BELIMO®

VAV solutions for comfort applications

Table of contents

Function	VAV Compact		VAV Universal	
	LON/MOD types	MP types	VRP-M system solutions	Universal program
Sensors	LONMARK®	MP BUS®	VFP.. VFD3	VFP..
Controller	Modbus	LMV-D3-MP / NMV-D3-MP	MP BUS® VRP-M	VRD3 VRP / VRP-STP
Actuators	LMV-D3LON / NMV-D3LON / LMV-D3-MOD / NMV-D3-MOD	LHV-D3-MP	LMQ24A-SRV-ST / NMQ24A-SRV-ST / NM24A-V-ST / SF24A-V-ST with emergency control function	LM24A-V / NM24A-V / SM24A-V / LF24-V with emergency control function / SF24A-V with emergency control function
Bus integration		MP BUS® Into field bus systems via MP-Gateway. LONWORKS®: Gateway UK24LON / Konnex: Gateway UK24EIB / Modbus RTU: Gateway UK24MOD / BACnet MS/TP: Gateway UK24BAC		
Ventilator optimisation	DDC with Optimiser function	MP BUS® Fan Optimiser COU24-A-MP / DDC with Optimiser function		
Smartphone App		Belimo Assistant App *		
Service tool	ZTH-GEN		ZTH EU	
Parameterisation and Service software		PC-Tool MFT-P		
Room controllers			CR24.. / CRA24..	
Positioners			CRP24.. SG..	

Information: Documents on VAV-Compact LON version, VRP-M system solution, VAV-Universal, single room controllers CR24, CRA24, CRP24, Fan Optimiser COU24-A-MP and Tools and Interfaces can be accessed as separate documents under **www.belimo.eu**.

* exclusively for VAV-Compact MP with integrated NFC interface (starting 2015).

VAV-Compact controller with integrated pressure sensor, VAV controller and damper actuator for pressure-independent VAV and CAV applications in the comfort zone

- Control:
  DC 0/2 … 10V / MP-Bus
- Integration in bus systems
  – DDC controller with MP interface
  – LONWORKS®/Modbus systems
  – Fan optimiser systems
- With additional switch-on option for sensors and switches
- Diagnostic socket for Service and PC-Tool
- NFC interface for Smartphone operation

LMV-D3-MP

NMV-D3-MP

SMV-D3-MP

LHV-D3-MP

Brief description

Application	The digital VAV-Compact has PI control characteristics and is used for pressure-independent control of VAV units in the comfort zone.
Pressure measurement	The integrated maintenance-free Belimo D3 pressure valve sensor is also suitable for very small volumetric flows. It is for this reason that it enables versatile applications in the comfort zone, e.g. in residential construction, offices, hospitals, hotels, cruise ships, etc.
Actuator	Three versions available, depending on the size of the VAV unit: 5 / 10 / 20 Nm. – Rotary actuator, depending on the size – Linear actuator 150 N with 100, 200 or 300 mm linear movement
Control function	VAV-CAV or Open-Loop operation for integration in an external VAV control loop.
Feedback	Damper position for fan optimiser systems, current volumetric flow or pressure value.
VAV – variable volumetric flow	For variable volumetric flow applications with a modulating reference variable, e.g. room temperature controller, direct digital control or bus system, it enables demand-related, energy-saving ventilation of individual rooms or zones. The operating range $\dot{V}_{min} … \dot{V}_{max}$ can be connected via selectable mode. The following are available: DC 2 … 10V / 0 … 10V / adjustable division / bus operation
CAV – constant volumetric flow	For constant volumetric flow applications, e.g. in step mode, controlled by means of a switch. The following operating modes can be selected from: CLOSED / $\dot{V}_{min}$ / ($\dot{V}_{mid}$) / $\dot{V}_{max}$ / OPEN
Bus function	Up to eight Belimo MP devices (VAV / damper actuator / valve actuator) can be connected together over the MP-Bus and integrated into the following systems: – LONWORKS® applications with Belimo UK24LON interface – Konnex applications with Belimo UK24EIB interface – Modbus RTU applications with Belimo UK24MOD interface – BACnet applications with Belimo UK24BAC interface – DDC controller with integrated MP-Bus protocol – Fan optimiser applications with optimiser COU24-A-MP or DDC with Optimiser function A sensor (0...10V or passive), e.g. a temperature sensor or a switch, can optionally be integrated into the higher-level direct digital control or bus system via the MP-Bus.
Operating and service devices	MP types: onboard NFC interface for Android Smartphone Assistant App. PC-Tool or service tool ZTH.., pluggable on the VAV-Compact (PP connection) or via MP-Bus.
Assembly and connection	The VAV-Compact device is connected using the prefabricated connecting cable.
Test function / test display	The VAV-Compact features two LEDs with a functional readiness display for commissioning and functional checking. Extended information with ZTH.. .
OEM factory settings	The VAV-Compact is mounted on the VAV unit by the unit manufacturer, who adjusts and tests it according to the application. The VAV-Compact is sold exclusively via the OEM channel for this reason.

Type overview

Type	Torque	Power consumption	Rating	Weight
LMV-D3-MP	5 Nm	2 W	3.5 VA (max. 8 A @ 5 ms)	Approx. 500 g
NMV-D3-MP	10 Nm	3 W	5 VA (max. 8 A @ 5 ms)	Approx. 700 g
SMV-D3-MP	20 Nm	3 W	5.5 VA (max. 8 A @ 5 ms)	Approx. 830 g
LHV-D3-MP	150 N	2.5 W	4.5 VA (max. 8 A @ 5 ms)	Approx. 550 g

Technical Data

Supply

Nominal voltage	AC 24V, 50/60 Hz DC 24V
Operating range	AC 19.2 … 28.8 V DC 21.6 … 28.8 V

Differential pressure sensor

Type, principle of operation	Belimo D3 sensor, dynamic response
Operating range	0 … 600 Pa
Overload capability	±3000 Pa
Installation position	Any, no reset necessary
Materials in contact with medium	Glass, epoxy resin, PA, TPE

Control function

	– VAV-CAV – Open-loop operation

Adjustment values

$\dot{V}_{nom}$	OEM-specific nominal volumetric flow setting, suitable for the VAV unit
$\Delta p \, @ \, \dot{V}_{nom}$	38 ... 450 Pa
$\dot{V}_{max}$	20 … 100% of $\dot{V}_{nom}$
$\dot{V}_{min}$	0 … 100% of $\dot{V}_{nom}$
$\dot{V}_{mid}$	50% of $\dot{V}_{min}$ to $\dot{V}_{max}$

Classic control

VAV mode for reference value input Y (Connection 3)	– DC 2 … 10V / (4 … 20 mA with 500 Ω resistance) – DC 0 … 10V / (0 … 20 mA with 500 Ω resistance) Input impedance min. 100 kOhm – Adjustable DC 0 … 10V
Mode for actual value signal U_5 (Connection 5)	– DC 2 … 10V – DC 0 … 10V max. 0.5 mA – adjustable: volumetric flow, damper position or differential pressure
CAV operating modes (constant volumetric flow)	CLOSED / $\dot{V}_{min}$ / ($\dot{V}_{mid}$ *) / $\dot{V}_{max}$ / OPEN * (* only with AC 24V supply)

MP-Bus function

Address in bus operation	MP1 … 8 (classic operation: PP)
LONWORKS® / Konnex / Modbus RTU / BACnet	with BELIMO Interface UK24LON / UK24EIB / UK24MOD / UK24BAC 1 … 8 BELIMO MP devices (VAV / damper actuator / valve)
DDC controller	DDC controllers/programmable controller with an integrated MP interface from various manufacturers
Fan optimiser (fan control)	with BELIMO Fan Optimiser COU24-A-MP
Sensor integration	Passive (Pt1000, Ni1000, etc.) and active sensors (0…10V), e.g. temperature, humidity 2-point signal (switching capacity 16 mA @ 24V), e.g. switches, occupancy switches

Operation and servicing

	MP types: onboard NFC interface for Android Smartphone Assistant App, Pluggable / PC-Tool (V3.9 or higher) / service tool ZTH..
Communication	PP/MP-Bus, max. DC 15V, 1200 baud
Push-button	Adaption / addressing
LED display	– 24V supply – Status / bus function

Actuator

	Brushless, non-blocking actuator with power-save mode
Direction of rotation	left / right or ↑ / ↓
Adaptation	Capture of setting range and resolution to control range
Gear disengagement	Push-button self-resetting without functional impairment
Sound power level	max. 35 dB (A), SMV-D3-MP max. 45 dB (A)

Actuator - rotating

Angle of rotation	95°⦨, adjustable mechanical or electronic limiting
Position Indication	Mechanical with pointer
Spindle holder	– Spindle clamp, spindle round 10 ... 20 mm / spindle square 8 ... 16 mm – Form fit in various versions, e.g. 8 x 8 mm

Actuator – linear

Stroke	100, 200 or 300 mm, adjustable mechanical or electronic limiting
Connection	Cable, 4 x 0.75 mm²

Safety

Protection class	III Safety extra-low voltage
Degree of protection	IP54
EMC	CE according to 89/336/EEC

FCC: see US-relevant notes on page 47

Technical data   *(continued)*

Safety

Mode of operation	Type 1 (in acc. with EN 60730-1)
Rated impulse voltage	0.5 kV (in accordance with EN 60730-1)
Control pollution degree	2 (in accordance with EN 60730-1)
Ambient temperature	0 … +50°C
Non-operating temperature	–20 … +80°C
Ambient humidity	5 ... 95% r.h., non-condensing (in accordance with EN 60730-1)
Maintenance	Maintenance-free

Connection

Connecting cable   The connection is made using the connecting cable mounted to the VAV-Compact device.

Note
⚠
– Supply via safety isolating transformer!
– Connections 1 and 2 (AC/DC 24V) and 5 (MP signal) must be routed to accessible terminals (room temperature controller, floor distributor, control cabinet, etc.) in order to enable access with the tool for diagnostic and service work.

No.	Designation	Wire colour	Function	
1	─ ⊥	black	⊥ ─	AC/DC 24V supply
2	+ ~	red	~ +	
3	◄ Y	white	Reference signal VAV/CAV	
5	► U	orange	– Actual value signal – MP-Bus connection	

VAV – Variable operation $\dot{V}_{min}…\dot{V}_{max}$

Wiring diagrams

Example 1:
VAV with analogue reference signal

⊥ ~ AC 24 V
─ + DC 24 V

⊥
VAV reference signal
0 … 10V / 2 … 10V

Tool / Actual value signal
0 … 10V / 2 … 10V

1   2   3   5

⊥ ~ Y U
─ +   ..MV-D3-MP   ◄▷ PC-Tool ZTH-GEN

Example 2:
VAV with shut-off (CLOSE), 2 ... 10V mode

⊥ ~ AC 24 V
─ + DC 24 V

⊥
VAV reference signal
2 … 10V

CLOSED VAV

----- Switching CLOSED / VAV mode

Tool / Actual value signal
0 … 10V / 2 … 10V

1   2   3   5

⊥ ~ Y U
─ +   ..MV-D3-MP   ◄▷ PC-Tool ZTH-GEN
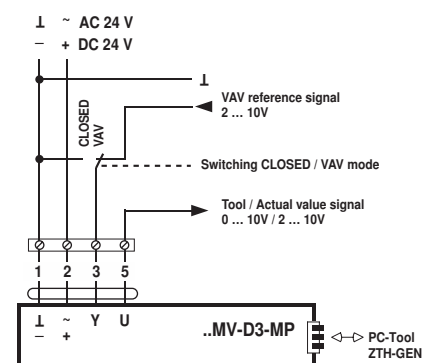
Example 3:
VAV with analogue reference signal
supply/exhaust air in parallel operation

⊥ ~ AC 24 V
─ + DC 24 V

⊥
VAV reference signal
0 … 10V / 2 … 10V

Tool / Actual value signal
0...10V / 2...10V

Supply air

1   2   3   5

⊥ ~ Y U
─ +   ..MV-D3-MP   ◄▷ PC-Tool ZTH-GEN

Tool / Actual value signal
0 … 10V / 2 … 10V

Exhaust air

1   2   3   5

⊥ ~ Y U
─ +   ..MV-D3-MP   ◄▷ PC-Tool ZTH-GEN
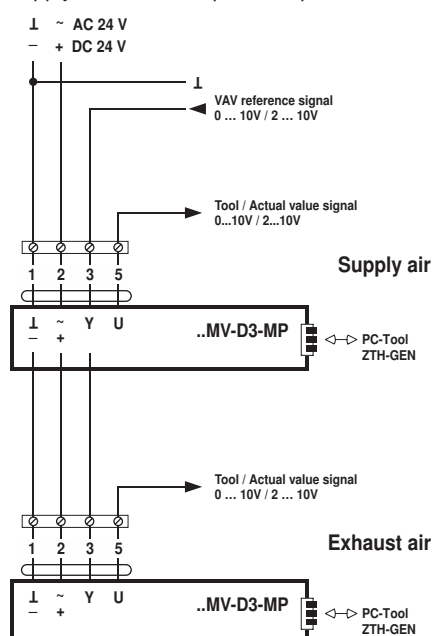
Example 4:
VAV with analogue reference signal,
in Master/Slave operation

⊥ ~ AC 24 V
─ + DC 24 V

⊥
VAV reference signal
0 … 10V / 2 … 10V

Tool / Actual value signal
0...10V / 2...10V

Master

1   2   3   5

⊥ ~ Y U
─ +   ..MV-D3-MP   ◄▷ PC-Tool ZTH-GEN

Reference signal Slave

Tool / Actual value signal
0 … 10V / 2 … 10V

Slave

1   2   3   5

⊥ ~ Y U
─ +   ..MV-D3-MP   ◄▷ PC-Tool ZTH-GEN
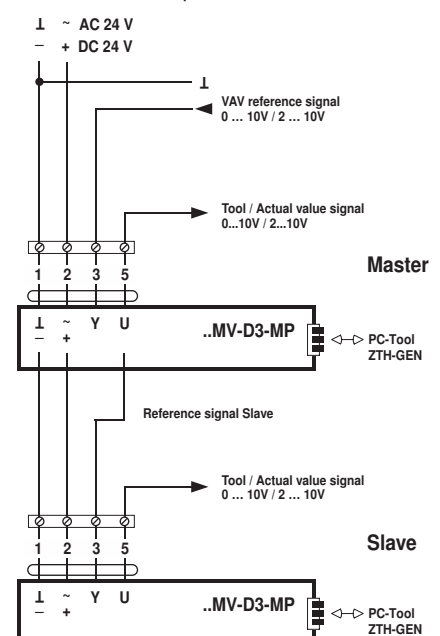
CAV – Step mode CLOSED / $\dot{V}_{min}$ / $\dot{V}_{mid}$ / $\dot{V}_{max}$ / OPEN

CAV control

Note
«Standard 0.5 V shut-off» not use at:
– Mode 2 ... 10 V and MP bus operation
– Mode 2 ... 10 V and CAV control

Three options are available for the CAV control:
– CAV function Standard: 0.1 V shut-off level: CLOSED – $\dot{V}_{min}$ – $\dot{V}_{max}$ – OPEN (default setting)
– CAV function Standard: 0.5 V shut-off level: CLOSED – $\dot{V}_{min}$ – $\dot{V}_{max}$ – OPEN
– CAV function Old Generation (NMV-D2M): CLOSED – $\dot{V}_{min}$ – $\dot{V}_{mid}$ – $\dot{V}_{max}$ – OPEN

Wiring diagrams

Note
The contacts are mutually interlocking!

* Not available with DC 24 V supply.

CAV function: Standard

Mode setting	–	0 ... 10 V	0 ... 10 V	0 ... 10 V	0 ... 10 V
	2 ... 10 V	2 ... 10 V	2 ... 10 V	2 ... 10 V	2 ... 10 V
Signal	⊥ / –	0 ... 10 V / 2 ... 10 V	~	~ / +	~
Function	3	3	3	3	3
Damper CLOSED	a) CLOSED		c) CLOSED *		
$\dot{V}_{min}$ ... $\dot{V}_{max}$		b) VAV			
CAV – $\dot{V}_{min}$	All open – $\dot{V}_{min}$ active **				
Damper OPEN					e) OPEN *
CAV – $\dot{V}_{max}$				d) $\dot{V}_{max}$	

Legend
■ Contact closed, function active
■ Contact closed, function active, only in 2 ... 10 V mode
□ Contact open
* Not available with DC 24 V supply
** The damper is closed when the 0.5 V shut-off level is used.

Example:
CAV application CLOSED – $\dot{V}_{min}$ – $\dot{V}_{max}$
(mode 2 … 10 V)

Setting CAV function:
Standard (Default)
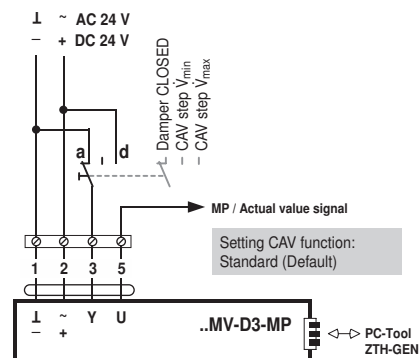
Note
In order to use the CAV step $\dot{V}_{mid}$, the Old Generation (NMV-D2M) CAV function must be selected.

CAV function: Old Generation (NMV-D2M)

Mode setting	–	0 ... 10 V	0 ... 10 V	0 ... 10 V	0 ... 10 V
	2 ... 10 V	2 ... 10 V	2 ... 10 V	2 ... 10 V	2 ... 10 V
Signal	⊥ / –	0 ... 10 V / 2 ... 10 V	~	~ / +	~
Function	3	3	3	3	3
Damper CLOSED	a) CLOSED				
$\dot{V}_{min}$ ... $\dot{V}_{max}$		b) VAV			
CAV – $\dot{V}_{min}$	All open – $\dot{V}_{min}$ active				
Damper OPEN					e) OPEN *
CAV – $\dot{V}_{max}$				d) $\dot{V}_{max}$	
CAV – $\dot{V}_{mid}$			c) $\dot{V}_{mid}$ *		

Legend
■ Contact closed, function active
■ Contact closed, function active, only in 2 ... 10 V mode
□ Contact open
* Not available with DC 24 V supply

Example:
CAV application $\dot{V}_{min}$ – $\dot{V}_{mid}$ – $\dot{V}_{max}$
(Mode 0 … 10 or 2 … 10 V)
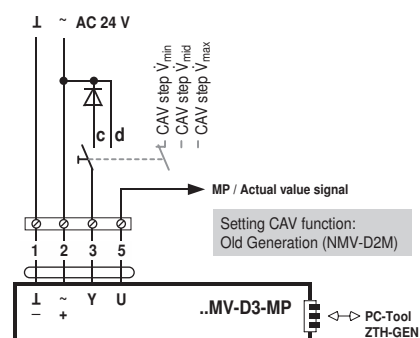
Setting CAV function:
Old Generation (NMV-D2M)

Note
– Supply via safety isolating transformer! ⚠
– Connections 1 and 2 (AC/DC 24V) and 5 (MP signal) must be routed to accessible terminals (room temperature controller, floor distributor, control cabinet, etc.) in order to enable access with the tools for diagnostic and service work.
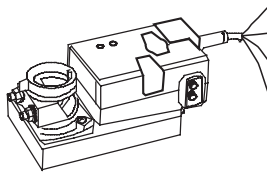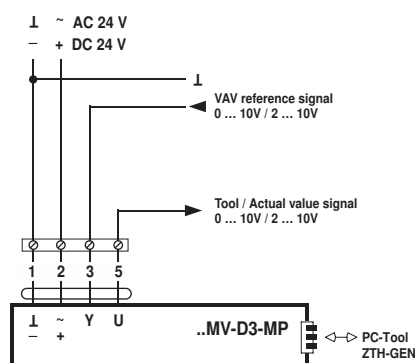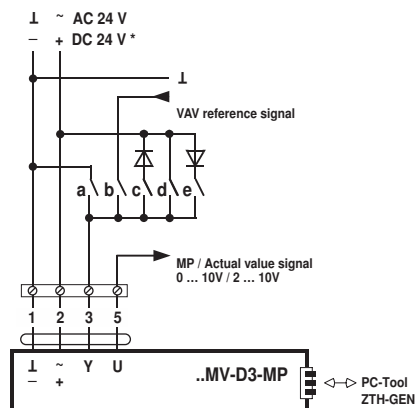
MP-Bus operation – VAV / CAV operation

Connecting cable

The connection to the MP-Bus is made using the connecting cable mounted to the VAV-Compact device.

Note
– Supply via safety isolating transformer!
– Connections 1 and 2 (AC/DC 24V) and 5 (MP signal) must be routed to accessible terminals (room temperature controller, floor distributor, control cabinet, etc.) in order to enable access with the tools for diagnostic and service work.

No.	Designation	Wire colour	Function
1	– ⊥	black	⊥ – ⎫ AC/DC 24V supply
2	+ ~	red	~ + ⎭
3	Y	white	Input for – Sensor interface – Override control
5	U	orange	MP-Bus connection

Wiring diagrams

Control via MP-Bus
For detailed information, see section «MP-Bus integration»

MP-Bus control with integrated switch
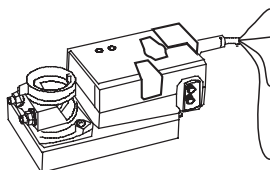For detailed information on sensor integration, see section «MP-Bus integration»

Note
– For further information about the connection, override controls, MP-Bus cables, etc., see section «MP-Bus integration»
– This is a connection description. Depending on the application, the terminal allocation may vary. The connection and commissioning must be carried out by trained personnel.

MP address: 1 … 8

..MV-D3-MP   ◁–▷ PC-Tool ZTH-GEN
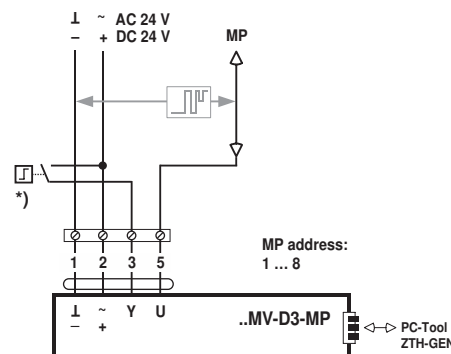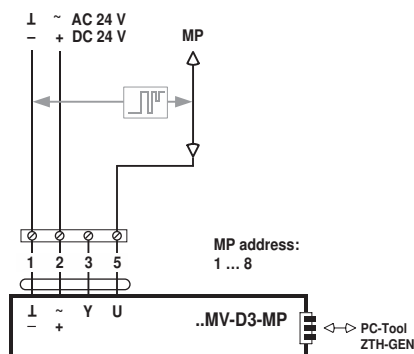
*) e.g. window contact

Dimensioning of supply and connecting cable

General

In addition to the actual wire sizing, attention must also be paid to the surrounding area and the cable routing.Signal cables must not be laid in the vicinity of load cables, objects liable to cause EMC interference etc. if possible. Paired or layer stranded cables improve immunity to interference.

24 V supply, dimensioning and cabling

The dimensioning and installation of the AC 24V supply, the fuse protection and the cables are dependent on the total operated load and local regulations. Account must be taken of the following performance data, including the starting currents of the actuators:
– Dimensioning values VAV-Compact controller, see Technical data
– Dimensioning values of further controlling elements etc. can be found in the current data sheets and product information
– Other devices which are intended to be connected to the same 24 V supply
– Reserve capacity for subsequent expansion, if planned.

MP-Bus integration – supply, dimensioning and cabling

Tool connection

Settings and diagnostics

Belimo VAV operating and service devices
Smartphone operation – Belimo Assistant App
Service tool
– ZTH-GEN (replace by ZTH EU)
– Service tool ZTH EU
Belimo PC-Tool, with level converter
– ZIP-USB-MP
– ZTH EU (with integrated MP-USB converter)

For simple checking and adaptation of the VAV unit, the VAV-Compact can be operated via the integrated NFC interface using the Android Smartphone.
The more comprehensive settings and diagnostics of the connected VAV-Compact controller can – thanks to MP bus technology – be checked and adjusted easily and rapidly with the Belimo PC-Tool or with the ZTH.. service tool.

Smartphone – Belimo Assistant App

NFC-capable devices
– LMV-D3-MP, NMV-D3-MP, SMV-D3-MP and LHV-D3-MP with printed NFC mark

Non-NFC-capable versions
– All devices without NFC mark
– LMV-D3-MF
– ..-D3LON, ..-MOD and ..-KNX

The NFC antenna range of the VAV-Compact is located between Belimo or the OEM logo and the NFC mark.
Align NFC-capable Android Smartphone, with Assistant App loaded, in such a way on the VAV-Compact that the two NFC antennas are above one another.

Depending on the model of the Smartphones, its antenna could be located at a different position
(see documentation for the Smartphone).

The Belimo Assistant App can be downloaded via the Google Play Store (www.google.xx).

On-board service connection

The service connection integrated in the VAV-Compact enables rapid connection of the operating devices ZTH.. and PC-Tool.
For the PC-Tool connection, the PC is connected per USB cable with the level converter ZTH EU or ZIP-USB-MP.
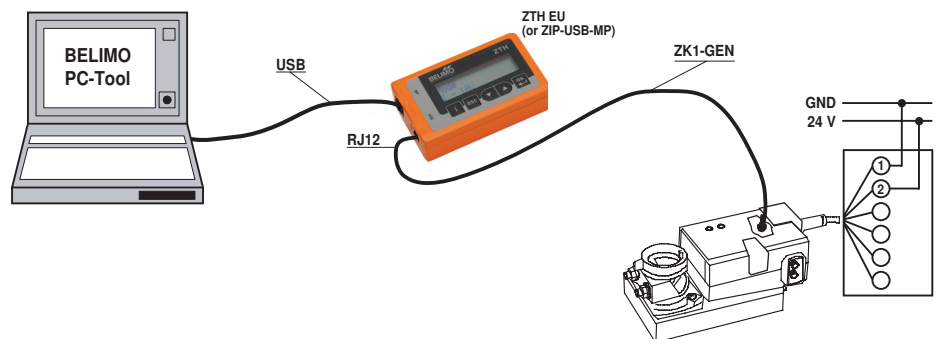
MP connection (5)

The VAV-Compacts can also communicate with the Service tools via the MP connection (connection wire 5). The connection be set up during operations on-site, i.e. in the connection socket, on the tool socket of the Belimo room temperature controller CR24 or at the tier or control cabinet terminals.
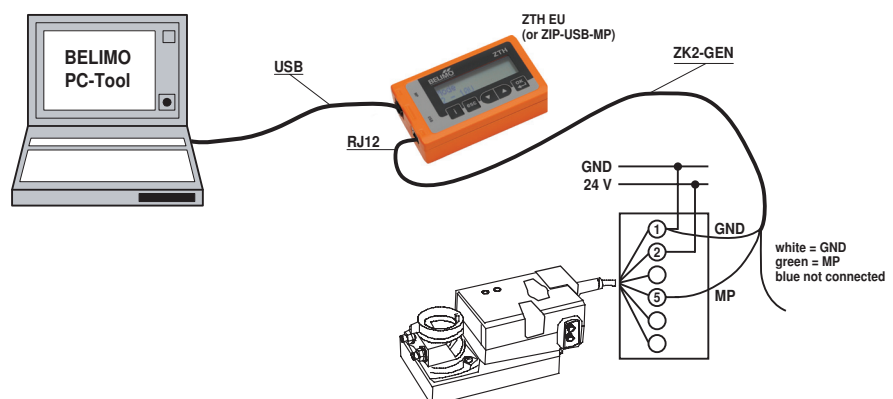
Compatibility

Current overview

An overview of the compatibility of the VAV-Compact controller with current and replaced products can be found under www.belimo.eu.

VAV-Compact – Customer versions

A VAV-Compact in a customer version is a device which has been specially produced for a VAV unit manufacturer (OEM). These versions are adapted specifically for the sensors, damper spindles and fastening systems of the OEM.

Designation: ..V-D3-MP   yyy

                          1   2

1 Product designation, 2 Customer designation

Retrofit – old Belimo or VAV controllers from third-party manufacturers

A special retrofit set is available for replacing old VAV controllers. Please contact your local Belimo representative!

Replacement devices

When replacement devices are ordered, they are parameterised at the OEM factory in accordance with the installed system.
The VAV-Compact controller is sold exclusively via the OEM channel for this reason.

Tool versions

See www.belimo.eu

Safety notes

⚠️

- **The device is not allowed to be used outside the specified field of application, especially in aircraft or in any other airborne means of transport.**
- **It may only be installed by suitably trained personnel. Legal regulations and regulations issued by authorities must be observed during installation.**
- **The device may only be opened at the manufacturer's site. It does not contain any parts that can be replaced or repaired by the user.**
- **The cable must not be removed from the device.**
- **When calculating the torque required, the specifications supplied by the damper manufacturers (cross-section, construction, place of installation), and the ventilation conditions must be observed.**
- **The device contains electrical and electronic components and is not allowed to be disposed of as household refuse. All locally valid regulations and requirements must be observed.**

Dimensions [mm]

Dimensional drawings LMV-D3-..
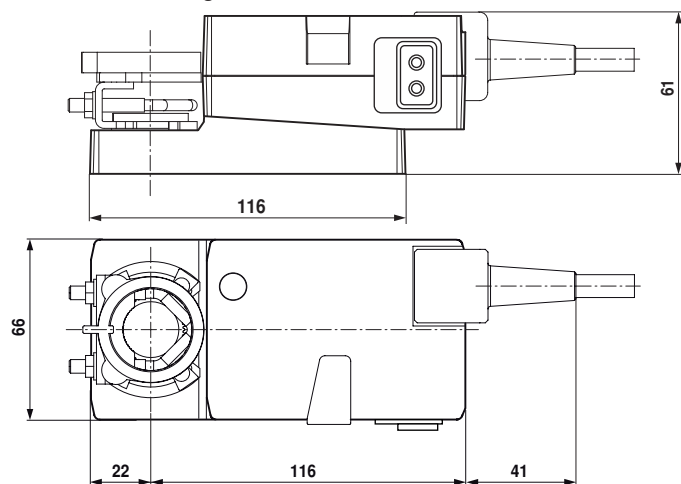
Dimensional drawings NMV-D3-..
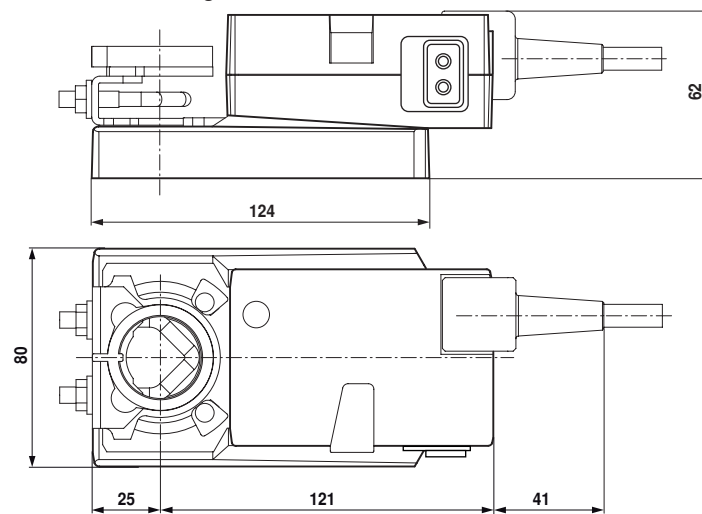
Dimensional drawings SMV-D3-

Dimensional drawings LHV-D3-..
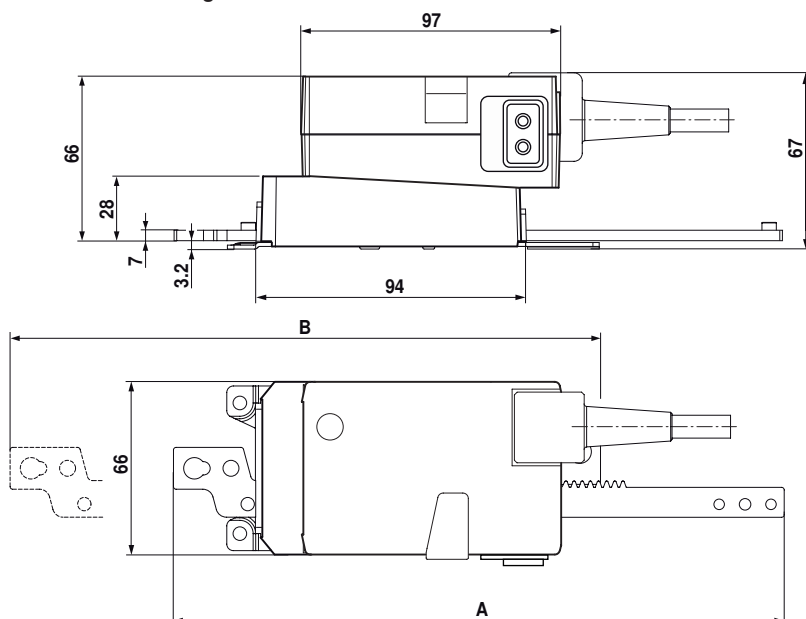
Type	Max. stroke	A	B
LHV-D3-MP100	100	233-5	264.2
LHV-D3-MP200	200	333.5	364.2
LHV-D3-MP300	300	433.5	464.2

Table of contents

Volumetric flow measurement / setting

Supply

Δp microprocessor

$Δp @ \dot{V}_{nom}$

D / A U_5

Reference variable w

A / D

z
w
$\dot{V}_{min}$
$\dot{V}_{max}$
cw ... ccw
...

+
−

Communication ↔ PP/MP

Sensor electronics

$\dot{Q}$ → $\dot{V}$

Memory
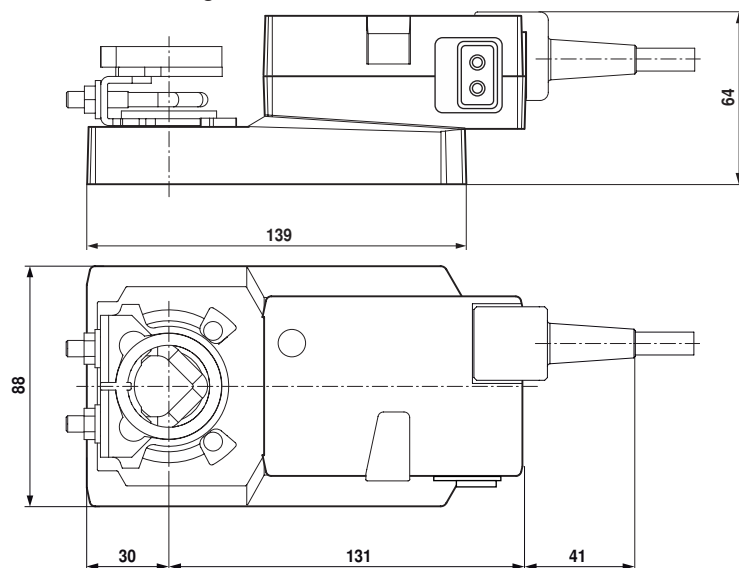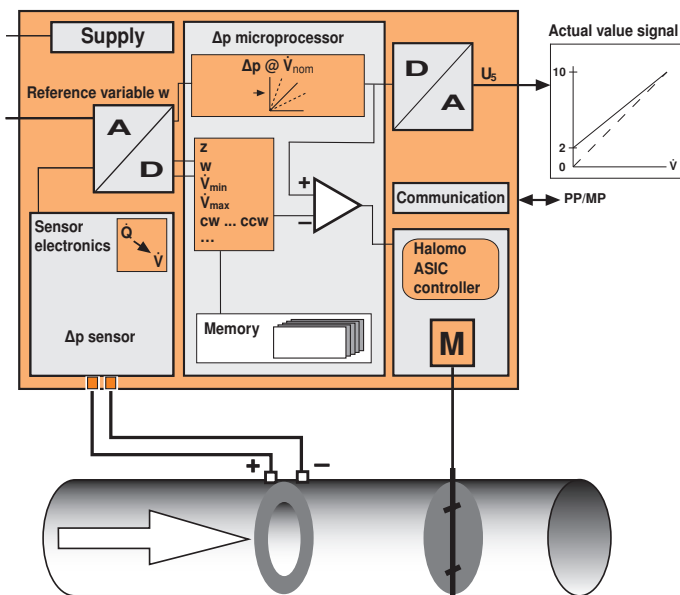
Halomo ASIC controller

M

Δp sensor

Actual value signal

10
2
0
$\dot{V}$

+ −

Δp

$$\dot{V} = c \cdot \sqrt{Δp / ϱ}$$

Legend:
$\dot{V}$ = Volumetric flow
c = Geometry-related constant of the baffle device
Δp = Differential pressure
ρ = Medium density

Calibration data

Temperature compensation

A / D

A / D

Amplifier

Sensor Chip

Linearization

PC interface

Principle of operation VAV-Compact

Block diagram

The pressure value signal from the sensor is converted in the measuring component (sensor electronics) into a signal proportional to the volumetric flow. The reference signal w is conditioned as a setpoint signal according to the operating volumetric flow setting $\dot{V}_{min}/\dot{V}_{max}$.

The current system deviation acts as the control signal for the integrated actuator. The current volumetric flow is made available as an actual value signal for indicating and controlling slave VAV controllers.

In combination with a precise differential pressure sensor, the specially designed running time logic of the VAV-Compact guarantees high control quality for the VAV unit in which it is installed.

You can choose between control with a classic control signal or via the MP-Bus, depending on the application.

Volumetric flow measurement

The principle of the volumetric flow measurement is a pick-up device which is usually installed in the air duct in the form of a measuring diaphragm, a venturi nozzle or a measuring nozzle. Several measuring procedures have established themselves on the market for the recording of the volumetric flow.

Reliable and accurate differential pressure measurement – the key to exact volumetric flow control

The differential pressure measurement used by Belimo permits a reliable, averaging measurement, even with unfavourable inflow conditions.
Each of the sensors used for recording the differential pressure has its own dynamic behaviour. The influence of this measuring element in the volumetric flow calculation is designated the device constant «c».
The sensor element is comprised of a centrally located heating element with two temperature sensors aligned in the direction of the flow. A temperature 'dome' forms above the heating element which is deformed by the air flow in the direction of the flow. The resulting temperature difference between the two temperature sensors is a measure of the existing differential pressure on the sensor.
Features of the Belimo differential pressure sensor D3:
– Precise, proven heat transport measuring principle
– Minimal flow rate through the sensor, therefore insensitive to contamination
– Null measurement required neither at the time of commissioning nor during operation
– Suitable for every installation position
– maintenance-free and with long-term stability for versatile applications
– Parallel measurements are possible thanks to the very low air flow rate
– Display of the current differential pressure of –600 … 600 Pa
– The direction of flow is detected
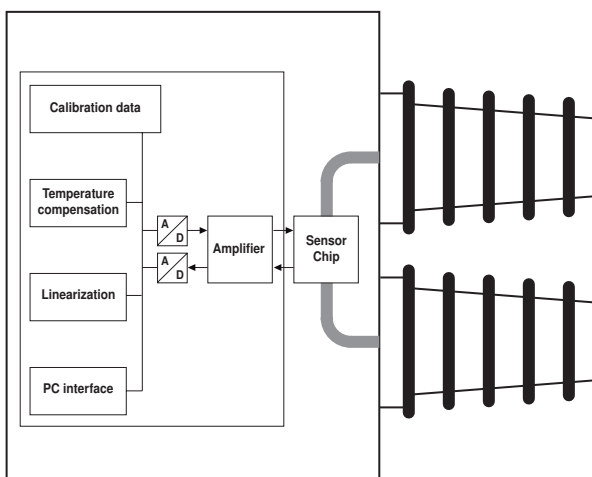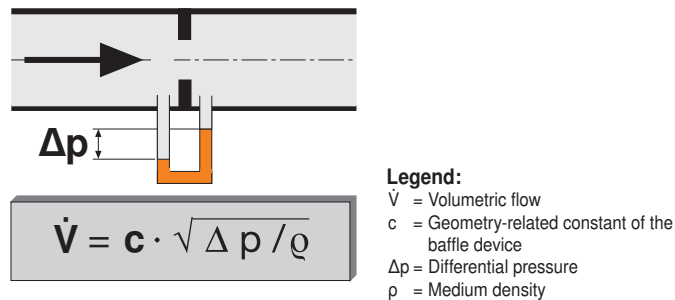
Volumetric flow measurement / setting   *(continued)*

Volumetric flow
actual value signal U_5
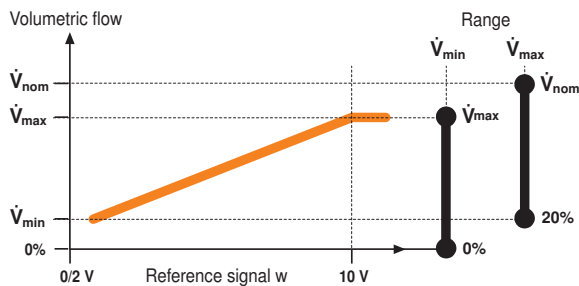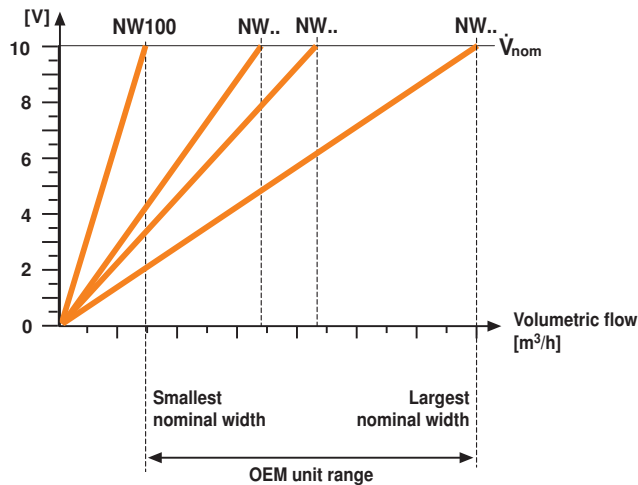
Nominal volumetric flow $\dot{V}_{nom}$

Energy and acoustic considerations mean that the specific volumetric flow for each duct diameter is not allowed to exceed a defined value. The binding nominal volumetric flowis fixed by the unit manufacturer, who is also responsible for the functionality of the VAV units.The nominal volumetric flow setting entails adapting the VAV-Compact to the installed VAV unit. The size, the nominal volumetric flow and the operating parameters are taken into account and set. $\dot{V}_{nom}$ corresponds to the maximum volumetric flow of the VAV unit at which the pressure drop and noise are still within the permissible operating conditions. The active calibration method used by Belimo, i.e. calibration with a reference volumetric flow, compensates any deviations due to mechanical tolerances in the manufacturing process.Since these values and the operating data of each VAV unit are unique, this process is carried out by the manufacturer when the unit is assembled in the factory.

No subsequent settings are necessary on the system – helping to significantly reduce installation and commissioning time and costs.

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

The linear characteristic curve of the air volume controller enables the operating volumetric flows on the system side to be set easily.
This setting is usually carried out either by the unit manufacturer or when the system is commissioned. $\dot{V}_{max}$ acts as the upper limit value as a function of the nominal volumetric flow. $\dot{V}_{min}$ can be set as a percentage of the required $\dot{V}_{nom}$.
For constant air volume (CAV), an intermediate position $\dot{V}_{mid}$ at 50% between $\dot{V}_{min}$ and $\dot{V}_{max}$ is available as needed. [1]

Function	Volumetric flow	Range
$\dot{V}_{nom}$	Nominal	OEM-specific value, depending on the VAV unit type and the application
$\dot{V}_{max}$	Maximum	20 … 100% of $\dot{V}_{nom}$
$\dot{V}_{min}$	Minimum	*0 … 100% von $\dot{V}_{nom}$ (* OEM-specific)
$\dot{V}_{mid}$ [1]	Intermediate position	between $\dot{V}_{min}$ and $\dot{V}_{max}$

* The minimum volumetric flow setting $\dot{V}_{min}$ varies according to the type of VAV unit.
[1] Requires CAV setting: NMV-D2M-compatible, see page 6. Not available with DC 24 V supply.

Reference signal Y
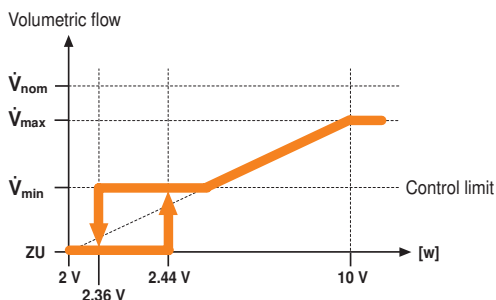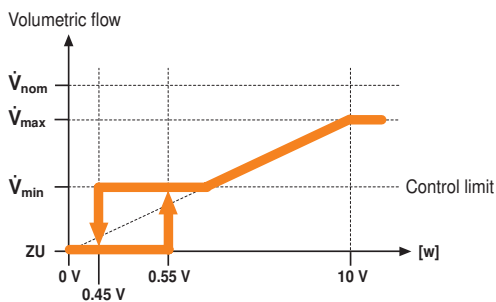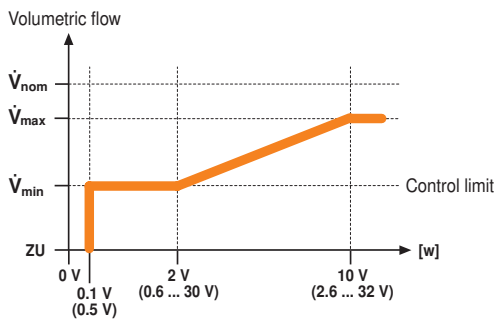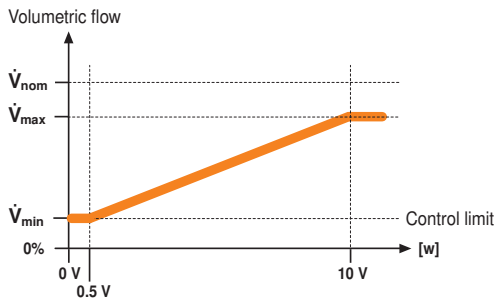
Behaviour in the lower control range

The following descriptions explain the behaviour of the VAV-Compact D3 in the lower control range. The different behaviours arise on the one hand from the setting of the reference signal (0 ... 10V / 2 ... 10V) and on the other hand from the set value for $\dot{V}_{min}$.

Reference signal 0 ... 10V and $\dot{V}_{min}$ >0%

As soon as the reference signal [w] which is connected to terminal 3 [Y] of the controller falls below 0.5V, the volumetric flow unit adjusts to $\dot{V}_{min}$ or to the lowest adjustable differential pressure.

> **Note**
> «Standard 0.5 V shut-off» not use at:
> – Mode 2 ... 10 V and MP bus operation
> – Mode 2 ... 10 V and CAV control

Reference signal 2 ... 10V (or adjustable) and $\dot{V}_{min}$ > 0%

As soon as the reference signal [w] which is connected to terminal 3 [Y] of the controller falls below 2.0V, the volumetric flow unit adjusts to $\dot{V}_{min}$ or to the lowest adjustable differential pressure. The shut-off level (damper CLOSED) is fixed at 0.1V, but can if necessary be set with the PC-Tool to 0.5 V.

Reference signal 0 ... 10V and $\dot{V}_{min}$ = 0%

The damper will close as soon as the reference signal [w] which is connected to terminal 3 [Y] of the controller falls below 0.45V. The controller will return to control mode when the signal rises again above 0.55V.

Reference signal 2 ... 10V and $\dot{V}_{min}$ = 0%

The damper will close as soon as the reference signal [w] which is connected to terminal 3 [Y] of the controller falls below 2.36V. The controller will return to control mode when the signal rises again above 2.44V.
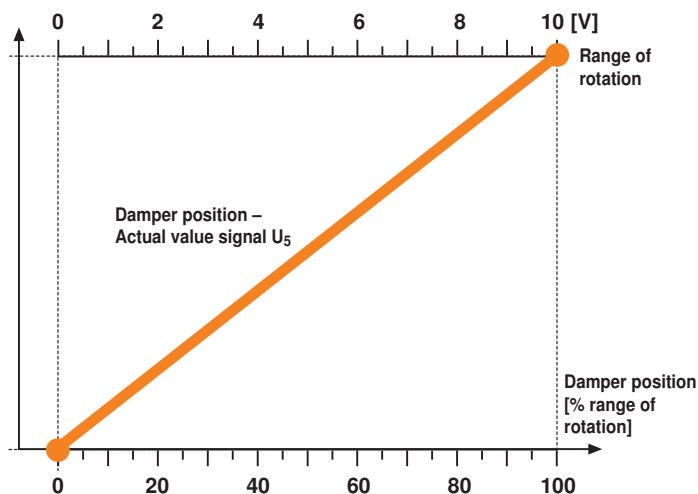
Actual value signal U_5

Note
We recommend installing connection U_5 (actual value signal / MP connection) of each VAV controller in an accessible position, e.g.: room temperature controller (CR24-Bx), floor controller, control cabinet. This allows you to use setting and control functions without direct access to the VAV controller.
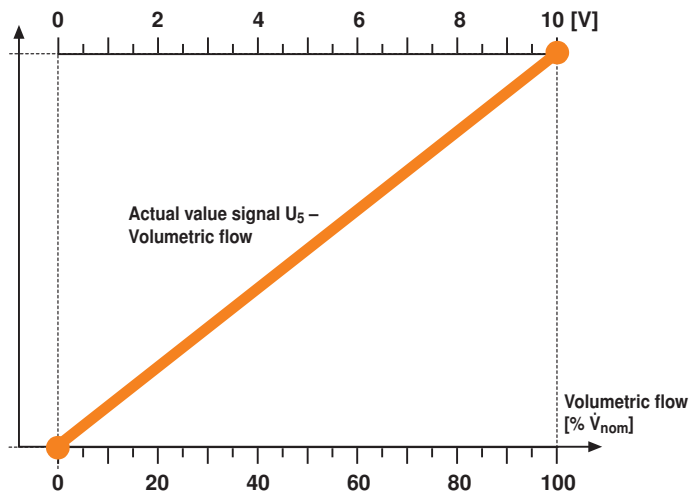
Three measured variables

The VAV-Compact provides three measured values to choose from as actual value signal:
• Volumetric flow as 0 … 100% $\dot{V}_{nom}$ (default setting)
• Damper position as 0 … 100% of the available angle of rotation
• Δp actual value from 0 ... 100% of Δp @ $\dot{V}_{nom}$
The setting can be switched with PC-Tool (Version V3.6 or higher).

Actual value signal U_5 – volumetric flow

The volumetric flow actual value signal U_5 indicates the current volumetric flow measured through the pick-up device of the VAV unit. This value corresponds to 0 … 100% of the set nominal volumetric flow. $\dot{V}_{nom}$ is set in the factory by the unit manufacturer and indicated on the VAV unit nameplate

Example
with Mode
0 … 10V

Actual value signal U_5 –
Volumetric flow

Volumetric flow
[% $\dot{V}_{nom}$]

The actual value signal U_5 – volumetric flow:
– Corresponds to 0 … 100% of $\dot{V}_{nom}$
– Indicates the current actual volumetric flow
– Is not influenced by the $\dot{V}_{min}$ and $\dot{V}_{max}$ settings
– Has a shape that can be influenced by the mode and/or variable settings
– Must not be interconnected with the U_5 signals of other VAV-Compact controllers in conventional operation

Application:
• Reference signal for the slave unit in master / slave applications
• Volumetric flow indication, e.g. on BMS, totalising function

Actual value signal U_5 – damper position

The damper position actual value signal indicates the current damper position.
The value is shown as 0 … 100% of the adapted, i.e. available, damper setting range.

Example
with Mode
0 … 10V

Damper position –
Actual value signal U_5

Range of
rotation

Damper position
[% range of
rotation]

The actual value signal U_5 – damper position:
– Corresponds to 0 … 100 % of the adapted damper range of rotation
– Indicates the current damper position
– Cannot be used to determine the current volumetric flow but is primarily a function of the prevailing system supply pressure
– Has a shape that can be influenced by the mode and/or variable settings
– Must not be interconnected with the U_5 signals of other VAV-Compact controllers in conventional operation

Application:
• Indication, e.g. display on BMS
• Evaluation of the damper position for analogue-controlled fan optimisation

Actual value signal U$_5$ *(continued)*

Example
with Mode
0 … 10V

Actual value signal U$_5$ – Differential pressure

Differential pressure [% Δp @ $\dot{V}_{nom}$]
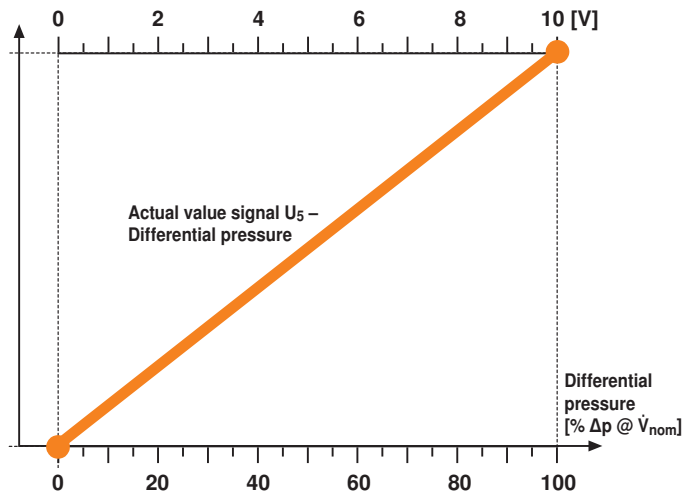
Actual value signal U$_5$ – differential pressure

The differential pressure actual value signal U$_5$ indicates the current differential pressure measured with the differential pressure sensor of the VAV unit.

This value corresponds to 0 … 100% of the set Δp @ $\dot{V}_{nom}$. This value is set in the factory by the unit manufacturer.

The actual value signal U$_5$ – differential pressure:
– Corresponds to 0 … 100% Δp @ $\dot{V}_{nom}$
– Indicates the currently existing differential pressure
– Has a shape that can be influenced by the mode and/or variable settings
– Must not be interconnected with the U$_5$ signals of other VAV-Compact controllers in conventional operation

Application:
• Pressure monitoring in Open Loop operation, e.g. filter monitoring
• Display, e.g: Display on BMS

Actual value signal U$_5$ – setting

• Influence of the mode setting on the actual value signal U$_5$

The actual value signal U$_5$ is influenced by the set operating range. If the mode is set to 0 … 10 V, the display range of the U$_5$ signal is 0 … 10 V while if the mode is 2 … 10 V, the display range is 2 … 10 V.

• Adjustable actual value signal U$_5$

The U$_5$ signal can be adapted with the PC-Tool U$_5$ feedback function for special applications; adjustable operating range:
– Starting point DC 0.0 … 8 V
– End point DC 2.0 … 10 V

Control functions

CAV operating mode 2 … 10 V

$\dot{V}_{max}$

$\dot{V}_{max}$

$\dot{V}_{nom}$

Open
(depending on supply pressure)

Constant operation

$\dot{V}_{mid}$ [1)]

$\dot{V}_{min}$

CLOSED

Volumetric flow [%$\dot{V}_{nom}$]

$\dot{V}_{min}$
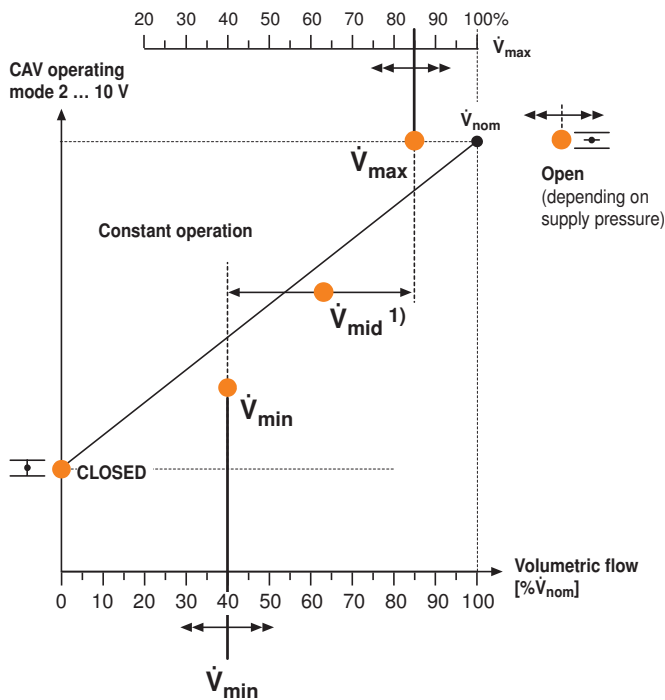
CAV / VAV and open loop control functions

The VAV-Compact can be operated with either of two control functions:
• CAV / VAV operation (default setting)
• Open loop operation
The setting can be switched with PC-Tool (Version V3.6 or higher).

CAV / VAV operation

This control function corresponds to the conventional CAV / VAV function.
• CAV (constant air volume) control in step mode CLOSED / $\dot{V}_{min}$ / $\dot{V}_{mid}$ / $\dot{V}_{max}$ / OPEN.
  For step control acting on input terminal 3, see page 6.

Application

Step-controlled CAV application, e.g.:
– Occupancy switch $\dot{V}_{min}$ / $\dot{V}_{max}$ or
– Meeting room with veto push-button for flushing mode $\dot{V}_{min}$ / $\dot{V}_{max}$

The VAV-Compact adjusts the volumetric flow to the fixed selected value in constant air volume applications. One or more operating modes can be specified as required.

The following operating modes are available:

CLOSED / $\dot{V}_{min}$ / $\dot{V}_{mid}$ [1)] / $\dot{V}_{max}$ / OPEN

– Shut-off operation – damper CLOSED:
  The damper is moved into the CLOSED position (0%).
– $\dot{V}_{max}$ / $\dot{V}_{mid}$ / $\dot{V}_{min}$ operating modes:
  The VAV-Compact adjusts the volumetric flow to the fixed selected value.
– Flushing operation – damper OPEN:
  The damper can be opened (100%) for maximum ventilation, in which case air volume control is deactivated.

[1)] Requires CAV setting: NMV-D2M compatible, see page 6.
  Not available with DC 24V supply.

Control functions　　　　　　　　　　(continued)

Reference signal Y
Example with
Mode 2 … 10V
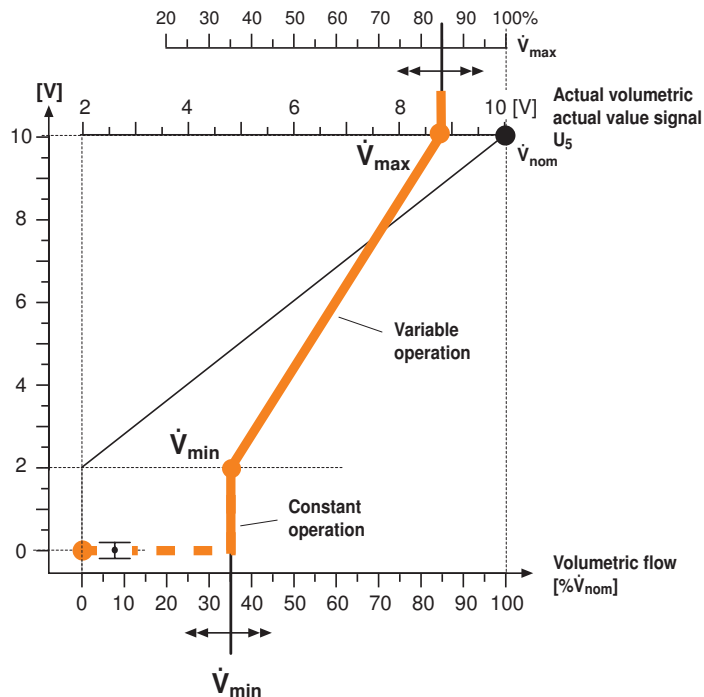
VAV (variable air volume) controller $\dot{V}_{min}$ … $\dot{V}_{max}$

Corresponds to the VAV reference value input Y

Application
Room temperature-controlled VAV application, e.g.:   – Belimo CR24 room temperature controller (Mode 2 ... 10V) or   – Third-party controller with 0 … 10V output (Mode 0 ... 10V)

VAV – reference signal Y

The reference signal Y allows the volumetric flow to be controlled linearly within the bandwidth of the set operating volumetric flows. This allows ventilation to be controlled according to demand, for example in a conference room where the volumetric flow increases continuously from the minimum setting (hygiene ventilation) up to the maximum value as a function of the room temperature.

The output signal of a master controller or a setpoint generator is supplied to the reference value input of the VAV-Compact for this purpose. This signal controls the volumetric flow linearly in the set operating volumetric flow range.

The reference signal Y
– Controls linearly in the $\dot{V}_{min}$ … $\dot{V}_{max}$ – Is used to control the VAV-Compact in VAV and CAV applications   – Has a shape that can be influenced by the mode and / or variable settings

Variable air volume operation (VAV)

The required volumetric flow is specified linearly in the $\dot{V}_{min}$ … $\dot{V}_{max}$ range by means of an analogue reference signal or via the MP-Bus.

Shut-off operation (CLOSED) with $\dot{V}_{min}$ 0%

If a shut-off function is required in VAV operation, it can be achieved by setting $\dot{V}min$ to 0%.

Shut-off operation (CLOSED)

The following function can be implemented with a 0 … 10 V signal in 2 … 10 V mode:

| Reference signal Y	Volumetric flow	Function
< 0.1 V * (0.5 V)	0	Damper CLOSED, VAV controller inactive
0.2 … 2 V (0.6 ... 2 V)	$\dot{V}_{min}$	Operating level $\dot{V}_{min}$ active
2 … 10 V	$\dot{V}_{min}$ … $\dot{V}_{max}$	Modulating operation $\dot{V}_{min}$ … $\dot{V}_{max}$

* Please note: The controller / DDC must be capable of pulling the reference signal to 0 V.

Control functions   (continued)

> **Note**
> The VAV control circuit – in open loop operation – is the responsibility of the supplier of the VAV controller.
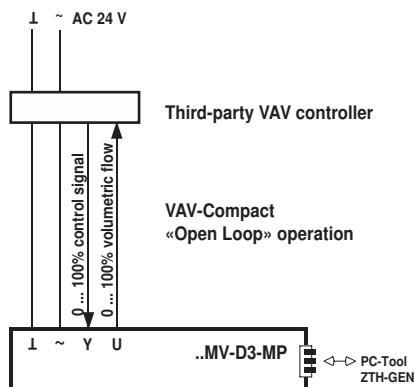
> **The switching between volumetric flow and differential pressure display (U5) takes place with the PC-Tool (Version 3.6 or higher).**

Open-loop operation

This control function deactivates the integrated CAV / VAV control function. The VAV-Compact works as a modulating actuator with an integrated volumetric flow sensor.

- Typical application: Pressure-independent control of CAV / VAV units in the comfort zone, with utilisation of an external volumetric flow controller.

- Actuator, control via Y:
– The actuator is controlled by means of an analogue control signal, e.g. 0 … 10 V, and moves to the defined position.
– Running time: The running time in open loop mode is fixed at 150 s.

- Volumetric flow, measurement via U_5:
– Actual value signal: selectable signal (0 … 10 V or 2 … 10 V) corresponding to 0 … 100% $\dot{V}_{nom}$. The $\dot{V}_{nom}$ setting is made by the manufacturer of the VAV unit.

> **Application**
> New or retrofit solutions in connection with VAV controllers without actuator and sensor unit from various third-party manufacturers, e.g.:
> – Siemens RXC ...
> – TAC Xenta ...

- Differential pressure measurement via U_5:
– Actual value signal: selectable signal (0 … 10 V or 2 … 10 V) corresponding to 0 … 100% Δp @ $\dot{V}_{nom}$. The Δp @ $\dot{V}_{nom}$ setting is made by the manufacturer of the VAV unit.

Open loop in MP-Bus mode

The open loop function was developed for analogue control. Open loop operation is available in principle, even in MP-Bus mode, although the transfer time of the data is still subject to the cycle time of the MP-Bus. Implementation of a VAV control loop through the MP-Bus, based on the open loop function, is for this reason not permitted.

Master / slave connection
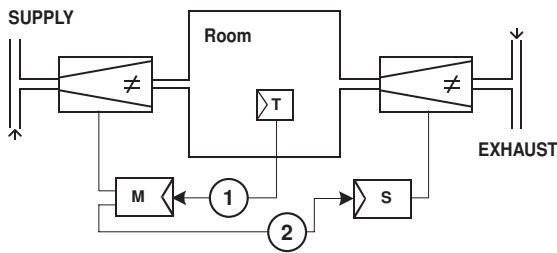
Principle:

1. A reference signal, e.g. from a room temperature controller, is connected to the master input. $\dot{V}_{min}$ and $\dot{V}_{max}$ are set on the master controller.
2. The volumetric flow actual value signal from the master acts as a reference signal for the slave controller. The master is installed on the supply or exhaust air side, depending on the application. See "Determination of the master controller".

For connection diagram, see page 5 … 6

Reference signal Y
Example with mode:
0 … 10 V

The ratio is set with the $\dot{V}_{max}$ parameter on the slave
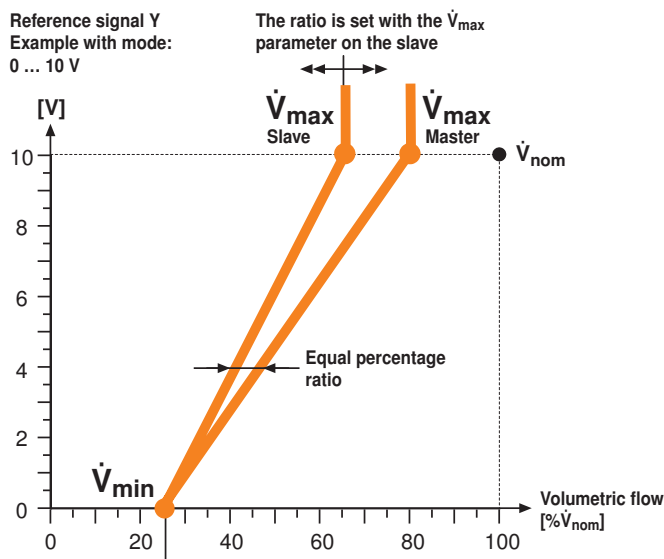
The slave $\dot{V}_{min}$ setting «0%» forms the pivot and intersection point

Determination of the master controller

If both units have:

– Non-identical $\dot{V}_{nom}$ settings, the controller with the lower $\dot{V}_{nom}$.
– Identical $\dot{V}_{nom}$ settings, the controller with the higher air volume setting acts as master

– **Positive pressure in the room**
Master: Supply air unit   Slave: Exhaust air unit

– **Negative pressure in the room**
Master: Exhaust air unit   Slave: Supply air unit

Room pressure ratio

In a master / slave connection, any changes in the air system of the master (supply pressure too low, e.g. due to a pressure control fault) are detected and reported to the slave. This guarantees an equal percentage ratio of supply air to exhaust air.
In a master / slave configuration, only one controller can act as master. However, one master controller can control several parallel slave controllers.

When are master / slave connections used?

- In systems with air volume controllers in the supply and exhaust air that are required to work sequentially
- When an equal percentage ratio of supply air to exhaust air is specified.

Operating volumetric flow settings

The $\dot{V}_{max}$- and $\dot{V}_{min}$ values used for the required volumetric flow are set on the master and transferred to the slave by means of a reference signal.

CAV application

In constant air volume applications, operating mode control (CLOSED / $\dot{V}_{min}$ etc.) is only set on the master controller.

Slave setting if the room pressure ratio is balanced

The $\dot{V}_{min}$ setting on the slave is always 0%. If the room pressure ratio is 1:1 and all controllers are the same size, the slave controller is set to $\dot{V}_{max}$ 100% / $\dot{V}_{min}$ 0%.

Slave setting if the room pressure ratio is unbalanced

The $\dot{V}_{min}$ setting on the slave is always 0%.

Setting with % scale on the ZTH-GEN service-tool

The ratio of slave volume to master volume is set as follows with the $\dot{V}_{max}$ value on the slave controller:

$$\dot{V}_{max}\, S\% = \frac{\dot{V}_{max}\, S \cdot \dot{V}_{nom}\, M}{\dot{V}_{max}\, M \cdot \dot{V}_{nom}\, S} \cdot 100$$

$\dot{V}_{max}\, S\%$	=	$\dot{V}_{max}$ value that must be set on the controller in %
$\dot{V}_{nom}\, M$	=	Nominal volume of the master unit in m³/h
$\dot{V}_{max}\, M$	=	Maximum volume of the master unit in m³/h
$\dot{V}_{nom}\, S$	=	Nominal volume of the slave unit in m³/h
$\dot{V}_{max}\, S$	=	Maximum volume of the slave unit in m³/h

Setting with PC-Tool / ZTH-GEN

These two setting tools can be used to enter the volumetric flow ratio directly in m³/ h, ll/s or cfm, i.e. there is no need to calculate the setting ratio.
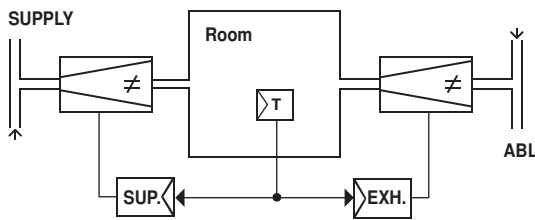
Example

Required: Positive pressure in the room with 20% excess air

– Supply air unit: $\dot{V}_{nom}$ 1600 m³/h / $\dot{V}_{max}$ 1500 m³/h
– Exhaust air unit: $\dot{V}_{nom}$ 2400 m³/h / $\dot{V}_{max}$ 1200 m³/h

Find: $\dot{V}_{max}$ setting of the slave controller

$$53\% = \frac{1200 \cdot 1600}{1500 \cdot 2400} \cdot 100$$
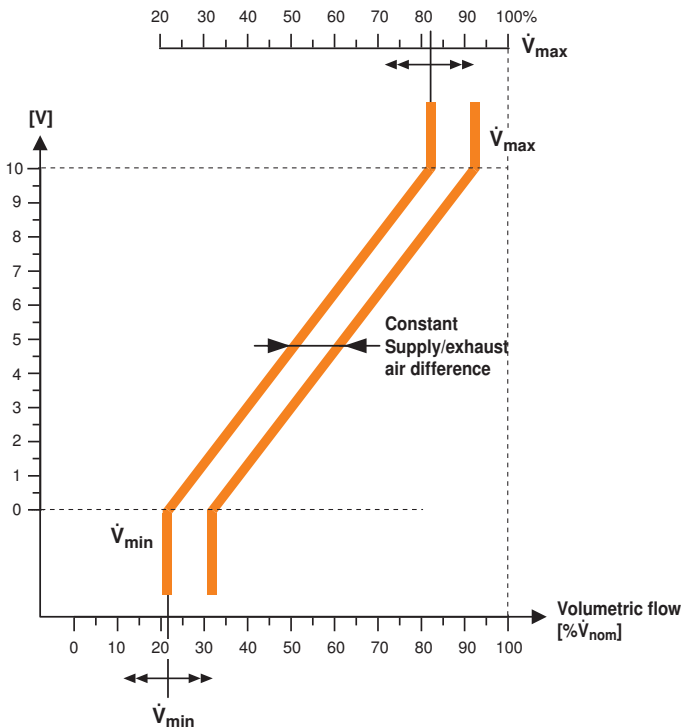
Parallel connection

SUPPLY

Principle:

The reference signal of the temperature controller is connected in a parallel circuit with the reference value inputs of the supply and exhaust air controllers. The operating volumetric flows $\dot{V}_{max}$ and $\dot{V}_{min}$ are set on both controllers.

For connection diagram, see page 5 … 6

Volumetric flow - actual value signal U_5, example with mode 0 … 10V

Room pressure ratio

In a parallel connection, the two VAV units are operated independently of one another with a common reference signal. The operating volumetric flows of the supply and exhaust air units must be set according to the required room pressure ratio.

The supply and exhaust air controllers work independently of one another, i.e. if a fault occurs in the supply or exhaust air system, the room pressure ratio is impaired for technical reasons. In the worst case, the unit tolerances may be accumulated. This circumstance must be taken into account by the project planning engineer.

When are parallel connections used?

- If air volume controllers operate with parallel supply and exhaust air (controlled by a common reference variable)
- If the supply and exhaust air devices have different sizes and different minimum and maximum volumetric flow settings
- If constant differential control is active between the supply and exhaust air
- In systems with several supply and exhaust air devices
- In circulating air systems for airtight rooms.

Operating volumetric flow settings

The $\dot{V}_{max}$ and $\dot{V}_{min}$ values used for the required volumetric flow must be set on each VAV controller.

CAV application

In constant air volume applications, operating mode control (CLOSED / $\dot{V}min$ etc.) is set on both controllers.

Setting if the room pressure ratio is balanced

Owing to the proportional assignment of the reference signal to the value ranges for $\dot{V}_{max}$ and $\dot{V}_{min}$, it is possible to operate VAV units with different nominal widths and differentiated ranges parallel to one another.

Setting if the room pressure ratio is unbalanced

The operating volumetric flows of the supply and exhaust air units must be set according to the difference:
- Positive pressure ratio in the room
  Supply air volume > exhaust air volume
- Negative pressure ratio in the room
  Exhaust air volume > supply air volume

Operation
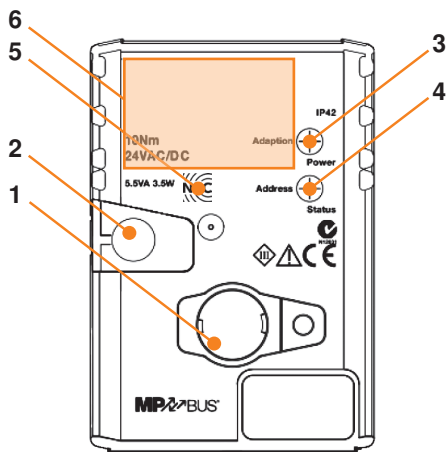
Operating and display elements:

1 Tool connection with cover
2 Gear disengagement
3 Button 1 «Adaption» LED 1 «Power»
4 Button 2 «Address» LED 2 «Status»
5 NFC logo
6 NFC antenna range

Tool connection (1)

Enables the direct connection of a Belimo operating device, e.g.: PC-Tool, ZTH-GEN service tool for adjusting or checking the VAV-Compact. This connection is also available with an active MP integration.

Gear disengagement (2)

At the time of commissioning, the damper blade can be adjusted by hand with the aid of the push-button (**2**) on the VAV-Compact. Manual overrides are possible at any time – even under voltage – without limiting the functioning of the device. In order to avoid deviations in control mode, a synchronisation is carried out after each manual override – with visual display (**4**, Status LED).

Power and operating display (3)

The status of the 24V voltage supply and the operational readiness of the VAV-Compact is displayed by the green LED (Power).

Synchronisation (2) – with visual display (4)

In order to prevent permanent deviations caused by an actuation of the gear disengagement (**2**), a synchronisation of the position calculation is carried out. This ensures a correct position modulation of the damper blade. The progress of the function can be seen on the Status LED (**4**). Deviations caused by a manual override are excluded as a result.
This synchronisation acts at the same time as a simple functional check.
The synchronisation behaviour can be adjusted in accordance with the utilisation.

Angle of rotation adaption (3) – with visual display (4)

This function detects the upper and lower spindle end stops and stores them in the VAV-Compact. The running time and the working range are adapted to the available angle of rotation. Detection of the mechanical end stops enables a gentle approach to the end position and protects the actuator and damper mechanisms. The progress of the function can be seen on the Status LED (**4**).
The adaption behaviour can be adjusted in accordance with the utilisation.

Bus function – Addressing (4)

During the addressing, the VAV-Compact is assigned an MP-Bus address (MP1 … 8) and the device is switched in bus function.
For the process, see the section: MP-Bus integration

Display of active MP-PP communication (4)

During the addressing, the VAV-Compact is assigned an MP-Bus address (MP1 … 8) and the device is switched in bus function.

NFC logo (5) and NFC antenna range (6)

Devices with NFC logo (**5**) have the antenna in the area marked (**6**).

LED function table

Application	Function	Description / action	LED pattern	Adaption ⊕ LED 1 Power / Address ⊕ LED 2 Status
N1 operation	Status information	– 24V power supply OK – VAV-Compact ready for operation	LED 1 LED 2	
S1 service function	Synchronisation	Synchronisation started by: a) Operating / service device b) Manual disengagement on the VAV-Compact c) Power On behaviour	LED 1 LED 2	Start Sync time
S2 service function	Adaption	Adaption started by: a) Operating / service device b) Button on VAV-Compact	LED 1 LED 2	Start Adaption time
B1 bus control	Addressing via MP master: (acknowledgement on VAV-Compact)	a) Addressing triggered on the MP master	LED 1 LED 2	
		b) Press the address pushbutton LED indicates active communication again as soon as the addressing function has finished	LED 1 LED 2	◄ On event ► MP communication
B2 bus control	Addressing via MP master (with serial number)	Addressing triggered on the MP master, LED indicates active communication again as soon as the addressing function has finished	LED 1 LED 2	◄ Not addressed ► MP communication
B3 bus control communication	MP-PP communication	Indicates active communication with the MP master or an operating / service device	LED 1 LED 2	MP communication

Legend:

▫ Green LED (power) lit

▪ Yellow LED (status) lit

▮▮▮ Yellow LED lit intermittently

Settings

Function	Adjustment values, limits	Operating device		Remarks, notes
		PC-Tool V3.9.2	ZTH-GEN	
System-specific settings				
$\dot{V}_{max}$	20 … 100% of $\dot{V}_{nom}$	r / w	r / w	
$\dot{V}_{min}$	0 … 100% of $\dot{V}_{nom}$	r / w	r / w	
Mode	0 … 10V / 2 … 10V	r / w	r / w	
– Reference signal Y (terminal 3)	– Start value: 0.6 ... 30V – Stop value: 2.6 ... 32V	r / w	–	
Actual value signal U (terminal 5)	– Start value: 0.6 ... 8V – Stop value: 2.6 ... 10V	r / w	–	
Address	MP1 … MP8	r / w	r / w	MP-Bus address
Position	16 characters	r / w	r	Display in operating and bus devices
Designation	16 characters	r / w	r	Display in operating and bus devices
Feedback U_5 – function	Volumetric flow / damper position differential pressure	r / w	–	
Controller function	Volumetric flow / open loop	r / w	–	
Unit-specific settings				
$\dot{V}_{nom}$ [1]	Unit-specific value	r / (w)	r	[1] Value is permanently set by the OEM at the time of calibration
Δp @ $\dot{V}_{nom}$	Unit-specific value	r / (w)	r	Unit manufacturer-specific setting parameters
Reset OEM values		w	w	Reactivating OEM basic values ($\dot{V}_{max}$ / $\dot{V}_{min}$)
NFC interface	– read only – reading and writing	r / (w)	–	Function is permanently set by the OEM
Range of rotation	– Adapted 30 … 95° – Electronically limited 30 … 95°	r r / w	–	
Direction of rotation for Y = 100%	– cw – ccw	r / w	r / w	
Torque	100 / 75 / 50 / 25%	r / w	–	
Special settings				
Response when switched on	– No action – Adaption – Synchronisation	r / w	–	Power On behaviour
Synchronisation behaviour	– Y = 0% – Y = 100%	r / w	–	Synchronisation to Y = 0 or 100%
Bus fail position	– Last setpoint – CLOSED – $\dot{V}_{min}$ – $\dot{V}_{max}$ – OPEN	r / w	–	MP-Bus function: Behaviour with bus master failure
Sensitivity	Normal / muted	r / w	–	Setting for open loop input signal
CAV functions	– Standard 0.1V shut-off – Standard 0.5V shut-off – Old generation (NMV-D2M)	r / w	–	
Displays				
Control loop display	Actual – set volume deviation	r	r	Display: Setpoint, actual value
Version overview	– Firmware – Config table ID	r r	r –	
Operating data	– Operating time – Running time – Ratio	r r r	–	
Alarm messages	– Setting range enlarged – Mechanical overload – Stop & Go ratio too high	r / w r / w r / w	–	
Series number	nnnnn-nnnnn-nnn-nnn	r	r	Belimo designation: ID and series number
Type	Type designation	r	r	Belimo product designation

Note: Setting data can be saved and printed out with the PC-Tool (V3.9.2 or higher).

Operation and malfunction messages

Recording of operating data

The VAV-Compact controller records the following operating data, which can be uploaded via the PC-Tool or, in the case of MP-Bus integrations, via the MP-Bus master:

Operating time

Operating hours during which the VAV-Compact was connected to the supply.

Active time

Operating hours during which the VAV-Compact was mechanically in movement and was connected to the supply.

Stop & Go ratio

Ratio of active time/operating time (calculation = active time [h] / operating time [h] x 100)

The VAV-Compact generates the error messages described below under corresponding operating conditions. The error messages are legible with the PC-Tool and are displayed in the bus master with MP-Bus integrations.

"Actuation path increased"

If, in the case of an angle of rotation that is limited, e.g. to 60°, a mechanical defect (angle of rotation limitation incorrectly set or loose) causes the setting range to be suddenly >60°. This is detected by the VAV-Compact and the aforesaid message is generated.

Mechanical overload

The actuator is stopped before the expected end position of 0% or 100%. Possible causes include incorrect adaption, mechanical obstacle or that the damper requires an excessively high torque (is damaged, ageing). If this message is present , then the ring running of the damper and the area should be checked. Afterwards, the actuator should be readapted and the message deleted.

"Stop & Go ratio too high"

If the Stop & Go ratio exceeds 20% – i.e. the actuator is too often in movement in terms of its operating time – then the message "Stop & Go ratio too high" will be generated. Possible cause: an unstable reference signal, e.g. caused by swings in the upstream room temperature cascade.

S4-VAV-Compact D3 • en • v2.0 • 04.2015 • Subject to changes

Table of contents

Additional VAV applications, including material lists and specification texts,
can be found in the Applications library CR24 at www.belimo.eu

**Energy-optimised VAV/CAV system solutions for fan regulations
in the room ventilation applications.**

Function and product description plus typical applications can be found in the
System Documentation Optimiser COU24-A-MP at www.belimo.eu

Single-duct systems

IRC-VAV   **CAV room solution with motion detector**

Functional diagram

Room occupied

Volumetric flow $\dot{V}_{max}$

Room not occupied

$\dot{V}_{min}$

CAV single-duct plant, occupancy-controlled
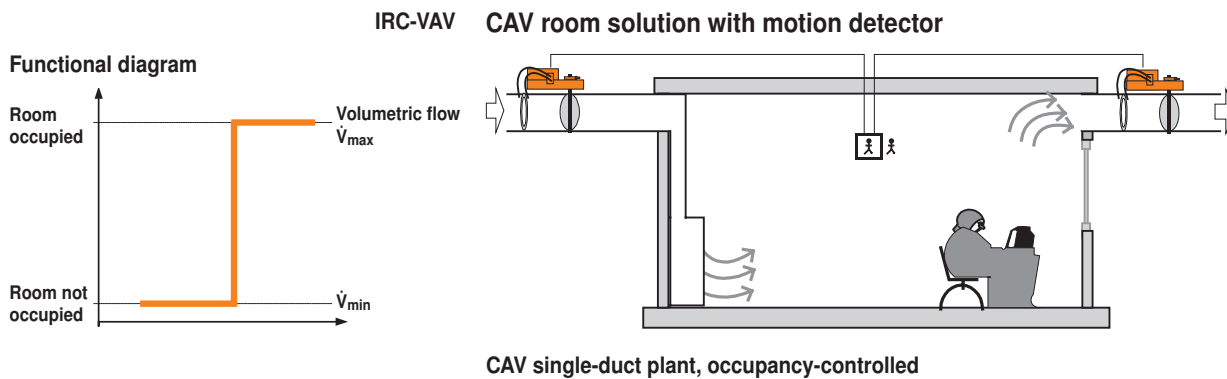
Brief description

Control solution for CAV single-room application

CAV single-duct system, occupancy-controlled
Stand-alone operation or integrated in a building automation system (I/O integration)

Functions   The CAV controller is controlled by means of the motion detector in two modes on the basis of room occupancy $\dot{V}_{min} \dots \dot{V}_{max}$:
– Room unoccupied: constant air volume $\dot{V}_{min}$
– Room occupied: constant air volume $\dot{V}_{max}$

Motion detector   With switching output for low switching capacity (load 0.24 mA)

VAV-Compact control device ..MV-D3-MP   VAV-Compact control device for supply air, exhaust air or mixing units, comprising a sensor, VAV controller and actuator for pressure-independent air volume controls.

Wiring diagram

Notes
• Connection and terminal designations of the motion detector in accordance with the manufacturer's specification
• Mode setting on the CAV controller: 0 … 10 V oder 2 … 10 V
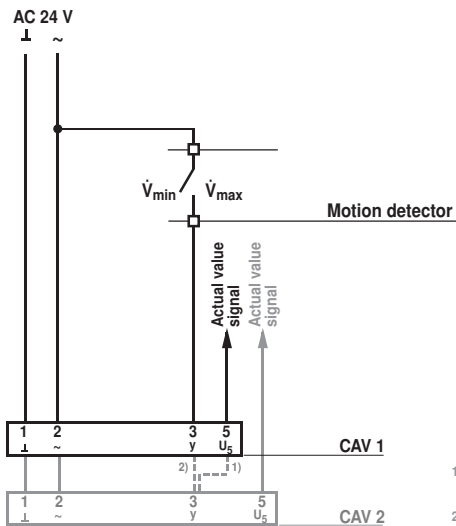
Single-duct systems   *(continued)*

IRC-VAV   **VAV room solution with 0 … 10 V control**

Functional diagram
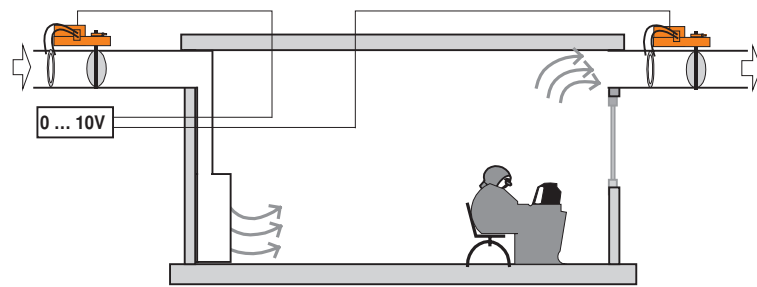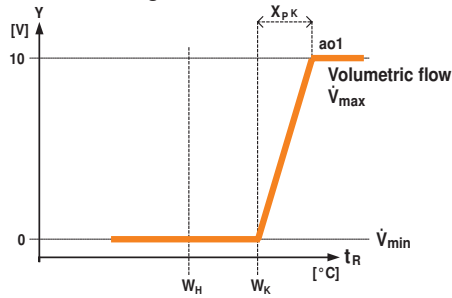
VAV single-duct system, room temperature-controlled

Brief description

Control solution for VAV single-room application

VAV single-duct system, room temperature-controlled
Stand-alone operation or integrated in a building automation system (I/O integration)

Functions
The 0 … 10 V single-room or DDC controller controls the VAV controller with a variable air volume in the range from $\dot{V}_{min}$ … $\dot{V}_{max}$, depending on the room cooling needs.

Single-room or DDC controller
With 0 … 10 V output signal (cooling sequence).
Controller functions in accordance with the manufacturer's specification.

VAV-Compact control device ..MV-D3-MP
VAV-Compact control device for supply air, exhaust air or mixing units, comprising a sensor, VAV controller and actuator for pressure-independent air volume controls.

Wiring diagram
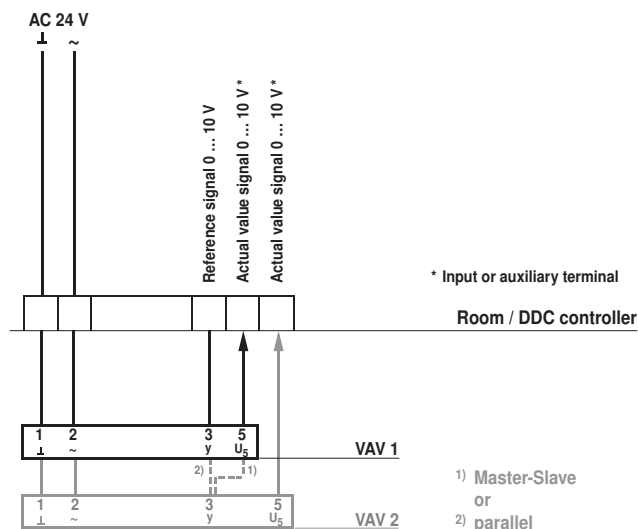
Notes
• Connection and terminal designations in accordance with the controller manufacturer's specification
• Mode setting on the VAV controller: 0 … 10 V

Single-duct systems *(continued)*

IRC-VAV **VAV room solution with CR24 room controller**

Functional diagram
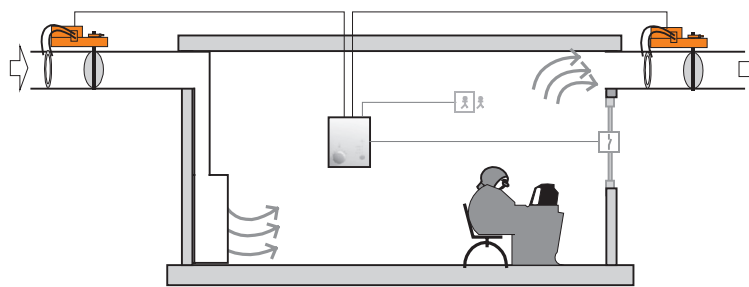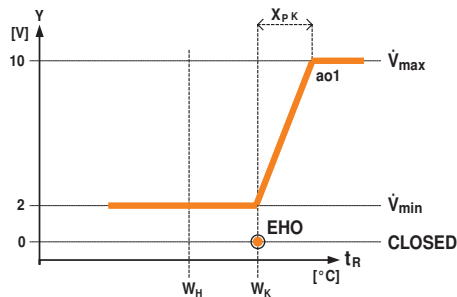
VAV single-duct system, room temperature-controlled

Brief description

Note

For technical data and a detailed description of functions, see CR24 product information.

Control solution for VAV single-room application

VAV single-duct system, room temperature-controlled
Stand-alone operation or integrated in a building automation system (I/O integration)

Functions

The CR24-B1 single-room controller controls the connected VAV controllers with a variable air volume in the range from $\dot{V}_{min} … \dot{V}_{max}$, depending on the room cooling needs.
Other functions can be optionally connected (e.g. with a motion detector): energy hold off, standby, etc.

Room temperature controller CR24-B1 (automatic) CR24-A1

Room temperature controller (15 … 36 °C) with an integrated or external temperature sensor
• Mode selection with a pushbutton and three LEDs: AUTO, ECO (reduced room temperature for standby or night operation) and MAX (flushing operation with 15' timer)
• Room protection function (frost / excess temperature)
• Inputs for energy hold off, standby operation, external temperature sensor, summer / winter compensation
• VAV system output
• Self-resetting start-up and service function
• Tool connection for diagnostics, settings and trend recordings

VAV-Compact control device ..MV-D3-MP

VAV-Compact control device for supply air, exhaust air or mixing units, comprising a sensor, VAV controller and actuator for pressure-independent air volume controls.

Wiring diagram

Notes
• Further VAV applications such as boost (fast heat up), night cool down (air heated with water or electrically), night cooling, combination available with chilled ceiling. See www.belimo.eu
• Mode setting for VAV controller for this application: 2 … 10 V

1) Master-Slave or
2) parallel

Input and output assignment

Functions	Description	Assignment
VAV	VAV system output (0) 2 ... 10 V	Output ao1
Optional functions	**Description**	**Assignment**
EHO	Energy hold off (window)	Input di1
Sensor	External temperature sensor NTC 5K	Input ai1
Shift	External shift 0 ... 10 V (Summer / Winter compensation)	Input ai2

Note

Terminal designations in accordance with the Belimo final controlling element.

Configuration, settings

DIP switches

1	P-Band	**normal**	wide
2	di2	**Stand by**	Change over

Setpoint WH range: 15 … 36 °C

Dual-duct systems

IRC-VAV **VAV dual-duct solution with CR24 room controller**

Functional diagram
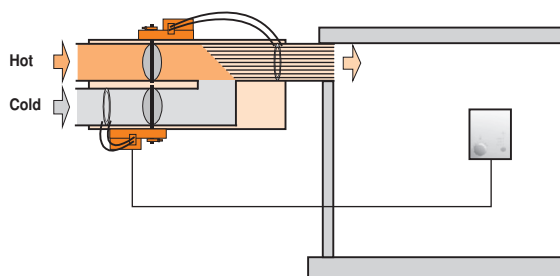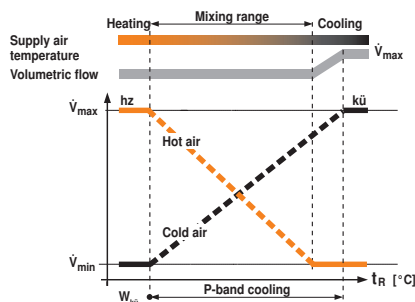
VAV dual-duct system, room temperature-controlled

Brief description

Information
For technical data and a detailed description of functions, see CR24 product information.

Control solution for VAV single-room application

VAV dual-duct system, room temperature-controlled
Stand-alone operation or integrated in a building automation system (I/O integration)

Functions

The two air volume controllers mix the hot and cold air supplied by the dual-duct air conditioning system to obtain the condition requested by the CR24-B1 room temperature controller.
The constant air volume (CAV) controller for the hot air adjusts to the set $\dot{V}_{max}$ volume for heating. The variable air volume (VAV) controller for the cold air adds the variable amount of cold air requested by the room temperature controller. If cooling needs exceed the hot air volume, the hot-air part is shut off and only cold air is supplied.
Optional: The cold-air part can be shut off by means of a switching contact at input d1.
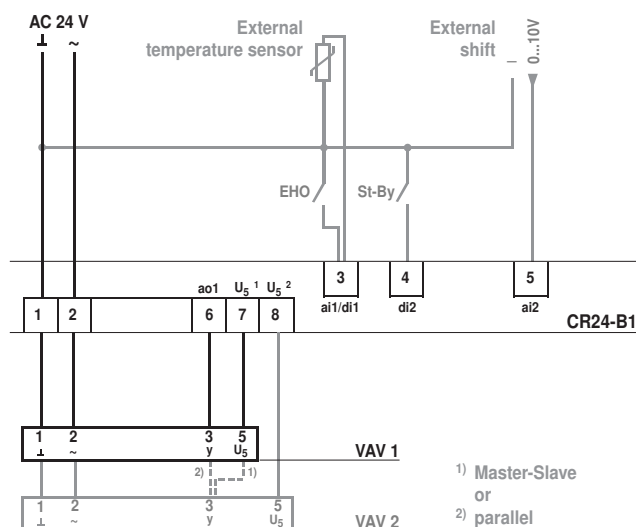
Room temperature controller CR24-B1 (automatic) CR24-A1

Room temperature controller (15 … 36 °C) with an integrated or external temperature sensor
• Mode selection with a pushbutton and three LEDs: AUTO, ECO (reduced room temperature for standby or night operation) and MAX (flushing operation with 15' timer)
• Room protection function (frost / excess temperature)
• Inputs for cold air shut-off, external temperature sensor, summer / winter compensation
• VAV system output
• Self-resetting start-up and service function
• Tool connection for diagnostics, settings and trend recordings

VAV-Compact control device ..MV-D3-MP

VAV-Compact control device for supply air, exhaust air or mixing units, comprising a sensor, VAV controller and actuator for pressure-independent air volume controls.

Wiring diagram

Notes
• Terminal descriptions correspond to the Belimo actuator connection.
• Mode setting for VAV controller for this application: 2 … 10 V
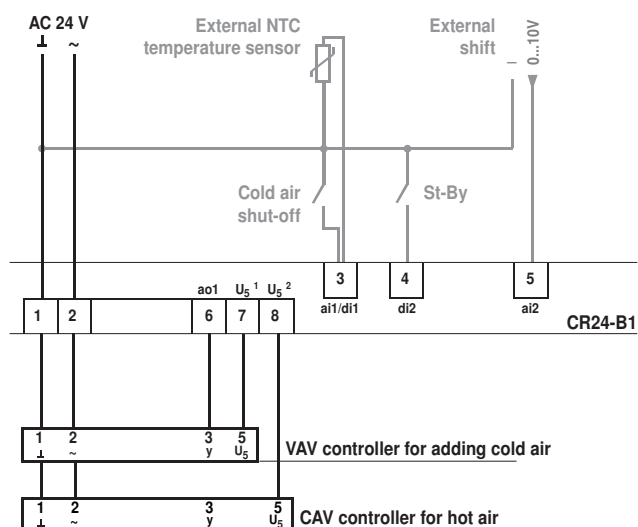
Input and output allocation

Functions	Description	Assignment
VAV	VAV system output (0) 2 ... 10 V	Output ao1
Optional functions	**Description**	**Assignment**
Shut-off CA	Cold air shut-off	Input di1
Sensor	External temperature sensor NTC 5K	Input ai1
Shift	External shift 0 ... 10 V (Summer / Winter compensation)	Input ai2

Configuration, settings

DIP switches

1	P-Band	**normal**	wide
2	di2	**Stand by**	Change over

Setpoint WH range: 15 … 36 °C

S4-VAV-Compact D3 • en • v2.0 • 04.2015 • Subject to changes

Table of contents

General

Conventional or via MP-Bus

Up-to-date and more detailed information about bus solutions: www.belimo.eu.

VAV-Compact controllers can be controlled either conventionally or via the MP-Bus. Integrations in LONWORKS®, EIB/Konnex, Modbus RTU, BACnet MS/TP or DDC systems with an MP interface can thus be realised simply and inexpensively.

Principle of operation

MP address

The assignment of an MP address turns a standard VAV-Compact into a bus-capable system controller with considerable added value.

In bus mode, the VAV-Compact controller is supplied with a reference signal over the MP-Bus from the higher-level building automation system and adjusts to the specified volumetric flow. The VAV-Compact is switched to MP-Bus mode automatically as soon as it is assigned an MP address. One active or passive sensor or one switch can be connected to each VAV-Compact. This input value can be used in the higher-level system, e.g. for VAV control in room temperature or other applications.

For the direct integration of VAV controllers in a LONWORKS® system there are new VAV-Compact controllers available in a certified LONMARK® version:
• LMV-D3LON
• NMV-D3LON

MP-Bus

The VAV-Compact can be interconnected with up to eight Belimo MP devices (damper actuators, valve actuators, VAV-Compact controllers) thanks to the integrated communication principle over the Belimo MP-Bus. These slave devices are supplied by the higher-level bus master with a digital control signal over the MP-Bus and then opened to the position dictated by this signal.

Integration for LONWORKS®
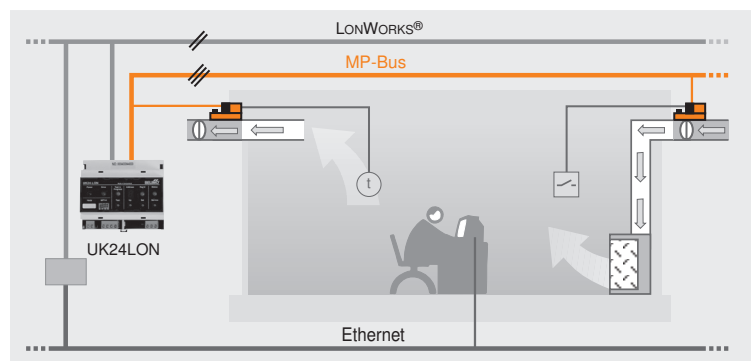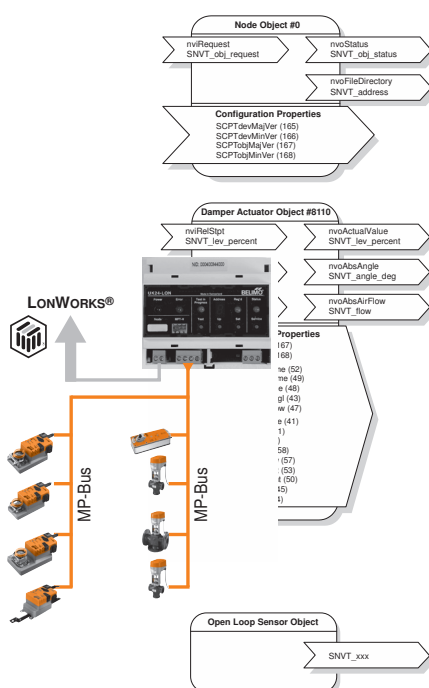

The LONMARK® certified UK24LON gateway connects the Belimo MP-Bus with LONWORKS®. Up to eight MP actuators can be connected on the MP-Bus side.
The UK24LON allows the actuators to be digitally controlled via the MP-Bus and send back their current operating status. It converts the digital information from the controller and the feedback into standardised network variables (SNVTs). The functions of the field devices can thus be directly integrated into LONWORKS®.

Damper actuator object #8110

The actuator object is used to map the functions of the MP actuators to the LONWORKS® network. There are eight of these objects in the UK24LON, i.e. one per MP actuator.

Open loop sensor object #1

An optional sensor or switch can be connected to each MP actuator. The open loop sensor object transfers the linked sensor values to the LONWORKS® network.
VAV controllers are also available in a LONMARK® certified LON version as an alternative to cost-effective integration via the UK24LON: LMV-D3LON / NMV-D3LON.

Controller object #8060

A temperature controller is integrated in each actuator. This makes it easy to implement individual room control solutions.

For more detailed information, see UK24LON Product Information.

Integration for EIB/Konnex, Modbus RTU and BACnet MS/TP systems

Field bus

UK24EIB
UK24MOD
UK24BAC

MP-Bus

MP-Bus

The respective Belimo Gateway allows up to eight MP actuators or VAV-Compact controllers to be digitally controlled via the MP-Bus and to report back their current operating status. The digital i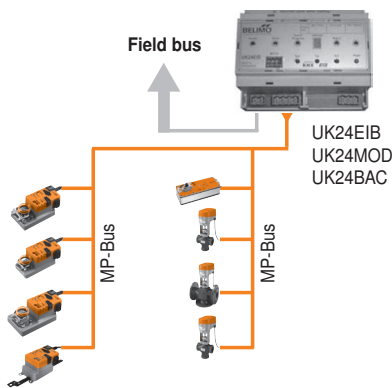nformation from the controller and the feedback are translated in the Gateway into telegrams of the respective field bus system. The functions of the MP field devices can thus be directly integrated into these systems.

Sensor connection

An optional sensor or switch can be connected to each MP actuator. The analogue sensor values are digitised in this way and transferred to the higher-level system.

For more detailed information, see product information UK24EIB, UK24MOD und UK24BAC.

Integration with DDC / PLC controllers

DDC

MP-Bus

MP-Bus

MP-Bus
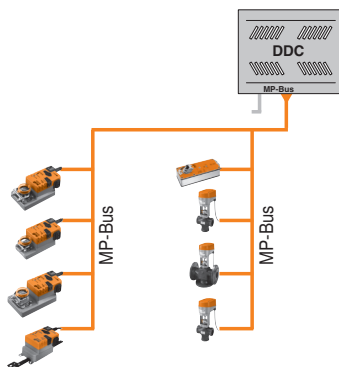
DDC / PLC devices with an MP interface are available from several manufacturers. These control devices can thus communicate directly and digitally with the connected MP field devices.

Sensor integration

An optional sensor or switch can be connected to each MP actuator. The analogue sensor values are digitised in this way and supplied to the DDC / PLC system for its control functions.

MP-Bus protocol

DDC / PLC manufacturers who would like to implement the MP-Bus protocol in their controllers can be provided with the technical specifications on request.

For more information, please contact the DDC / PLC supplier or your Belimo representative.

Integration with COU24-A-MP Fan Optimiser

Frequency converter　**FC**　**Ventilator**

Fan Optimiser

MP-Bus

VAV 1

Room 1

VAV 8

Room 8

Expandable

Room 9 …
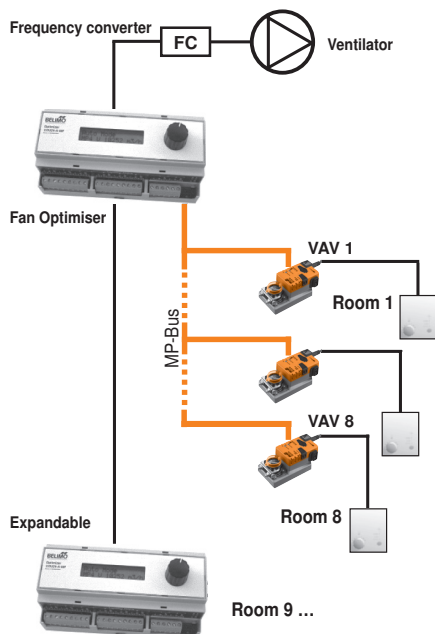
MP-Bus controlled variable and constant air volume systems for room ventilation applications with fans controlled by a frequency converter.

The system is operated by the Fan Optimiser with optimum damper positions based on the current demand signals. The objective is to keep the pressure loss through the VAV units as low as possible and thus permanently reduce operating costs by decreasing the fan output.The damper positions of each VAV-Compact controller are recorded, transferred via the MP-Bus to the Fan Optimiser and used there as a control variable for regulating the fan controlled by the frequency converter.

As a result of this technology – which is based on the Belimo MP-Bus – up to 50% energy savings can be achieved compared to conventional systems with fans controlled by air-duct pressure.

System size: Any
Number of VAV / CAV units per Fan Optimiser: 1 … 8

For more detailed information, see
• COU24-A-MP Fan Optimiser system description
• COU24-A-MP product information

Addressing
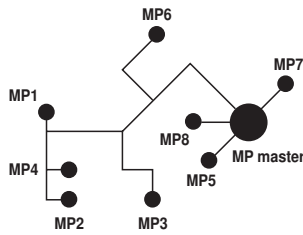
Each device in a bus system must be uniquely identifiable. Each MP slave must therefore be assigned an address.
Address range: MP1 … 8

The slaves can be addressed either directly on the MP master unit or by means of a Belimo operating device. They are addressed using the serial number (numerical / barcode) or with the address pushbutton on the MP device.

Procedure: Refer to the documentation for the MP master unit or the PC-Tool online help (<F1> function).

Connection, MP-Bus topology, power supply and wiring

MP-Bus connection

The MP-Bus connection is a network for 1 … 8 Belimo MP devices. Like the VAV-Compact, it consists of a 3-pole connection for MP-Bus communication and the AC or DC 24 V power supply.

Neither special cables nor terminating resistors are required for the wiring.
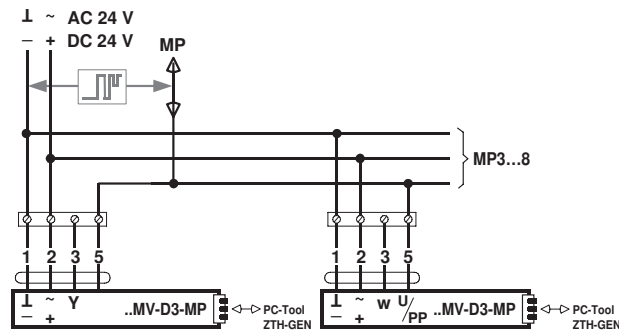
The cable lengths (see calculation overleaf) are limited by:

– The sum of the performance data of the connected MP devices,
– The type of supply (AC 24 V via the bus or DC 24 V)
– The cable cross-section.

MP-Bus topology

Up to 8 actuators (•)
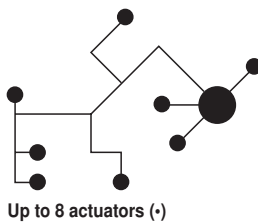
The cables of up to eight MP devices / VAV controllers can be laid in a freely definable bus topology. The following topologies are permitted: star-shaped, ring-shaped, tree-shaped or mixed forms.

Cable lengths

Limits

The cable lengths (see calculation below) are limited by:
- The sum of the performance data of the connected devices, e.g. LMV-D3-MP 4 VA / 2 W
- The type of supply (AC 24 V or DC 24 V)
- The cable cross-section.

MP-Bus cable length for AC 24V supply via the bus cable
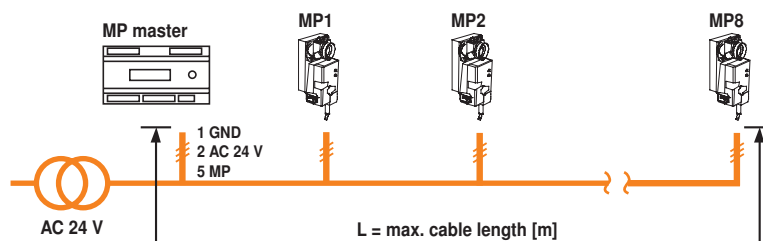
Total power rating of VAV controllers [VA]
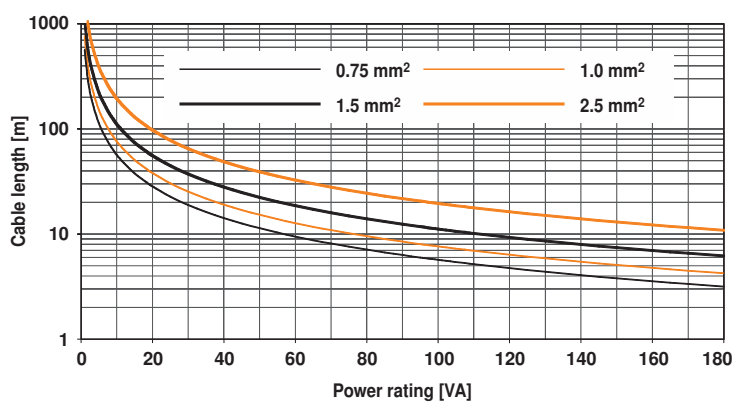
Cable length vs. power rating applies to AC supply (minimum transformer voltage AC 21.6 V)

Calculation of the maximum cable lengths (AC 24V)

The power ratings (VA) of the individual devices must first be added together. The corresponding cable lengths can then be read from the graph.

Example:

MP-Bus with 5 x LMV-D3-MP
Total power rating: 5 x 4 VA = 20 VA

Values read from the graph:
- Cable with wire Ø 0.75 mm^2 requires: Cable length 28 m
- Cable with wire Ø 1.0 mm^2 requires: Cable length 40 m
- Cable with wire Ø 1.5 mm^2 requires: Cable length 54 m
- Cable with wire Ø 2.5 mm^2 requires: Cable length 100 m

Signal cable lengths   *(continued)*

MP-Bus cable length for DC 24V supply via the bus cable

1 GND
2 + DC 24 V
5 MP

DC / DC 24 V
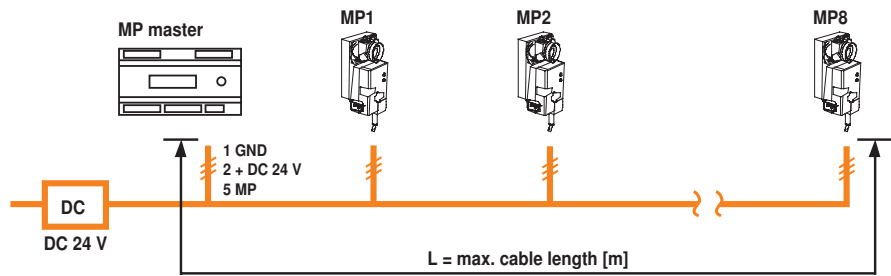
L = max. cable length [m]

Total dimensioning of VAV controllers [W]

- 0.75 mm²
- 1.0 mm²
- 1.5 mm²
- 2.5 mm²

Cable length [m] vs Active power [W]
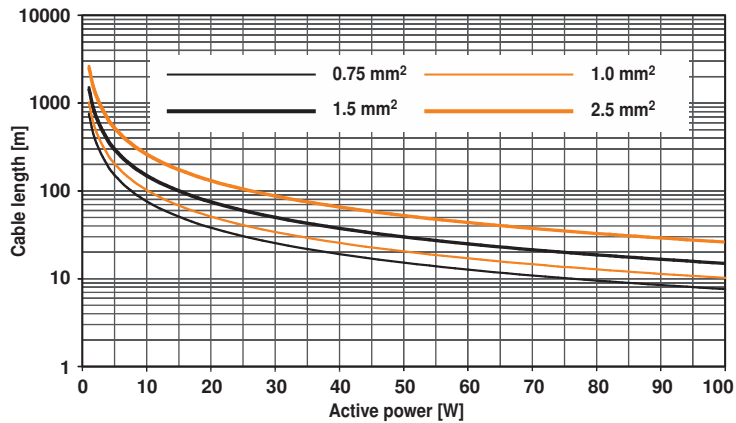
Cable length vs active power applies to DC supply (minimum supply voltage AC 24.0 V)

Calculation of the maximum cable lengths

The power consumption [W] of the individual devices must first be added together. The corresponding cable lengths can then be read from the graph.

Example:

MP-Bus with 5 x LMV-D3-MP
Total power rating: 5 x 2 W = 10 W

Values read from the graph:

- Cable with wire Ø 0.75 mm² requires: Cable length 75 m
- Cable with wire Ø 1.0 mm² requires: Cable length 100 m
- Cable with wire Ø 1.5 mm² requires: Cable length 130 m
- Cable with wire Ø 2.5 mm² requires: Cable length 250 m

Bus cable length for local AC 24V supply

1 GND
5 MP

AC 24V   AC 24V   AC 24V
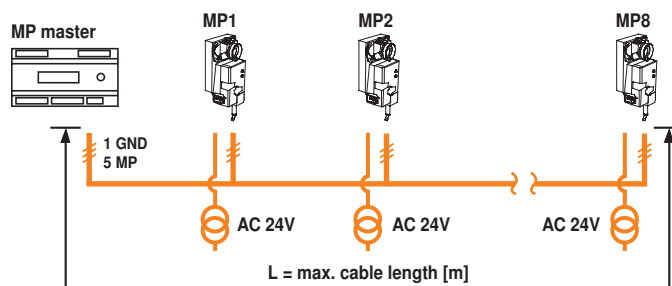
L = max. cable length [m]

Maximum length of bus cable for local AC 24 V supply

Wire Ø mm²	L = max. cable length [m]
0.75	
1.0	800
1.5	

If the VAV controllers are supplied locally with AC 24V via a separate transformer, the cable lengths can be significantly increased. The cable lengths indicated in the table apply regardless of the performance data of the connected actuators.

Control / operating volumetric flow settings

Reference variable and actual volumetric flow in bus mode

In bus mode, the reference variable is specified to the VAV-Compact as a digital signal by the higher-level system via the MP-Bus. The actual volumetric flow signal and the current damper position are supplied to this system for display or control functions.

The 0 ... 100% setpoint selected via the MP-Bus is resolved by the $\dot{V}_{min}$ / $\dot{V}_{max}$ setting of the VAV-Compact controller, i.e.: the
– 0% setpoint corresponds to $\dot{V}_{min}$ volume
– 100% setpoint corresponds to $\dot{V}_{max}$ volume
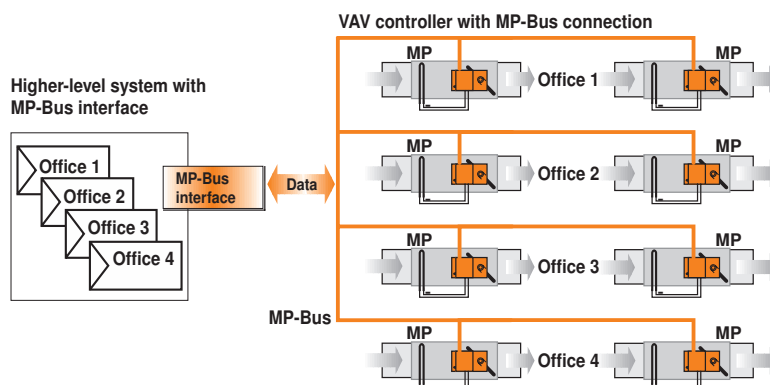
Operating volumetric flow setting $\dot{V}_{min}/\dot{V}_{max}$

Function	Volumetric flow	Range
$\dot{V}_{nom}$	Nominal	OEM-specific value, depending on the application and the VAV unit type
$\dot{V}_{max}$	Maximum	20 … 100% of $\dot{V}_{nom}$
$\dot{V}_{min}$	Minimum	0 *… 100% of $\dot{V}_{nom}$

* The $\dot{V}_{min}$ must be set to 0% for shut-off operation. For VAV operation, on the other hand, a minimum value higher than the minimum setting limit should be used. See page 14.

Open operating volumetric flow setting

The $\dot{V}_{min}$ / $\dot{V}_{max}$ setting can be open if necessary, i.e. the two values can be set to 0 and 100%. In this case, the volumetric flow must be limited in the higher-level system. This operating setting allows the limitation of the volumetric flow to be adjusted without altering the parameters on the VAV controller.
Responsibility for the limiting function passes from the OEM to the system supplier or integrator.

Master / slave and parallel control

Master / slave control

The actual volumetric flow is read from the master VAV controller by the higher-level system and specified to the slave controller as a reference signal.

Parallel control

If the VAV units are operated in parallel, the setpoints for the supply and exhaust air VAV units are transferred in parallel to the two VAV controllers.

Positive and negative room pressure

If a system with positive or negative room pressure is planned, the room pressure ratio must be taken into account in the setpoint calculation.
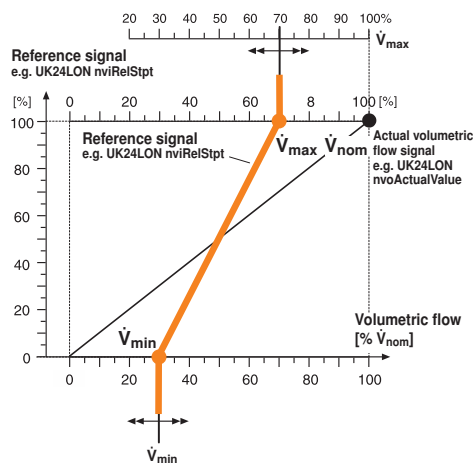
Example: VAV application with UK24LON

Bus fail function

Response to bus failure   It is possible to specify the response to an MP-Bus failure, essential maintenance work, faults, etc. on each VAV-Compact controller. This setting can be displayed or changed in PC-Tool (Version V3.9 or higher).

The following functions are available:
- CLOSED
- $\dot{V}_{min}$
- $\dot{V}_{max}$
- OPEN
- Last value (default setting, last setpoint command received from the bus master)

Sensor integration

Mode of operation

An additional sensor or switch can be connected to the VAV-Compact in MP-Bus mode independently of the VAV control loop. The sensor signal is connected to the reference value input that is not used in MP-Bus mode (connection 3).
The VAV-Compact then acts as an analogue / digital converter for transmitting the sensor signal to the higher-level system. This system must know the physical address (which sensor is connected to which MP device) and be capable of interpreting the corresponding sensor signal. If possible, the sensors should be connected using separate cables to prevent compensation currents. The sensor ground (GND) cable, as a minimum, should be laid separately from the power supply cable over as long a distance as possible.

Signals that can be linked in
- Active sensor with DC 0 … 10 V signal
- Passive resistance sensor, e.g. Pt1000, Ni1000, NTC
- Switching contacts

MP-Bus cycle time

Typical value 2 … 8 s
Dependent on the number of connected MP devices and sensors. The cycle time must be taken into account in the application and / or implementation!

Switching contact connection
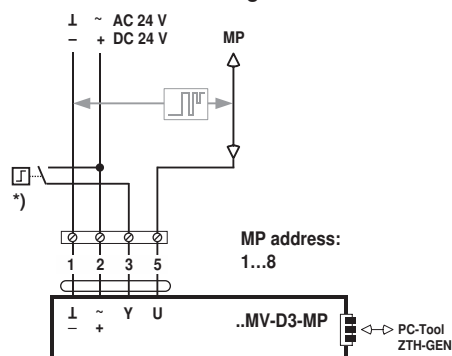
*) e.g. window contact

For external switching contacts with control functions in the higher-level system, e.g. window switch for energy hold-off when the window is open, light switch (auxiliary contact) for occupancy-controlled standby circuit.
The cycle time must be taken into account in the implementation!

Switching contact requirement

The switching contact must be able to accurately switch a current of 16 mA at 24V.

Reference signal Y setting if a switch is connected

The VAV-Compact must be set to 2 ... 10 V mode to enable the states of a connected switch to be evaluated:
The setting can be changed with PC-Tool or a ZTH.. .

See «Settings», page 24.

Passive sensor connection
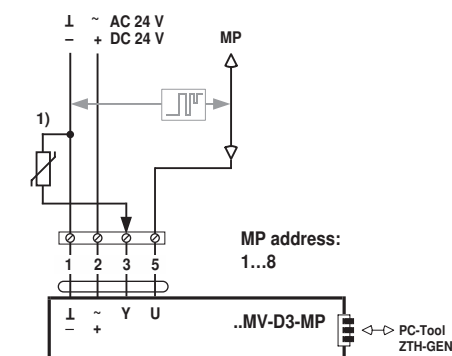
[1] Room temperature sensor e.g. Pt1000

Passive resistance sensors, e.g: Pt1000, Ni1000, NTC, for open and closed-loop control functions in the higher-level system, such as a temperature sensor for monitoring the minimum room temperature. The cycle time must be taken into account in the implementation!

Reference signal Y setting for passive sensor integration

No special settings are required.

Active sensor connection
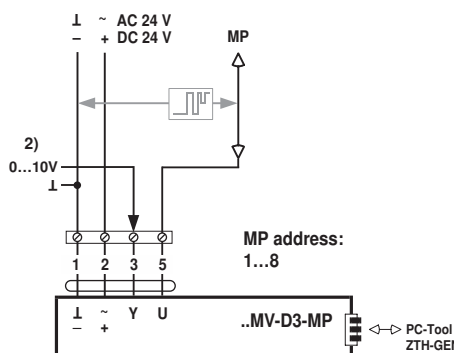
[2] e.g. moisture sensor

Active 0...10 V sensors for open and closed-loop control functions in the higher-level system, such as a humidity or CO_2 sensor. The cycle time must be taken into account in the implementation!

Reference signal Y setting for active sensor integration
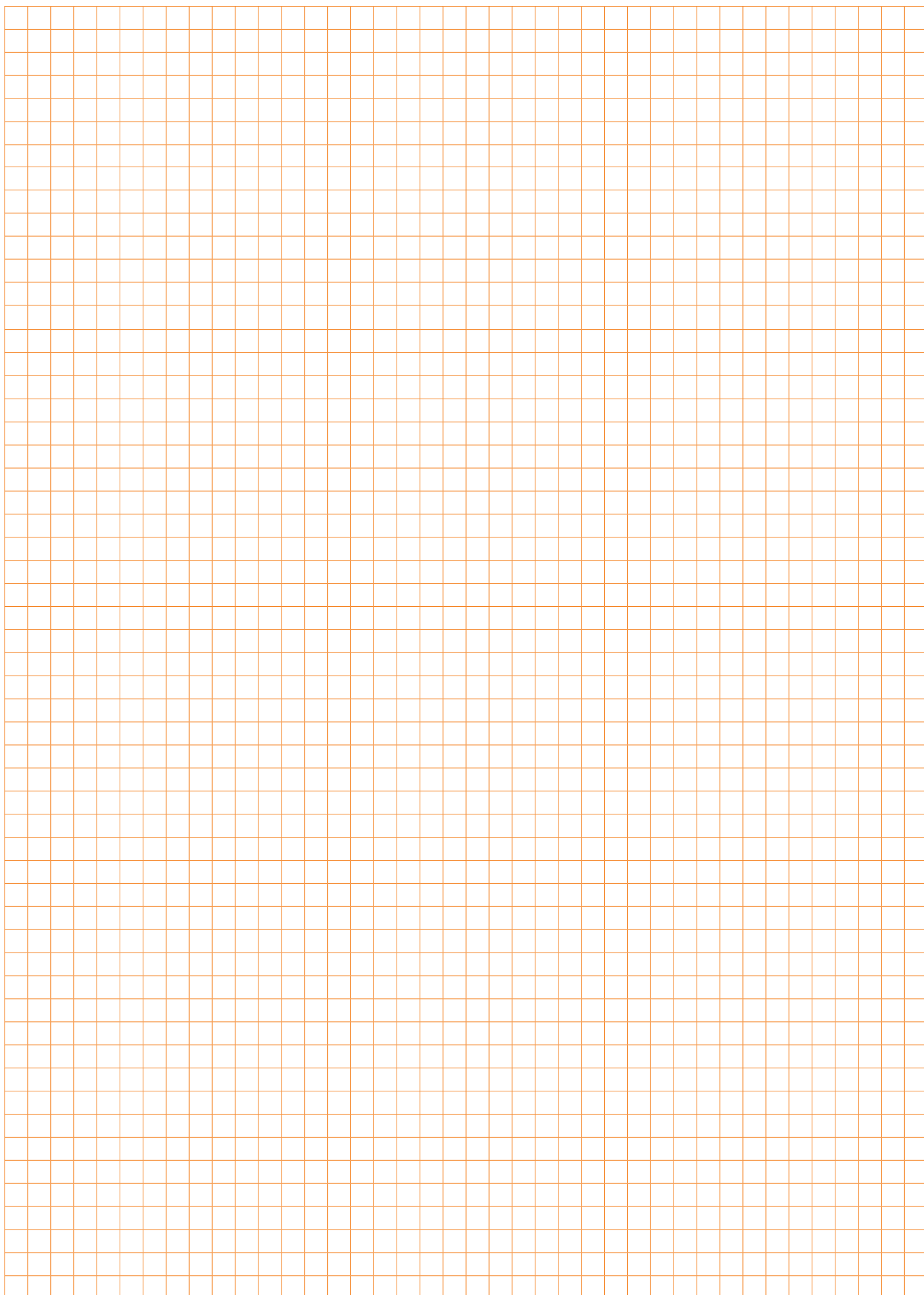
No special settings are required.

S4-VAV-Compact D3 • en • v2.0 • 04.2015 • Subject to changes

Table of contents

Flow chart

Functional check

↓

Press manual pushbutton for gear disengagement

Reaction:

Actuator moves to end position

Actuator does not move

Possible cause:
No 24 V supply

Check:

- Is power LED (green) on device lit? If not:
- Measure power supply in control cabinet and on VAV-Compact
- Correct fault

Possible cause:
Damper blocked

Check:

- Check damper mobility by means of manual adjustment
- Correct fault

↓

Possible cause:
Damper already in end position

Check:

- Move damper manually into mid-position

Reaction:

Actuator moves to end position

Actuator does not move

↓

Report to manufacturer

Functional check ✓
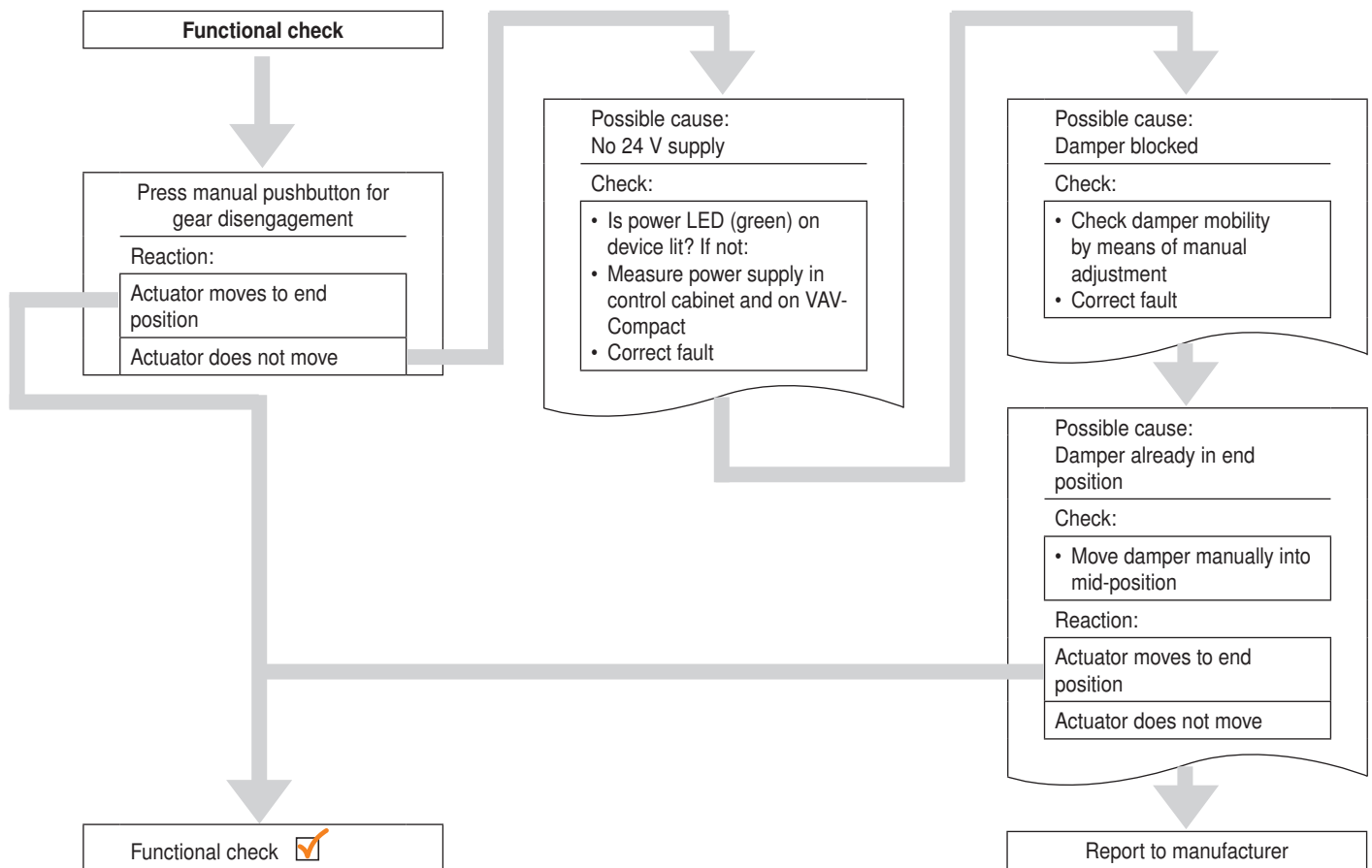
Analysing faulty behaviour

Symptoms, causes and rectification

Various fault symptoms, their possible causes and recommended rectification steps are described below.

Based on past experience, the faulty behaviour is probably due to the settings or control mode rather than to the air volume controller itself. A structured approach is essential to identify the most efficient remedy regardless of the particular malfunction:

Step 1:	Step 2:	Step 3:	Step 4:
Determine and make a note of the actual state	**Functional check** ✓	**Compare the faulty behaviour with the described symptoms**	• **Rectify the fault** • **Check the functions**

↓

Example:

Actual state

**Volumetric flow too low
Supply air unit (master)
Damper (100%) → open**

**Exhaust air unit (slave):
Damper in control range**

Note the state:

- **Reference signal w (#3) 6.5 V**
- **Actual value U5 (#5): 3.5 V**
- **Damper position 100%**

↓

Functional check ✓

↓

Compare

Damper 100% and volumetric flow too low

↕

«Insufficient volumetric flow, damper open in end position»

↓

Cause

Supply air fan output too low

↓

Rectify

- **Check the supply air fan**
- **Rectify the fault**

Fault descriptions, symptoms, causes and rectification

Insufficient volumetric flow, damper OPEN in end position

Symptom	Possible cause	Rectification steps
Set volume not reached although damper is 100% open (end stop)	Air hoses between pick-up device and pressure sensor have been interchanged or are not connected	Monitoring with ZTH-GEN Connect air hoses correctly. Observe + / –
	Fan failure	Check the fan, including the control functions, and rectify the fault
	Fire dampers tripped, i.e. closed	Check whether all fire and/or shut-off dampers between the fan and the VAV unit are open
	Fan air output too low	Check whether all fire and/or shut-off dampers between the fan and the VAV unit are open
	Some or all rooms are often set positively (manually) to maximum volumetric flow when the system is started up. Consequence: The fan is unable to produce the required air output (simultaneity factor)	Deactivate override control and/or reduce the reference signal

Insufficient volumetric flow, master damper OPEN / slave damper CLOSED

Symptom	Possible cause	Rectification steps
Set volume not reached: • Damper of master unit is open • Damper of slave unit is closed	VAV units in master / slave connection: • Master in air shortage situation (fan defective or OFF), i.e. damper is 100% open	Check the fan in the line of the master unit and rectify the fault
	• Slave does not receive reference signal from master because master does not measure actual volume → damper CLOSED	Check whether all fire and/or shut-off dampers between the fan and the master unit are open

Volumetric flow too high, damper CLOSED

Symptom	Possible cause	Rectification steps
Set volume not reached and damper closed although reference signal is present	see «Behaviour in the lower control range», page 14	Increase the $\dot{V}_{min}$ parameter Adjust the reference signal or correct the VAV-Compact mode setting
Damper closes (0%) instead of opening to $\dot{V}_{min}$ value	VAV-Compact set to 2 … 10 V mode but controlled with 0 … 10 V reference signal	Change the VAV-Compact mode setting to 0 … 10 V

Volumetric flow too high, damper OPEN

Symptom	Possible cause	Rectification steps
Actual volume too high, damper open at end stop	Pressure hose squeezed off (jammed)	Check the pressure hoses: – Mark the ± connections – Pull the pressure hoses off of the VAV-Compact – Blow through the hose lines
	pick-up device, pressure hose or pressure sensor contaminated **Note:** The differential pressure sensor of the VAV-Compact does not normally need to be cleaned	Check the parts and clean them if necessary: – Mark the ± connections – Pull the pressure hoses off of the VAV-Compact – Clean and blow out the pick-up device – Blow through the hose lines – Blow out the pressure sensor on the VAV-Compact and connect the hand pump to the (minus) connection. Remove any visible dirt – Mount the pressure hoses – Carry out a functional check

Volumetric flow too low, damper in control range

Symptom	Possible cause	Rectification steps
Required volumetric flow not reached	Reference signal (DDC, room controller) limited by software	Check the reference signal (DDC, room controller) and adjust the limitation
	VAV-Compact set to 2 … 10 V mode but controlled with 0 … 10 V reference signal	Correct the VAV-Compact mode setting

Fault descriptions, symptoms, causes and rectification *(continued)*

Volumetric flow too high, damper in control range

Symptom	Possible cause	Rectification steps
Steady-state deviation of volumetric flow (too high) relative to reference signal	VAV-Compact set to 0 … 10 V mode but controlled with 2 … 10 V reference signal	Adjust the reference signal or correct the VAV-Compact mode setting

Positive / negative room pressure, damper in control range

Symptom	Possible cause	Rectification steps
Undesirable positive or negative pressure in room	Clamp loose, turns without spindle driver	Check the clamp mounting
	Room pressure ratio not set correctly	Check the operating volumetric flow setting
	Master / slave application with limited operating volumetric flow setting on slave controller	Check the operating volumetric flow setting. If the room pressure is balanced, the slave setting should be as follows: $\dot{V}_{min}$ 0% / $\dot{V}_{max}$ 100% (for an identical nominal width and air volume)
	Wiring incorrect, VAV units interchanged (master / slave or parallel connection)	Check the wiring and correct it if necessary
	Example:	
	Supply air office a and exhaust air office b Supply air office b and exhaust air office a	
	VAV units set to master / slave but controlled in parallel	

Air volume controller does not react to reference signal

Symptom	Possible cause	Rectification steps
VAV controller adjusts to fixed value and does not react to reference signal changes	0 / 2 … 10 V reference signal has no reference, i.e. ground connection (GND) is missing	Measure the signal between VAV-Compact terminals 1 (GND) and 3 (0 / 2 … 10 V) Check the wiring and correct it if necessary
	Polarity of reference signal and ground (GND) reversed	Measure the signal between VAV-Compact terminals 1 (GND) and 3 (0 / 2 … 10 V) Check the wiring and correct it if necessary
	AC 24 V connection reversed. If several devices are connected to the same AC 24 V transformer, this connection must be in phase	Check the wiring and correct it if necessary
	Operating mode (override control) active	Check the controller

Damper does not move

Symptom	Possible cause	Rectification steps
Damper does not move	Clamp loose, turns without spindle driver	Check the clamp mounting

FCC notes

This device complies with part 15 of the FCC:
Operation is subject to the following two conditions:
1. This device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

The following statement applies to the products covered in this manual, unless otherwise specified herein. The statement for other products will appear in the accompanying documentation.

NOTE:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
– Reorient or relocate the receiving antenna.
– Increase the separation between the equipment and receiver.
– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
– Consult the dealer or an experienced radio / T.V. technician for help.

All-inclusive.

5-year guarantee

On site around the globe

A complete range of products from one source

Tested quality

Short delivery times

Comprehensive support

Belimo Europe

BELIMO Automation AG
Brunnenbachstrasse 1
CH-8340 Hinwil, Switzerland

Tel. +41 (0)43 843 61 11
Fax +41 (0)43 843 62 68

info@belimo.ch
www.belimo.ch

Belimo worldwide: www.belimo.com

BELIMO®