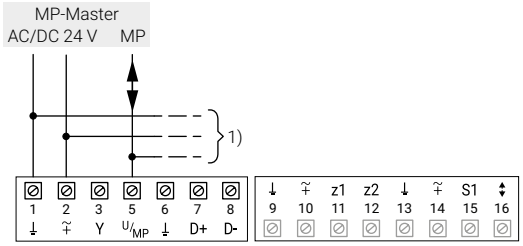


Analogue control [Mode 2...10 V]

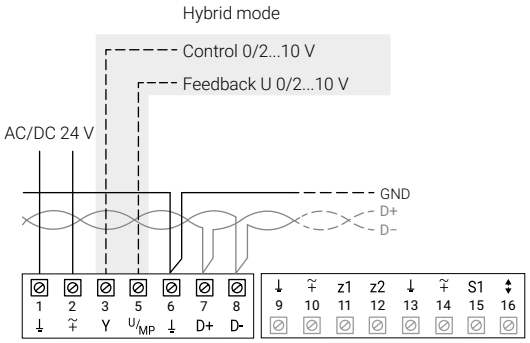
– Step mode: damper CLOSED/P'$_{min}$/P'$_{max}$



MP-Bus



Mode RTU, BACnet MS/TP



[1] Other MP devices (total 8)

Safety requirements

Only authorised specialists may carry out installation. All applicable legal and government agency regulations must be complied with during use. Connection via an isolating transformer.

See VAV-Universal-VRU Product Information: www.belimo.eu

Explanations/notes

– Priority control	p. 71
– Connection z1/z2	p. 61
– Sensor integration bus mode	p. 61
– VRP-M replacement in existing MP-Bus system:	See separate instructions VAV-Universal-VRU in VRP-M compatibility mode (MP)

Parameter and tool overview for duct pressure control STP

Parameter/function	Unit/value	Function/description/(area)	Application	Tool			Authorisation
			STP	Assistant app	PC-Tool	ZTH EU	Expert/OEM
Pressure control damper – manufacturer parameters (OEM values – not variable)							
Application	Air duct pressure	Application setting	■	r	r	r	O
Designation	Text	Model designation damper (16 Z.)	■	r	r	–	O
P'_{nom}	Pa	Nominal value P'_{nom} VRU-D3 38…500 Pa VRU-M1 38…600 Pa	■	r	r	r	O
SN actuator	xxxxx-xxxxx-xxx-xxx	Actuator serial number	■	r	–	–	
Rotation direction	ccw/cw	Actuator direction of rotation setting	■	r/w	r/w	–	E
Range of rotation	Adapted/programmed	Actuator adapted/programmed 30…95°	■	r/w	r/w	–	E
Power-on behaviour	No action/synch./ adaptation	Actuator power-on behaviour	■	r/w	r/w	–	E
NFC interface	ON/OFF	NFC Communication for app access	■	r	r	–	O
Parametrisation – Project specific settings							
Position	Text	System designation (64 Z./ZTH 16 Z.)	■	r/w	r/w	r	
P'_{max}	Pa (ZTH %)	38 Pa…100% P'_{nom} [2)] Δp step P'_{max}	■	r/w	r/w	r/w	
P'_{min}	Pa (ZTH %)	38 Pa…100% P'_{nom} [2)] Δp step P'_{min}	■	r/w	r/w	r/w	
Altitude compensation [1)]	ON/OFF	Switch function on/off	■	r/w	r/w	–	E
Altitude of installation [1)]	0 m	Compensated Δp value to set the altitude of installation (above sea level)	■	r/w	r/w	–	E
Setpoint	Analogue/bus	Analogue and hybrid mode/bus	■	r/w	r/w	–	E
Reference signal Y	2…10 V/0…10 V/adjustable	Setting for modulating control	■	r/w	r/w	–	E
Feedback type	Δp/position	Δp/damper position	■	r/w	r/w	–	E
Feedback U	2…10 V/0…10 V/adjustable	Setting U signal	■	r/w	r/w	–	E

[1)] Only for VRU-D3-BAC
[2)] Lower control limit: 38 Pa (as of 31.03.2021).
Note: The control limit/nominal voltage range STP is under revision.
(Release: 3rd quarter 2021)

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

Permissions: [O – OEM, manufacturer mode] – VRU controllers are calibrated and parameterised by the unit manufacturer according to the application and the 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
r Tool: read
w Tool: write
– Tool: Does not support parameter
E Only visible in Expert Mode

5

Room-pressure control RP

VRU-M1R-BAC

Room-pressure control RP

Brief description

Room-pressure control RP, suitable for rooms with non-critical leakage rates/ overflows

– Modulating P'_{min} ...P'_{max}/Motor stop
– Step mode P'_{min} /P'_{max}/damper CLOSED/damper OPEN/Motor stop

Principle diagram

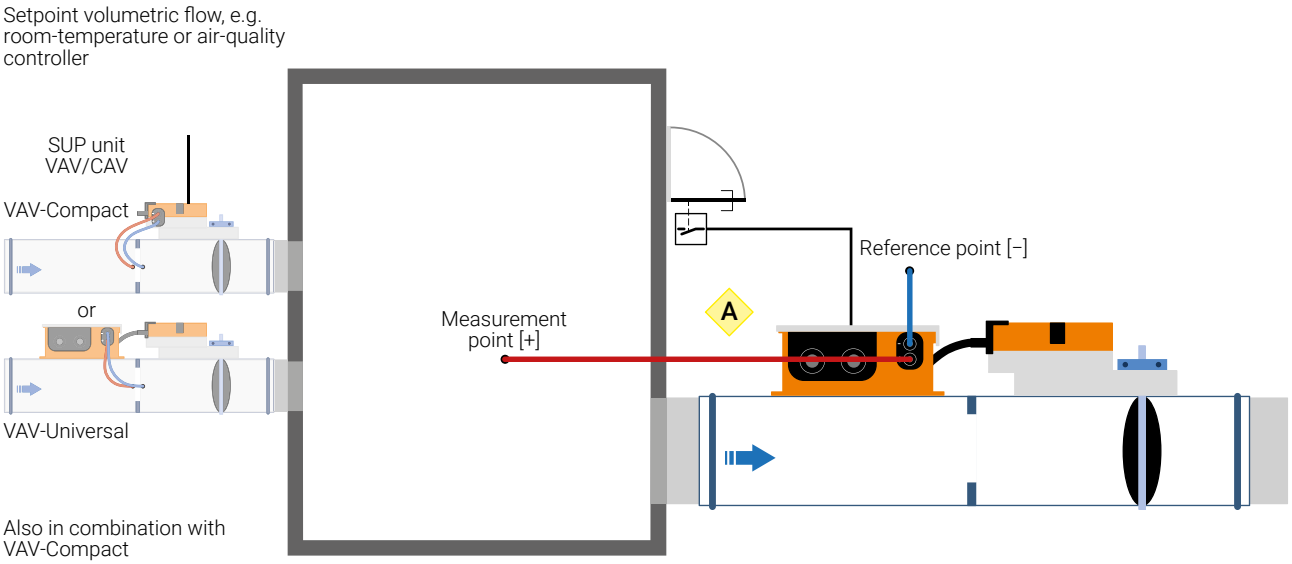


Illustration example

Ventilation systems – with non-critical leakage rates – for defined positive or negative room-pressure conditions:

– Leakage rate of >5...10% V'_{supply}
– Room tightness class according to VDI 2083-19; Class 0 and 1
– Room and zone applications, e.g. with odour nuisance in restaurants, smoking rooms
– Room applications with polluted extract air, e.g. extract air in commercial kitchens

The room-pressure controller – VRU-M1R-BAC Application [RP] – compares the pressure in the room relative to the reference value and controls the control damper to the adjusted room-pressure setpoint. With actuator solution optimally suited to the application.

The opposite VAV unit is responsible for the air exchange rate required for the room, e.g. external room temperature or air quality controller.

Control setting, see Commissioning room/duct pressure applications page 73

Requirements (applies to positive and negative room-pressure applications)

– VRU-M1R-BAC	Room-pressure application [RP] with sensor range −75…75 Pa
– Measurement room	Connect pressure line to the (+) of the VRU-M1R-BAC
– Reference room	Connect pressure line to (−) of the VRU-M1R-BAC

Room-pressure – Operation mode (positive/negative pressure)

If necessary, the room pressure can be switched from positive to negative pressure (pressure lines remain unchanged!):
For this purpose, the P'_{nom}/P'_{max}/P'_{min} are mirrored in the negative range.
Example: P'_{min} 10 Pa becomes −10 Pa.
The changeover takes place at:

– Analogue control/MP-Bus	Belimo Assistant App
– Modbus/BACnet	Belimo Assistant App or Command "Operating Mode"

– Control functions	
– P'_{min}	Room-pressure setpoint 1
P'_{max}	Room-pressure setpoint 2 (step mode or modulating control)
– Application area	SUP-side or ETA-side assembly arrangement
– Room-pressure mode	Positive/negative pressure

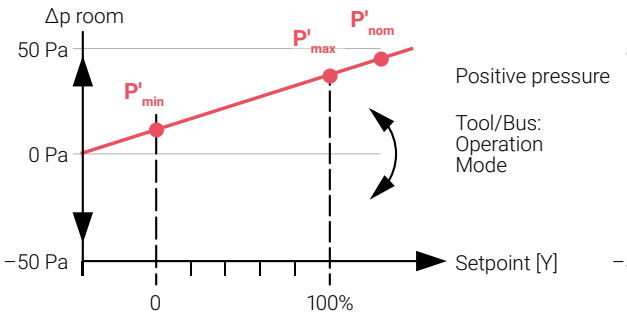
– Door monitoring	– Motor stop

Actuator remains in current position when door is open (z2)
– "Operation Mode" positive/negative pressure
Changeover via "Operation Mode" bus or Assistant App, PC-Tool
– Local override (z1/z2)
Motor stop, damper OPEN, P'_{max}, damper CLOSED
– Control: analogue 0…10 V/2…10 V, Modbus [1], BACnet [1], MP-Bus

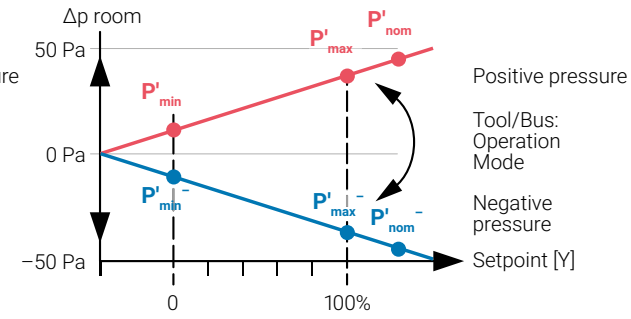
[1] Hybrid mode possible

Function diagram

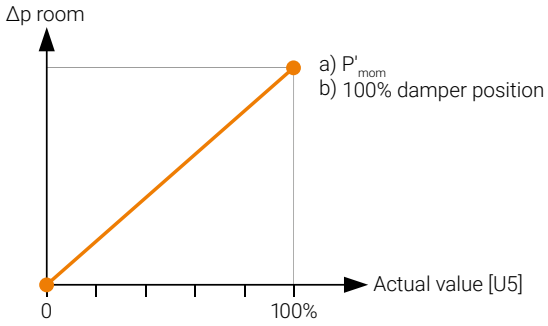
Positive room pressure



Changeover operation: positive/negative pressure



Feedback U5/bus (actual value)



For operation in the negative-pressure range, P'_{nom}/P'_{max}/P'_{min} are mirrored in the negative range.
Example:

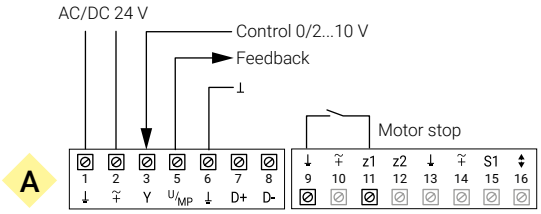
+ Positive pressure: P'_{min} 5 Pa/P'_{max} 10 Pa, becomes
− Negative pressure setting: P'_{min} −5 Pa/P'_{max} −10 Pa

Device selection

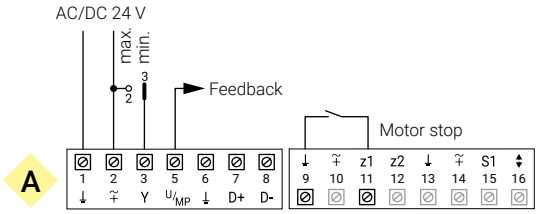
Product type from Belimo	Function	Sensor/actuator characteristic	Field of application	SUP	ETA
VRU-M1R-BAC	Room-pressure controller	Δp sensor, integrated M1 diaphragm sensor −75...75 Pa	Comfort, polluted air	■	■
L/N/SM24A-VST	Rotary actuator, default	5/10/20 Nm, 120 s	All ranges		
LF/NF/SF24A-VST	Rotary actuator, mechanical fail-safe	4/10/20 Nm, 120 s, spring 20 s	All ranges		
LMQ24A-VST	Rotary actuator, very fast running	4 Nm, 2.4 s	All ranges		
NMQ24A-VST	Rotary actuator, very fast running	8 Nm, 4 s	All ranges		
NKQ24A-VST	Rotary actuator, very fast running, electrial fail-safe	6 Nm, 4 s	All ranges		

Diagram

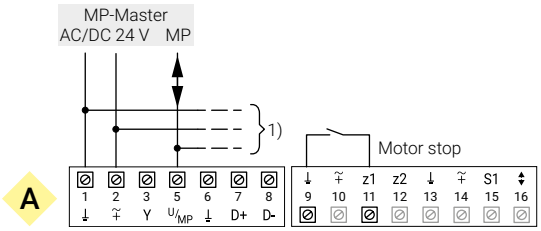
Analogue control [Mode 0...10/2...10 V]
– Modulating operation: P'$_{min}$...P'$_{max}$



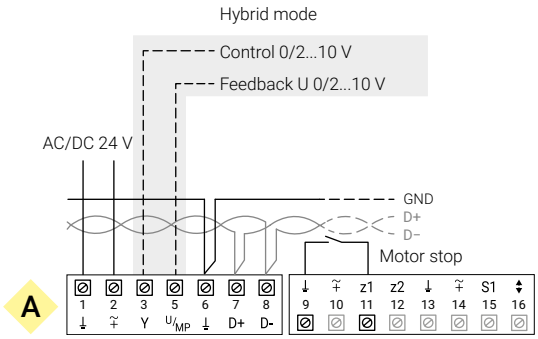
Analogue control [Mode 0...10/2...10 V]
– Step mode: P'$_{min}$ /P'$_{max}$



MP-Bus



Mode RTU, BACnet MS/TP



[1] Other MP devices (total 8)

Safety requirements

Only authorised specialists may carry out installation. All applicable legal and government agency regulations must be complied with during use. Connection via an isolating transformer.

See VAV-Universal-VRU Product Information: www.belimo.eu

Explanations/notes

Reference measurement for the [–] connection	A pressure-stable environment is a prerequisite for the reference measuring point [–] connection, as this has a direct influence on the room-pressure control. Any pressure fluctuation of the reference is transmitted to the room to be controlled. A pressure-controlled anteroom as a reference makes reliable room-pressure control impossible. An environment isolated from the ventilation system - no pressure-controlled or volume-controlled rooms - provides this prerequisite.
Measurement signal cables	To minimise the influence of the measurement signal cables, the signal cable lengths should be kept as short as possible.
Door switch	The VRU-M1R can be equipped with a "Motor Stop" command to prevent the damper actuator from moving to the end position when the door is opened. Switch design: Note performance data of input z2!

– Priority control p. 71
– Connection z1/z2 p. 61
– Sensor integration bus mode p. 61
– VRP-M replacement in existing MP-Bus system: See separate instructions VAV-Universal-VRU in VRP-M compatibility mode (MP)

Parameter and tool overview for room-pressure control RP

Parameter/function	Unit/value	Function/description/(area)	Application	Tool			Authorisation
			VAV/CAV	Assistant app	PC-Tool	ZTH EU	Expert/OEM
Pressure control damper – manufacturer parameters (OEM values – not variable)							
Application	Room pressure	Application setting	■	r	r	r	O
Designation	Text	Model designation damper (16 Z.)	■	r	r	–	O
P'_{nom}	Pa	Nominal value Δp RP [5…75 Pa]	■	r	r	r	O
SN actuator	xxxxx-xxxxx-xxx-xxx	Actuator serial number	■	r	–	–	
Rotation direction	ccw/cw	Actuator direction of rotation setting	■	r/w	r/w	–	E
Range of rotation	Adapted/programmed	Actuator adapted/programmed 30…95°	■	r/w	r/w	–	E
Power-on behaviour	No action/synch./ adaptation	Actuator power-on behaviour	■	r/w	r/w	–	E
NFC interface	ON/OFF	NFC Communication for app access	■	r	r	–	O
Parametrisation – Project specific settings							
Position	Text	System designation (64 Z./ZTH 16 Z.)	■	r/w	r/w	r	
P'_{max}	Pa (ZTH %)	Δp step max. 20…100% P'_{nom}	■	r/w	r/w	r/w	
P'_{min}	Pa (ZTH %)	Δp step min. 0…100% P'_{nom}	■	r/w	r/w	r/w	
Room-pressure mode	Positive pressure/negative pressure	Room operating mode aseptic (+)/ septic (–)	■	r/w	r/w	–	E
Application area	Exhaust air/supply air	Mounting location of the control damper	■	r/w	r/w	–	E
Room-pressure cascade	OFF	In connection with the room-pressure cascade	■	r/w	r/w	–	E
Setpoint	Analogue/bus	Analogue and hybrid mode/bus	■	r/w	r/w	–	E
Reference signal Y	2…10 V/0…10 V/adjustable	Setting for modulating control P'_{min} …P'_{max}	■	r/w	r/w	–	E
Feedback type	Δp/position	Δp/damper position	■	r/w	r/w	–	E
Feedback U	2…10 V/0…10 V/adjustable	Setting U signal	■	r/w	r/w	–	E

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

Permissions: [O – OEM, manufacturer mode] – VRU controllers are calibrated and parameterised by the unit manufacturer according to the application and the 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
r Tool: read
w Tool: write
– Tool: Does not support parameter
E Only visible in Expert Mode

6

Room-pressure – VAV unit with bypass control RP

VRU-D3-BAC/VRU-M1-BAC, VRU-M1R-BAC

Room-pressure – VAV unit with bypass control RP

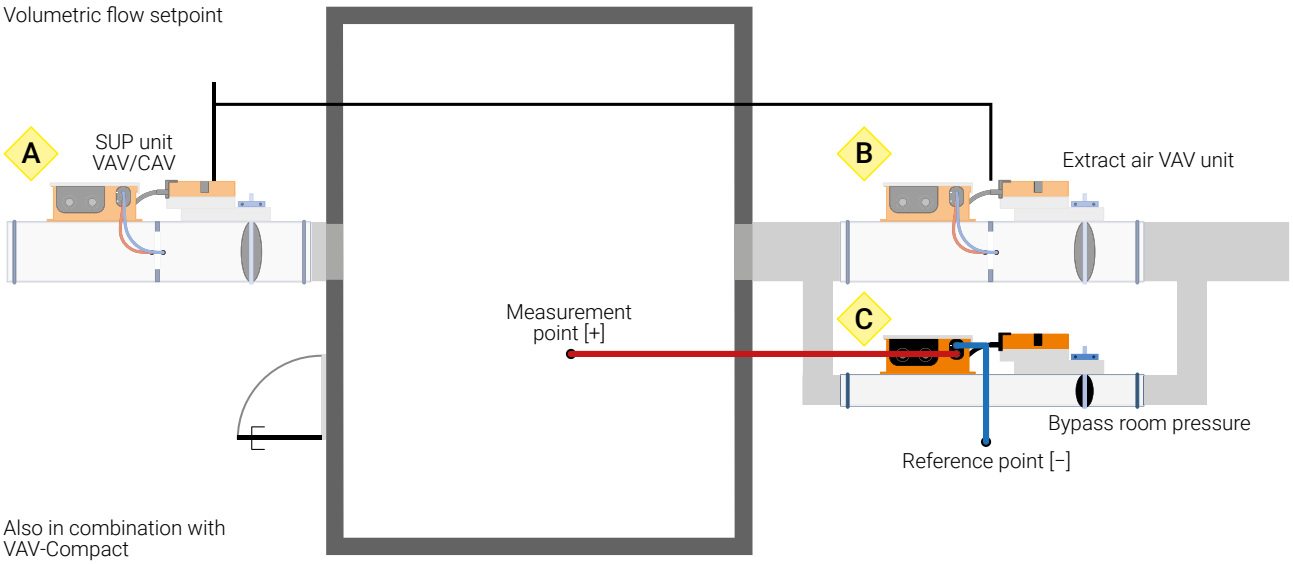
Brief description

Room-pressure volumetric flow bypass damper control for rooms with low leakage rate/overflow:

<A> <B> Volumetric flow VAV/CAV $V'_{min}...V'_{max}$
VRU-D3-BAC/VRU-M1-BAC [VAV]

<C> Room-pressure bypass damper $P'_{min}...P'_{max}$
VRU-M1R-BAC [RPC] −75...75 Pa

Principle diagram



Also in combination with VAV-Compact

Illustration example

Ventilation systems with defined positive or negative room pressure for rooms with low leakage rate/overflow.

– Leakage rate of <5% from V'_{supply}
– Room tightness class according to VDI 2083-19; Class 2 and 3
– Application examples for "sensitve room pressure applications"

The two VAV units <A> <B> are responsible for the air exchange rate required for the room, e.g. external room temperature or air quality controller. The room-pressure controller VRU-M1R-BAC <C> compares the pressure in the room with the defined reference value and then controls the bypass damper to the specified room-pressure setpoint.

Requirements (applies to positive and negative room-pressure applications)

– VRU-M1R-BAC Room-pressure application [RP] with sensor range −75...75 Pa
Extract-air-side-mounted or supply-air-side-mounted (setting parameters)
– Measurement room Connect pressure line to the (+) of VRU-M1R-BAC
– Reference room Connect pressure line to (−) of the VRU-M1R-BAC

Control setting, see Commissioning room/duct pressure applications page 73

Room-pressure – Operation mode (positive/negative pressure)
If necessary, the room pressure can be switched from positive to negative pressure (pressure lines remain unchanged!): for this purpose, $P'_{nom}/P'_{max}/P'_{min}$ are mirrored in the negative range.
Example: P'_{min}
The changeover takes place at:
– Analogue control/MP-Bus Belimo Assistant App
– Modbus/BACnet Belimo Assistant App or "Operating Mode" command

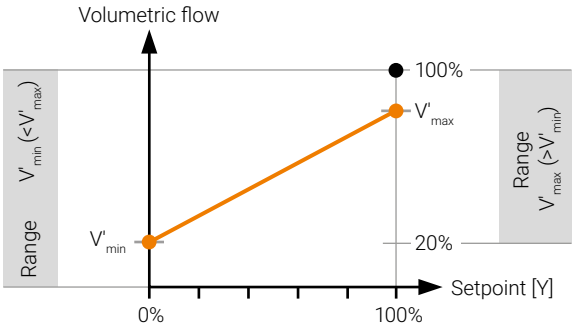
VAV control functions <A> <B>
– $V'_{min}...V'_{max}$ Air exchange rate, CAV step mode or VAV modulating control $V'_{min}...V'_{max}$

RP control functions <C>
– P'_{min} Room-pressure setpoint 1
– P'_{max} Room-pressure setpoint 2 (step mode or modulating control)
– Application area: SUP or ETA-side assembly arrangement
– Room-pressure mode Positive/negative pressure
– "Operation Mode" positive/negative pressure
Changeover via "Operation Mode" bus or Assistant App, PC-Tool
– Local override (z1/z2)
P'_{max}, damper CLOSED, damper OPEN, motor stop
– Control: analogue 0…10 V/2…10 V, Modbus [1], BACnet [1], MP-Bus

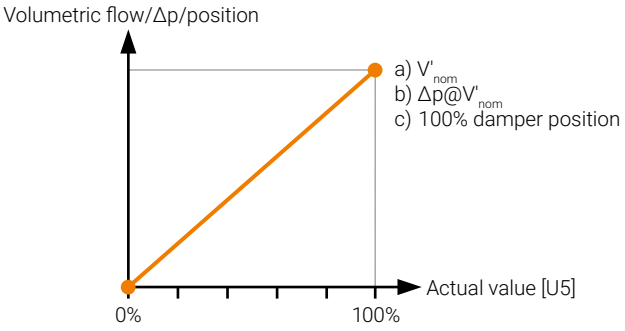
[1] Hybrid mode possible

Function diagram

VAV mode: analogue/bus (setpoint)

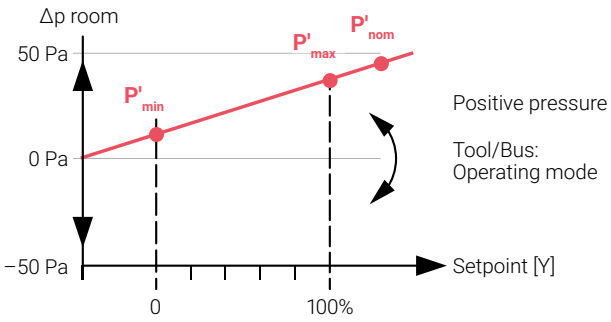


Feedback U5/bus (feedback)

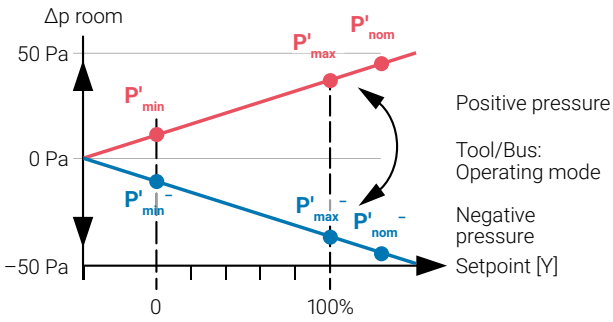


Function diagram

Positive pressure

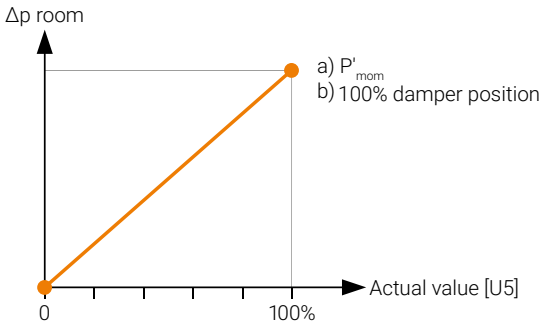


Changeover positive: overpressure/negative pressure



For operation in the negative-pressure range, $P'_{nom}/P'_{max}/P'_{min}$ are mirrored in the negative range.
Example:
+ Positive pressure setting:
P'_{min} 5 Pa/P'_{max} 10 Pa, becomes
− Negative pressure setting:
P'_{min} −5 Pa/P'_{max} −10 Pa

Feedback U5/bus (actual value)



Device selection <A> <B> VAV units

Product type from Belimo	Function	Sensor/actuator characteristic	Field of application	SUP unit	ETA unit
VRU-D3-BAC	Volumetric flow controller [VAV] <A> <B>	Δp sensor, D3 flow 0…500 Pa	Comfort	■	■
VRU-M1-BAC	Volumetric flow controller [VAV] <A> <B>	Δp sensor, M1 diaphragm 0…600 Pa	Comfort Polluted air	■	■
L/N/SM24A-VST	Rotary actuator, default	5/10/20 Nm, 120 s	All ranges		

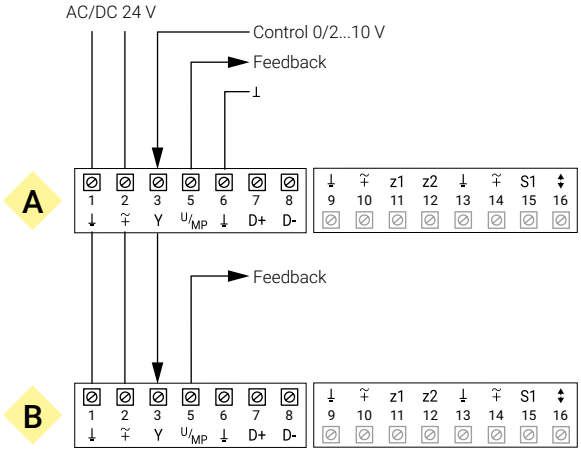
Device selection <C> bypass damper

Product type from Belimo	Function	Sensor/actuator characteristic	Field of application	SUP unit	ETA unit
VRU-M1R-BAC	Room-pressure controller [RP] <C>	Δp sensor, M1 diaphragm −75…75 Pa	Comfort Polluted air	■	■
L/N/SM24A-VST	Rotary actuator, default	5/10/20 Nm, 120 s	All ranges	■	■
LMQ24A-VST	Rotary actuator, very fast running	4 Nm, 2.4 s	All ranges		
NMQ24A-VST	Rotary actuator, very fast running	8 Nm, 4 s	All ranges		
NKQ24A-VST	Rotary actuator, very fast running electrical fail-safe	6 Nm, 4 s	All ranges		

Diagram

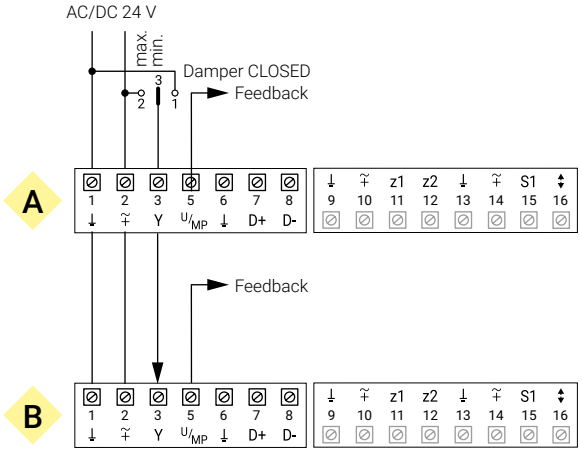
Analogue control [Mode 0...10/2...10 V]

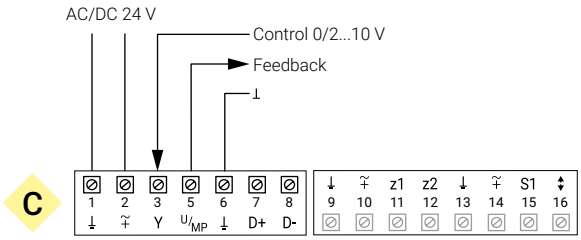
– Modulating operation: P'$_{min}$...P'$_{max}$

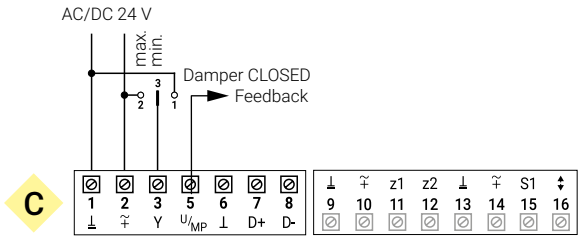


Analogue control [Mode 2...10 V]

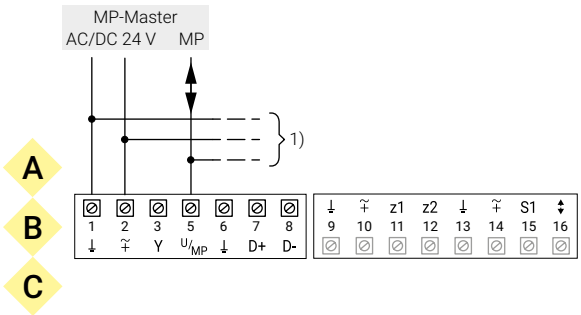
– Step mode: damper CLOSED/P'$_{min}$/P'$_{max}$



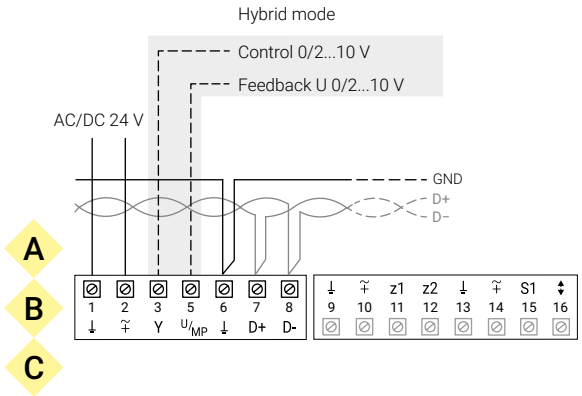




MP-Bus



Mode RTU, BACnet MS/TP



[1] Other MP devices (total 8)

Safety requirements

Only authorised specialists may carry out installation. All applicable legal and government agency regulations must be complied with during use. Connection via an isolating transformer.

See VAV-Universal-VRU Product Information: www.belimo.eu

Explanations/notes

– Priority control p. 71
– Connection z1/z2 p. 61
– Sensor integration bus mode p. 61

– VRP-M replacement in existing MP-Bus system:
See separate instructions VAV-Universal-VRU in VRP-M compatibility mode (MP)

Parameter and tool overview for VAV unit <A> <B>

			Applica-tion	Tool			Authori-sation
Parameter/function	**Unit/value**	**Function/description/(area)**	**VAV/CAV**	**Assistant app**	**PC-Tool**	**ZTH EU**	**Expert/OEM**
VAV unit – manufacturer parameters (OEM values – not variable)							
Application	Volumetric flow	Application setting	■	r	r	r	O
Designation	Text	Model designation unit/damper (16 Z.)	■	r	r	–	O
V'_{nom}	m^3/h/l/s/cfm	Volumetric flow nominal value	■	r	r	r	O
$\Delta p@V'_{nom}$	Pa	Calibration VAV unit [38…500 Pa]	■	r	r	–	O
SN actuator	xxxxx-xxxxx-xxx-xxx	Serial number of the connected actuator	■	r	–	–	
Rotation direction	ccw/cw	Actuator direction of rotation setting	■	r/w	r/w	–	E
Range of rotation	Adapted/programmed	Actuator adapted/programmed 30...95°	■	r/w	r/w	–	E
Power-on behaviour	No action/synch./ adaptation	Actuator power-on behaviour	■	r/w	r/w	–	E
NFC interface	ON/OFF	NFC Communication for app access	■	r	r	–	O
Parametrisation – Project specific settings							
Position	Text	System designation (64 Z./ZTH 16 Z.)	■	r/w	r/w	r	
V'_{max}	m^3/h/l/s/cfm (ZTH %)	V'_{max} - operating volumetric flow 20…100% V'_{nom}	■	r/w	r/w	r/w	
V'_{min}	m^3/h/l/s/cfm (ZTH %)	V'_{min} - operating volumetric flow 0…100% V'_{nom}	■	r/w	r/w	r/w	
Altitude compensation	ON/OFF	Switch function on/off	■	r/w	r/w	–	E
Altitude of installation	0 m	Compensated Δp and volumetric flow values to set the altitude of installation (above sea level)	■	r/w	r/w	–	E
Function	VAV/CAV/position control	Control function		r/w	r/w	–	E
Room-pressure cascade	OFF	VAV: secondary circuit room-pressure cascade		r/w	r/w	–	E
Setpoint	Analogue/bus	Analogue and hybrid mode/bus	■	r/w	r/w	–	E
Setpoint offset	0%	VAV: ±5% compensation ETA unit (room balance)		r/w	r/w	–	E
Reference signal Y	2...10 V/0...10 V/adjustable	Setting for modulating control V'_{min}...V'_{max}	■	r/w	r/w	–	E
Feedback type	Volumetric flow/Δp/position	Volume/Δp/damper position	■	r/w	r/w	–	E
Feedback U	2...10 V/0...10 V/adjustable	Setting U signal	■	r/w	r/w	–	E

Parameter and tool overview for room-pressure bypass damper <C>

Parameter/function	Unit/value	Function/description/(area)	Application	Tool			Authorisation
			RP	Assistant app	PC-Tool	ZTH EU	Expert/OEM
Pressure control damper – manufacturer parameters (OEM values – not variable)							
Application	Room pressure	Application setting	■	r	r	r	O
Designation	Text	Model designation damper (16 Z.)	■	r	r	–	O
$\Delta p'_{nom}$	Pa	Nominal value Δp RP [5…75 Pa]	■	r	r	r	O
SN actuator	xxxxx-xxxxx-xxx-xxx	Serial number of the connected actuator	■	r	–	–	
Rotation direction	ccw/cw	Actuator direction of rotation setting	■	r/w	r/w	–	E
Range of rotation	Adapted/programmed	Actuator adapted/programmed 30…95°	■	r/w	r/w	–	E
Power-on behaviour	No action/synch./ adaptation	Actuator power-on behaviour	■	r/w	r/w	–	E
NFC interface	ON/OFF	NFC Communication for app access	■	r	r	–	O
Parametrisation – Project specific settings							
Position	Text	System designation (64 Z./ZTH 16 Z.)	■	r/w	r/w	r	
P'_{max}	Pa (ZTH %)	Δp step max. 20…100% P'_{nom}	■	r/w	r/w	r/w	
P'_{min}	Pa (ZTH %)	Δp step min. 0…100% P'_{nom}	■	r/w	r/w	r/w	
Room-pressure mode	Positive pressure/negative pressure	Room operating mode positive [+]/ negative pressure [–]	■	r/w	r/w	–	E
Application area	Exhaust air/supply air	Mounting location of the bypass damper	■	r/w	r/w	–	E
Room-pressure cascade	OFF	in connection with the room-pressure cascade		r/w	r/w	–	E
Setpoint	Analogue/bus	Analogue and hybrid mode/bus	■	r/w	r/w	–	E
Reference signal Y	2…10 V/0…10 V/adjustable	Setting for modulating control P'_{min}…P'_{max}	■	r/w	r/w	–	E
Feedback type	Δp/position	Δp/damper position	■	r/w	r/w	–	E
Feedback U	2…10 V/0…10 V/adjustable	Setting U signal	■	r/w	r/w	–	E

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

Permissions: [O – OEM, manufacturer mode] – VRU controllers are calibrated and parameterised by the unit manufacturer according to the application and the 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
r Tool: read
w Tool: write
– Tool: Does not support parameter
E Only visible in Expert Mode

6

Explanations/notes

Reference measurement for the [–] connection	A pressure-stable environment is a prerequisite for the reference measuring point [–] connection, as this has a direct influence on the room-pressure control. Any pressure fluctuation of the reference is transmitted to the room to be controlled. A pressure-controlled anteroom as a reference makes reliable room-pressure control impossible. An environment isolated from the ventilation system – no pressure-controlled or volume-controlled rooms – provides this prerequisite.
Measurement signal cables	To minimise the influence of the measurement signal cables, the signal cable lengths should be kept as short as possible.

7

Volumetric flow and room-pressure cascade control [RPC]

VRU-D3-BAC/VRU-M1-BAC, VRU-M1R-BAC

Volumetric flow and room-pressure cascade control [RPC]

Brief description

Room-pressure volumetric flow cascade control consisting of
<A> Room-pressure cascade controller: VRU-M1R-BAC [RPC] −75...75 Pa
<B> Volumetric-flow cascade controller: VRU-D3-BAC/VRU-M1-BAC [VAV]
<C> Volumetric-flow controller: VRU-D3-BAC/VRU-M1-BAC [VAV]

Principle diagram

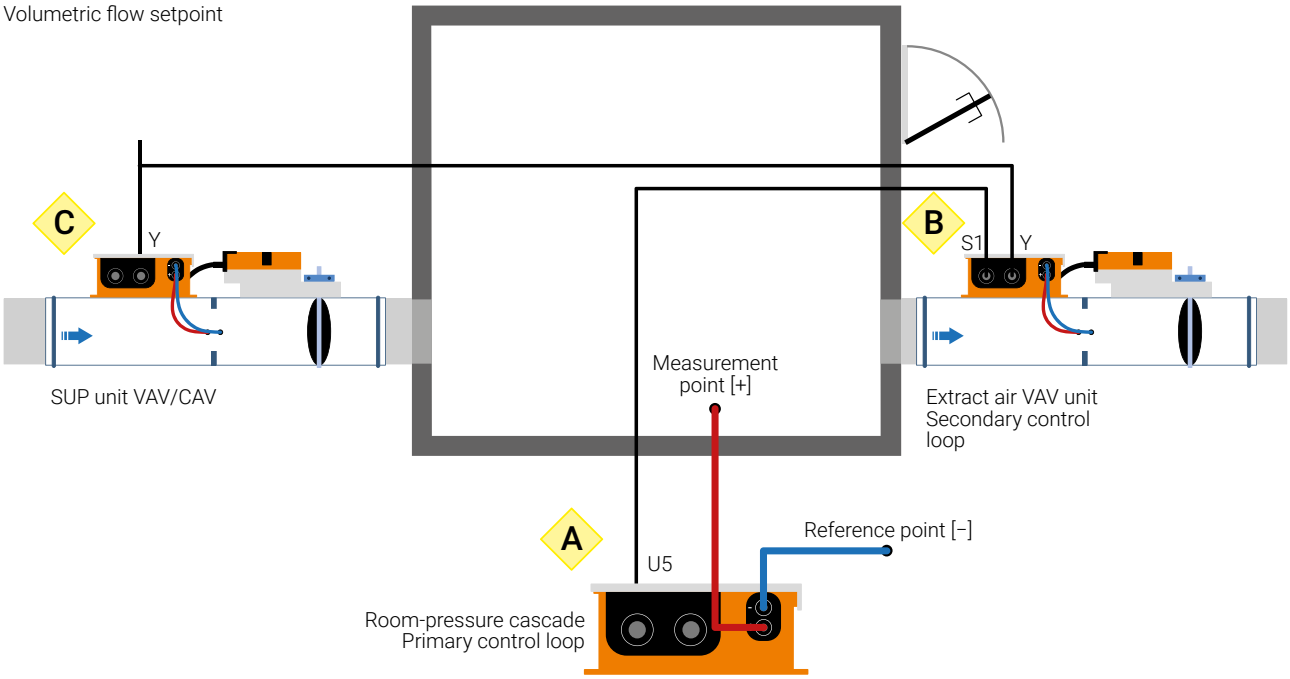


Illustration example

Ventilation systems with defined positive or negative room pressure in rooms with low leakage rates. Tight rooms place higher demands on the control because the room leakage is too low, which means that the usual volumetric flow tolerances cannot be compensated. This places high demands on the control equipment. For this purpose, the VAV unit <B> is operated with an additional room-pressure controller <C> as a so-called room-pressure volumetric-flow cascade.
– Room tightness class according to VDI 2083-19; Class 1

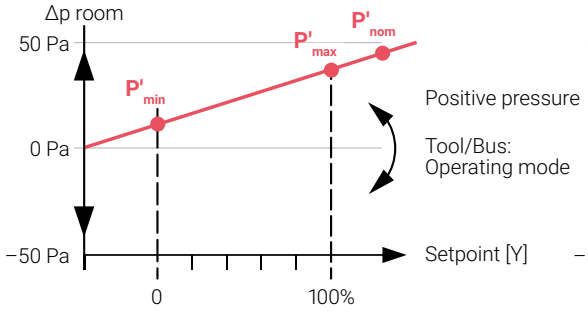
The currently required air exchange rate (room temperature, air quality, etc.) is switched to the two VAV controllers <B> and <C>. In addition, the output signal of the room-pressure controller <A> [primary control loop] is switched to the VAV controller <B> [secondary control loop]. The volumetric flow of the VAV controller is corrected by ±20% to maintain the desired room pressure. Due to the limited influence of the room pressure on the extract air volumetric flow controller, the influence is limited when the door is actuated. The damper is not moved to the end position and minimises the influence by closing the door.

Control setting, see Commissioning room/duct pressure applications page 73

Function diagram

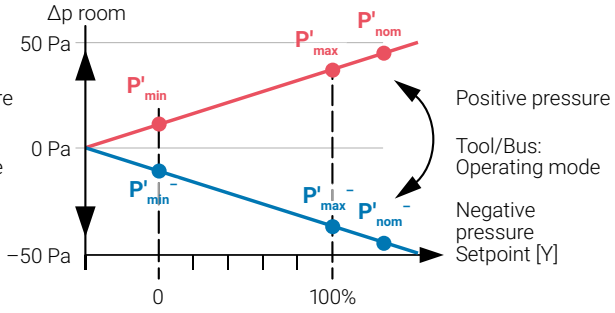
<A> Primary control-loop room pressure

– Positive pressure

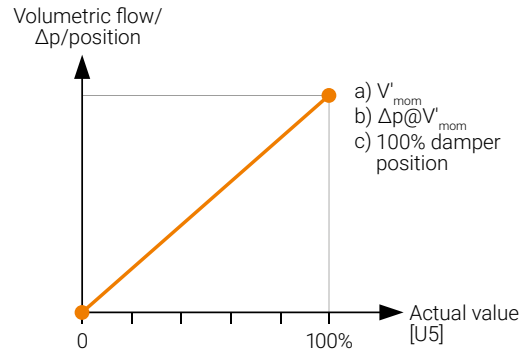


Option

– Changeover operation: positive/negative pressure

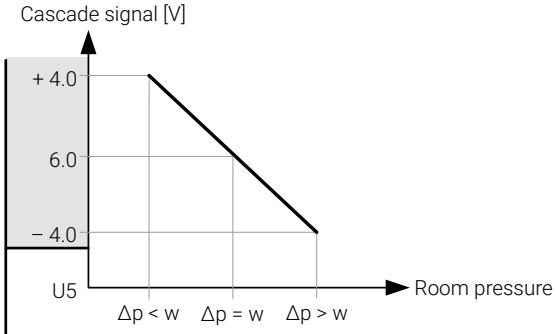


Feedback [U5]/bus (actual value)

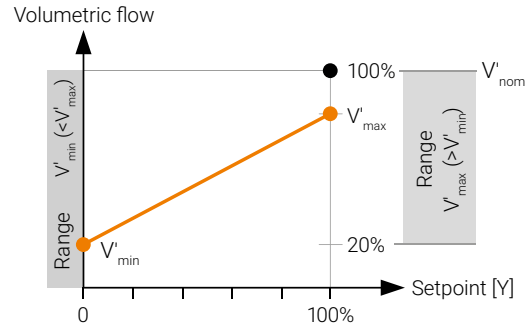


Feedback [U5] (also in bus mode)

Cascade signal [6...±4 V]

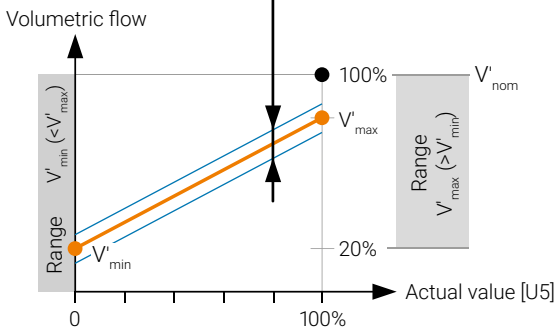


<C> VAV mode: Y/bus (setpoint)



<B> Primary control-loop VAV-unit extract air

Control: Y/bus (setpoint, input S1)



7

Requirements (positive and negative room-pressure applications)

–Room-pressure controller <A>	Room-pressure cascade controller, VRU-M1R-BAC [1], sensor range –75…75 Pa application [room pressure] Application area: [extract air/supply air] Room-pressure cascade parameter: [ON]
–Measurement signal cables <A>	Measurement room: Connect pressure line to (+) Reference point: Connect pressure line to (–)
–VAV unit <B>	VAV unit – volumetric flow cascade, VRU-D3/M1-BAC Application: [VAV] Room-pressure cascade parameter: [ON]
–VAV unit <C>	VAV unit – application: [VAV], VRU-D3/M1-BAC Application: [VAV] Room-pressure cascade parameter: [OFF]

[1] Restrictions

– MP-Bus [1]	The cascade pressure controller [A] cannot be integrated into an MP-Bus system.
– Hybrid mode [1]	In hybrid mode, the U5 signal is not available for the cascade pressure controller <A>.
– Sensor input S1	Sensor input S1 is not available for the cascade volumetric flow controller [B].

Room-pressure – Operation mode (positive/negative pressure)

If necessary, the room pressure can be switched from positive to negative pressure (pressure lines remain unchanged!):

– Analogue control/MP-Bus	Belimo Assistant App
– Modbus/BACnet	Belimo Assistant App or "Operating Mode" command

Control function room-pressure cascade controller <A>

– P'_{min}	Room-pressure setpoint 1
– P'_{max}	Room-pressure setpoint 2
– Application area	Extract air/supply air
– Room-pressure mode	Positive/negative pressure

VAV control functions <B> <C>

– V'_{min}...V'_{max}	Air exchange rate, CAV step mode or VAV modulating control V'_{min}...V'_{max}

Local override (z1/z2)

– Room-pressure controller <A>	P'_{max}
– VAV controller <B>, <C>	V'_{max}/damper CLOSED/damper OPEN/motor stop

Control

– Analogue 0…10 V/2…10 V, Modbus [2], BACnet [2], MP-Bus [3]

[2] Hybrid mode possible

[3] The cascade pressure controller <A> cannot be integrated into the MP system.

Device selection <A> room-pressure cascade controller

Product type from Belimo	Function	Sensor/actuator characteristic	Field of application	SUP unit	ETA unit
VRU-M1R-BAC	Room-pressure cascade controller <A>	Δp sensor M1 diaphragm −75...75 Pa	Comfort Polluted air	■	■

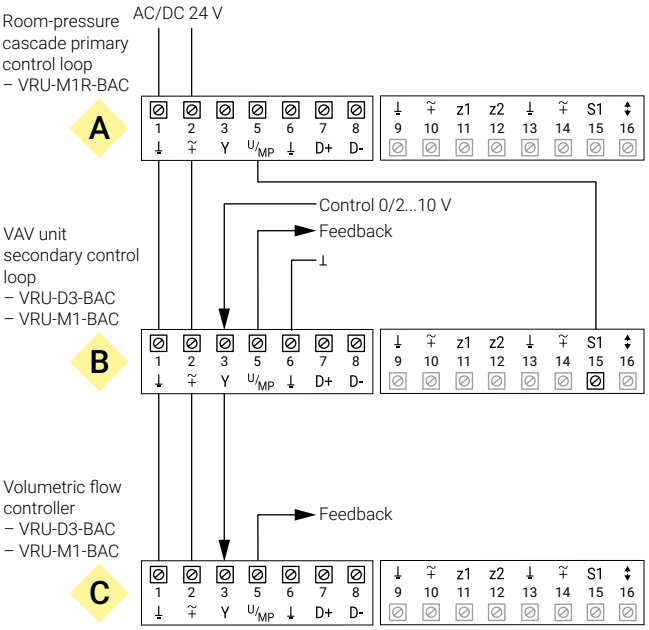
Device selection <B> <C> VAV units

Product type from Belimo	Function	Sensor/actuator characteristic	Field of application	SUP unit	ETA unit
i) Variant Δp sensor: D3 flow (dynamic)					
VRU-D3-BAC	VAV controller extract air <B> [cascade]	Δp sensor, integrated D3 flow sensor	Comfort	■	■
VRU-D3-BAC	VAV controller supply air <C>	Δp sensor, integrated D3 flow sensor	Comfort	■	■
ii) Variant Δp sensor: M1 diaphragm (static)					
VRU-M1-BAC	VAV controller extract air <B> [cascade]	Δp sensor, integrated M1 diaphragm sensor	Comfort Polluted air	■	■
VRU-M1-BAC	VAV controller supply air <C>	Δp sensor, integrated M1 diaphragm sensor	Comfort Polluted air	■	■
L/N/SM24A-VST	Rotary actuator, default	4/10/20 Nm, 120 s	All ranges		
NF/SF24A-VST	Rotary actuator, mechanical fail-safe	10/20 Nm, 120 s, spring 20 s	All ranges		
LMQ24A-VST	Rotary actuator, very fast running	4 Nm, 2.4 s	All ranges		
NMQ24A-VST	Rotary actuator, very fast running	8 Nm, 4 s	All ranges		
NKQ24A-VST	Rotary actuator, very fast running electrical fail-safe	6 Nm, 4 s	All ranges		

Diagram

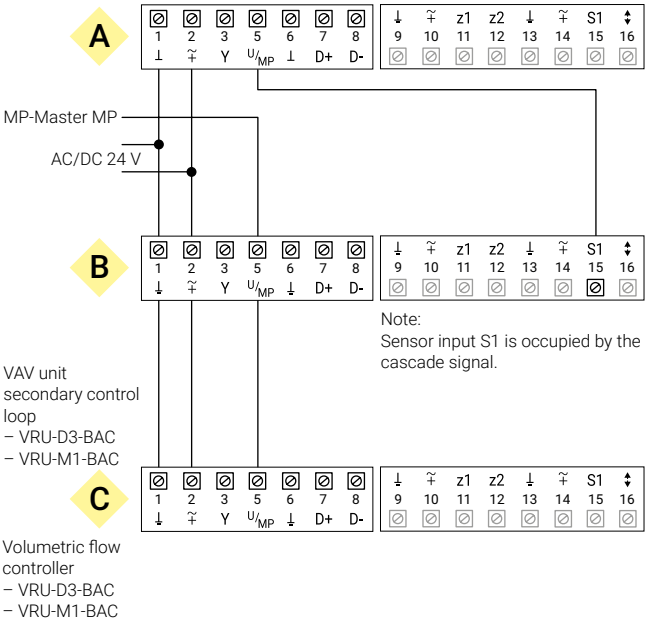
Analogue control

Room-pressure cascade — P'_{min} constant Δp
Volumetric flow — [mode 0...10/2...10 V]
– Operating volumetric flow — $V'_{min}...V'_{max}$



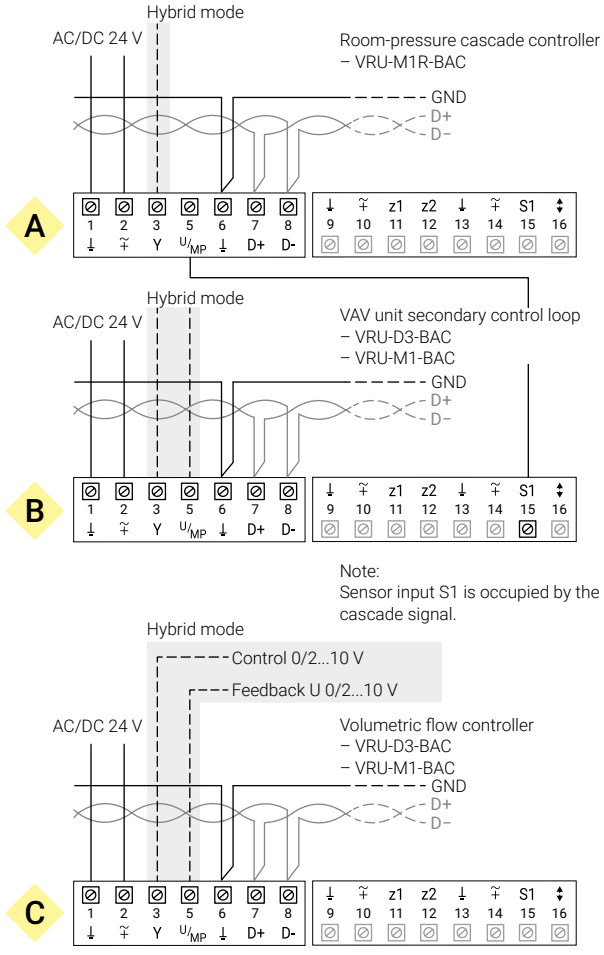
MP-Bus

Room-pressure cascade — P'_{min} constant Δp
Volumetric flow — $V'_{min}...V'_{max}$
Note:
The room-pressure controller <A> cannot be integrated into the MP-Bus system.



Modbus RTU, BACnet MS/TP

Room-pressure cascade — P'_{min} constant Δp
Operating volumetric flow — $V'_{min}...V'_{max}$
– Operating volumetric flow — $V'_{min}...V'_{max}$
Note:
In hybrid mode, the feedback signal is not available for the room-pressure controller <A>.



Safety requirements

Only authorised specialists may carry out installation. All applicable legal and government agency regulations must be complied with during use. Connection via an isolating transformer.

See VAV-Universal-VRU Product Information: www.belimo.eu

Explanations/notes

Reference measurement for the [–] connection	A pressure-stable environment is a prerequisite for the reference measuring point [–] connection, as this has a direct influence on the room-pressure control. Any pressure fluctuation of the reference is transmitted to the room to be controlled. A pressure-controlled anteroom as a reference makes reliable room-pressure control impossible. An environment isolated from the ventilation system – no pressure-controlled or volume-controlled rooms – provides this prerequisite.
Measurement signal cables	To minimise the influence of the measurement signal cables, the signal cable lengths should be kept as short as possible.
VAV control	It is recommended that the two VAV controllers <B> and a master controller- <C> be operated in a parallel circuit and not in a sequential circuit (master controller-sequential controller follower controller). Sequential circuits are not permitted in this application.
Override controls ETA unit	Override controls acting on the damper actuator must be connected to the VRU <B> for the ETA unit.
Ground connection	Connect connecting terminal 1 or 6 GND, respectively
– Priority control	p. 71
– Connection z1/z2	p. 61
– Sensor integration bus mode	p. 61
– VRP-M replacement in existing MP-Bus system:	See separate instructions VAV-Universal-VRU in VRP-M compatibility mode (MP)

Parameter and tool overview for room-pressure cascade primary control loop <A>

			Applica-tion	Tool			Authori-sation
Parameter/function	**Unit/value**	**Function/description/(area)**	**RPC**	**Assistant app**	**PC-Tool**	**ZTH EU**	**Expert/OEM**
Pressure controller – manufacturer parameters (OEM values – not variable)							
Application	Room pressure	Application setting	■	r	r	r	O
Designation	Text	Model designation unit/damper (16 Z.)	■	r	r	–	O
Δp@V'$_{nom}$	Pa	Nominal value Δp (5...75 Pa)	■	r	r	r	O
NFC interface	ON/OFF	NFC Communication for app access	■	r	r/w	–	O
Parametrisation – Project specific settings							
Position	Text	System designation (64 Z./ZTH 16 Z.)	■	r/w	r/w	r	
P'$_{max}$	Pa (ZTH %)	Δp step P'$_{max}$ 20...100% P'$_{nom}$	■	r/w	r/w	r/w	
P'$_{min}$	Pa (ZTH %)	Δp step P'$_{min}$ 0...100% P'$_{nom}$	■	r/w	r/w	r/w	
Room-pressure mode	Positive pressure	Positive (+)/negative pressure (–)	■	r/w	r/w	–	E
Application area	Exhaust air/supply air	Mounting location of the control/bypass damper	■	r/w	r/w	–	E
Room-pressure cascade	ON ON fast	ON: cascade function activated ON fast: activates with VAV fast runner	■	r/w	r/w	–	E
Setpoint	Analogue/bus	Analogue and hybrid mode/bus	■	r/w	r/w	–	E
Reference signal Y	2...10 V/0...10 V/adjustable	Setting for modulating control P'$_{min}$...P'$_{max}$	■	r/w	r/w	–	E

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

Permissions: [O – OEM, manufacturer mode] – VRU controllers are calibrated and parameterised by the unit manufacturer according to the application and the 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
r Tool: read
w Tool: write
– Tool: Does not support parameter
E Only visible in Expert Mode

Parameter and tool overview for VAV unit secondary control loop <B>

Parameter/function	Unit/value	Function/description/(area)	Application	Tool			Authorisation
			VAV/CAV	Assistant app	PC-Tool	ZTH EU	Expert/OEM
VAV unit – manufacturer parameters (OEM values – not variable)							
Application	Volumetric flow	Application setting	■	r	r	r	O
Designation	Text	Model designation unit/damper (16 Z.)	■	r	r	–	O
Δp@V'$_{nom}$	Pa	Nominal value Δp (5...75 Pa)	■	r	r	r	O
SN actuator	xxxxx-xxxxx-xxx-xxx	Serial number of the connected actuator	■	r	–	–	
Rotation direction	ccw/cw	Actuator direction of rotation setting	■	r/w	r/w	–	E
Range of rotation	Adapted/programmed	Actuator adapted/programmed 30...95°	■	r/w	r/w	–	E
Power-on behaviour	No action/synch./ adaptation	Actuator power-on behaviour	■	r/w	r/w	–	E
NFC interface	ON/OFF	NFC Communication for app access	■	r	r/w	–	O
Parametrisation – Project specific settings							
Position	Text	System designation (64 Z./ZTH 16 Z.)	■	r/w	r/w	r	
V'$_{max}$	m^3/h/l/s/cfm (ZTH %)	V'$_{max}$ - operating volumetric flow 20...100% V'$_{nom}$	■	r/w	r/w	r/w	
V'$_{min}$	m^3/h/l/s/cfm (ZTH %)	V'$_{min}$ - operating volumetric flow 0...100% V'$_{nom}$	■	r/w	r/w	r/w	
Altitude compensation	ON/OFF	Switch function on/off	■	r/w	r/w	–	E
Altitude of installation	0 m	Compensates volumetric flow value at set altitude of installation (above sea level)	■	r/w	r/w	–	E
Function	VAV/CAV	Control function	■	r/w	r/w	–	E
Room-pressure cascade	ON	VAV: secondary circuit room-pressure cascade	■	r/w	r/w	–	E
Setpoint	Analogue/bus	Analogue and hybrid mode/bus	■	r/w	r/w	–	E
Setpoint offset	0% (must be 0%!)	VAV: ±5% compensation ETA unit (room balance)	■	r/w	r/w	–	E
Reference signal Y	2...10 V/0...10 V/adjustable	Setting for modulating VAV control V'$_{min}$...V'$_{max}$	■	r/w	r/w	–	E
Feedback type	Volumetric flow/Δp/position	Volume/Δp/damper position	■	r/w	r/w	–	E
Feedback U	2...10 V/0...10 V/adjustable	Setting U signal	■	r/w	r/w	–	E

Parameter and tool overview for opposite VAV unit <C>

			Applications	Tool			Authorisation
Parameter/function	**Unit/value**	**Function/description/(area)**	**VAV/CAV**	**Assistant app**	**PC-Tool**	**ZTH EU**	**Expert/OEM**
VAV unit – manufacturer parameters (OEM values – not variable)							
Application	Volumetric flow	Application setting	■	r	r	r	O
Designation	Text	Model designation unit/damper (16 Z.)	■	r	r	–	O
V'_{nom}	m^3/h/l/s/cfm	Volumetric flow nominal value	■				
$\Delta p@V'_{nom}$	Pa	Nominal value Δp (5...75 Pa)	■	r	r	r	O
SN actuator	xxxxx-xxxxx-xxx-xxx	Serial number of the connected actuator	■	r	–	–	
Rotation direction	ccw/cw	Actuator direction of rotation setting	■	r/w	r/w	–	E
Range of rotation	Adapted/programmed	Actuator adapted/programmed 30...95°	■	r/w	r/w	–	E
Power-on behaviour	No action/synch./ adaptation	Actuator power-on behaviour	■	r/w	r/w	–	E
NFC interface	ON/OFF	NFC Communication for app access	■			–	O
Parametrisation – Project specific settings							
Position	Text	System designation (64 Z./ZTH 16 Z.)	■	r/w	r/w	r	
V'_{max}	m^3/h/l/s/cfm (ZTH %)	V'_{max} - operating volumetric flow 20…100% V'_{nom}	■	r/w	r/w	r/w	
V'_{min}	m^3/h/l/s/cfm (ZTH %)	V'_{min} - operating volumetric flow 0…100% V'_{nom}	■	r/w	r/w	r/w	
Altitude compensation	ON/OFF	Switch function on/off	■	r/w	r/w	–	E
Altitude of installation	0 m	Compensates volumetric flow value at set altitude of installation (above sea level)	■	r/w	r/w	–	E
Function	VAV/CAV	Control function	■	r/w	r/w	–	E
Room-pressure cascade	OFF (must be OFF!)	VAV: secondary circuit room-pressure cascade	■	r/w	r/w	–	E
Setpoint	Analogue/bus	Analogue and hybrid mode/bus	■	r/w	r/w	–	E
Setpoint offset	0% (must be 0%!)	VAV: ±5% compensation ETA unit (room balance)	■				
Reference signal Y	2...10 V/0...10 V/adjustable	Setting for modulating VAV control V'_{min}...V'_{max}	■				
Feedback type	Volumetric flow/Δp/ oosition	Volume/Δp/damper position	■	r/w	r/w	–	E
Feedback U	2...10 V/0...10 V/adjustable	Setting U signal	■				

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

Permissions: [O – OEM, manufacturer mode] – VRU controllers are calibrated and parameterised by the unit manufacturer according to the application and the 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
r Tool: read
w Tool: write
– Tool: Does not support parameter
E Only visible in Expert Mode

8

Connection

VRU-D3-BAC/VRU-M1-BAC/VRU-M1R-BAC

Connection

Brief description

VRU-...-BAC – Connection and basic functions

Principle diagram

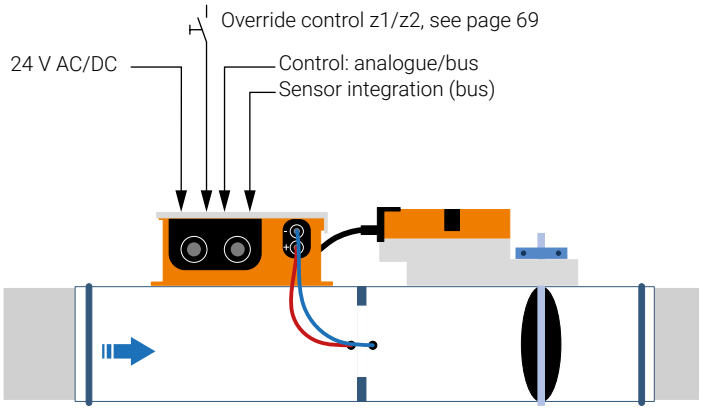


Illustration example

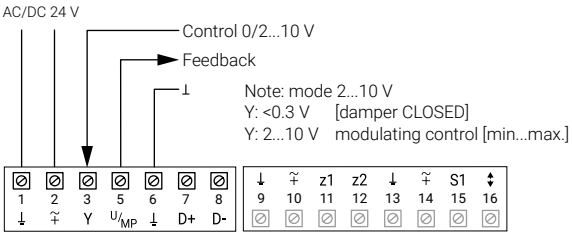
Explanations/notes

Safety requirements — Only authorised specialists may carry out installation. All applicable legal and government agency regulations must be complied with during use.
Connection via an isolating transformer.

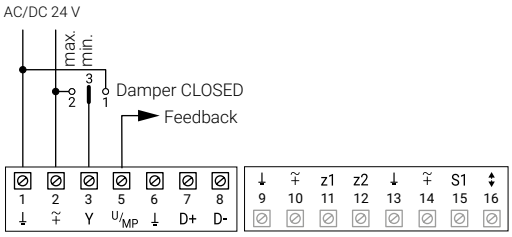
Override controls z1/z2 — Connection and priority control, see page 69

Diagram

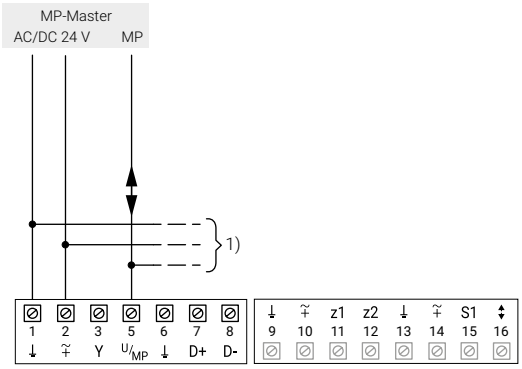
Analogue control [Mode 0...10/2...10 V]
– Modulating operation: min...max.



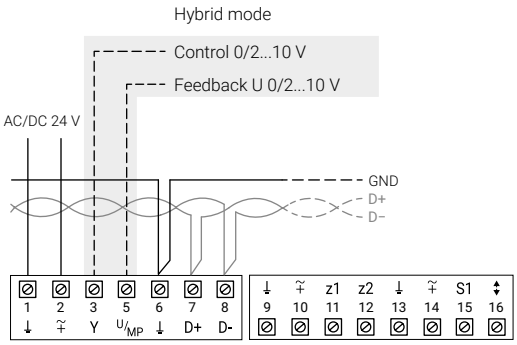
Analogue control [Mode 2...10 V]
– Step mode: damper CLOSED/min./max.



MP-Bus



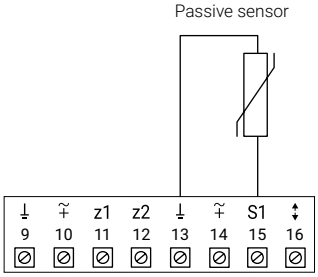
Mode RTU, BACnet MS/TP



[1] Other MP devices (total 8)
z1/z2 see page 69 for connection and priority control

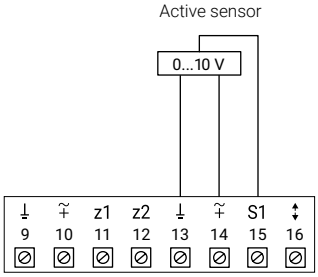
Sensor integration (Modbus, BACnet, MP-Bus)

Connection of passive sensors
e.g. Pt1000/Ni1000/...



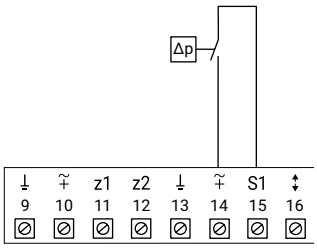
Connection of active sensors
e.g. 0...10 V @ 0...50°C

Possible voltage ranges: 0...32 V
(resolution 30 mV)



Connection of the switching contact
e.g. Δp monitor

Switching contacts: the switching contact must be able to accurately switch a current of 16 mA at 24 V.



8

9

SUP/ETA unit in conjunction

VRU-D3-BAC/VRU-M1-BAC

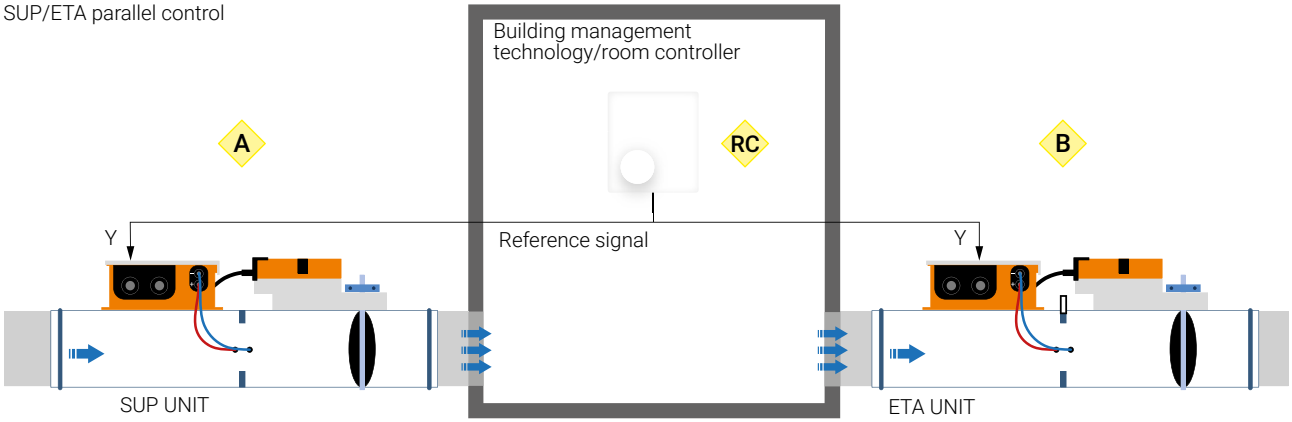
SUP/ETA unit in conjunction

Brief description

Network of SUP and ETA units, jointly controlled by building management technology/room controller/CAV circuit

Principle diagram

SUP/ETA parallel control



Sequential circuit

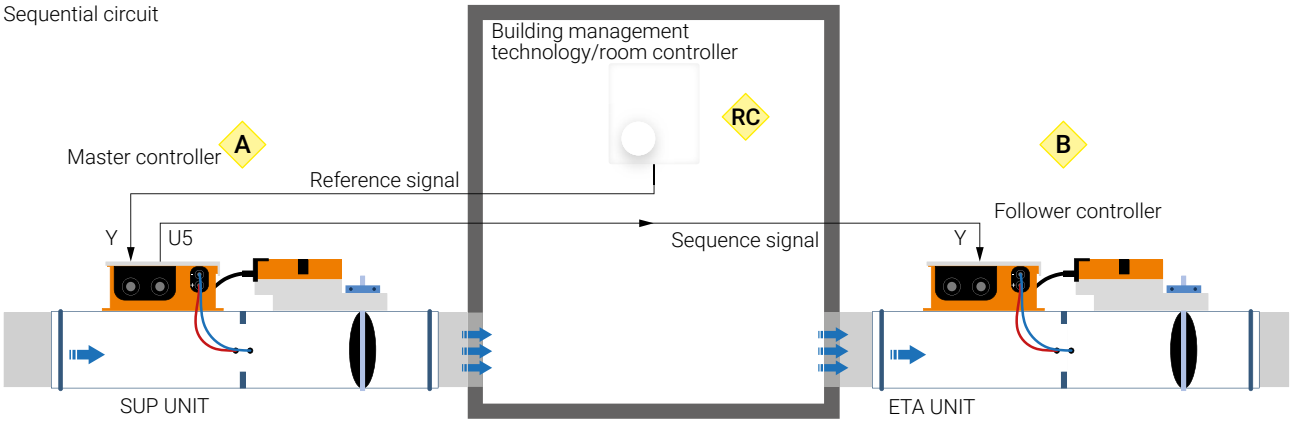


Illustration example

Function

Parallel control

With **parallel control**, the reference signal of the higher-level room automation (building management technology, room temperature or air quality control, CAV steps) is wired in parallel to the VAV controllers of the SUP and ETA unit (connecting terminal 3 - Y).
For even room balance, the operating volumetric flow settings V'_{min}...V'_{max} of both VAV units are set to identical values.
If necessary, the room-pressure balance can be adjusted with the "Setpoint Offset" parameter.

Sequential circuit

The operating volumetric flow is set on the master controller, the follower controller follows the setting automatically. In a sequential circuit, the follower controller follows the current volumetric flow of the master controller. Undersupply by the fan is detected (e.g. unfavourable simultaneity factors at fan full load), and the room-pressure balance is maintained.
For this purpose, the reference signal of the higher-level room automation (building management technology, room temperature or air quality control, CAV steps) is wired to the master controller unit (connecting terminal 3 - Y). The current volumetric flow of the master controller (connecting terminal 5 - U) serves as the reference variable of the follower controller unit (connecting terminal 3 - Y). The operating volumetric flow is usually set on the master controller; the follower controller is set for this purpose (for identical nominal diameter or V'_{nom}) at V'_{min} 0%/V'_{max} 100%.
With different unit sizes, the setting on the follower controller is: V'_{min} 0%/V'_{max} = V'_{max} of the master controller. Ideally, the master controller is placed on the more important side of the system (SUP or ETA).

Advantages/disadvantages

Parallel control

+ Simple planning/ordering/installation/commissioning.
− Identical setting of the operating volumetric flow for SUP and ETA units.
+ The two units are interchangeable from a control engineering point of view.

Sequential circuit

+ Inlet pressure influences on the master controller side are "supported" by the follower controller.
+ The operating volumetric flow is set on the master controller; the follower controller follows the setting automatically.
− Complicated handling of ordering, installation, wiring.
− If the SUP and ETA units are switched during installation, then the operating volumetric flow settings V'_{min}...V'_{max} must be adapted on both units and the signals must be corrected by adapting the wiring.
− Recognition and rectification of system errors (SUP/ETA units switched, wiring errors) requires expert know-how.

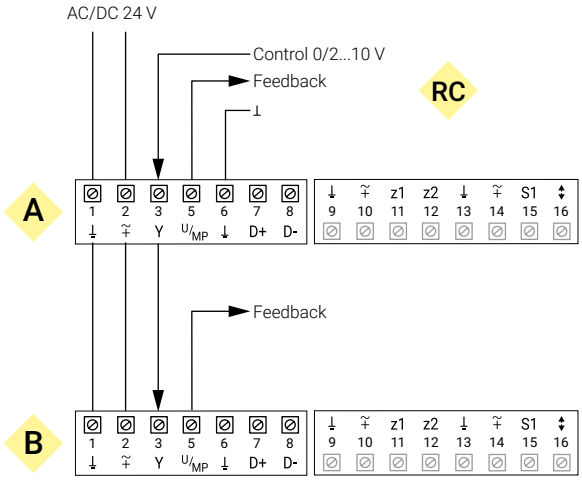
Recommendation

In practice, parallel circuits have proven to be much easier than sequential circuits. If monitoring in the SUP and/or ETA duct is required, this can be implemented much more easily and comprehensively with the bus systems commonly used today.

Diagram

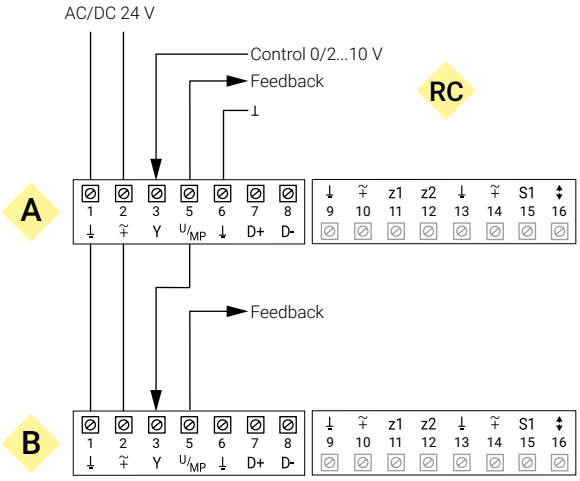
Parallel control

e.g. VAV mode: V'$_{min}$/V'$_{max}$



Sequential circuit

e.g. VAV mode: V'$_{min}$/V'$_{max}$



Explanations/notes

Safety requirements	Only authorised specialists may carry out installation. All applicable legal and government agency regulations must be complied with during use. Connection via an isolating transformer.
CAV steps	see page 61
Override controls z1/z2	The override commands must be wired to both VAV controllers.
Connection z1/z2	see page 61
Priority control	see page 71

10

Local override control z1/z2
Priority control

VRU-D3-BAC/VRU-M1-BAC/VRU-M1R-BAC

BELIMO

Local override control z1/z2
Priority control

Brief description

Local override - input z1/z2
Description of the priorities and the interaction of the individual regulation and control functions

Principle diagram

Override control z1/z2

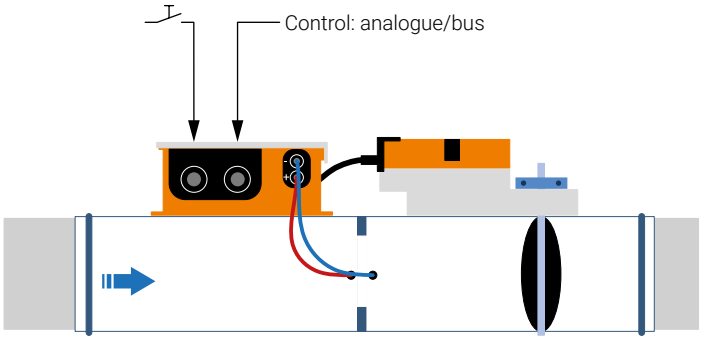
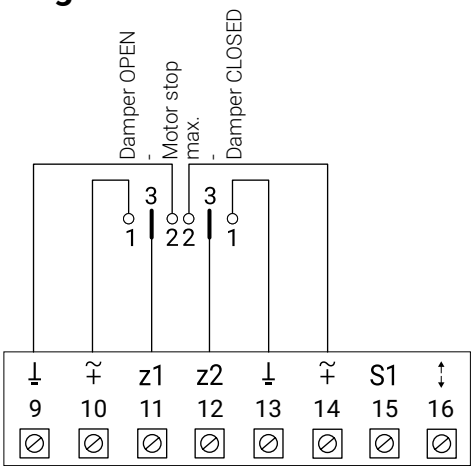


Illustration example

Diagram



Function

The two inputs z1/z2 are available for local intervention or higher-level control commands. The interaction of the control and setpoint signals for each operating mode is shown in the table below.

Priority control

Prio	Analogue operation Modulating 0/2…10 V: min…max.	Analogue operation Step mode: Damper CLOSED/min./max.	MP-Bus	Modbus	BACnet	Hybrid mode (Modbus/BACnet)
1	z1	z1	z1	z1	z1	z1
2	z2	z2	z2	z2	z2	z2
3	a) Adaptation b) Synchronisation	a) Adaptation b) Synchronisation	Bus Watchdog	Bus Watchdog	Bus Watchdog	Bus Watchdog
4	Setpoint min...max.	Steps damper CLOSED/min./max.	a) Adaptation b) Synchronisation	a) Adaptation b) Synchronisation	a) Adaptation b) Synchronisation	a) Adaptation b) Synchronisation
5	–	–	Y steps Damper CLOSED/min./max.	Bus override	Bus override	Bus override
6	–	–	Bus override	Bus setpoint: min./max.	Bus setpoint: min...max.	Y Hybrid steps: Damper CLOSED/min./max.
7	–	–	Bus setpoint: min...max.	–	–	Y Hybrid modulating: Damper CLOSED/min./max.

Exception: application room-pressure volumetric flow cascade control

The functions damper CLOSED/damper OPEN/(motor stop) are not available with the room-pressure cascade controller <A> and must be connected to the VRU-D3-BAC/VRU-M1-BAC of the VAV unit extract air <B>.

See page 51

Explanations/notes

Safety requirements	Only authorised specialists may carry out installation. All applicable legal and government agency regulations must be complied with during use. Connection via an isolating transformer.
CAV steps	Connection Y, see page 61

11

Commissioning room/duct pressure applications – Controller setting

Commissioning room/duct pressure applications – Controller setting

A room or duct pressure regulation requires on-site adaptation of the control to the control section during commissioning of the system. Unbalanced control loops lead to malfunctions and increased wear of the actuators.
Two parameters are available to the commissioning technician for adaptation of the controller,

Two parameters are available to the commissioning technician for adaptation of the controller,
– Controller sensitivity – to adapt the controller speed to the control section
– Controller deadband – the controller operates as soon as the measured Δp value is outside the deadband

The controller operates as soon as the measured Δp value is outside the set deadband (setpoint +/- deadband). This function protects the actuator from continuous motion (lifetime) and helps maintain the pressure balance in stable conditions. If, for example, the Δp actual value falls below the setpoint, the actuator starts to correct the deviation after the value falls below the lower deadband limit. To do so, the pressure controller changes the damper position until the actual value corresponds to the setpoint.

Room pressure [VRU-M1R-BAC]

Recommended actuation time: 2.4...120 s

Controller sensitivity

In tight rooms - low leakage rates and/or high air exchange rates - it may be necessary to dampen (brake) the sensitivity of the controller to ensure stable operation. Too much damping of the control loop, in turn, can cause the controller to become too slow to compensate for disturbances within a reasonable time. The room pressure setpoint must be selected such that the room pressure balance does not, unintentionally, shift to negative pressure or overpressure.

Range	Function
0.1…10	Default = 1.0
0.1	10 times slower than normal
10	10 times faster than normal

Controller deadband

The setting must be selected so that the actuator does not run continuously. Deadband settings <5±Pa require precise verification that the system is running stable.

Range	Function
±1…10 Pa	Default = ±5 Pa

Duct pressure [VRU-D3-BAC/VRU-M1-BAC]

Recommended actuation time: 120 s

In order to operate the downstream control devices in a stable manner, the duct pressure control is normally a slow control loop. The default setting will work well for line pressure control systems with connected volumetric flow controllers (e.g. VAV-Compact). If mechanical constant volumetric flow controllers (CAV) are used, the controller speed can be increased slightly if necessary.

Controller sensitivity

This parameter serves to adapt the controller speed to the downstream consumers.

Range	Function
0.1…10	Default = 1.0
0.1	10 times slower than normal
10	10 times faster than normal

Controller deadband

The deadband must be set so that the actuator does not continuously move.

Range	Function
±1…10% of P'_{nom}	Default = ±5% of P'_{nom}

Duct pressure control with VRU-D3-BAC:

The pressure drop in the measurement signal cable generates a measuring error of maximum 2.5%. Use of the VRU-M1-BAC is recommended for appli- cations with measurement signal cables >20 m.

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EN – 2021-05/A – Subject to technical modifications

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