Convenient solutions

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## VAV-Compact

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</tr>
</thead>
<tbody>
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<td>LMV-D2LON</td>
<td>NMV-D2LON</td>
</tr>
<tr>
<td>LMV-D2-MP</td>
<td>NMV-D2-MP</td>
</tr>
<tr>
<td>SMV-D2-MP</td>
<td>LHV-D2-MP</td>
</tr>
</tbody>
</table>

### VAV controller
- Sensor
- Actuator

### Accessories
- COU24-A-MP Fan optimiser
- CR24 Single-room controller
- SG Position sensor

### Bus integration and tools:
- UK24LON Interface for LonWorks® applications
- UK24EIB Interface for EIB-Konex applications

### ZTH-VAV VAV-Compact setting device

### PC-Tool Parameterisation and service software
- VAV-Compact module
- VRP-M module

## VAV-Universal

<table>
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</tr>
</thead>
</table>

### VAV controller
- VRP-M
- VRP-M STP
- [STP pressure]

### Accessories
- LM/NM/SM24-A-V
- VNMQB24-SRV-ST

### Integrated
- LM/NM/SM24-A-V

### Across
- L/A/F24-A-V with safety function

### Note:
A pressure sensor, digital VAV controller and damper actuator all in one, providing a VAV-Compact solution with a communications capability for pressure-independent VAV and CAV systems in the comfort zone
• Control function: VAV-CAV / Open-Loop
• Control:
  DC 2…10 V / 0…10 V / MP-bus
• Integration into
  – DDC controller with MP interface
  – LonWorks® systems
  – EIB-Konnex systems
  – Fan optimiser systems
• With additional connection facility for sensors or switches
• Service button and LEDs for servicing and commissioning
• Diagnostic socket for operating devices

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
Maintenance-free, dynamic, differential pressure sensor technology, proven in a wide range of applications, suitable for use in offices, hospital wards, alpine hotels or cruise liners.
Actuator
Three versions available, depending on the size of the VAV unit: 5 / 10 / 20 Nm.
  – Rotary actuator, depending on size
  – Linear actuator 150 N with 100, 200 or 300 mm linear motions
Control function
VAV-CAV or open-loop operation (actuator / volumetric flow sensor) for integration in an external VAV control circuit. Feedback of damper position for fan optimisation.

VAV – variable air volume
For variable air volume applications based on a modulating reference variable, e.g. supplied by a room temperature controller or a DDC or bus system. It facilitates demand-related, power-saving ventilation in individual rooms or in zones of air conditioning systems. The \( V_{\text{min}} \ldots V_{\text{max}} \) working range can be subdivided by selecting a mode. The following operating modes are available: DC 2 … 10 V / 0 … 10 V / adjustable / bus.

CAV – constant air volume
For constant air volume applications, e.g. in step mode, controlled by means of a switch. The following operating modes are available: CLOSE / \( V_{\text{min}} \) / \( V_{\text{mid}} \) / \( V_{\text{max}} \) / OPEN

Bus function
Up to eight Belimo MP devices (VAV / damper actuator / valve) can be connected together over the MP-Bus and integrated into the following systems:
  – LonWorks® applications with Belimo UK24LON interface
  – EIB-Konnex applications with Belimo UK24EIB interface
  – DDC controller with integrated MP-Bus protocol
  – Fan optimiser applications with optimisation COU24-A-MP
A sensor (0 … 10 V or passive, e.g. a temperature sensor) or a switch can optionally be integrated into the higher-level DDC or bus system via the MP-Bus.

Test function / test display
The VAV-Compact features an LED with a ready display for commissioning and functional checking as well as a service mode with air shortage, excess air and setpoint = actual value display with LEDs.

Operating and service devices
Belimo PC-Tool, remote control or ZTH-VAV, plugged into the VAV-Compact or via MP-bus

Assembly and connection
The VAV-Compact, which is assembled on the unit by the OEM, is connected using the pre-fabricated connecting cable.

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.

Overview of types

<table>
<thead>
<tr>
<th>Type</th>
<th>Torque</th>
<th>Power consumption</th>
<th>For wire sizing</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>LMV-D2-MP</td>
<td>5 Nm</td>
<td>2.5 W</td>
<td>5 VA (max. 5 A @ 5 ms)</td>
<td>approx. 500 g</td>
</tr>
<tr>
<td>NMV-D2-MP</td>
<td>10 Nm</td>
<td>3 W</td>
<td>6 VA (max. 5 A @ 5 ms)</td>
<td>approx. 700 g</td>
</tr>
<tr>
<td>SMV-D2-MP</td>
<td>20 Nm</td>
<td>3 W</td>
<td>6 VA (max. 5 A @ 5 ms)</td>
<td>approx. 830 g</td>
</tr>
<tr>
<td>LHV-D2-MP</td>
<td>150 N</td>
<td>3.5 W</td>
<td>5.5 VA (max. 5 A @ 5 ms)</td>
<td>approx. 550 g</td>
</tr>
</tbody>
</table>
Technical data

Supply
Nominal voltage
AC 24 V, 50/60 Hz
DC 24 V

Power supply range
AC 19.2 … 28.8 V
DC 21.6 … 28.8 V

Differential pressure sensor
2 … -300 Pa (OEM-specific)

Operating pressure
max. 1000 Pa

Characterising
OEM-specific differential pressure sensor, linearisation

Installation position
Any, no reset necessary

Operating medium (see «Materials»)
Supply and exhaust air in the comfort zone and in applications with sensor-compatible media

Materials
PC + ABS to UL94-V0; stainless steel, DIN 1.4301 X10CrNiS1810; PP Santoprene

Measuring air conditions
0 … +50°C / 5 … 95% rH, non-condensing

Control function
– VAV-CAV
– Open-loop operation

VAV and CAV applications
– Supply / exhaust air units in stand-alone operation / master-slave / parallel connection for rooms with positive / negative pressure or neutral air pressure
– Mixing units

Operating volumetric flow

\( V_{\text{nom}} \) OEM-specific nominal volumetric flow setting, matches VAV box
\( V_{\text{max}} \) 30 … 100% of \( V_{\text{nom}} \)
\( V_{\text{min}} \) 0 … 100% of \( V_{\text{nom}} \) (see page 17 «Minimum setting limit»)
\( V_{\text{mid}} \) 0 … 100% of \( (V_{\text{min}} … V_{\text{max}}) \)

Classic control
Mode for reference value input \( w \) (connection 3)
– DC 2 … 10 V / (4 … 20 mA with 500 Ω resistance)
– DC 0 … 10 V / (0 … 20 mA with 500 Ω resistance)
– Adjustable DC 0 … 10 V

Input resistance min. 100 kOhm

Mode for actual value signal \( U_5 \) (connection 5).
– DC 2 … 10 V
– DC 0 … 10 V
– Adjustable: Air volume or damper position

Max. 0.5 mA

Operating modes for constant air volume
CLOSED / \( V_{\text{min}} \) / \( V_{\text{mid}} \) * / \( V_{\text{max}} \) / OPEN * (* only with AC 24 V supply)

MP-Bus function
Address in bus operation
MP 1 … 8 (classic control: PP)

LowWorks® / EIB-Konnex
With BELIMO UK24LON / UK24EIB interface, 1 … 8 BELIMO MP devices (VAV / damper actuator / valve)

DDC controller
DDC controller / PLC, from various manufacturers, with integrated MP interface

Fan optimiser
With BELIMO optimiser COU24-A-MP

Sensor integration
Passive (Pt1000, Ni1000 etc.) and active sensors (0…10 V) e.g. temperature, humidity
2-point signal (switching capacity 16 mA @ 24 V), e.g. switches, occupancy switches

Operation and servicing
Pluggable / PC-Tool (V3.1 or higher) / ZTH-VAV hand-operated device

Communication
PP / MP-Bus, max. DC 15 V, 1200 baud

Button
Adaptation / addressing / service function

LED indicator
– 24 V feed
– Status / service / bus function

Actuator
Brushless, non-blocking actuator with current reduction

Direction of rotation
cw / cw or 1 / ↓

Adaptation
Setting range recording and resolution to control range

Manual disengagement
Pushbutton, self-resetting without affecting functions

Sound power level
max. 35 dB (A), SMV-D2-MP max. 45 dB (A)

Actuator – full-rotation
Angle of rotation
95°*↑, with adjustable mechanical or electronic limiting

Position indication
Mechanical with pointer

Spindle driver
– Clamp, for round spindles 10 … 20 mm / square spindles 8 … 16 mm
– Positive fit, wide range of versions, e.g. 8 x 8 mm

Actuator – linear
Stroke
100, 200 or 300 mm, with adjustable mechanical or electronic limiting

Connection
Cable, 4 x 0.75 mm², terminals

Safety
Protection class
III Safety extra-low voltage

Degree of protection
IP54

EMC
CE according to 89/336/EEC
VAV-Compact 

Technical data sheet

Technical data (continued)

Safety

- Mode of operation: Type 1 (to EN 60730-1)
- Rated impulse voltage: 0.5 kV (to EN 60730-1)
- Control pollution degree: 2 (to EN 60730-1)
- Ambient conditions: 0 ... +50°C
- Non-operating temperature: −20 ... +80°C
- Ambient humidity range: 5 ... 95% rH, non-condensing (to EN 60730-1)
- Maintenance: Maintenance-free

Connection

Connecting cable

The connection is established via the connection cable installed on the VAV-Compact device.

Note

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

VAV – Variable operation $V_{\text{min}}$...$V_{\text{max}}$

Wiring diagrams

Example 1:
VAV with analogue reference signal

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

Example 3:
VAV parallel operation with analogue reference signal
Supply / exhaust air

Example 4:
VAV master-slave operation with analogue reference signal

Table

<table>
<thead>
<tr>
<th>No</th>
<th>Designation</th>
<th>Wire colour</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BK COM</td>
<td>black</td>
<td>↓</td>
</tr>
<tr>
<td>2</td>
<td>RD</td>
<td>red</td>
<td>+ ~</td>
</tr>
<tr>
<td>3</td>
<td>WH Y</td>
<td>white</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>OG U</td>
<td>orange</td>
<td></td>
</tr>
</tbody>
</table>

Product no longer available
VAV-Compact Technical data sheet

CAV – Step mode CLOSED / ̅V_{\text{min}} / ̅V_{\text{mid}} / ̅V_{\text{max}} / OPEN

CAV control

Two options are available for CAV control:

- Standard: CLOSED – ̅V_{\text{min}} – ̅V_{\text{max}} – OPEN (default setting)
- NMV-D2M-compatible CLOSED – ̅V_{\text{min}} – ̅V_{\text{mid}} – ̅V_{\text{max}} – OPEN

The setting can be changed with the PC-Tool from Version V3.1

Wiring diagrams

Note

The contacts are mutually interlocking!

CAV function: Standard

\[ \text{Mode setting} \]

<table>
<thead>
<tr>
<th>Signal</th>
<th>0 … 10 V</th>
<th>0 … 10 V</th>
<th>0 … 10 V</th>
<th>0 … 10 V</th>
<th>2 … 10 V</th>
<th>2 … 10 V</th>
<th>2 … 10 V</th>
<th>2 … 10 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Damper CLOSED</td>
<td>( a )</td>
<td>( \text{CLOSED} )</td>
<td>( b )</td>
<td>( \text{VAV} )</td>
<td>( \text{VAV} )</td>
<td>( \text{CLOSED} )</td>
<td>( \text{VAV} )</td>
<td>( \text{VAV} )</td>
</tr>
<tr>
<td>CAV – ̅V_{\text{min}}</td>
<td>All open – ̅V_{\text{max}} active</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAV – ̅V_{\text{max}}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAV – ̅V_{\text{mid}}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAV – ̅V_{\text{max}}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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: CLOSED – ̅V_{\text{min}} – ̅V_{\text{max}}

(2 … 10 V mode)

CAV function: NMV-D2M-compatible

\[ \text{Mode setting} \]

<table>
<thead>
<tr>
<th>Signal</th>
<th>0 … 10 V</th>
<th>0 … 10 V</th>
<th>0 … 10 V</th>
<th>0 … 10 V</th>
<th>2 … 10 V</th>
<th>2 … 10 V</th>
<th>2 … 10 V</th>
<th>2 … 10 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Damper CLOSED</td>
<td>( a )</td>
<td>( \text{CLOSED} )</td>
<td>( b )</td>
<td>( \text{VAV} )</td>
<td>( \text{VAV} )</td>
<td>( \text{CLOSED} )</td>
<td>( \text{VAV} )</td>
<td>( \text{VAV} )</td>
</tr>
<tr>
<td>CAV – ̅V_{\text{min}}</td>
<td>All open – ̅V_{\text{max}} active</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAV – ̅V_{\text{max}}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>CAV – ̅V_{\text{mid}}</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAV – ̅V_{\text{max}}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 ̅V_{\text{min}} – ̅V_{\text{mid}} – ̅V_{\text{max}}

(0 … 10 or 2 … 10 V mode)

Note

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

Note

You must set the CAV function to NMV-D2M-compatible in order to use the CAV ̅V_{\text{mid}} step.
MP-Bus operation – VAV- / CAV operation

Connecting cable

The connection to the MP-Bus is established via the connection cable installed in the VAV-Compact device.

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

Wiring diagrams

Bus operation – VAV function
For detailed information, see section «MP-Bus integration»

Bus operation – VAV function 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.

Sizing of feed and connection cables

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 feed, sizing and wiring
The wire sizing and installation of the AC 24 V 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 starting currents of the actuators:
– Sizing values VAV-Compact controller, see Technical Data
– Sizing 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 feed
– Reserve capacity for subsequent expansion, if planned.

MP-Bus integration – supply, Sizing and wiring
See MP-Bus integration, page 33 … 42
Tool connection

Setting and diagnostics

Setting and the diagnostics of the connected VAV-Compact controller can – thanks to the MP-Bus technology – be checked and set quickly and easily with the Belimo PC-Tool or the ZTH-VAV hand-operated device.

On-board service connection

The service connection integrated in the VAV-Compact allows the console used to be connected quickly.

Feed via ZIP-RS232

The VAV-Compact can also communicate (connection wire 5) with the available service tools via the MP connection. The connection can be established during operation on site, i.e. in the connection socket, at the tool socket of the Belimo room temperature controller CR24 or on the floor or control cabinet terminals. If needed, the VAV-Compact can be fed via the 24 V of the level converter ZIP-RS232.
### Compatibility

#### Current overview
An overview of VAV-Compact controller compatibility with current and phased-out products can be found on the Internet at www.belimo.com.

#### VAV-Compact – customised versions
VAV-Compact controllers are also available as customised versions made to order for VAV unit manufacturers (OEMs). These versions are adapted to each OEM’s specific sensor, damper spindle and fastening system.

**Designation:** ..V-D2-MP yyy

1 Product designation, 2 Customer designation

#### Retrofit solutions – old Belimo or VAV controllers from third-party manufacturers
A special retrofit kit can be supplied for replacing old VAV controllers. Please contact your local Belimo representative!

#### Replacement devices
If replacement devices are ordered, they are parameterised by the OEM at the factory according to the installed system.

VAV-Compact controllers are sold exclusively via the OEM channel for this reason.

### Safety notes

- The device is not allowed to be used outside the specified field of application, especially in aircraft or any other form of air transport.
- Assembly must be carried out by trained personnel. Any legal regulations or regulations issued by authorities must be observed during assembly.
- 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 required torque, the specifications supplied by the damper manufacturers (cross section, design, installation site), and the air flow 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-D2-MP

Dimensional drawings NMV-D2-MP

Dimensional drawings SMV-D2-MP

Dimensional drawings LHV-D2-MP

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VAV-Compact Functions

Volumetric flow measurement / setting

Principle of operation of the VAV-Compact

Block diagram

The non-linear differential pressure signal is converted by the sensor in the measurement section (sensor electronics, linearisation) to a linear signal that is proportional to the volumetric flow. The reference signal \( w \) is conditioned as a setpoint signal according to the operating volumetric flow setting \( V_{\text{min}} \) / \( V_{\text{max}} \).

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 volumetric flow measurement is based on a differential pressure sensor, which is usually installed in the air duct in the form of a diaphragm, a Venturi nozzle or a measuring cross. Various measurement methods for detecting volumetric flow are meanwhile established.

Reliable and exact differential pressure measurement – the key to precise air volume control

The differential pressure measurement method adopted by Belimo permits reliable averaging measurements even under unfavourable inflow conditions.

Every sensor used to measure differential pressure has its own dynamic response. The influence of this measuring body on the volumetric flow calculation is referred to as the instrument constant \( c \). In reality, however, this constant is not as constant as its name suggests but rather dependent on the effective flow rate. Each differential pressure sensor exhibits more or less non-linear behaviour, depending on the physical characteristics of its particular design. Belimo calculates the response of the respective differential pressure sensor in multiple measurement series as the basis for customised VAV-Compact controllers. The recorded measurement curve is compensated in a linearisation process developed by Belimo specifically for this purpose. This process is referred to as characterising.

Features of the Belimo D2 differential pressure sensor

- Precise and proven thermoanemometric measurement principle, temperature-compensated.
- Wide measuring range, high degree of accuracy over the complete \( \approx 2 \ldots 300 \) Pa range in combination with conventional, proprietary differential pressure sensors.
- Also in the lower differential pressure range.
- No need to balance the zero during start-up or operation.
- Maintenance-free technology, proven in a wide range of applications.
- No condensation remains in the sensor, i.e. any installation position is possible.
- Measurement in any position, i.e. no special installation requirements.
- Insensitivity to contamination because the measuring element is located outside the air flow.

Legend:

\( \dot{V} = c \cdot \sqrt{\Delta p / \rho} \)

Legend:

- \( V \) = Volumetric flow
- \( c \) = Geometry-related constant of the baffle device
- \( \Delta p \) = Differential pressure
- \( \rho \) = Medium density

Flow medium

<table>
<thead>
<tr>
<th>Flow medium</th>
<th>non-corrosive flow medium</th>
<th>slightly corrosive flow medium</th>
<th>Sea air (salty)</th>
<th>corrosive flow medium</th>
<th>dusty flow medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>good suitability</td>
<td>good suitability</td>
<td>good suitability</td>
<td>examine makeup and material compatibility</td>
<td>limited suitability</td>
<td></td>
</tr>
</tbody>
</table>

Check use with VAV-Universal
Volumetric flow measurement / setting (continued)

**Nominal volumetric flow $\dot{V}_{\text{nom}}$**

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 flows is fixed by the unit manufacturer, who is also responsible for the functionality of the VAV units. The nominal volumetric flow setting – also referred to as the calibration value – 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. $\dot{V}_{\text{nom}}$ 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 $\dot{V}_{\text{min}} / \dot{V}_{\text{mid}} / \dot{V}_{\text{max}}$**

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. $\dot{V}_{\text{max}}$ acts as the upper limit value as a function of the nominal volumetric flow. $\dot{V}_{\text{min}}$ can be set as a percentage of the required $\dot{V}_{\text{nom}}$. An intermediate position $\dot{V}_{\text{mid}}$ is available for constant air volume (CAV) applications to facilitate finer steps. 1)

<table>
<thead>
<tr>
<th>Function</th>
<th>Volumetric flow</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\dot{V}_{\text{nom}}$</td>
<td>Nominal</td>
<td>OEM-specific value, depending on the VAV unit type and the application</td>
</tr>
<tr>
<td>$\dot{V}_{\text{max}}$</td>
<td>Maximum</td>
<td>30 ... 100% of $\dot{V}_{\text{nom}}$</td>
</tr>
<tr>
<td>$\dot{V}_{\text{min}}$</td>
<td>Minimum</td>
<td>*0 ... 100% of $\dot{V}_{\text{nom}}$ (*OEM-specific)</td>
</tr>
<tr>
<td>$\dot{V}_{\text{mid}}$ 1)</td>
<td>Intermediate position</td>
<td>0 ... 100% in the range from $\dot{V}<em>{\text{min}}$ to $\dot{V}</em>{\text{max}}$</td>
</tr>
</tbody>
</table>

* The minimum volumetric flow setting $\dot{V}_{\text{min}}$ varies according to the type of VAV unit.

See «minimum setting limit» and «creep flow suppression» functions, page 17.

1) Requires CAV setting: NMV-D2M compatible, see page 6.
**Reference signal Y**

The reference signal Y is defined by the mode function. The following settings are available:

- **0…10 V**
- **2…10 V**
- **Adjustable.**

---

**Vmin 0% setting**

The actuator positively closes the damper if the minimum volumetric flow is set to 0% and the reference signal corresponds to the value.

**Settings: Responsibility, tools**

After the CAV / VAV unit has been manufactured, the operating volumetric flows \( V_{\text{min}} \) / \( V_{\text{max}} \) calculated by the system planning engineer are set in the factory. Various setting devices are available for checking and correcting these values on the system (see tools and settings).

**OEM basic values**

If the OEM settings have been corrected on the system, the basic values \( (V_{\text{min}}, V_{\text{mid}}, V_{\text{max}}) \) can be restored using the OEM reset function.

---

The actuator positively closes the damper if the minimum volumetric flow is set to 0% and the reference signal corresponds to the value.

**Shut-off operat.**

**Volumetric flow measurement / setting**

(continued)
VAV-Compact Functions

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.

**Two measured variables**

The VAV-Compact supplies one of two measured variables as an actual value signal:

- Volumetric flow as 0 … 100 % of \( V_{\text{nom}} \) (default setting)
- Damper position as 0 … 100 % of the available angle of rotation

The setting can be switched with PC-Tool (Version V3.1 or higher).

**Actual value signal \( U_5 \) – volumetric flow**

The volumetric flow actual value signal \( U_5 \) indicates the current volumetric flow measured with the differential pressure sensor of the VAV unit.

This value corresponds to 0 … 100% of the set nominal volumetric flow. \( V_{\text{nom}} \) is set in the factory by the unit manufacturer and indicated on the VAV unit nameplate.

**Application:**

- Reference signal for the slave unit in master / slave applications
- Volumetric flow indication, e.g. display 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.

**Application:**

- Indication, e.g. display on BMS
- Evaluation of the damper position for analogue-controlled fan optimisation
Actual value signal U₅

(continued)

Actual value signal U₅ – setting

• Influence of the mode setting on the actual value signal U₅

The actual value signal U₅ is influenced by the set operating range. If the mode is set to 0 … 10 V, the display range of the U₅ signal is 0 … 10 V while if the mode is 2 … 10 V, the display range is 2 … 10 V.

• Adjustable actual value signal U₅

The U₅ signal can be adapted with the PC-Tool U₅ feedback function for special applications; adjustable operating range:

– Starting point DC 0.0 … 8 V
– End point DC 2.0 … 10 V

Actual value signal U₅ – volumetric flow determination based on voltage level

The volumetric flow can be determined based on the actual value signal U₅ using a standard voltmeter. The two formulae below show how the voltage signal is converted to a volumetric flow:

For 0 … 10 V mode:

\[ V = \frac{U₅ \cdot V_{nom}}{10} \]

Example: 0 … 10 V

Find: Current volumetric flow

Voltage measured at U₅: 3.5 V

\[ \frac{3.5 \cdot 2500}{10} = 875 \]

The current volumetric flow is thus 875 m³/h

Example: 2 … 10 V

Find: Current volumetric flow

Voltage measured at U₅: 6 V

\[ \frac{6.0 - 2.0}{8.0} \cdot 3300 = 1650 \]

The current volumetric flow is thus 1650 m³/h

Mode determination with the U₅ signal

If no tool is available, the mode can be determined with the U₅ signal and a voltmeter:

a) Mark the ± pressure hoses and disconnect them from the VAV-Compact.
b) Allow the sensor to cool down for 2–3 minutes.
c) Measure the U₅ signal
d) Connect the pressure hoses again.

Display | Mode
--- | ---
0 Volt | 0 … 10 V
2 Volt | 2 … 10 V
x Volt | variable setting

Note

If actual value signal U₅ is used to display the damper position, this method cannot be implemented.
Control functions

Minimum setting limit (1) (unit-specific value)
Oversizing of the VAV units can make control more difficult in the lowest differential pressure range. A minimum volumetric flow, usually corresponding to a differential pressure of ~ 5 ... 12 Pa, is therefore specified for these units by the manufacturer. Functional restrictions in this range can be avoided by complying with the unit manufacturer's volumetric flow setting.

Creep flow suppression (2)
The creep flow suppression function suppresses differential pressure signals in the zero region. Undefined actuator movements in the pressure range below 2 Pa are prevented by this limitation. The operating range is physically limited owing to the dynamic behaviour of the differential pressure sensor, the flow pattern of the fluid being pumped and the response threshold of the sensor.

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 V3.1 or higher).

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

Application
Step-controlled CAV application, e.g.:
- Occupancy switch \( \dot{V}_{\text{min}} / \dot{V}_{\text{max}} \) or
- Conference room with veto button for flushing operation \( \dot{V}_{\text{min}} / \dot{V}_{\text{max}} \)

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 / \( \dot{V}_{\text{min}} / \dot{V}_{\text{mid}} \) / \( \dot{V}_{\text{max}} / \text{OPEN} \)
- Shut-off operation – damper CLOSED:
  The damper is moved into the CLOSED position (0%) in a defined way.
- \( \dot{V}_{\text{max}} / \dot{V}_{\text{mid}} / \dot{V}_{\text{min}} \) 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.
VAV (variable air volume) controller $\dot{V}_{\text{min}} \ldots \dot{V}_{\text{max}}$

Corresponds to the VAV reference value input $Y$

**Application**

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

**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 $\dot{V}_{\text{min}} \ldots \dot{V}_{\text{max}}$
- 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 $\dot{V}_{\text{min}} \ldots \dot{V}_{\text{max}}$ range by means of an analogue reference signal or via the MP-Bus.

**Shut-off operation (CLOSED) with $V_{\text{min}}$ 0%**

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

**Shut-off operation (CLOSED)**

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

<table>
<thead>
<tr>
<th>Reference signal $Y$</th>
<th>Volume flow</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt; 0.1 \text{ V} \ast$</td>
<td>0</td>
<td>Damper CLOSED, VAV controller inactive</td>
</tr>
<tr>
<td>0.2 … 2 V</td>
<td>$V_{\text{min}}$</td>
<td>Operating level $V_{\text{min}}$ active</td>
</tr>
<tr>
<td>2 … 10 V</td>
<td>$V_{\text{min}} \ldots V_{\text{max}}$</td>
<td>Modulating operation $V_{\text{min}} \ldots V_{\text{max}}$</td>
</tr>
</tbody>
</table>

* Please note: The controller / DDC must be capable of pulling the reference signal to 0 V.
**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. The MP-Bus is not available if open loop operation is active.

- **Typical application:** Pressure-independent control of CAV / VAV units in the comfort zone, similar to the standard VAV-Compact.

- **Actuator:**
  - Control: 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 sensor:**
  - Actual value signal: Selectable signal (0 … 10 V or 2 … 10 V) corresponding to 0 … 100% of \( V_{\text{nom}} \). The \( V_{\text{nom}} \) setting and / or calibration of the volumetric flow sensor are the responsibility of the VAV unit manufacturer.

**Application**

New or retrofit solutions in conjunction with VAV controllers without an actuator and sensor unit from various third-party manufacturers, e.g.:

- Siemens RXC ...
- TAC Xenta ...

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**Note**

The VAV control circuit – in open loop operation – is the responsibility of the supplier of the VAV controller.
Master / slave connection

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.

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 $V_{\text{max}}$ and $V_{\text{min}}$ 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 / $V_{\text{min}}$ etc.) is only set on the master controller.

Slave setting if the room pressure ratio is balanced
The $V_{\text{min}}$ 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 $V_{\text{max}} 100\% / V_{\text{min}} 0\%$.

Slave setting if the room pressure ratio is unbalanced
The $V_{\text{min}}$ setting on the slave is always 0%.

Setting with % scale on the ZTH-VAV hand-operated device
The ratio of slave volume to master volume is set as follows with the $V_{\text{max}}$ value on the slave controller:

$$V_{\text{max}} S\% = \frac{V_{\text{max}} S \cdot V_{\text{nom}} M}{V_{\text{max}} M \cdot V_{\text{nom}} S} \cdot 100$$

- $V_{\text{max}} S\% =$ $V_{\text{max}}$ value that must be set on the controller in %
- $V_{\text{nom}} M =$ Nominal volume of the master unit in $\text{m}^3/\text{h}$
- $V_{\text{nom}} S =$ Nominal volume of the slave unit in $\text{m}^3/\text{h}$
- $V_{\text{max}} S =$ Maximum volume of the slave unit in $\text{m}^3/\text{h}$

Setting with PC-Tool / ZTH-VAV
These two setting tools can be used to enter the volumetric flow ratio directly in $\text{m}^3/\text{h}$, $\text{l/s}$ or $\text{cfm}$, 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: $V_{\text{nom}} 1600 \text{ m}^3/\text{h} / V_{\text{max}} 1500 \text{ m}^3/\text{h}$
- Exhaust air unit: $V_{\text{nom}} 2400 \text{ m}^3/\text{h} / V_{\text{max}} 1200 \text{ m}^3/\text{h}$

Find: $V_{\text{max}}$ setting of the slave controller

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

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 $V_{\text{max}}$ and $V_{\text{min}}$ are set on both controllers.

For connection diagram, see page 5 … 6

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 $V_{\text{max}}$ and $V_{\text{min}}$ 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 / $V_{\text{min}}$ 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 $V_{\text{max}}$ and $V_{\text{min}}$, 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
VAV-Compact Functions

Operation

Tool connection (1)
A Belimo operating device can be connected here directly, e.g. PC-Tool or a ZTH-VAV hand-operated device for setting and checking the VAV-Compact. This connection is also available if an MP integration is active.

Manual disengagement (2)
The damper blade can be adjusted manually when the system is started up using the push button on the VAV-Compact. Manual adjustments are possible at any time – even if the system is energised – without impairing operation. The position calculation – with visual indication (status LED) – is synchronised automatically in order to prevent deviations as a result of manual control.

Power and operation LED (3)
The status of the 24 V power supply and the readiness of the VAV-Compact for operation are indicated by the green LED (power).

Synchronisation – with visual indication (4)
The position calculation is synchronised in order to prevent permanent deviations as a result of manual control. Correct control of the damper blade position is thus guaranteed. The status LED indicates the progress of the function. Deviations due to manual control are eliminated. This synchronisation also acts as a simple functional check. The synchronisation behaviour can be set according to the application.

Angle of rotation adaption – with visual indication (4)
This function detects the upper and lower spindle end stops and stores them in the VAV-Compact. The running time and the operating range are adapted to the available angle of rotation. By detecting the mechanical end stops, it is possible to approach the end position gently and protect the actuator and damper mechanisms. The status LED indicates the progress of the function. The adaption behaviour can be set according to the application.

VAV service mode (V1) – visual indication (LED) for the VAV control loop Service mode is deactivated during normal operation. It can be activated using the two buttons on the VAV-Compact:
- To activate service mode (green LED flashes):
  - Press the «Adaption» and «Address» buttons simultaneously (> 3 seconds)
- To deactivate service mode:
  - Disconnect the 24 V supply briefly
  - Press one of the two buttons again
  - Service mode is deactivated automatically after 2 hours

Note
When the Service mode is active, the other key functions are out of operation.

Bus function – addressing (4)
The address button assigns an MP-Bus address (MP1 … 8) to the VAV-Compact and switches the device to the bus function.
For details of the procedure, refer to “MP-Bus integration”

MP-PP communication active (4)
The address button assigns an MP-Bus address (MP1 … 8) to the VAV-Compact and switches the device to the bus function.
## Functions

### LED function table

<table>
<thead>
<tr>
<th>Application</th>
<th>Function</th>
<th>Description / action</th>
<th>LED pattern</th>
</tr>
</thead>
</table>
| N1 Operation       | Status information                | – 24 V power supply OK  
VAV-Compact ready for operation | LED 1 ON  LED 2 OFF |
| S1 Service function| Synchronisation                   | Synchronisation started by:  
a) Operating / service device  
b) Manual disengagement on the VAV-Compact  
c) Power ON behaviour | LED 1 START LED 2 SYNC TIME |
| S2 Service function| Adaption                          | Adaption started by:  
a) Operating / service device  
b) Button on VAV-Compact | LED 1 START LED 2 ADAPT TIME |
|                    | VAV service active                | a) «Adaption» and «Address» buttons pressed simultaneously  
b) VAV service deactivated:  
– When the 24 V power supply is disconnected  
– When the two buttons are pressed again  
– Automatically after 2 hours | LED 1 OFF LED 2 OFF |
| V1 VAV service     | Air shortage                      | Damper opens because the actual volume is too low | LED 1 OFF LED 2 OFF |
|                    | Set volume reached                | Control loop balanced | LED 1 OFF LED 2 OFF |
|                    | Excess air                        | Damper closes because the actual volume is too high | LED 1 OFF LED 2 OFF |
| B1 Bus control     | Addressing via MP master          | a) Addressing triggered on the MP master | LED 1 ON LED 2 OFF |
|                    | (acknowledgement on VAV-Compact)  | b) Press the address pushbutton  
LED indicates active communication again as soon as the addressing function has finished | LED 1 OFF LED 2 START MP COMMUNICATION |
| B2 Bus control     | Addressing via MP master          | Addressing triggered on the MP master  
LED indicates active communication again as soon as the addressing function has finished | LED 1 OFF LED 2 START MP COMMUNICATION |
|                    | (with serial number)              |                                                                                      |             |
| B3 Bus control     | MP-PP communication               | Indicates active communication with the MP master or an operating / service device | LED 1 OFF LED 2 OFF |

**Legend:**
- Green LED (power) lit
- Yellow LED (status) lit
- Yellow LED lit intermittently

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www.belimo.com
### VAV-Compact Functions

#### Settings

<table>
<thead>
<tr>
<th>Function</th>
<th>Settings, limits</th>
<th>Operating device</th>
<th>Remarks, notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating volumetric flow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{\text{nom}}$ ¹)</td>
<td>Unit-specific value</td>
<td>$r$ / $w$</td>
<td></td>
</tr>
<tr>
<td>$V_{\text{max}}$</td>
<td>$30 \ldots 100%$ of $V_{\text{nom}}$</td>
<td>$r$ / $w$</td>
<td></td>
</tr>
<tr>
<td>$V_{\text{min}}$ ²)</td>
<td>$x$ $\ldots 100%$ of $V_{\text{nom}}$</td>
<td>$r$ / $w$</td>
<td></td>
</tr>
<tr>
<td>Reset OEM values</td>
<td>$V_{\text{min}}$ ... $V_{\text{max}}$</td>
<td>$r$ / $w$</td>
<td>CAI step in the range from $V_{\text{min}}$ to $V_{\text{max}}$</td>
</tr>
<tr>
<td>Control loop</td>
<td>Actual / set volume deviation</td>
<td>$r$ / $w$</td>
<td>Shows setpoint / actual value</td>
</tr>
<tr>
<td>Mode</td>
<td>$0 \ldots 10,\text{V} / 2 \ldots 10,\text{V}$</td>
<td>$r$ / $w$</td>
<td></td>
</tr>
</tbody>
</table>

#### Variable settings:

- Reference signal $Y$ (terminal 3)  
  - Start value: $0.6 \ldots 30\,\text{V}$  
  - Stop value: $2.6 \ldots 32\,\text{V}$  
  - Start value: $0.6 \ldots 8\,\text{V}$  
  - Stop value: $2.6 \ldots 10\,\text{V}$
- Type designation  
  - Type designation | $r$ / $w$  
  - Belimo product designation
- Position  
  - Indication in operating and bus devices
- Designation  
  - Indication in operating and bus devices
- Serial number  
  - Belimo designation: ID and serial number
- Adress  
  - MP-Bus address
- Calibration value  
  - Unit-specific parameter
- Minimum setting limit  
  - Smallest possible control range (unit and / or manufacturer-specific value)
- Controller function  
  - Air volume / open loop
- Sensitivity  
  - Normal / damped
- Us feedback function  
  - Volumetric flow / damper position
- Range of rotation  
  - Adapted $33 \ldots 95^\circ$
  - Electronically limited $33 \ldots 95^\circ$
- Direction of rotation at $Y=100\%$  
  - $\text{cw}$  
  - $\text{ccw}$
- Torque  
  - $100 / 75 / 50 / 25\%$
- Power ON behaviour  
  - Power ON behaviour
- Synchronisation behaviour  
  - Synchronisation set to $Y = 0$ or $100\%$
- Bus fail position  
  - MP-Bus function
- Operating data  
  - Behaviour if the bus master is faulty
- Alarm signals  
  - Setting range too large
  - Mechanical overload
  - Stop & go ratio too high
- Version overview  
  - Firmware
  - Config. table ID

**Note:** Settings can be saved and printed with PC-Tool V3.x.

---

1) This value is fixed by the OEM when the VAV-Compact is calibrated.
2) This value is determined by the minimum setting limit, see below. 0% allowed for shut-off operation.

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Products no longer available
## VAV-Compact Functions

### Operating and fault messages

#### Operating data recording
The VAV-Compact controller records the following operating data, which can be read out with PC-Tool or via the MP-Bus master if MP-Bus integrations are active:

**Operating time**
Number of hours for which the VAV-Compact was connected to the power supply.

**Active time**
Number of hours for which the VAV-Compact was mechanically in motion and connected to the power supply.

**Stop & go ratio**
Ratio of active time to operating time (formula: active time [h] / operating time [h] x 100).

The VAV-Compact generates the error messages described below in the corresponding situations. The error messages can be read out with PC-Tool and are also indicated via the bus master if MP-Bus integrations are active.

**“Setting range too large”**
Occurs if, when the angle of rotation is limited to 60° for example, the setting range suddenly exceeds > 60° owing to a mechanical defect (angle of rotation limiting altered or loose). This is detected by the VAV-Compact and the above message is generated.

**Mechanical overload**
**“Stop & go ratio too high”** occurs if the stop & go ratio exceeds 20%, in other words if the actuator moves too frequently in relation to its operating time. Possible cause: Unstable reference signal, e.g. because the upstream room temperature cascade is oscillating.
Products no longer available
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More VAV applications, including lists of materials and specification texts, can be found in application library CR24 under www.belimo.com.

VAV-Compact

Conventional applications

Single-duct systems

IRC-VAV

CAV room solution with motion detector

CAV single-duct system, occupancy-controlled

Function diagram

Volumetric flow $V_{\text{max}}$

Room occupied

Room unoccupied

$V_{\text{min}}$

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)

The CAV controller is controlled by means of the motion detector in two modes on the basis of room occupancy $V_{\text{min}}$ ... $V_{\text{max}}$:

- Room unoccupied: constant air volume $V_{\text{min}}$
- Room occupied: constant air volume $V_{\text{max}}$

Motion detector

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

VAV-Compact control device

..MV-D2-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.

- Damper position feedback controlled via the MP-Bus for demand based fan optimisation.

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

Products no longer available
**VAV-Compact**

**Conventional applications**

### Single-duct systems

**IRC-VAV**

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

![VAV room solution with 0 ... 10 V control](image)

**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 $V_{\text{min}}$ … $V_{\text{max}}$, 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**

- 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.
  - Damper position controlled via the MP-Bus for demand based fan optimisation.

### Anschlusschema

![Function diagram](image)

- **AC 24 V**
- **Reference signal 0 … 10 V**
- **Actual value signal 0 … 10 V**
- **Room / DDC controller**

**Notes**

- Connection and terminal designations in accordance with the controller manufacturer’s specification.
- Mode setting on the VAV controller: 0 … 10 V

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Products no longer available
VAV-Compact

Conventional applications

Single-duct systems

(continued)

IRO-VAV

VAV room solution with CR24 room controller

![Diagram of VAV room solution with CR24 room controller]

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)

The CR24-B1 single-room controller controls the connected VAV controllers with a variable air volume in the range from $V_{\text{min}}$ to $V_{\text{max}}$, 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-D2-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.

- Damper position controlled via the MP-Bus for demand based fan optimisation.

Wiring diagram

Input and output assignment

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

Note

Terminal designations in accordance with the Belimo final controlling element.

Configuration, settings

DIP switches

- DIP switch 1: P-Band normal wide
- DIP switch 2: di2 Stand by Change over

Setpoint WH range: 15 ... 36 °C
**VAV-Compact**

**Conventional applications**

**Dual-duct systems**

**Function diagram**

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

**VAV dual-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 dual-duct system, room temperature-controlled

Stand-alone operation or integrated in a building automation system (I/O integration)

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 $V_{\text{max}}$ 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 ($15 \ldots 36^\circ\text{C}$) 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-D2-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**

**Input and output assignment**

**Functions**

<table>
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<th>Description</th>
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<tbody>
<tr>
<td>VAV</td>
<td>VAV system output (0) 2 \ldots 10 V</td>
<td>Output ao1</td>
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</tbody>
</table>

**Optional functions**

<table>
<thead>
<tr>
<th>Functions</th>
<th>Description</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shut-off CA</td>
<td>Cold air shut-off</td>
<td>Input di1</td>
</tr>
<tr>
<td>Sensor</td>
<td>External temperature sensor NTC 5K</td>
<td>Input ai1</td>
</tr>
<tr>
<td>Shift</td>
<td>External shift 0 \ldots 10 V (Summer / Winter compensation)</td>
<td>Input ai2</td>
</tr>
</tbody>
</table>

**Configuration, settings**

**DIP switches**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-Band</td>
<td>normal</td>
</tr>
<tr>
<td>di2</td>
<td>Stand by</td>
</tr>
</tbody>
</table>

**Setpoint WH range**: $15 \ldots 36 \: ^\circ\text{C}$
## Table of contents

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

**General**

**Conventional or via MP-Bus**

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

**Mode 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.

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 moved 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-D2LON / NMV-D2LON.

For more detailed information, see UK24LON product information.
**MP-Bus integration**

### Integration for EIB / KNX systems

The KNX certified UK24EIB allows up to eight MP actuators or VAV-Compact controllers to be digitally controlled via the MP-Bus and send back their current operating status. It translates the digital information from the controller and the feedback into KNX telegrams. The functions of the MP field devices can thus be directly integrated into KNX 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 supplied to the KNX system via the UK24EIB.

For more detailed information, see UK24EIB Product information.

### Integration with DDC / PLC controllers

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

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**

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-D2-MP 5 VA / 3 W
- The type of supply (AC 24 V or DC 24 V)
- The cable cross-section.

**MP-Bus cable length for AC 24 V 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 24 V)**
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 4x LMV-D2-MP
Total power rating: 4 x 5 VA = 20 VA

Values read from the graph:
- Cable with wire Ø 0.75 mm² requires: cable length 28 m
- Cable with wire Ø 1.0 mm² requires: cable length 40 m
- Cable with wire Ø 1.5 mm² requires: cable length 54 m
- Cable with wire Ø 2.5 mm² requires: cable length 90 m
Cable lengths

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

Total power rating of VAV controllers [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 4x LMV-D2-MP
Total power rating: 4 x 3 W = 12 W
Values read from the graph:
• Cable with wire Ø 0.75 mm² requires: cable length 60 m
• Cable with wire Ø 1.0 mm² requires: cable length 80 m
• Cable with wire Ø 1.5 mm² requires: cable length 115 m
• Cable with wire Ø 2.5 mm² requires: cable length 200 m

Bus cable length for local AC 24 V supply

Maximum length of bus cable for local AC 24 V supply

If the VAV controllers are supplied with AC 24 V locally 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 $V_{\min}$ / $V_{\max}$ setting of the VAV-Compact controller, i.e.:
- 0% setpoint corresponds to $V_{\min}$ volume
- 100% setpoint corresponds to $V_{\max}$ volume

Operating volumetric flow setting $V_{\min}$ / $V_{\max}$

<table>
<thead>
<tr>
<th>Function</th>
<th>Volumetric flow</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{\text{nom}}$</td>
<td>Nominal</td>
<td>OEM-specific value, depending on the application and the VAV unit type</td>
</tr>
<tr>
<td>$V_{\text{max}}$</td>
<td>Maximum</td>
<td>30 … 100% of $V_{\text{nom}}$</td>
</tr>
<tr>
<td>$V_{\text{min}}$</td>
<td>Minimum</td>
<td>0* … 100% of $V_{\text{nom}}$</td>
</tr>
</tbody>
</table>

* $V_{\text{min}}$ 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 «minimum setting limit» function, page 17.

Open operating volumetric flow setting

The $V_{\text{min}}$ / $V_{\text{max}}$ 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.
### 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 V3.1 or higher.

The following functions are available:

- CLOSED
- $V_{\text{min}}$
- $V_{\text{max}}$
- OPEN
- Last value (default setting, last setpoint command received from the bus master)
VAV-Compact

MP-Bus integration

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.

MP-Bus cycle time

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

Signals that can be linked in

- Active sensor with a DC 0 ... 10 V signal
- Passive resistance sensor e.g. Pt1000, Ni1000, NTC
- Switching contacts

Typical value 2 ... 8 s

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!

Passive sensor connection

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!

Active sensor connection

Active 0 ... 10 V sensors for open and closed-loop control functions in the higher-level system, such as a moisture or CO2 sensor. The cycle time must be taken into account in the implementation!

Reference signal Y setting if a passive sensor is connected

No special settings are required.

Reference signal Y setting if an active sensor is connected

No special settings are required.
Products no longer available
Table of contents

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Flow chart 44
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Fault descriptions, symptoms, causes and rectification 45
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: Determine and make a note of the actual state

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%

Step 2: Functional check

Step 3: Compare the faulty behaviour with the described symptoms

Compare

Damper 100% and volumetric flow too low
«Insufficient volumetric flow, damper open in end position»

Cause

Supply air fan output too low

Step 4: Rectify

- Check the supply air fan
- Rectify the fault

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

Press manual pushbutton for gear disengagement

Reaction:

Actuator moves to end position
Actuator does not move

Functional check

Report to manufacturer
## VAV-Compact Functional check

### Fault descriptions, symptoms, causes and rectification

#### Insufficient volumetric flow, damper OPEN in end position

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Rectification steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set volume not reached although damper is 100% open (end stop)</td>
<td>Fan failure</td>
<td>Check the fan, including the control functions, and rectify the fault</td>
</tr>
<tr>
<td></td>
<td>Fire dampers tripped, i.e. closed</td>
<td>Check whether all fire and/or shut-off dampers between the fan and the VAV unit are open</td>
</tr>
<tr>
<td></td>
<td>Fan air output too low</td>
<td>Check whether all fire and/or shut-off dampers between the fan and the VAV unit are open</td>
</tr>
<tr>
<td></td>
<td>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)</td>
<td>Deactivate override control and/or reduce the reference signal</td>
</tr>
</tbody>
</table>

#### Insufficient volumetric flow, master damper OPEN / slave damper CLOSED

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

#### Volumetric flow too high, damper OPEN

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Rectification steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set volume not reached and damper closed although reference signal is present</td>
<td>Current setpoint or $V_{\text{min}}$ setting corresponds to differential pressure $&lt; 2$ Pa. Damper closed due to «creep flow suppression» function</td>
<td>Increase the $V_{\text{min}}$ parameter Adjust the reference signal or correct the VAV-Compact mode setting</td>
</tr>
<tr>
<td>Damper closes (0%) instead of opening to $V_{\text{min}}$ value</td>
<td>VAV-Compact set to 2 … 10 V mode but controlled with 0 … 10 V reference signal</td>
<td>Change the VAV-Compact mode setting to 0 … 10 V</td>
</tr>
</tbody>
</table>

#### Volumetric flow too low, damper in control range

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

### Note:
The differential pressure sensor of the VAV-Compact does not normally need to be cleaned.

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Products no longer available
## VAV-Compact Functional check

### Fault descriptions, symptoms, causes and rectification

(continued)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Rectification steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volumetric flow too high, damper in control range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steady-state deviation of volumetric flow (too high) relative to reference signal</td>
<td>VAV-Compact set to 0 … 10 V mode but controlled with 2 … 10 V reference signal</td>
<td>Adjust the reference signal or correct the VAV-Compact mode setting</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Rectification steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive / negative room pressure, damper in control range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undesirable positive or negative pressure in room</td>
<td>Clamp loose, turns without spindle driver</td>
<td>Check the clamp mounting</td>
</tr>
<tr>
<td>Room pressure ratio not set correctly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Master / slave application with limited operating volumetric flow setting on slave controller</td>
<td>Check the operating volumetric flow setting</td>
<td></td>
</tr>
<tr>
<td>Room pressure ratio not set correctly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wiring incorrect, VAV units interchanged (master / slave or parallel connection)</td>
<td>Check the wiring and correct it if necessary</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>Supply air office a and exhaust air office b</td>
<td></td>
</tr>
<tr>
<td>VAV units set to master / slave but controlled in parallel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Rectification steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damper does not move</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damper does not move</td>
<td>Clamp loose, turns without spindle driver</td>
<td>Check the clamp mounting</td>
</tr>
</tbody>
</table>

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<tr>
<td>Argentina</td>
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