Control components for VAV terminal units
Type Compact

With service interface and bus communication facility
Compact device for use with VAV terminal units
- Controller, differential pressure transducer, and actuator are fitted together in one casing
- Volume flow rates $V_{\text{min}}$ and $V_{\text{max}}$ are factory set as parameters
- Ideal for carrying out service from the switch cabinet or control panel
- Change of parameters using adjustment devices
- Suitable for constant and variable volume flows as well as for $V_{\text{min}}$ / $V_{\text{max}}$ switching
- Bus communication is possible due to MP bus or LonWorks interfaces
Control components for VAV terminal units

General information

Application

- Electronic volume flow controllers of Type Compact are compact, all-in-one control devices for VAV terminal units
- Dynamic differential pressure transducer, electronic controller, and actuator are fitted together in one casing
- Suitable for different control tasks depending on how the input for the setpoint value signal is used
- The output signals of the room temperature controller, central BMS, air quality controller or similar units control the volume flow rate setpoint
- Override control by means of switches or relays
- Volume flow rate actual value is available as linear voltage signal
- Controller parameters are factory set

Standard filtration in comfort air conditioning systems allows for use of the controller in the supply air without additional dust protection. Since a partial volume flow is passed through the transducer in order to measure the volume flow rate, please note:

- With heavy dust levels in the room, suitable extract air filters must be provided.
- If the air is polluted with fluff or sticky particles or contains aggressive media, Compact controllers cannot be used

Commissioning

- On-site adjusting is not required
- Integration of voltage signals into the central BMS
- If data transmission via bus interfaces is required, a system integrator should be involved in commissioning

Compact controllers for VAV terminal units

<table>
<thead>
<tr>
<th>Order code detail</th>
<th>Part number</th>
<th>Type</th>
<th>Type of VAV terminal unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC0</td>
<td>M466BA0</td>
<td>LMV-D3L-MP-F</td>
<td>1</td>
</tr>
<tr>
<td>BC0</td>
<td>A00000043141</td>
<td>LMV-D3-MP-F</td>
<td>2</td>
</tr>
<tr>
<td>BC0</td>
<td>A00000043140</td>
<td>LMV-D3-MP</td>
<td>3</td>
</tr>
<tr>
<td>BC0</td>
<td>A00000043142</td>
<td>N MV-D3-MP</td>
<td>4</td>
</tr>
<tr>
<td>BF0</td>
<td>A00000043140</td>
<td>LMV-D3-MP</td>
<td>5</td>
</tr>
<tr>
<td>BL0</td>
<td>M466ES7</td>
<td>LMV-D3LON</td>
<td>6</td>
</tr>
<tr>
<td>BL0</td>
<td>M466ES8</td>
<td>N MV-D3LON</td>
<td>7</td>
</tr>
<tr>
<td>X B0</td>
<td>M466DC1</td>
<td>227V-024-10</td>
<td>8</td>
</tr>
<tr>
<td>X G0</td>
<td>M466DC1</td>
<td>227V-024-10</td>
<td>9</td>
</tr>
<tr>
<td>L N0</td>
<td>M466EG7</td>
<td>GLB181.1E/3</td>
<td>10</td>
</tr>
<tr>
<td>L Y0</td>
<td>M466EG7</td>
<td>GLB181.1E/3</td>
<td>11</td>
</tr>
</tbody>
</table>

Any attachments must be defined with the order code of the VAV terminal unit.
**Function**

**Functional description**
The volume flow rate is determined by measuring the differential pressure (effective pressure). For this purpose the VAV terminal unit is fitted with a differential pressure sensor.

The integral differential pressure transducer transforms the effective pressure into a voltage signal. The volume flow rate actual value is hence available as a voltage signal. The factory setting is such that 10 V DC always corresponds to the nominal volume flow rate ($V_{nom}$).

The volume flow rate setpoint value comes from a higher-level controller (e.g. room temperature controller, air quality controller, central BMS) or from switch contacts. Variable volume flow control results in a value between $V_{min}$ and $V_{max}$.

It is possible to override the room temperature control, e.g. by a complete shut-off of the duct.

The controller compares the volume flow rate setpoint value to the actual value and controls the integral actuator accordingly.

Volume flow rate parameters and voltage ranges are factory stored in the controller. Changes on the customer's site can easily be carried out using an adjustment device, a notebook with service tool, or a bus interface.

**Volume flow control**
- The volume flow controller works independent of the duct pressure
- Differential pressure fluctuations do not result in permanent volume flow rate changes
- To prevent the control from becoming unstable, a dead band is allowed within which the damper blade does not move.

---

**Principle of operation – Easy and Compact controllers**

![Diagram](image)

- Differential pressure transducer
- Actuator
- Volume flow controller
- Setpoint value signal
Control components for VAV terminal units
Special information – BC0, BF0

Application
- Electronic volume flow controller LMV-D3L-MP-F, LMV-D3-MP, LMV-D3-MP-F or NMV-D3-MP as Compact controller
- Variable air or constant air volume flow control
- The flow rate is measured using the dynamic measurement principle
- Voltage range for the actual and setpoint value signals 0 – 10 V DC or 2 – 10 V DC
- MP bus interface: Up to eight users can be addressed on an MP bus (LAN). This allows for the integration with higher-level systems (LonWorks, EIB-Konex, Modbus RTU and BACnet); as an alternative, a DDC controller with MP bus interface can control the Compact controller.
- Controller with NFC technology, i.e. settings and operating values can be read out using a smartphone app

Construction
- BC0: LMV-D3L-MP-F für LVC
- BC0: LMV-D3-MP-F for TVR
- BC0: NMV-D3-MP for TVJ, TVT
- BC0: LMV-D3-MP for TZ-Silenzio, TA-Silenzio, TVZ, TVA
- BF0: LMV-D3-MP for TVM

Useful additions
- AT-VAV-B: Adjustment device

Signal voltage range
- 0: 0 – 10 V DC
- 2: 2 – 10 V DC with shut-off function (< 0.1 V DC)

Operating modes
- E: Single and M: Master
  - \( V_{\text{min}} \): minimum volume flow rate
  - \( V_{\text{max}} \): maximum volume flow rate
- S: Slave
  - \( V_{\text{max}} \): 0 %
  - \( V_{\text{max}} \): Volume flow rate ratio to the master controller
- F: Constant value
  - \( V_{\text{max}} \): constant volume flow rate
  - \( V_{\text{max}} \): 100 %

Parameters are factory set. The customer defines the required operating mode and the volume flow rates in the order code at the time of ordering.

Commissioning
- On-site adjusting is not required
- When installing the VAV terminal units it is important to assign each room the correct unit based on the ordered volume flow rates
- After successful installation and wiring the controller is ready for use on the analog interface
- If the MP bus interface is used, additional commissioning steps are required

Technical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (AC)</td>
<td>24 V AC ± 20 %, 50/60 Hz</td>
</tr>
<tr>
<td>Supply voltage (DC)</td>
<td>24 V DC −10/+20 %</td>
</tr>
<tr>
<td>Power rating (AC)</td>
<td>3.5 VA max.</td>
</tr>
<tr>
<td>Power rating (DC)</td>
<td>2 W max.</td>
</tr>
<tr>
<td>Torque</td>
<td>5 Nm</td>
</tr>
<tr>
<td>Running time for 90°</td>
<td>120 – 150 s</td>
</tr>
<tr>
<td>Setpoint value signal input</td>
<td>0 – 10 V DC, ( R_i &gt; 100 \text{ k} )</td>
</tr>
<tr>
<td>Actual value signal output</td>
<td>0 – 10 V DC, 0.5 mA max.</td>
</tr>
<tr>
<td>IEC protection class</td>
<td>III (protective extra-low voltage)</td>
</tr>
<tr>
<td>Protection level</td>
<td>IP 54</td>
</tr>
<tr>
<td>EC conformity</td>
<td>EMC to 2004/108/EC, low voltage to 2006/95/EC</td>
</tr>
<tr>
<td>Weight</td>
<td>0.5 kg</td>
</tr>
</tbody>
</table>

Compact controller LMV-D3L-MP-F
### Compact controller LMV-D3-MP und LMV-D3-MP-F

<table>
<thead>
<tr>
<th>Specification</th>
<th>LMV-D3-MP-F</th>
<th>LMV-D3-MP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (AC)</td>
<td>24 V AC ± 20 %, 50/60 Hz</td>
<td>24 V AC ± 20 %, 50/60 Hz</td>
</tr>
<tr>
<td>Supply voltage (DC)</td>
<td>24 V DC −10/+20 %</td>
<td>24 V DC −10/+20 %</td>
</tr>
<tr>
<td>Power rating (AC)</td>
<td>4 VA max.</td>
<td>4.5 VA max.</td>
</tr>
<tr>
<td>Power rating (DC)</td>
<td>2 W max.</td>
<td>3 W max.</td>
</tr>
<tr>
<td>Torque</td>
<td>5 Nm</td>
<td>10 Nm</td>
</tr>
<tr>
<td>Running time for 90°</td>
<td>110 – 150 s</td>
<td>110 – 150 s</td>
</tr>
<tr>
<td>Setpoint value signal input</td>
<td>0 – 10 V DC, Ra &gt; 100 kΩ</td>
<td>0 – 10 V DC, Ra &gt; 100 kΩ</td>
</tr>
<tr>
<td>Actual value signal output</td>
<td>0 – 10 V DC, 0.5 mA max.</td>
<td>0 – 10 V DC, 0.5 mA max.</td>
</tr>
<tr>
<td>IEC protection class</td>
<td>III (protective extra-low voltage)</td>
<td>III (protective extra-low voltage)</td>
</tr>
<tr>
<td>Protection level</td>
<td>IP 54</td>
<td>IP 54</td>
</tr>
<tr>
<td>EC conformity</td>
<td>EMC according to 2004/108/EC</td>
<td>EMC according to 2004/108/EC</td>
</tr>
<tr>
<td>Weight</td>
<td>0.5 kg</td>
<td>0.7 kg</td>
</tr>
</tbody>
</table>

### Compact controller NMV-D3-MP

<table>
<thead>
<tr>
<th>Specification</th>
<th>NMV-D3-MP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (AC)</td>
<td>24 V AC ± 20 %, 50/60 Hz</td>
</tr>
<tr>
<td>Supply voltage (DC)</td>
<td>24 V DC −10/+20 %</td>
</tr>
<tr>
<td>Power rating (AC)</td>
<td>5.5 VA max.</td>
</tr>
<tr>
<td>Power rating (DC)</td>
<td>3 W max.</td>
</tr>
<tr>
<td>Torque</td>
<td>10 Nm</td>
</tr>
<tr>
<td>Running time for 90°</td>
<td>110 – 150 s</td>
</tr>
<tr>
<td>Setpoint value signal input</td>
<td>0 – 10 V DC, Ra &gt; 100 kΩ</td>
</tr>
<tr>
<td>Actual value signal output</td>
<td>0 – 10 V DC, 0.5 mA max.</td>
</tr>
<tr>
<td>IEC protection class</td>
<td>III (protective extra-low voltage)</td>
</tr>
<tr>
<td>Protection level</td>
<td>IP 54</td>
</tr>
<tr>
<td>EC conformity</td>
<td>EMC according to 2004/108/EC</td>
</tr>
<tr>
<td>Weight</td>
<td>0.7 kg</td>
</tr>
</tbody>
</table>
Control components for VAV terminal units
Special information – BC0, BF0

Compact

Function

VAV-Compact

1. VAV-Compact
2. Gear release button
3. Connections for differential pressure sensor
4. Service socket
5. Blade shaft clamp
6. Rotation stop
7. Indicator lights
8. Connecting cable

Characteristics

Characteristic of the setpoint value signal

<table>
<thead>
<tr>
<th>Volume flow</th>
<th>Setpoint value signal</th>
<th>0 – 10 V DC</th>
<th>2 – 10 V DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 ( V_{\text{setpoint}} )</td>
<td>10 ( V_{\text{DC}} )</td>
<td>10 ( V_{\text{DC}} )</td>
</tr>
<tr>
<td>2</td>
<td>( V_{\text{DC}} )</td>
<td>( V_{\text{DC}} )</td>
<td>( V_{\text{DC}} )</td>
</tr>
</tbody>
</table>

Characteristic of the actual value signal

<table>
<thead>
<tr>
<th>Volume flow</th>
<th>Actual value signal U5</th>
<th>0 – 10 V DC</th>
<th>2 – 10 V DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 ( V_{\text{actual}} )</td>
<td>10 ( V_{\text{DC}} )</td>
<td>10 ( V_{\text{DC}} )</td>
</tr>
<tr>
<td>2</td>
<td>( V_{\text{DC}} )</td>
<td>( V_{\text{DC}} )</td>
<td>( V_{\text{DC}} )</td>
</tr>
</tbody>
</table>

Characteristic of the setpoint value signal

\[ V_{\text{setpoint}} = \frac{w}{10} (V_{\text{max}} - V_{\text{min}}) + V_{\text{min}} \]

Characteristic of the actual value signal

\[ V_{\text{actual}} = \frac{U_5}{10} V_{\text{nom}} \]

\[ V_{\text{setpoint}} = \frac{w - 2}{8} (V_{\text{max}} - V_{\text{min}}) + V_{\text{min}} \]

\[ V_{\text{actual}} = \frac{U_5 - 2}{8} V_{\text{nom}} \]
Control components for VAV terminal units
Special information – BC0, BF0

**Connecting cable core identification**

<table>
<thead>
<tr>
<th>BK</th>
<th>RD</th>
<th>WT</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>⊥</td>
<td>~</td>
<td>w</td>
<td>U5/MP</td>
</tr>
<tr>
<td>−</td>
<td>+</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 ⊥, ~: Ground, neutral
2 −, +: Supply voltage
3 w: Setpoint value signal and override control
5 U5/MP: Actual value signal and communication

**Compact:** LMV-D3-MP, LMV-D3-MP-F, NMV-D3-MP, LMV-D3L-MP-F

**Variable volume flow control and override control, voltage signal 0 to 10 V DC**

Switch functions:
- S1 Room temperature control
- S3 Maximum volume flow rate $V_{\text{max}}$
- S4 Damper blade CLOSED
  - (only with supply voltage 24 V AC)
- S5 Damper blade OPEN
  - (only with supply voltage 24 V AC)
- All OPEN: Minimum volume flow rate $V_{\text{min}}$

When combining several override controls, the switches must be interlocked to prevent short-circuits.

Diode: e.g. 1N 4007

**Compact:** LMV-D3-MP, LMV-D3-MP-F, NMV-D3-MP, LMV-D3L-MP-F
Variable volume flow control and override control, voltage signal 2 to 10 V DC

Switch functions
S1 Room temperature control
S2 Shut-off CLOSED
S3 Maximum volume flow rate \( \dot{V}_{\text{max}} \)
S4 Damper blade CLOSED
(only with supply voltage 24 V AC)
S5 Damper blade OPEN
(only with supply voltage 24 V AC)
All OPEN: Minimum volume flow rate \( \dot{V}_{\text{min}} \)

When combining several override controls the switches must be interlocked to prevent short-circuits.
Diode: e.g. 1N 4007

Compact: LMV-D3-MP, LMV-D3-MP-F, NMV-D3-MP, LMV-D3L-MP-F
Compact controller for cold air duct

Compact controller for warm air duct

Operating mode E, M, F

Folgeregler Compact
Operating mode S

Compact: LMV-D3-MP, LMV-D3-MP-F, NMV-D3-MP, LMV-D3L-MP-F
Control components for VAV terminal units
Special information – BL0

Application
- Electronic volume flow controller LMV-D3LON or NMV-D3LON as Compact controller
- Variable air or constant air volume flow control
- The flow rate is measured using the dynamic measurement principle
- Voltage range for the actual value signal 2 – 10 V DC
- Volume flow controller with LonMark certification
- LonWorks interfaces for the transmission of standard network variables
- Functional profiles: Node-Object #0, Damper-Actuator-Object #8110, Open-Loop-Sensor-Object #1 and Thermostat-Object #8060
- The Thermostat-Object #8060 enables individual room control
- A plug-in for all LNS-based network integration tools (LNS version 3.3 and higher) is available for configuration

Construction
- BL0: LMV-D3LON for TVR, TZ-Silenzio, TA-Silenzio, TVZ, TVA
- BL0: NMV-D3LON for TVJ, TVT

Useful additions
- AT-VAV-B: Adjustment device

Signal voltage range
Actual value signal
- 2: 2 – 10 V DC

Commissioning
- A trained LonWorks systems integrator must carry out the integration into the overall system

Description
For detailed information on adjustment devices see chapter K5 – 1.4

Order code detail
For detailed information on adjustment devices see chapter K5 – 1.4

Technical data

<table>
<thead>
<tr>
<th>Compact controller LMV-D3LON</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supply voltage (AC)</strong></td>
<td>24 V AC ± 20 %, 50/60 Hz</td>
</tr>
<tr>
<td><strong>Supply voltage (DC)</strong></td>
<td>24 V DC –10/+20 %</td>
</tr>
<tr>
<td><strong>Power rating (AC)</strong></td>
<td>4.5 VA max.</td>
</tr>
<tr>
<td><strong>Power rating (DC)</strong></td>
<td>2.5 W max.</td>
</tr>
<tr>
<td><strong>Torque</strong></td>
<td>5 Nm</td>
</tr>
<tr>
<td><strong>Running time for 90°</strong></td>
<td>110 – 150 s</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>LonWorks-Transceiver FTT-10A, free topology, twisted pair</td>
</tr>
<tr>
<td><strong>Actual value signal output</strong></td>
<td>2 – 10 V DC, 0.5 mA max.</td>
</tr>
<tr>
<td><strong>IEC protection class</strong></td>
<td>III (protective extra-low voltage)</td>
</tr>
<tr>
<td><strong>Protection level</strong></td>
<td>IP 54</td>
</tr>
<tr>
<td><strong>EC conformity</strong></td>
<td>EMC according to 2004/108/EC</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>0.5 kg</td>
</tr>
</tbody>
</table>
Compact controller NMV-D3LON

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (AC)</td>
<td>24 V AC ± 20 %, 50/60 Hz</td>
</tr>
<tr>
<td>Supply voltage (DC)</td>
<td>24 V DC −10/+20 %</td>
</tr>
<tr>
<td>Power rating (AC)</td>
<td>6 VA max.</td>
</tr>
<tr>
<td>Power rating (DC)</td>
<td>3.5 W max.</td>
</tr>
<tr>
<td>Torque</td>
<td>10 Nm</td>
</tr>
<tr>
<td>Running time for 90°</td>
<td>110 – 150 s</td>
</tr>
<tr>
<td>Communication</td>
<td>LonWorks-Transceiver FTT-10A, free topology, twisted pair</td>
</tr>
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<td>2 – 10 V DC, 0.5 mA max.</td>
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<td>IEC protection class</td>
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<tr>
<td>Protection level</td>
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<td>EMC according to 2004/108/EC</td>
</tr>
<tr>
<td>Weight</td>
<td>0.7 kg</td>
</tr>
</tbody>
</table>

Function

VAV-Compact

1. VAV-Compact
2. Gear release button
3. Connections for differential pressure sensor
4. Service socket
5. Blade shaft clamp
6. Rotation stop
7. Indicator lights and LonWorks service button
8. Connecting cable
Control components for VAV terminal units
Special information – BL0

Characteristics

**Characteristics of the actual value signal**

![Graph showing characteristic of the actual value signal](image)

\[ V_{\text{actual}} = \frac{U_5 - 2}{8} V_{\text{nom}} \]

**Electrical connection**

**Connecting cable core identification**

- **Compact:** LMV-D3LON, NMV-D3LON

<table>
<thead>
<tr>
<th>Core</th>
<th>Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-7</td>
<td>Ground, neutral</td>
</tr>
<tr>
<td>2-7</td>
<td>Supply voltage</td>
</tr>
<tr>
<td>3</td>
<td>Connection of external sensor or switch</td>
</tr>
<tr>
<td>5</td>
<td>Actual value signal and communication</td>
</tr>
<tr>
<td>6, 7</td>
<td>LonWorks</td>
</tr>
</tbody>
</table>

**Volume flow control**

- **Compact:** LMV-D3LON, NMV-D3LON
Application
- Electronic volume flow controller 227V-024-10 as Compact controller
- Variable air or constant air volume flow control
- The flow rate is measured using the dynamic measurement principle
- Voltage range for the actual and setpoint value signals 0 – 10 V DC or 2 – 10 V DC

Construction
- XB0: 227V-024-10 for TVR, TVJ, TVT, TZ-Silenzio, TA-Silenzio, TVZ, TVA
- BG0: 227V-024-10 for TVM

Useful additions
- AT-VAV-G: Adjustment device

Signal voltage range
- 0: 0 – 10 V DC
- 2: 2 – 10 V DC with shut-off function (< 0.8 V DC)

Operating modes
E: Single and M: Master
- \( V_{\text{min}} \): Minimum volume flow rate
- \( V_{\text{max}} \): Maximum volume flow rate

S: Slave operation
- \( V_{\text{min}} \): 0 %
- \( V_{\text{max}} \): Volume flow rate ratio to the master controller

F: Constant value
- \( V_{\text{min}} \): constant volume flow rate
- \( V_{\text{max}} \): 100 %

Parameters are factory set. The customer defines the required operating mode and the volume flow rates in the order code at the time of ordering.

Commissioning
- On-site adjusting is not required
- It is important to assign each room the correct unit based on the ordered volume flow rates
- After successful installation and wiring the controller is ready for use

Technical data

<table>
<thead>
<tr>
<th>Compact controller 227V-024-10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supply voltage (AC)</strong></td>
</tr>
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<td><strong>Supply voltage (DC)</strong></td>
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<tr>
<td><strong>Power rating (AC)</strong></td>
</tr>
<tr>
<td><strong>Power rating (DC)</strong></td>
</tr>
<tr>
<td><strong>Torque</strong></td>
</tr>
<tr>
<td><strong>Running time for 90°</strong></td>
</tr>
<tr>
<td><strong>Setpoint value signal input</strong></td>
</tr>
<tr>
<td><strong>Actual value signal output</strong></td>
</tr>
<tr>
<td><strong>IEC protection class</strong></td>
</tr>
<tr>
<td><strong>Protection level</strong></td>
</tr>
<tr>
<td><strong>EC conformity</strong></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
</tr>
</tbody>
</table>
Control components for VAV terminal units
Special information – XB0, XG0

**Compact**

<table>
<thead>
<tr>
<th>Function</th>
<th>VAV-Compact</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="Image" /></td>
<td></td>
</tr>
</tbody>
</table>

1. VAV-Compact
2. Connections for differential pressure sensor
3. Gear release button
4. Service socket
5. Connecting cable

### Characteristics

#### Characteristic of the setpoint value signal

<table>
<thead>
<tr>
<th>Volume flow</th>
<th>Setpoint value signal Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 10 V DC</td>
<td>0 min unit</td>
</tr>
<tr>
<td>2 10 V DC</td>
<td>100% setpoint</td>
</tr>
</tbody>
</table>

#### Characteristic of the actual value signal

<table>
<thead>
<tr>
<th>Volume flow</th>
<th>Actual value signal U</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 10 V DC</td>
<td>0 min unit</td>
</tr>
<tr>
<td>2 10 V DC</td>
<td>100% actual flow</td>
</tr>
</tbody>
</table>

#### Setting range

<table>
<thead>
<tr>
<th>Volume flow</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 10 V DC</td>
<td>0 min unit</td>
</tr>
<tr>
<td>2 10 V DC</td>
<td>100% actual flow</td>
</tr>
</tbody>
</table>

#### Equation

0 10 V DC

\[
\dot{V}_{\text{setpoint}} = \frac{Y}{10} (V_{\max} - V_{\min}) + V_{\min}
\]

0 10 V DC

\[
\dot{V}_{\text{actual}} = \frac{U}{10} V_{\text{nom}}
\]

2 10 V DC

\[
\dot{V}_{\text{setpoint}} = \frac{Y-2}{8} (V_{\max} - V_{\min}) + V_{\min}
\]

2 10 V DC

\[
\dot{V}_{\text{actual}} = \frac{U-2}{8} V_{\text{nom}}
\]
**Control components for VAV terminal units**

**Special information – XB0, XG0**

**Compact**

---

### Electrical connection

#### Connecting cable core identification

<table>
<thead>
<tr>
<th>BL</th>
<th>BR</th>
<th>BK</th>
<th>GR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

1. \( \perp, \sim \): Ground, neutral
2. \( \sim, + \): Supply voltage
3. Y/Z: Setpoint value signal and override control
4. U/pp: Actual value signal and communication

Compact: 227V-024-10

---

### Variable volume flow control and override control, voltage signal 0 to 10 V DC

#### Order code detail

Order code detail

---

#### Diagram

- Room temperature controller
  - S5
  - S4
  - S3
  - S1

#### Switch functions

- All OPEN: Minimum volume flow rate \( V_{\text{min}} \)
- S1 Room temperature control
- S3 Maximum volume flow rate \( V_{\text{max}} \)
- S4 Damper blade CLOSED
  - (only with supply voltage 24 V AC)
- S5 Damper blade OPEN
  - (only with supply voltage 24 V AC)

When combining several override controls
the switches must be interlocked to prevent short-circuits.

Diode: e.g. 1N 4007

Compact: 227V-024-10
Control components for VAV terminal units
Special information – XB0, XG0

Variable volume flow control and override control, voltage signal 2 to 10 V DC

Switch functions
S1 Room temperature control
S2 Shut-off CLOSED
S3 Maximum volume flow rate $\dot{V}_{\text{max}}$
S4 Damper blade CLOSED
   (only with supply voltage 24 V AC)
S5 Damper blade OPEN
   (only with supply voltage 24 V AC)
All OPEN: Minimum volume flow rate $\dot{V}_{\text{min}}$

When combining several override controls the switches must be interlocked to prevent short-circuits.
Diode: e.g. 1N4007

Compact: 227V-024-10
Dual duct terminal units Type TVM

Compact controller for cold air duct

Compact controller for warm air duct

Slave controller Compact

Operating mode S

Operating mode E, M, F

Compact: 227V-024-10
Control components for VAV terminal units
Special information – LN0, LY0

**Application**
- Electronic volume flow controller GLB181.1E/3 as Compact controller
- Variable air or constant air volume flow control
- The flow rate is measured using the dynamic measurement principle
- Voltage range for the actual and setpoint value signals 0 – 10 V DC
- For room temperature controllers with output signal 0 – 10 V DC

**Construction**
- LN0: GLB181.1E/3 for TVR, TVJ, TVT, TZ-Silenzio, TA-Silenzio, TVZ, TVA
- LY0: GLB181.1E/3 for TVM

**Useful additions**
- AT-VAV-S: Adjustment device

**Signal voltage range**
- 0: 0 – 10 V DC

**Operating modes**
- E: Single and M: Master
- $V_{\text{min}}$: Minimum volume flow rate
- $V_{\text{max}}$: Maximum volume flow rate
- S: Slave
  - $V_{\text{min}}$: 0 %
  - $V_{\text{max}}$: Volume flow rate ratio to the master controller
- F: Constant value
  - $V_{\text{min}}$: constant volume flow rate
  - $V_{\text{max}}$: 100 %

Parameters are factory set. The customer defines the required operating mode and the volume flow rates in the order code at the time of ordering.

**Commissioning**
- On-site adjusting is not required
- When installing the VAV terminal units it is important to assign each room the correct unit based on the ordered volume flow rates
- After successful installation and wiring the controller is ready for use

---

**Technical data**

<table>
<thead>
<tr>
<th>Compact controller GLB181.1E/3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supply voltage (AC)</strong></td>
</tr>
<tr>
<td><strong>Power rating (AC)</strong></td>
</tr>
<tr>
<td><strong>Torque</strong></td>
</tr>
<tr>
<td><strong>Running time for 90°</strong></td>
</tr>
<tr>
<td><strong>Setpoint value signal input</strong></td>
</tr>
<tr>
<td><strong>Actual value signal output</strong></td>
</tr>
<tr>
<td><strong>IEC protection class</strong></td>
</tr>
<tr>
<td><strong>Protection level</strong></td>
</tr>
<tr>
<td><strong>EC conformity</strong></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
</tr>
</tbody>
</table>
Control components for VAV terminal units
Special information – LN0, LY0

Compact – DE/en

Function

VAV-Compact

① Rotation stop
② Blade shaft clamp
③ Position indicator
④ Service socket
⑤ Gear release button
⑥ Connections for differential pressure sensor
⑦ Connecting cable

Characteristics

Characteristic of the setpoint value signal

Characteristic of the actual value signal

\[ V_{\text{setpoint}} = \frac{Y_C}{10} (V_{\text{max}} - V_{\text{min}}) + V_{\text{min}} \]

\[ V_{\text{actual}} = \frac{U}{10} V_{\text{nom}} \]
Control components for VAV terminal units
Special information – LN0, LY0

### Electrical connection

#### Connecting cable core identification

<table>
<thead>
<tr>
<th>RD</th>
<th>BK</th>
<th>VI</th>
<th>OR</th>
<th>GR</th>
<th>PK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>G</td>
<td>G0</td>
<td>Y1</td>
<td>Y2</td>
<td>YC</td>
<td>U</td>
</tr>
</tbody>
</table>

1 G: Supply voltage  
2 G0: Ground, neutral  
6 Y1: Override control  
7 Y2: Override control  
8 YC: Setpoint value signal and communication  
9 U: Actual value signal

Compact: GLB181.1E/3

### Variable volume flow control and override control

24 V AC

Switch functions
- S1 Damper blade OPEN
- S2 Damper blade CLOSED
- S1 und S2: Maximum volume flow rate $V_{\text{max}}$
- All OPEN: Room temperature control or minimum volume flow rate $V_{\text{min}}$

Compact: GLB181.1E/3
Compact controller for cold air duct

Compact controller for warm air duct

Slave controller Compact

Dual duct terminal unit Type TVM

Compact: GLB181.1E/3
Variable volume flow control – VARYCONTROL

Basic information and nomenclature

- Product selection
- Principal dimensions
- Nomenclature
- Construction
- Correction values for system attenuation
- Measurements
- Sizing and sizing example
- Function
- Operating modes
### Product selection

<table>
<thead>
<tr>
<th>Type of system</th>
<th>LVC</th>
<th>TVR</th>
<th>TVJ</th>
<th>TVT</th>
<th>TZ-Silenzio</th>
<th>TA-Silenzio</th>
<th>TVZ</th>
<th>TVA</th>
<th>TVM</th>
<th>TVRK</th>
<th>TVLK</th>
<th>TVR-Ex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply air</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extract air</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual duct (supply air)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Duct connection, fan end</strong></td>
<td>▼▼▼▼</td>
<td>▼▼▼▼</td>
<td>▼▼▼▼</td>
<td>▼▼▼▼</td>
<td>●</td>
<td>●</td>
<td>▼▼▼▼</td>
<td>▼▼▼▼</td>
<td>▼▼▼▼</td>
<td>▼▼▼▼</td>
<td>▼▼▼▼</td>
<td>▼▼▼▼</td>
</tr>
<tr>
<td>Circular</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectangular</td>
<td></td>
<td></td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Volume flow rate range

- **Up to [m³/h]**: 1080, 6050, 36360, 36360, 3025, 3025, 6050, 6050, 6050, 6050, 1295, 6050
- **Up to [l/s]**: 300, 1680, 10100, 10100, 840, 840, 1680, 1680, 1680, 1680, 360, 1680

### Air quality

- Filtered: ●●●● ● ● ● ●●●●
- Office extract air: ●●●● ● ● ●●●
- Polluted: ○○○ ○ ○ ●●○
- Contaminated: ●●

### Control function

- Variable: ●●●● ● ● ●●●●●●
- Constant: ●●●● ● ● ●●●●●●
- Min/Max: ●●●● ● ● ●●●●●●
- Pressure control: ○○○ ○ ○ ○○ ○ ○
- Master/Slave: ●●●

### Shut-off mode

- Leakage: ●
- Low leakage: ● ● ● ● ● ●●●●●

### Acoustic requirements

- High < 40 dB(A): ○ ○ ● ● ○ ○ ○ ○
- Low < 50 dB(A): ● ● ● ● ● ● ● ●

### Other functions

- Volume flow rate measurement: ●●●● ● ● ●●●●●●

### Special areas

- Areas with explosive atmospheres: ●
- Labs, clean rooms, operating theatres (EASYLAB, TCU-LON II): ●●●

- Possible:●
- Possible under certain conditions: Robust unit variant and/or specific control component (attachment) or useful additional product: ○
- Not possible: ○
### Principal dimensions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ØD [mm]</td>
<td>Outside diameter of the spigot of the VAV terminal units made of stainless steel.</td>
<td></td>
</tr>
<tr>
<td>OD₁ [mm]</td>
<td>Pitch circle diameter of flanges.</td>
<td></td>
</tr>
<tr>
<td>OD₂ [mm]</td>
<td>Outside diameter of flanges.</td>
<td></td>
</tr>
<tr>
<td>OD₄ [mm]</td>
<td>Inside diameter of the screw holes of flanges.</td>
<td></td>
</tr>
<tr>
<td>L [mm]</td>
<td>Length of unit including connecting spigot.</td>
<td></td>
</tr>
<tr>
<td>L₁ [mm]</td>
<td>Length of casing or acoustic cladding.</td>
<td></td>
</tr>
<tr>
<td>B [mm]</td>
<td>Duct width.</td>
<td></td>
</tr>
<tr>
<td>B₁ [mm]</td>
<td>Screw hole pitch of flange (horizontal).</td>
<td></td>
</tr>
<tr>
<td>B₂ [mm]</td>
<td>Outside dimension of flange (width).</td>
<td></td>
</tr>
<tr>
<td>B₃ [mm]</td>
<td>Outside dimension of flange (height).</td>
<td></td>
</tr>
<tr>
<td>H [mm]</td>
<td>Duct height.</td>
<td></td>
</tr>
<tr>
<td>H₁ [mm]</td>
<td>Screw hole pitch of flange (vertical).</td>
<td></td>
</tr>
<tr>
<td>H₂ [mm]</td>
<td>Outside diameter of flanges.</td>
<td></td>
</tr>
<tr>
<td>H₃ [mm]</td>
<td>Unit height.</td>
<td></td>
</tr>
<tr>
<td>n [ ]</td>
<td>Number of flange screw holes.</td>
<td></td>
</tr>
<tr>
<td>T [mm]</td>
<td>Flange thickness.</td>
<td></td>
</tr>
<tr>
<td>m [kg]</td>
<td>Unit weight including the minimum required attachments (e.g., Compact controller).</td>
<td></td>
</tr>
</tbody>
</table>

### Acoustic data

- **fₜ [Hz]**: Octave band centre frequency.
- **L_{PA} [dB(A)]**: A-weighted sound pressure level of air-regenerated noise of the VAV terminal unit, system attenuation taken into account.
- **L_{PA1} [dB(A)]**: A-weighted sound pressure level of air-regenerated noise of the VAV terminal unit with secondary silencer, system attenuation taken into account.
- **L_{PA2} [dB(A)]**: A-weighted sound pressure level of case-regenerated noise of the VAV terminal unit with secondary silencer, system attenuation taken into account.
- **L_{PA3} [dB(A)]**: A-weighted sound pressure level of case-regenerated noise of the VAV terminal unit with acoustic cladding, system attenuation taken into account.

All sound pressure levels are based on 20 μPa.

### Nomenclature

- **fₜ [Hz]**: Octave band centre frequency.
- **L_{PA} [dB(A)]**: A-weighted sound pressure level of air-regenerated noise of the VAV terminal unit, system attenuation taken into account.
- **L_{PA1} [dB(A)]**: A-weighted sound pressure level of air-regenerated noise of the VAV terminal unit with secondary silencer, system attenuation taken into account.
- **L_{PA2} [dB(A)]**: A-weighted sound pressure level of case-regenerated noise of the VAV terminal unit with secondary silencer, system attenuation taken into account.
- **L_{PA3} [dB(A)]**: A-weighted sound pressure level of case-regenerated noise of the VAV terminal unit with acoustic cladding, system attenuation taken into account.

### Definition of noise

- **L_{PA}**: A-weighted sound pressure level of air-regenerated noise of the VAV terminal unit, system attenuation taken into account.
- **L_{PA1}**: A-weighted sound pressure level of air-regenerated noise of the VAV terminal unit with secondary silencer, system attenuation taken into account.
- **L_{PA2}**: A-weighted sound pressure level of case-regenerated noise of the VAV terminal unit with secondary silencer, system attenuation taken into account.
- **L_{PA3}**: A-weighted sound pressure level of case-regenerated noise of the VAV terminal unit with acoustic cladding, system attenuation taken into account.

All sound pressure levels are based on 20 μPa.
Volume flow rates

$V_{\text{nom}}$ [m³/h] and [l/s]
Nominal volume flow rate (100 %)
- The value depends on product type and nominal size
- Values are published on the internet and in technical leaflets, and stored in the Easy Product Finder design software.
- Reference value for calculating percentages (e.g. $V_{\text{max}}$)
- Upper limit of the setting range and maximum volume flow rate setpoint value for the VAV terminal unit

$V_{\text{min unit}}$ [m³/h] and [l/s]
Technically possible minimum volume flow rate
- The value depends on product type, nominal size and control component (attachment)
- Values are stored in the Easy Product Finder design software
- Lower limit of the setting range and minimum volume flow rate setpoint value for the VAV terminal unit
- Depending on the controller, setpoint values below $V_{\text{min unit}}$ (if $V_{\text{min}}$ equals zero) may result in unstable control or shut-off

$V_{\text{max}}$ [m³/h] and [l/s]
Upper limit of the operating range for the VAV terminal unit that can be set by customers
- $V_{\text{max}}$ can only be smaller than or equal to $V_{\text{nom}}$
- In case of analog signalling to volume flow controllers (which are typically used), the set maximum value ($V_{\text{max}}$) is allocated to the setpoint signal maximum (10 V) (see characteristic)

$V_{\text{min}}$ [m³/h] and [l/s]
Lower limit of the operating range for the VAV terminal unit that can be set by customers
- $V_{\text{min}}$ should be smaller than or equal to $V_{\text{max}}$
- Do not set $V_{\text{min}}$ smaller than $V_{\text{min unit}}$
- Otherwise the control may become unstable or the damper blade may close
- $V_{\text{min}}$ may equal zero
- In case of analog signalling to volume flow controllers (which are typically used), the set minimum value ($V_{\text{min}}$) is allocated to the setpoint signal minimum (0 or 2 V) (see characteristic)

$V$ [m³/h] and [l/s]
Volume flow rate

$\Delta V$ [± %]
Volume flow rate tolerance from setpoint value

$\Delta V_{\text{warm}}$ [± %]
Volume flow rate tolerance for the warm air flow of dual duct terminal units

Characteristic of the setpoint value signal

Characteristic of the actual value signal
Basic information and nomenclature

Differential pressure

\( \Delta p_{st} \text{ [Pa]} \)
Static differential pressure

\( \Delta p_{st,\min} \text{ [Pa]} \)
Static differential pressure, minimum

- The static minimum differential pressure is equal to the pressure loss of the VAV terminal unit when the damper blade is open, caused by flow resistance (sensor tubes, damper mechanism)
- If the pressure on the VAV terminal unit is too low, the setpoint volume flow rate may not be achieved, not even when the damper blade is open
- Important factor in designing the ductwork and in rating the fan including speed control
- Sufficient duct pressure must be ensured for all operating conditions and for all terminal units, and the measurement point or points for speed control must have been selected accordingly to achieve this

Constructions

**Galvanised sheet steel**
- Casing made of galvanised sheet steel
- Parts in contact with the airflow as described for the product type
- External parts, e.g. mounting brackets or covers, are usually made of galvanised sheet steel

**Powder-coated surface (P1)**
- Casing made of galvanised sheet steel, powder-coated RAL 7001, silver grey
- Parts in contact with the airflow are powder-coated or made of plastic
- Due to production, some parts that come into contact with the airflow may be stainless steel or aluminium, powder-coated
- External parts, e.g. mounting brackets or covers, are usually made of galvanised sheet steel

**Stainless steel (A2)**
- Casing made of stainless steel 1.4201
- Parts in contact with the airflow are powder-coated or made of stainless steel
- External parts, e.g. mounting brackets or covers, are usually made of galvanised sheet steel
The quick sizing tables show the sound pressure levels that can be expected in a room both for the air-regenerated noise and for the case-radiated noise. The sound pressure level in a room results from the sound power level of the products – for a given volume flow rate and differential pressure – and the attenuation and insulation on site. Generally accepted attenuation and insulation values have been taken into account. The distribution of air across the ductwork, changes of direction, end reflection, and room attenuation all affect the sound pressure level of the air-regenerated noise. Ceiling insulation and room attenuation influence the sound pressure level of the case-radiated noise.

**Correction values for acoustic quick sizing**

The correction values for the distribution in the ducting are based on the number of diffusers assigned to any one air terminal unit. If there is just one diffuser (assumption: 140 l/s or 500 m³/h), no correction is necessary.

One change of direction, e.g. at the horizontal connection of the diffuser plenum box, has been taken into consideration for the system attenuation values. Vertical connection of the plenum box does not result in a system attenuation. Additional bends result in lower sound pressure levels.

**System attenuation per octave to VDI 2081 for the calculation of the air-regenerated noise**

<table>
<thead>
<tr>
<th>Centre frequency [Hz]</th>
<th>63</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>4000</th>
<th>8000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change of direction</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Mündungsreflexion</td>
<td>10</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Room attenuation</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

The calculation is based on the end reflection for nominal size 250.

**Octave correction for the calculation of case-radiated noise**

<table>
<thead>
<tr>
<th>Centre frequency [Hz]</th>
<th>63</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>4000</th>
<th>8000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling insulation</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Room attenuation</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
Measurements

The acoustic data for the air-regenerated noise and case-radiated noise are determined according to EN ISO 5135. All measurements are carried out in a reverberation chamber to EN ISO 3741.

Measuring the air-regenerated noise

The sound pressure levels for air-regenerated noise $L_{PA}$ given by us result from measurements in a reverberation chamber. The sound pressure $L_p$ is measured for the entire frequency range. The evaluation of the measurements, including system attenuation and A-weighting, results in the sound pressure level $L_{PA}$.

Measuring the case-radiated noise

The sound pressure levels for case-radiated noise $L_{PA2}$ given by us result from measurements in a reverberation chamber. The sound pressure $L_p$ is measured for the entire frequency range. The evaluation of the measurements, including system attenuation and A-weighting, results in the sound pressure level $L_{PA2}$.
Sizing with the help of this catalogue

This catalogue provides convenient quick sizing tables for VAV terminal units. The sound pressure levels for air-regenerated noise and for case-radiated noise are provided for all nominal sizes. In addition, generally accepted attenuation and insulation values have been taken into account. Sizing data for other volume flow rates and differential pressures can be determined quickly and precisely using the Easy Product Finder design programme.

Sizing example

Given data
\[ V_{\text{max}} = 280 \text{ l/s} \quad (1010 \text{ m}^3/\text{h}) \]
\[ \Delta p = 150 \text{ Pa} \]
Required sound pressure level in the room 30 dB(A)

Quick sizing
TVZ-D/200
Air-regenerated noise \( L_{PA} = 23 \text{ dB(A)} \)
Case-radiated noise \( L_{PA3} = 24 \text{ dB(A)} \)

Sound pressure level in the room = 27 dB(A) (logarithmic addition since the terminal unit is installed in the suspended ceiling of the room)

Easy Product Finder

The Easy Product Finder allows you to size products using your project-specific data.

You will find the Easy Product Finder on our website.
Variable volume flow control

The volume flow rate is controlled in a closed loop. The controller receives from the transducer the actual value that results from the effective pressure. For most applications, the setpoint value comes from a room temperature controller. The controller compares the actual value with the setpoint value and alters the command signal of the actuator if there is a difference between the two values.

Correction of duct pressure changes

The controller detects and corrects changes of the duct pressure that may occur, for example, due to volume flow rate changes from other units. Pressure changes will therefore not affect the room temperature.

Variable volume flow

If the input signal is changed, the controller adjusts the volume flow rate to the new setpoint. The variable volume flow rate range is limited, i.e. there is a minimum value and a maximum value. This control strategy can be overridden, e.g. by shutting off the duct.

Supply/extract air tracking control

In individual rooms and closed-off office areas, where the balance between supply and extract air flow rate has to be maintained. Otherwise, annoying whistling noises can occur at door gaps, and the doors can be difficult to open. For this reason, the extract air should also have variable control in a VAV system. The supply air actual value (for dual duct terminal units the actual value signal of the warm air controller) is signalled to the extract air controller (slave controller) as setpoint signal. As a consequence, the extract air always follows the supply air.

**Control loop**

- Effective pressure transducer
- Actuator
- Volume flow controller
- Setpoint value signal

**Control diagram**

- Supply air
- Extract air