Electronic

# VRup/VRpro volume controller

for ventilation and air conditioning systems.

NEW

Versatile.

- Sizes DN 100 to DN 400.
- Operating voltage: 24 V AC/DC.
- Operation modes: Constant, 3-stage, variable (0 – 10 V, 2 – 10 V, adjustable).
- Leak tightness classes according to DIN EN 1751: Casing C, damper 3 and 4.
- Versatile variants for outstanding installation .
- Communication: analogue, with bus capability (MP, KNX, LON, MOD).
- pressure sensor: dynamic, static.
- Actuator: Standard speed, high speed, emergency operation via spring return.

# VRup/VRpro volume flow controller

Overview

## Electronic
## VRup volume flow controller

Pages 3 to 14 and 27 to 31

## Electronic
## VRpro volume flow controller

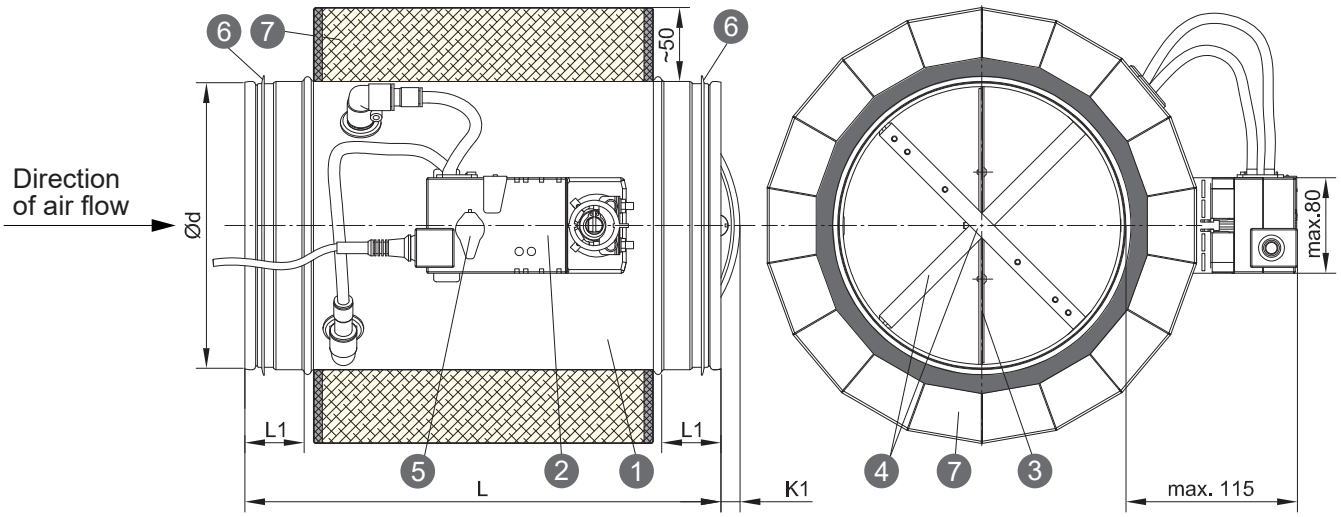
Pages 15 to 26 and 27 to 31

| Product features | | VRup | VRpro |
|---|---|---|---|
| Actuators | Standard speed (110 to 150 s) | ● | ● |
| | High speed (2.5 to 4 s) | | ● |
| | Spring return (150 s, 20 s spring) | | ● |
| Communication | analogue | ● | ● |
| | MP-Bus® | ● | ● |
| | KNX | ● | |
| | LonWorks® | ● | |
| | Modbus RTU | ● | |
| Sensors | dynamic (thermal measurement process)<br>- comfort air<br>- slightly dust-laden air | ● | ● |
| | static (membrane measurement method)<br>- comfort air<br>- slightly dust-laden air<br>- heavily dust-laden air | | ● |
| Installation | Consoles:<br>- manually foldable<br>- relocatable | | ● |
| Options | Lip seals on both sides | ● | ● |
| | Insulation:<br>- prepared for on-site insulation<br>- factory-mounted insulation | ● | ● |
| | Factory presets | ● | ● |
| | SRC duct silencer | ● | ● |

# VRup volume flow controller

## Description






L1 = 40 mm; from DN ≥ 250 L1 = 60 mm

**VRup volume flow controllers** are designed for constant and variable volume in ventilation and air conditioning systems. They can be installed and operated at any position in a supply air and exhaust air ventilation duct.

The casing and control mechanism are made of galvanised sheet steel. The damper blade that regulates the volume is supported centrally and has a peripheral gasket. The bearing axes are made of stainless steel and are guided in special bearing bushes. The measuring cross is made of aluminium.

Five 24 V AC/DC actuators are available.

- Operation of the AN actuator is based exclusively on analogue control.
- The MP actuator can be controlled via MP-Bus® or by analogue control and can be adjusted via an NFC interface.
- The KNX, LON, MOD actuators operate exclusively in their corresponding bus modes.

All actuators support the “Constant”, “Variable 0 – 10 V, 2 – 10 V and adjustable” and “3-stage” operation modes.

Overrides, parallel operation and sequential circuits are possible.

Factory settings can be ordered. Changes can be made on site using a programming unit, also in combination with a PC.

The volume controllers operate to a high degree of precision with roughly only a ± 5% to ± 20% deviation from the actual volume thus maintaining constant volume throughout the entire pressure range of 5 Pa to 1000 Pa.

1 Duct casing
2 Actuator
3 Damper blade
4 Measuring cross
5 Service port for programming unit
6 Lip seal (optional)
7 Acoustic insulation with sheet metal jacket *(optional)*

*Options*

- Lip seals on both sides
- prepared for on-site insulation
- Acoustic insulation with sheet metal jacket, factory-mounted
- Factory presets
  ⇒ see page 13
- SRC duct silencer, available in 600 mm and 900 mm lengths

| Size DN | $V_{limit}$ [m³/h] | $V_{start}$ [m³/h] | $V_{nom}$ [m³/h] | ∅d [mm] | L [mm] | $A_A$ [m²] | K1 [mm] |
|---|---|---|---|---|---|---|---|
| **100** | 31 | 42 | 340 | 99 | 329 | 0.008 | - |
| **125** | 50 | 59 | 530 | 124 | 329 | 0.012 | - |
| **160** | 85 | 103 | 870 | 159 | 329 | 0.020 | - |
| **200** | 140 | 162 | 1360 | 199 | 329 | 0.031 | 13 |
| **250** | 224 | 281 | 2120 | 249 | 406 | 0.049 | - |
| **315** | 366 | 433 | 3370 | 314 | 456 | 0.078 | 21 |
| **400** | 586 | 806 | 5430 | 399 | 551 | 0.126 | 14 |

# VRup volume flow controller

Technical data, nomenclature



## Technical data

- Nominal sizes: DN100, DN125, DN160, DN200, DN250, DN315, DN400
- Area of application:
  - Volume range: 42 m³/h*) to 5430 m³/h*)
  - Flow velocity in $A_A$: 1.50 m/s*) to 12 m/s
- Pressure control range: 5 Pa to 1000 Pa
- Maximum pressure: 2000 Pa
- Leak tightness according to DIN EN 1751:
  - Casing: Class C
  - damper DN100 and DN125: Class 3; DN160 to DN400: Class 4
- Ambient conditions:
  - Temperature: 0 to +50°C
  - Moisture: up to 95%, non-condensing
- Operating voltage: 24 V AC/DC, -10% +20%
- Power consumption, sizing, running time to a displacement of roughly 90°:
  - Actuators DN100 to DN250: 2 W, 4 VA (max. 8 A @ 5 ms), approx. 120 to 150 s
    DN315 to DN400: 3 W, 5 VA (max. 8 A @ 5 ms), approx. 120 to 150 s
- Control:
  - Reference signal, analogue: 0 - 10 V DC, 2 - 10 V DC, adjustable (0 – 32 V DC)
  - Actual value signal, analogue: 0 - 10 V DC, 2 - 10 V DC, adjustable (0 – 10 V DC)
  - Bus operation: MP-Bus®, KNX, LonWorks®, Modbus RTU
- Protection class: III protective extra-low voltage
- Protection rating: IP 54
- Safety: EMC CE in accordance with 2014/30/EG

*) depends on size

## Nomenclature

| | | |
|---|---|---|
| $V$ | [m³/h] | Volume |
| $V_{limit}$ | [m³/h] | Minimum volume to be d |
| $V_{start}$ | [m³/h] | Minimum adjustable volume |
| $V_{nom}$ | [m³/h] | Maximum adjustable volume |
| $V_{start}$ to $V_{nom}$ | | Operating range of volume controller |
| $V_{ref}$, $V_{min}$, $V_{mid}$, $V_{max}$ | [m³/h] | Reference volume |
| $V_{actual}$ | [m³/h] | Actual volume |
| $v_A$ | [m/s] | Flow velocity in $A_A$ |
| $A_A$ | [m²] | cross-section $A_A = \pi/4 \cdot DN^2$ |
| $\Delta p_S$ | [Pa] | Static pressure drop |
| $L_{WA}$ | [dB(A)] | A-weighted sound power level |
| $L_{W\text{-}oct}$ | [dB(A)] | Octave sound power level |
| $L_p$ | [dB] | Sound pressure level |
| $L_{p(A)}$ | [dB(A)] | A-weighted sound pressure level |
| Y | [V] | Reference signal (variable set point input) |
| UG | [V] | Lower limit of Y and U |
| OG | [V] | Upper limit of Y and U |
| U | [V] | Actual value signal |

# VRup volume flow controller

Features

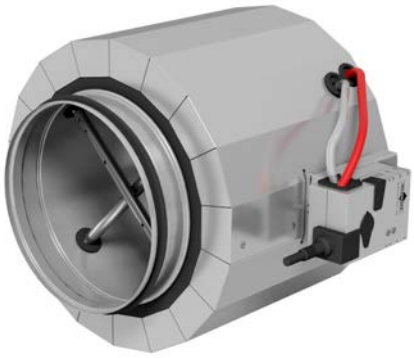


**VRup volume flow controller**

controls the volume via the pressure acting on the measuring cross assisted by a compact actuator which incorporates a sensor and the control technology, in addition to the actuator. Each actuator is equipped with LED status displays, an interlock bypass to allow manual adjustment and a service port.

The sensor operates according to a dynamic measurement principle. Depending on the pressure drop at the measuring cross, a small volume of air through the sensor. This is proportional to the pressure. It is thermally detected and is a measure for the volume .

In addition to a range of actuators, optional lip seals and acoustic insulation variants are available.



**Basic version:**

The actuator is mounted **in a space-saving manner close to the duct casing**.

**Option:**

The VRup volume controller is prepared **for on-site insulation.** The actuator is positioned at a distance of roughly 50 mm from the duct casing for this purpose.

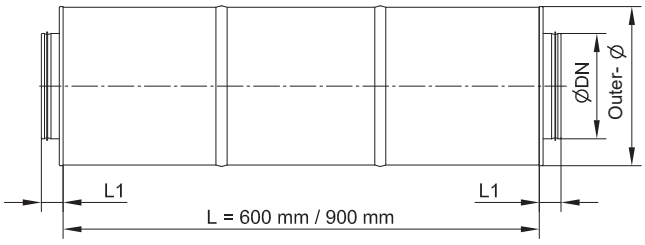
**Option:**

VRup volume controller **with** factory-mounted **acoustic insulation** for thermal insulation and reduction of external sound radiation.

All illustrations show VRup volume controllers with the AN actuator and lip seals!

***Option:***

**SRC duct silencer for volume flow controller** for reduction of noise in the ventilation duct.




Maximum reduction of noise with a

| Size DN | Outer diameter ∅ [mm] | L1 [mm] | Sound attenuator length L [mm] 600 | 900 |
|---|---|---|---|---|
| 100 | 200 | 40 | -27 dB | -31 dB |
| 125 | 225 | 40 | -25 dB | -28 dB |
| 160 | 260 | 40 | -22 dB | -26 dB |
| 200 | 300 | 40 | -20 dB | -25 dB |
| 250 | 355 | 40 | -18 dB | -22 dB |
| 315 | 415 | 40 | -16 dB | -20 dB |
| 400 | 500 | 65 | - | -20 dB |

# VRup volume flow controller

Operation modes (1)



### Function of operation modes

To use the operation modes, the required electrical connections must have been established and the corresponding parameters The volume control is applied as soon as the sensor in the actuator detects a pressure.

Uncontrolled control states, e.g. unwanted closing, can be avoided by specifying the reference volume from $V_{limit}$. The control accuracy is achieved in the volume range of $V_{start}$ to $V_{nom}$. This must be allowed for by specifying $V_{min}$ to ensure the control is for purpose.

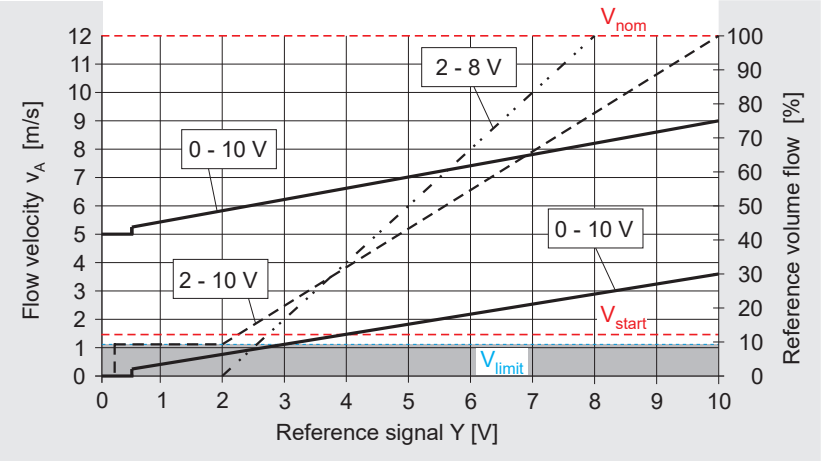
- **Constant:**

  A reference volume is set for $V_{min} < V_{nom}$ in order to keep the controller constant.

- **Variable:**

  A reference volume range with $V_{min} < V_{max}$ or $V_{min}$ = 0 [m³/h] and $V_{max} \geq 20\%$ $V_{nom}$ is set. Volume which are to be kept constant $V_{ref}$ can be within this range via a reference signal Y [V].

  With the analogue actuators AN and MP, this is applied on line 3.




Actuators MP, KNX, LON, MOD ⇒ page 11

### Reference signal Y

- **0 – 10 V**
  - If $V_{min}$ = 0 [m³/h] is set, the damper blade closes completely when Y = 0 to 0.5 V.
    The control function starts from Y ≥ 0.5 V. Illustration based on example $V_{min}$ = 0% and $V_{max}$ = 30%.
  - If $V_{min}$ > 0 m³/h is set, the control function starts from Y = 0 V – without closing – at this value.
    In this case, observe the switching threshold at 0.5 V! Illustration based on example $V_{min}$ = 42% and $V_{max}$ = 75%.
  - **Calculate the reference volume flow $V_{ref}$ for reference signal Y*):**
    $V_{ref}$ [m³/h] = $V_{min}$ [m³/h] + ($V_{max}$ [m³/h] – $V_{min}$ [m³/h]) • Y [V] : 10 V [1]

- **2 – 10 V**
  - If 0 V ≤ Y ≤ 0.1 V, the damper blade closes completely. If 0.1 V ≤ Y ≤ 2 V, the control function starts with $V_{min}$. Illustration based on example $V_{min}$ = $V_{limit}$ and $V_{max}$ = $V_{nom}$.
  - If $V_{min}$ = 0 m³/h is set, the damper blade closes completely when Y = 0 to 2 V.
    The control function starts from Y ≥ 2 V.
  - **Calculate the reference volume flow $V_{ref}$ for reference signal Y*):**
    $V_{ref}$ [m³/h] = $V_{min}$ [m³/h] + ($V_{max}$ [m³/h] – $V_{min}$ [m³/h]) • (Y [V] - 2 V) : 8 V [2]

- **Adjustable** (Y from UG = 0 to 30 V DC up to OG = 2 to 32 V DC) UG and OG can be adjusted in integer increments; in doing so OG must always be 2 V higher than UG.
  - If UG = 0 V, the functions correspond to 0 to 10 V, but in combination with OG instead of 10 V.
  - If UG > 0 V and if 0 V ≤ Y ≤ 0.1 V, the damper blade closes completely.
    If 0.1 V ≤ Y ≤ UG V, the control function starts with $V_{min}$.
  - If $V_{min}$ = 0 m³/h is set, the damper blade closes completely when Y = 0 up to UG V.
    The control function starts from Y ≥ UG V. Illustration based on example 2 to 8 V with $V_{min}$ = 0% and $V_{max}$ = $V_{nom}$.
  - **Calculate the reference volume flow $V_{ref}$ for reference signal Y*):**
    $V_{ref}$ [m³/h] = $V_{min}$ [m³/h] + ($V_{max}$ [m³/h] – $V_{min}$ [m³/h]) • (Y [V] - UG [V]) / (OG [V] - UG [V]) [3]

*) Volume in [% $V_{nom}$] instead of in [m³/h] can also be used. ⇒ see examples on pages 8 and 9
The results of the equation apply for $V_{ref}$ > $V_{limit}$.

# VRup volume flow controller

## Operation modes (2) / ACTUAL volume



- **3-stage:**

  The 3-stage operation is a straightforward alternative to the constant or variable operation, especially with analogue controlled volume controllers. Three volume can be and maintained constant with $V_{min}$, $V_{mid}$ and $V_{max}$. The value for $V_{min}$ can also be set to 0 m³/h for full closing.
  This mode requires the corresponding actuator settings and special 24 V AC connections. ⇒ see page 10

### Override

Overrides require corresponding actuator settings and electrical connection of 24 V AC/DC voltage signals. Analogue and bus controls can be used.

The signals override all operation modes and allow the damper blade to be fully opened or closed. The operating stage $V_{max}$ can also be enforced during constant operation, and the operating stages $V_{min}$ and $V_{max}$ can be enforced during variable operation. ⇒ see page 11

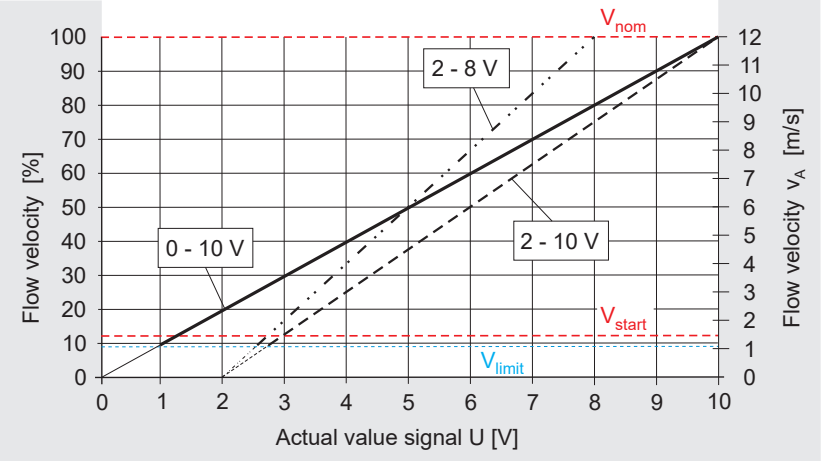
### Actual value signal U

With analogue control of the actuators AN and MP, an actual value signal U which is proportional to the actual volume $V_{act}$ is applied at line 5*) for display of the external volume and as reference signal for sequential circuits.

It is proportional to the maximum volume $V_{nom}$ and does not depend on the settings at the volume controller.

The voltage range is adjustable from UG = 0 to 8 V DC up to OG = 2 to 10 V DC.

*) In bus mode, line 5 is required for data communication! ⇒ see page 11




The following fundamentally applies:

$$V_{act}\ [m^3/h] = V_{nom}\ [m^3/h] \bullet (U\ [V] - UG\ [V]) : (OG\ [V] - UG\ [V]) \quad [1a]$$

$$U\ [V] = UG\ [V] + (OG\ [V] - UG\ [V]) \bullet V_{act}\ [m^3/h] : V_{nom}\ [m^3/h] \quad [1b]$$

The following applies for volume control in the voltage ranges 0 – 10 V and 2 – 10 V:

- For constant operation, the actual value signal U can be ordered in these two settings.
- The voltage range of the actual value signal U is adapted to the reference signal Y for variable operation.

The formulas [1a] and [1b] are used in both cases:

0 – 10 V:

$$V_{act}\ [m^3/h] = V_{nom}\ [m^3/h] \bullet U\ [V] : 10\ V \quad [2a]$$

$$U\ [V] = 10\ V \bullet V_{act}\ [m^3/h] : V_{nom}\ [m^3/h] \quad [2b]$$

2 – 10 V:

$$V_{act}\ [m^3/h] = V_{nom}\ [m^3/h] \bullet (U\ [V] - 2\ V) : 8\ V \quad [3a]$$

$$U\ [V] = 2\ V + 8\ V \bullet V_{act}\ [m^3/h] : V_{nom}\ [m^3/h] \quad [3b]$$

If the upper limit OG of the reference signal Y is set higher than 10 V, the actual value signal U is limited to 0 – 10 V; the formulas [2a] and [2b] apply.
The actual value signal U = 2 – 10 V is set in 3-stage operation; the formulas [3a] and [3b] apply.

# VRup volume flow controller

Stand-alone operation, parallel operation and Master/Slave sequential operation, examples (1)



During **stand-alone operation**, the volume controller is operated in one of the available operation modes.

During **parallel operation**, this two or more. The reference signals are always identical and electrically connected either individually or in parallel to line 3. When connected in parallel, controllers operate independently of one another. Reference volume $\mathbf{V_{min}}$, $\mathbf{V_{mid}}$, $\mathbf{V_{max}}$ can be adjusted independently of one another, and according to the size and operation modes of the controller. If changes are made to one controller, this does not the others.

During **Master/Slave sequential operation**, the actual volume $V_{act}$ of one controller guides the reference volume $V_{ref}$ of another.

With analogue control, the **actual value signal U** on line 5 of the Master controller is fed on line 3 of the Slave controller as **reference signal Y**.

If "Variable 0 – 10 V", "Variable 2 – 10 V" or "Variably adjustable" is set at the Master, the same mode must be set at the Slave. If a Master is operating in the "Constant" operation mode, the Slave must be operated in the "Variable" operating mode and adapted to the output signal of the Master (0 – 10 V or 2 – 10 V). If the operation mode is set to "3-stage" at the Master, "Variable 2 – 10 V" must be set at the Slave.

## Example 1: Stand-alone operation of volume flow controller and parallel operation with identical volume flow.

If the "Variably adjustable" operation mode is set to 2 to 8 V, the control range is controlled with Y = 2 to 8 V as reference signal.

A reference volume range is with $V_{min} = 35\%\ V_{nom}$ and $V_{max} = 70\%\ V_{nom}$.

According to the formula [3] on page 6, the reference signal obtained with Y = 2 V is:

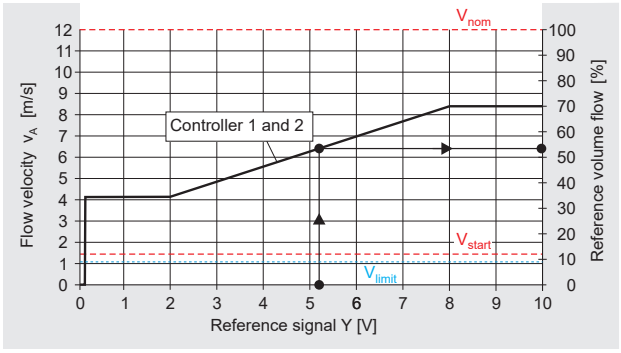
$V_{ref}\ [\%] = 35\% + (70\% - 35\%) \cdot (2\ V - 2\ V) : (8\ V - 2\ V) \quad = 35\%\ V_{nom}$

With Y = 5.2 V as the selected reference signal between 2 and 8 V:

$V_{ref}\ [\%] = 35\% + (70\% - 35\%) \cdot (5.2\ V - 2\ V) : (8\ V - 2\ V) \quad = 54\%\ V_{nom}$

With Y = 8 V as the largest reference signal:

$V_{ref}\ [\%] = 35\% + (70\% - 35\%) \cdot (8\ V - 2\ V) : (8\ V - 2\ V) \quad = 70\%\ V_{nom}$




## Example 2: Parallel operation of volume flow controllers with constant volume flow differential

If the "Variably adjustable" operation mode is set to 2 to 8 V, the control range is controlled with Y = 2 to 8 V as reference signal.

A reference volume range with $V_{min} = 35\%\ V_{nom}$ and $V_{max} = 70\%\ V_{nom}$ is d at controller 1.

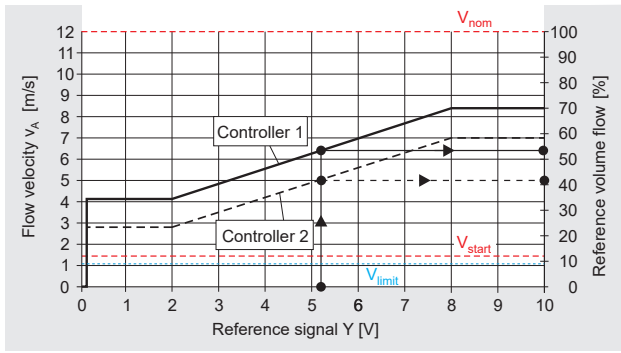
According to the formula [3] on page 6, with, for example, Y = 5.2 V, the following is obtained as possible reference signal between 2 and 8 V:

$V_{ref}\ [\%] = 35\% + (70\% - 35\%) \cdot (5.2\ V - 2\ V) : (8\ V - 2\ V) = 54\%\ V_{nom}$

If a constant volume which is 12% lower is to be established at controller 2, $V_{min} = 23\%\ V_{nom}$ and $V_{max} = 58\%\ V_{nom}$ must be set at this controller.

If Y = 5.2 V then

$V_{ref}\ [\%] = 23\% + (58\% - 23\%) \cdot (5.2\ V - 2\ V) : (8\ V - 2\ V) = 42\%\ V_{nom}$




## Example 3: Parallel operation of volume flow controllers with proportionally-equal volume flow differential

If the operation mode "Variable 0 – 10 V" is set at the controllers, the control range is controlled with Y = 0 to 10 V as reference signal. An initial reference volume range with $V_{min} = 0\%\ V_{nom}$ and $V_{max} = 100\%\ V_{nom}$ is at controller 1.

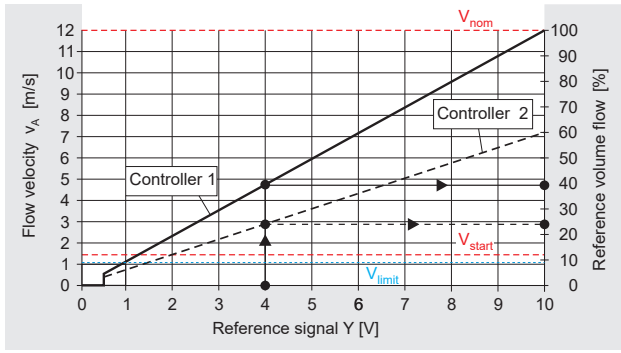
According to the formula [1] on page 6, with for example, Y = 4 V, the following is obtained as possible reference signal between 0 and 10 V:

$V_{ref}\ [\%] = 0\% + (100\% - 0\%) \cdot 4\ V : 10\ V \quad = 40\%\ V_{nom}$

If a volume which is 40% lower is to be established at controller 2, $V_{min} = 0\%\ V_{nom}$ and $V_{max} = 60\%\ V_{nom}$ must be set at this controller.

If Y = 4 V, on the other hand, then:

$V_{ref}\ [\%] = 0\% + (60\% - 0\%) \cdot 4\ V : 10\ V \quad = 24\%\ V_{nom}$

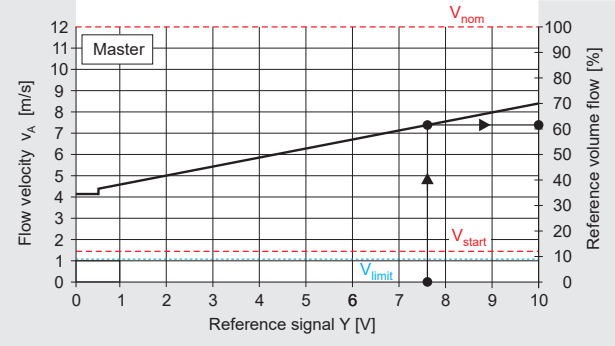


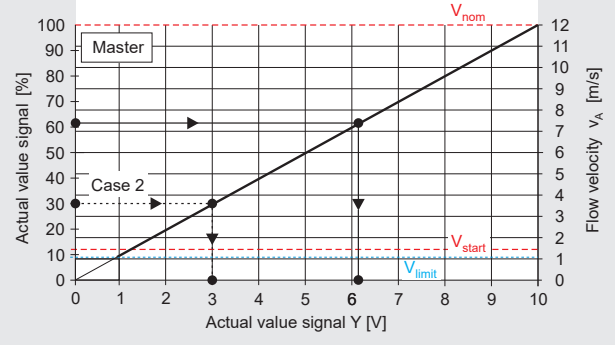
# VRup volume flow controller

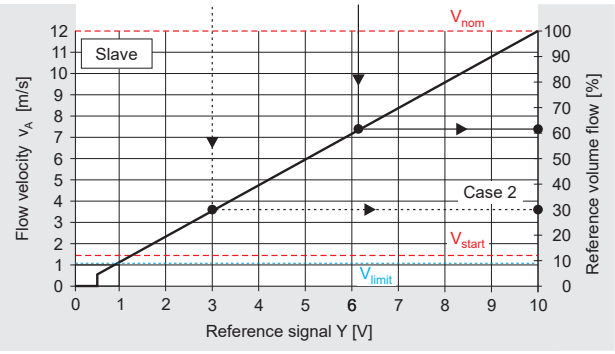
Stand-alone operation, parallel operation and Master/Slave sequential operation, examples (2)



## Example 4: Master/Slave sequential operation to volume flow controller with identical volume flow




The operation modes “Variable 0 – 10 V” are set at the **Master** and **Slave**. The Master is then controlled with Y = 0 to 10 V.

According to page 6, formula [1], the following is obtained for $V_{min}$ = 35% $V_{nom}$ and $V_{max}$ = 70% $V_{nom}$, and also with e.g. Y = 7.6 V:

$V_{ref}$ [%] = 35% + (70% - 35%) • 7.6 V : 10 V = 62% $V_{nom}$

When $V_{act}$ = $V_{ref}$, according to page 6, formula [2b] the actual value signal is:

U [V] = 10 V • $V_{act}$ : $V_{nom}$ = 10 V • 62% : 100% = 6.2 V

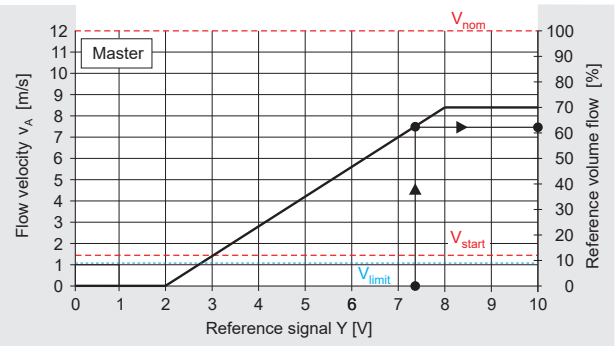
The Master a voltage of 6.2 V as reference signal Y to the Slave. $V_{max}$ = 20% to 100% • $V_{nom}$ can be variably adjusted there.

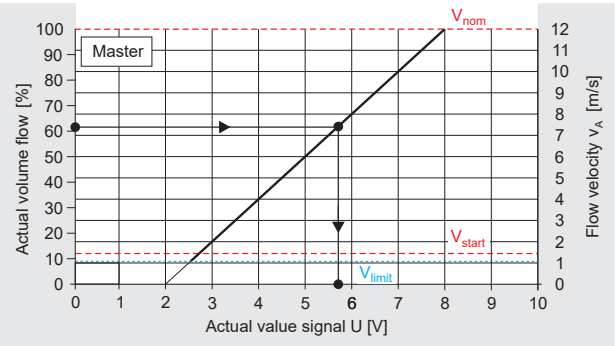
If $V_{max}$ = 100% $V_{nom}$ is set at the Slave, according to formula [1] on page 6:

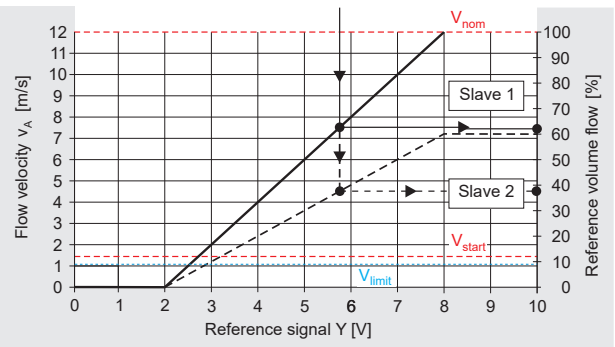
$V_{ref}$ [%] = 0% + (100% - 0%) • 6.2 V : 10 V = 62% $V_{nom}$

If the actual volume at the Master does not reach the reference volume , the Slave follows the actual volume ⇒ see case 2

## Example 5: Master/Slave sequential operation for volume flow controller with identical proportionally-equal volume flow




**Master** and **Slave** are set to 2 to 8 V in the “Variably adjustable” operation mode. The Master is set to $V_{min}$ = 0% $V_{nom}$ and $V_{max}$ = 70% $V_{nom}$ and controlled with Y = 2 to 8 V.

Where Y = 7.3 V, according to formula [3] on page 6

$V_{ref}$ [%] = 0% + (70% - 0%) • (7.3 V - 2 V) : (8 V - 2 V) = 62% $V_{nom}$

Where $V_{act}$ = $V_{ref}$, according to formula [1b] on page 7, the corresponding actual value signal is: U [V] = 2 V + (8 V - 2 V) • 62% : 100% = 5.7 V

The Master a voltage of 5.7 V as reference signal Y to the Slaves. $V_{max}$ = 20% to 100% • $V_{nom}$ can be variably adjusted there.

If $V_{max}$ = 100% $V_{nom}$ and $V_{min}$ = 0% $V_{nom}$ is set at **Slave 1**, according to formula [3] on page 6:

$V_{ref}$ [%] = 0% + (100% - 0%) • (5.7 V - 2 V) : (8 V - 2 V) = 62% $V_{nom}$

If $V_{max}$ = 60% $V_{nom}$ and $V_{min}$ = 0% $V_{nom}$ is set at **Slave 2**, according to formula [3] on page 6:

$V_{ref}$ [%] = 0% + (60% - 0%) • (5.7 V – 2 V) : (8 V - 2 V) = 37% $V_{nom}$

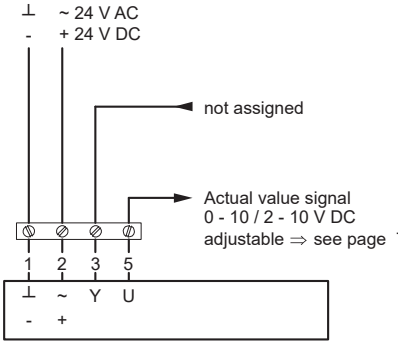
# VRup volume flow controller

Electrical connections (1)



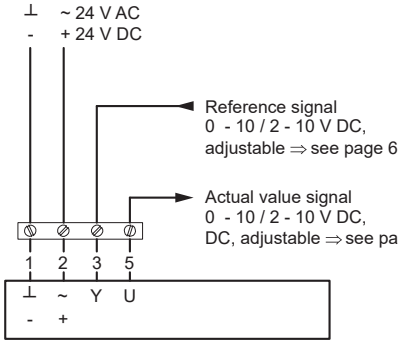
## Electrical connections

### Constant volume flow control



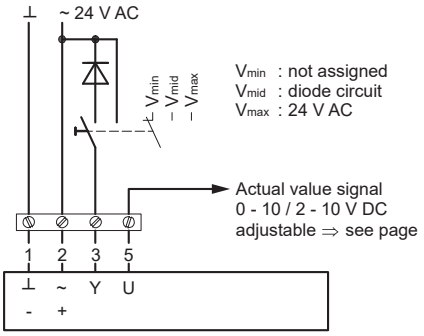

The “Standard” CAV function is preset

### Variable volume flow control



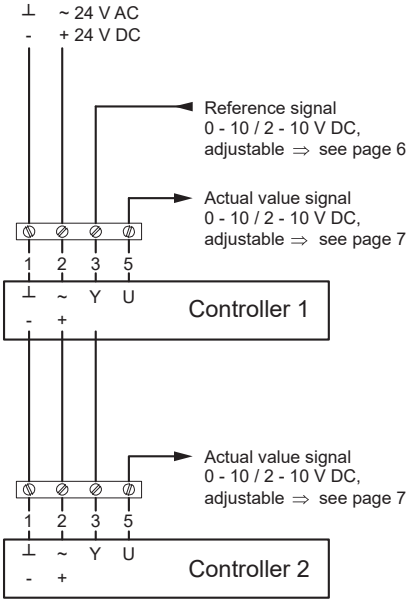

The “Standard” CAV function is preset

### 3-stage volume flow control:

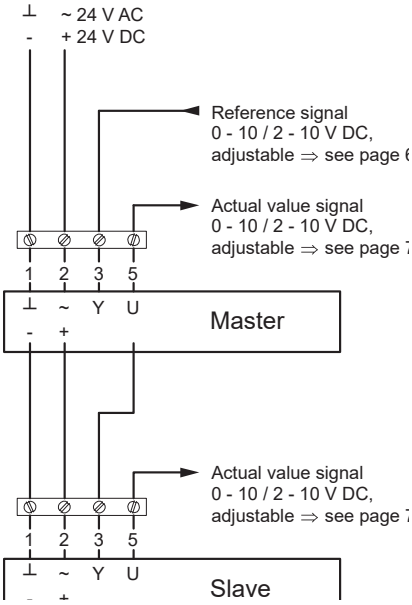



The “NMV-D2M compatible” CAV function is preset.
Pay attention to mutual interlocking of the contacts!

### Connection in parallel




### Sequential circuit



# VRup volume flow controller

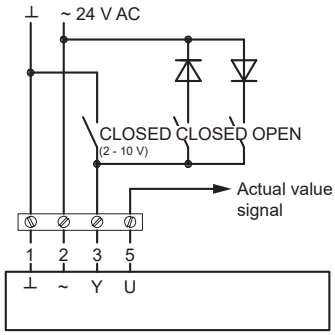
Electrical connections (2)/bus operation

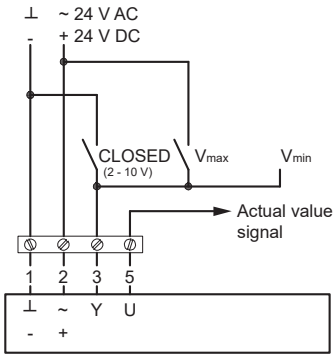


## Electrical connections

### Overrides

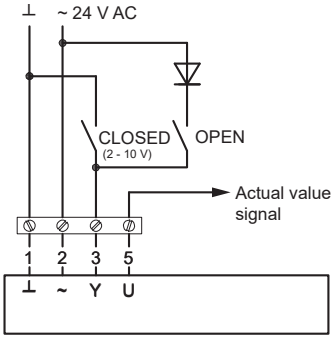
**in the “Constant” or “Variable” operation mode**




The “Standard” CAV function is preset

**In “3-stage” operation mode**

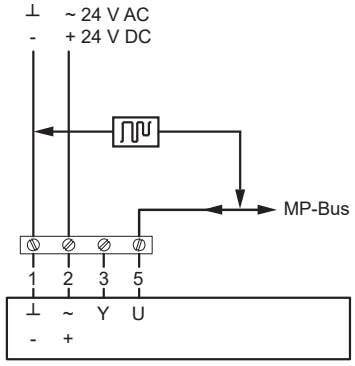


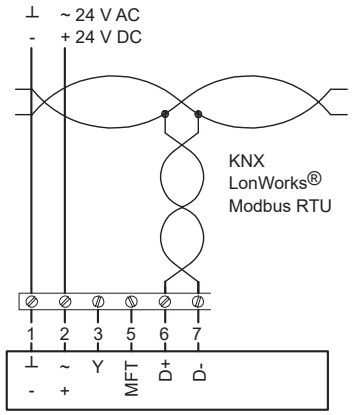

The “NMV-D2M compatible” CAV function is preset.

With overrides, pay attention to mutual interlocking of the contacts!
The CAV function is set at the factory as in the order data; changes can be made via PC and software.

## Bus operation

The VRup volume controller can be incorporated into a higher-level building control system via the **MP**-Bus. The bus connection at the MP actuator is established using conventional 3-core installation cables to lines 5 and 1 (GND). The supply voltage and bus signal are transmitted.




**Function:** The bus operation starts automatically once an address has been assigned. The actuator MP at the VRup volume controller represents one of a maximum of 8 possible slaves. They receive their digital reference signal from the MP master of the building control.

The bidirectional function of the MP-Bus transfers the address, commands, set points, overrides and settings such as $V_{min}$ and $V_{max}$ to each slave.

Each slave sends back its iden and settings, the actual volume , the damper blade setting, status messages and, if applicable, the value of a connected sensor.

The reference variable is d during MP-Bus operation in %. It is 0% = $V_{min}$, 100% = $V_{max}$.

The MP operation mode is therefore similar to the “Variable 0 – 10 V” operation mode, the only being that 0% to 100% is used instead of 0 V and 10 V.

⇒ see page 6

A parallel operation and a sequential circuit can also be put into via the MP-Bus control with identical or varying volume

⇒ see examples 1 to 5, pages 8 and 9

In MP-Bus operation, line 3 can be used for additional functions:

- For connection of analogue sensors or switches. In this case the MP actuator performs the role of an A/D converter and delivers digitalised sensor or switching signals to the Master.
- For local overrides for complete opening and closing or for the operating stage $V_{max}$. The reference variable of the MP-Bus is overridden in this instance.

VRup volume controllers can also be supplied with actuators for **KNX, LON** and **MOD**. They operate exclusively in bus operation and their options are more or less the same as those described for the MP-Bus.

Further information ⇒ see operating instructions.

# VRup volume flow controller

Operation



### Programming unit ZTH-EU

The VRup volume controller can be adjusted and operated using the ZTH-EU programming unit.

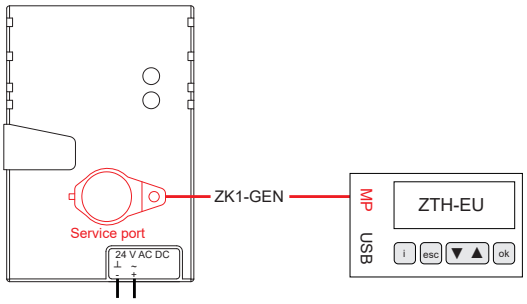
If voltage is supplied to the volume controller and the programming unit is connected with the corresponding cable, it is started and the data of the connected actuator is read out.

Actual values, changes to the settings, e.g. $V_{min}$, $V_{max}$, can be displayed. The keyboard can be used for control, e.g. to override the VRup volume controller.

If bus operation is active, this is interrupted while the ZTH-EU programming unit is connected.

- **Connection to the service port**

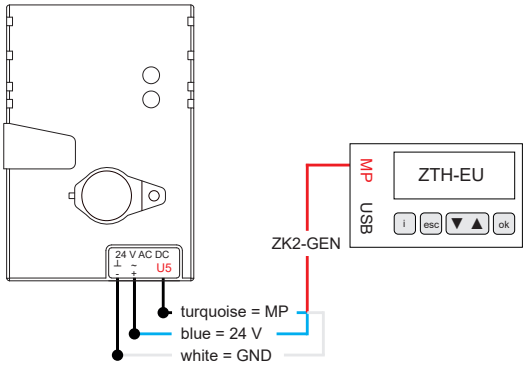
  Connect the ZK1-GEN connection cable (3 m) enclosed with the programming unit to the service port of the actuator.




- **Connection to the connecting duct**

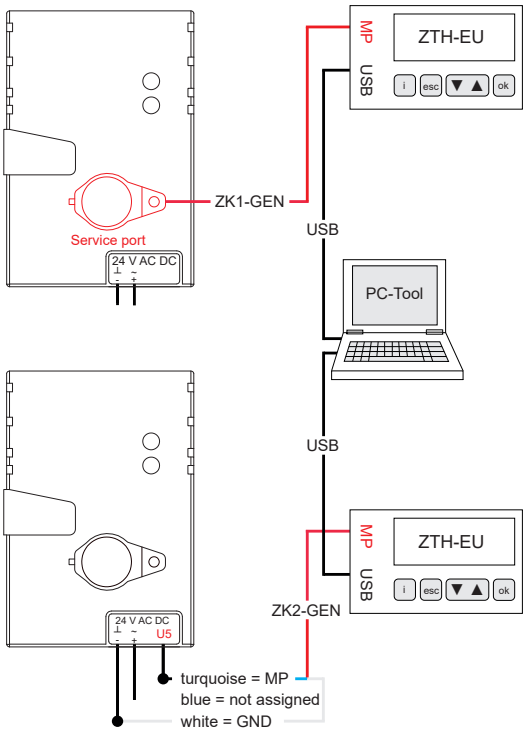
  Connect the ZK2-GEN connection cable (5 m) enclosed with the programming unit to the terminals on the actuator, or to the relevant terminals at the control cabinet.

  It is advisable to route the connection to an accessible location.




- **Connection of PC and ZTH-EU programming unit**

  A comprehensive range of settings can be made using the ZTH-EU programming unit and a PC. The programming unit serves as interface between the actuator and the PC. A USB cable is supplied with the programming unit.

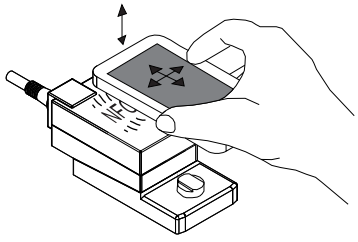



- **NFC - interface**

  MP actuators can be operated via the NFC interface using an NFC-compatible Android Smartphone with an Assistant App.

  Settings can be and actual values read out.

  The actuator does not have to be connected to a power supply in order to do this.



# VRup volume flow controller

## Order data



**VRup** - ___ - ___ - ___ - ___ - ___ - ___ - ___ - ___ ___ - ___

**DN size**
**100 / 125 / 160 / 200 / 250 / 315 / 400**

**24 V AC/DC actuator**

| | |
|---|---|
| - Analogue - Standard - | **AN** |
| - MP-Bus® | **MP** |
| - KNX-Bus | **KNX** |
| - LonWorks® | **LON** |
| - Modbus | **MOD** |

*Option:* **Lip seal**

| | |
|---|---|
| - with two lip seals | **LD** |

*Option:* **Acoustic insulation variants** ⇒ see page 5

| | |
|---|---|
| - for on-site insulation | **BD** |
| - with acoustic insulation | **DS** |

Operation mode

| | |
|---|---|
| - constant (U = 0 – 10 V) | **K01** |
| - constant (U = 2 – 10 V) | **K21** |
| - 3-stage: | **3P** |
| - variable, 0 – 10 V - **Standard** - | **01** |
| - variable, 2 – 10 V | **21** |
| - variable, adjustable | **VA** |
| - lower limit UG = 0 to 30 V | **UG =** |
| - upper limit OG = 2 to 32 V | **OG =** |

*Option:* **Factory presets**
for reference volume [m³/h] [1)]

| | |
|---|---|
| - constant reference volume | $\mathbf{V_{const}}$ = |
| - minimum reference volume | $\mathbf{V_{min}}$ = |
| - average reference volume | $\mathbf{V_{mid}}$ = |
| - maximum reference volume | $\mathbf{V_{max}}$ = |

*Option:* **Plant installation height** [1)]
values from 0 m to 3000 m **AH =**

**Duct silencer**
(attachment on site)
SRC 600 (up to DN 315)
SRC 900
⇒ see pages 5 and 17

[1)] The volume controllers are preset for a plant installation height of 120 m as **standard** and for:

$V_{const}$ = 50% $V_{nom}$; or for: $V_{min}$ = 25% $V_{nom}$ ; $V_{mid}$ = 50% $V_{nom}$; $V_{max}$ = 75% $V_{nom}$

Other **customer-specific** factory presettings are possible! The following limits must be observed, depending on the operation mode:

Constant: $V_{limit} \leq \mathbf{V_{const}} \leq V_{nom}$

Variable: $\mathbf{V_{min}}$ = 0 [m³/h] or $V_{limit} \leq \mathbf{V_{min}} < V_{max}$ and 20% $V_{nom} \leq \mathbf{V_{max}} \leq V_{nom}$

3-stage: $\mathbf{V_{min}}$ = 0 [m³/h] or $V_{limit} \leq \mathbf{V_{min}} < \mathbf{V_{mid}} < \mathbf{V_{max}} \leq V_{nom}$

**The presettings are omitted with KNX, LON, MOD!**

# VRup volume flow controller

text



**Electronic volume flow controller for constant and variable volume flow rates. Circular design for position-independent installation in circular ventilation ducts for supply and exhaust air ventilation and air conditioning systems. Duct casing and damper blade made of galvanised sheet steel. Centrally supported damper blade for volume flow control with stainless steel bearing axes in special bushings. With peripheral seal on the damper blade to shut off the ventilation duct.**
**Measuring cross made of aluminium acting as a differential pressure sensor. High degree of accuracy throughout entire volume flow range. The volume flow must be kept constant at variable pressures between 5 and 1000 Pa.**
**24 V AC/DC actuator with LED status indicators, for** analogue actuation/analogue actuation and MP-Bus®/KNX-Bus/LonWorks®/Modbus. **Constant/variable/3-stage operation modes, with 0 to 10 V, 2 to 10 V or adjustable.**
**Can be used for for higher-level overrides to open and close the damper blade and for parallel and sequential operation of several volume flow controllers. With output signal for actual volume flow,** with acoustic insulation and sheet metal jacket with lip seals.
**Leak tightness class C for the casing and leak tightness class 3 or 4 for the damper blade, each according to DIN EN 1751.**

..... **Pc**
**Volume flow:** ..... **m³/h to** ..... **m³/h**
**Maximum pressure loss:** ..... **Pa**
**Maximum sound power level**
**Flow noise** ..... **dB(A)**
including SRC duct silencer
**Radiated noise** ..... **dB(A)**
**Manufacturer:** **WILDEBOER**
**Type:** **VRup**
**Size:** **DN** .....
**complete with fixings deliver:** .....
**install:** ..... .....

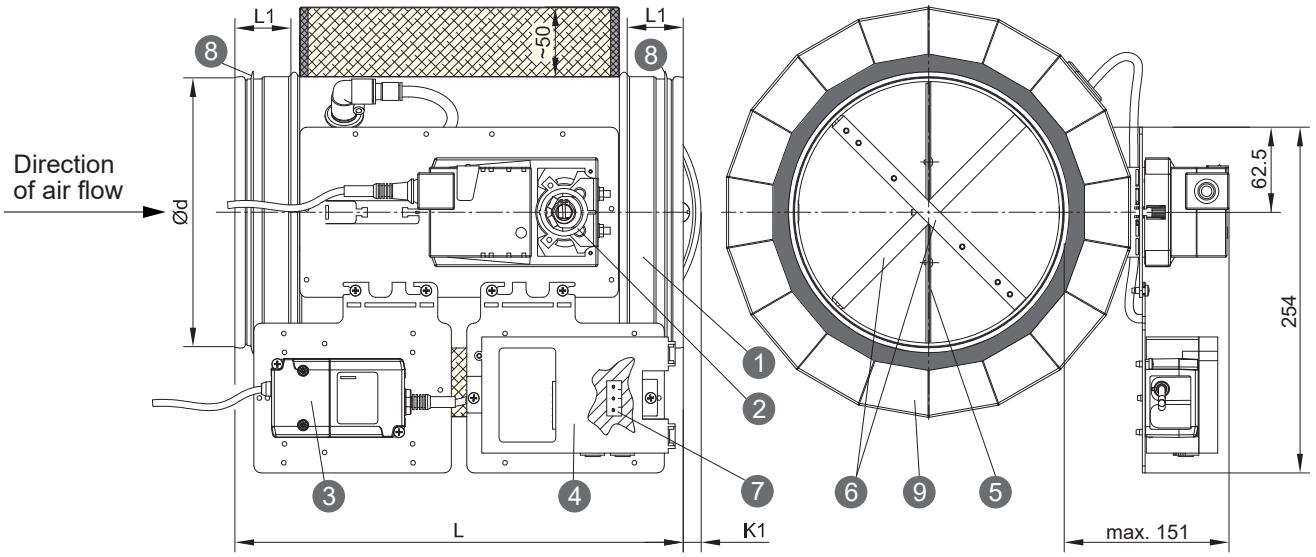
..... **pc SRC duct silencer** 600 / 900
**deliver:** .....
**install:** ..... .....

..... **pc ZTH-EU programming unit for adjustment and operation.**
**deliver:** .....
**install:** ..... .....

Select texts not highlighted in bold as required!

# VRpro volume flow controller

## Description




L1 = 40 mm; from DN ≥ 250 L1 = 60 mm

**VRpro volume flow controllers** are designed for constant and variable volume in ventilation and air conditioning systems. They can be installed and operated at any position in a supply air and exhaust air ventilation duct.

The casing and control mechanism are made of galvanised sheet steel. The damper blade that regulates the volume is supported centrally and has a peripheral gasket. The bearing axes are made of stainless steel and are guided in special bearing bushes. The measuring cross is made of aluminium.

The control components consist of static or dynamic sensors, actuators with standard speed, high speed or spring return and a controller. The sensors and controllers are to mounting brackets which can be manually folded or moved if space is restricted.

The control and electrical connection of the VRpro volume controller is achieved by analogue means, or via MP-Bus®.

All control components support the “Constant”, “Variable 0 – 10 V, 2 – 10 V adjustable”, and “3-stage” operation modes.

Overrides, parallel operation and sequential circuits are possible.

Factory settings can be ordered. Changes can be made on site using a programming unit, also in combination with a PC.

The volume ow controllers operate to a high degree of precision with roughly only a ± 5% to ± 20% deviation from the actual volume ow; thus maintaining constant volume ows throughout the entire pressure range of 5 Pa to 1000 Pa.

1 Duct casing
2 Actuator
3 Sensor with removable mounting console
4 Controller with removable mounting console
5 Damper blade
6 Measuring cross
7 Service port for programming unit
8 Lip seal *(Option)*
9 Acoustic insulation with sheet metal jacket*(Option)*

*Options*

- Lip seals on both sides
- prepared for on-site insulation
- Acoustic insulation with sheet metal jacket, factory-mounted
- Factory presets ⇒ see page 25
- SRC duct silencer, available in 600 mm and 900 mm lengths

| Size | $V_{limit}$ | $V_{start}$ 1) | $V_{start}$ 2) | $V_{nom}$ | Ød | L | $A_A$ | K1 |
|---|---|---|---|---|---|---|---|---|
| **DN** | [m³/h] | [m³/h] | [m³/h] | [m³/h] | [mm] | [mm] | [m²] | [mm] |
| **100** | 39 | 44 | 65 | 340 | 99 | 329 | 0.008 | - |
| **125** | 61 | 71 | 109 | 530 | 124 | 329 | 0.012 | - |
| **160** | 104 | 120 | 184 | 870 | 159 | 329 | 0.020 | - |
| **200** | 172 | 198 | 260 | 1360 | 199 | 329 | 0.031 | 13 |
| **250** | 275 | 317 | 484 | 2120 | 249 | 406 | 0.049 | - |
| **315** | 448 | 517 | 825 | 3370 | 314 | 456 | 0.078 | 21 |
| **400** | 718 | 829 | 1318 | 5430 | 399 | 551 | 0.126 | 14 |

1) Values with dynamic sensor
2) Values with static sensor

# VRpro volume flow controller

Technical data, nomenclature



## Technical data

- Nominal sizes: DN100, DN125, DN160, DN200, DN250, DN315, DN400
- Area of application:
  - Volume range: 44 m³/h*) to 5430 m³/h*)
  - Flow velocity in $A_A$: 1.55 m/s*) to 12 m/s
- Pressure control range: 5 Pa to 1000 Pa
- Maximum pressure: 2000 Pa
- Leak tightness according to DIN EN 1751:
  - Casing: Class C
  - damper DN100 and DN125: Class 3; DN160 to DN400: Class 4:
- Ambient conditions:
  - Temperature: 0 to +50°C
  - Moisture: up to 95%, non-condensing
- Operating voltage: 24 V AC/DC ±10%
- Power consumption, sizing, running time to a displacement of roughly 90°:
  - VRpro with standard speed actuator: DN100 to DN400: 4.6 W, 8.6 VA; approx. 150 s
  - VRpro with high speed actuator: DN100 to DN250: 14.1 W, 25.6 VA; approx. 2.5 s
    DN315 to DN400: 13.1 W, 20.6 VA; approx. 4 s
  - VRpro with spring return actuator: DN100 to DN400: 9.6 W, 13.6 VA; approx. 150 s (actuator)
    approx. 20 s (spring return)
- Control:
  - Reference signal, analogue: 0 – 10 V DC, 2 – 10 V DC, adjustable (0 – 10 V DC)
  - Actual value signal, analogue: 0 – 10 V DC, 2 – 10 V DC, adjustable (0 – 10 V DC)
  - Bus operation: MP-Bus®
- Protection class: III protective extra-low voltage
- Protection rating: IP 40
- Safety: EMC CE in accordance with 2014/30/EG

*) depends on size

## Nomenclature

| | | | | | |
|---|---|---|---|---|---|
| V | [m³/h] | Volume | $Dp_S$ | [Pa] | Static pressure drop |
| $V_{limit}$ | [m³/h] | Minimum volume to be d | $L_{WA}$ | [dB(A)] | A-weighted sound power level |
| $V_{start}$ | [m³/h] | Minimum adjustable volume | $L_{W\text{-}oct}$ | [dB(A)] | Octave sound power level |
| $V_{nom}$ | [m³/h] | Maximum adjustable volume | $L_p$ | [dB] | Sound pressure level |
| $V_{start}$ to $V_{nom}$ | Operating range of volume controller | | $L_{p(A)}$ | [dB(A)] | A-weighted sound pressure level |
| $V_{ref}$, $V_{min}$, $V_{mid}$, $V_{max}$ | [m³/h] | Reference volume | w | [V] | Reference signal (variable set point input) |
| $V_{actual}$ | [m³/h] | Actual volume | UG | [V] | Lower limit for w and U5 |
| $v_A$ | [m/s] | Flow velocity in $A_A$ | OG | [V] | Upper limit for w and U5 |
| $A_A$ | [m²] | cross-section $A_A = p/4 \cdot DN^2$ | U5 | [V] | Actual value signal |

# VRpro volume flow controller

Features

**VRpro volume flow controller**

Control the volume based on the pressure at the measuring cross using the control components controller, sensor and actuator. The controllers are equipped with LED status indicators and a service connection; the actuators can be operated manually.

With the dynamic sensor, a small quantity of the air volume passes through the sensor, depending on the - ential pressure drop at the cruciform. This is proportional to the pressure and is detected thermally.

Air does not through the static sensor. The pressures present at the measuring cross are guided into the measuring chamber of the sensor which is divided by a membrane. The of the membrane which is proportional to the tial pressure is inductively recorded. The sensor signals are a measure of the volume .

In addition to a range of sensors and actuators, lip seals on both sides and various insulation variants are available.

**Basic version:**

Control components and mounting brackets are mounted **close to the duct casing in a space-saving manner**.

**Option:**

The VRpro volume controller is prepared **for on-site acoustic insulation.** For this, the control components and mounting brackets are positioned at a distance of roughly 50 mm from the duct casing.

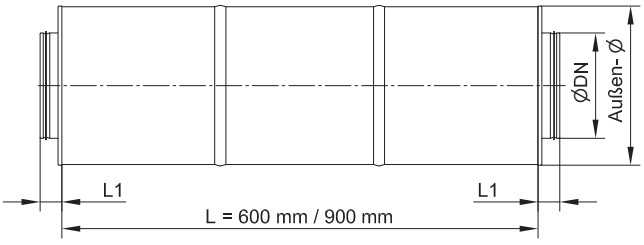
**Option:**

VRpro volume controller **with** factory-mounted **acoustic insulation** for thermal insulation and reduction of external sound radiation.

All illustrations show VRpro volume controllers with spring return actuator, dynamic sensor and lip seals.

***Option:***

**SRC duct silencer for volume flow controller** for reduction of noise in the ventilation duct.




Maximum reduction of noise with a

| Size DN | Outer diameter ∅ [mm] | L1 [mm] | Sound attenuator length L [mm] 600 | 900 |
|---|---|---|---|---|
| 100 | 200 | 40 | -27 dB | -31 dB |
| 125 | 225 | 40 | -25 dB | -28 dB |
| 160 | 260 | 40 | -22 dB | -26 dB |
| 200 | 300 | 40 | -20 dB | -25 dB |
| 250 | 355 | 40 | -18 dB | -22 dB |
| 315 | 415 | 40 | -16 dB | -20 dB |
| 400 | 500 | 65 | - | -20 dB |

# VRpro volume flow controller

Operation modes (1)

### Function of operation modes

To use the operation modes, the required electrical connections must have been established and the corresponding parameters The volume control is applied as soon as the sensor transmits a pressure above the leak low volume limit of 3 Pa; which corresponds to the volume $V_{limit}$.

Specifying a reference volume above $V_{start}$ prevents uncontrolled control states, e.g. unintentional closing, and achieves the accuracy in the volume range up to $V_{nom}$. This must be observed to ensure that control in the lower volume range is for purpose.

- **Constant:**

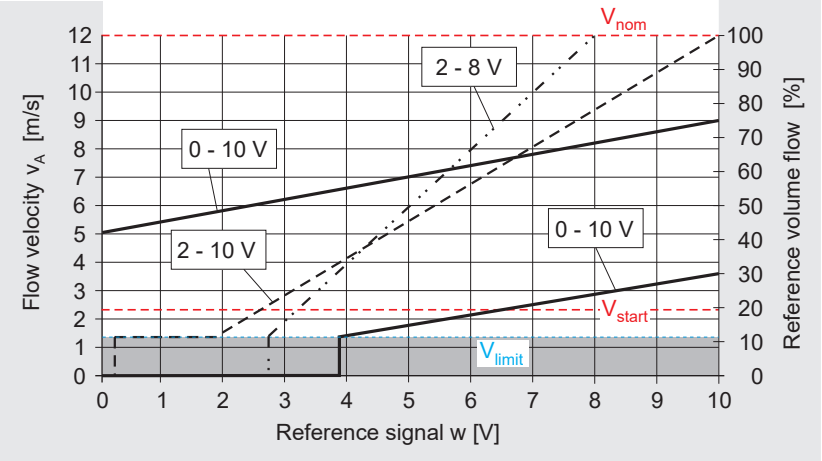
  A reference volume is set for $V_{min} < V_{nom}$ in order to keep the controller constant.

- **Variable:**

  A reference volume range with $V_{min} < V_{max}$ or $V_{min} = 0$ [m³/h] and $V_{max} \geq 30\%$ $V_{nom}$ is set.

  Volume which are to be kept constant by the controller $V_{ref}$ can be specwithin these limits via a reference signal Y [V]. With the VRP-M controller, this is applied at terminal 3.

MP-Bus operation ⇒ page 23




### Reference signal w

- 0 – 10 V
  - If $V_{min} = 0$ [m³/h] is set, the damper blade closes completely when w = 0 to $V_{limit} : V_{max} \cdot 10$ V.
    The control function starts from $w \geq V_{limit} : V_{max} \cdot 10$ V. Illustration based on example $V_{min} = 0\%$ and $V_{max} = 30\%$.
  - If $V_{min} > 0$ m³/h is set, the control function starts from w = 0 V at this value – without closing.
    Illustration based on example $V_{min} = 42\%$ and $V_{max} = 75\%$.
  - **Calculate the reference volume flow $V_{ref}$ for reference signal** w*):
    $V_{ref}$ [m³/h] = $V_{min}$ [m³/h] + ($V_{max}$ [m³/h] – $V_{min}$ [m³/h]) • w [V] : 10 V [1]

- 2 – 10 V
  - If 0 V ≤ w ≤ 0.1 V, the damper blade closes completely. If 0.1 V < w ≤ 2 V, the control function starts with $V_{min}$.
    Illustration based on example $V_{min} = V_{limit}$ and $V_{max} = V_{nom}$.
  - If $V_{min} = 0$ [m³/h] is set, the damper blade closes completely when w = 0 to $V_{limit} : V_{max} \cdot 8$ V + 2 V.
    The control function starts from $w \geq V_{limit} : V_{max} \cdot 8$ V + 2 V.
  - **Calculate the reference volume flow $V_{ref}$ for reference signal** w*):
    $V_{ref}$ [m³/h] = $V_{min}$ [m³/h] + ($V_{max}$ [m³/h] – $V_{min}$ [m³/h]) • (w [V] - 2 V) : 8 V [2]

- **Adjustable** (w from UG = 0 to 8 V DC to OG = 2 to 10 V DC)
  UG and OG can be adjusted in integer increments, in doing so OG must always be 2 V more than UG.
  - If UG = 0 V, the functions correspond to 0 to 10 V, but in combination with OG instead of 10 V.
  - If UG > 0 V and if 0 V ≤ w ≤ 0.1 V, the damper blade closes completely.
    If 0.1 V < w ≤ UG V, the control function starts with $V_{min}$.
  - If $V_{min} = 0$ [m³/h] is set, the damper blade closes completely when w = 0 to $V_{limit} : V_{max} \cdot (OG - UG) + UG$.
    The control function starts from $w \geq V_{limit} : V_{max} \cdot (OG - UG) + UG$.
    Illustration based on example 2 to 8 V with $V_{min} = 0\%$ and $V_{max} = V_{nom}$.
  - **Calculate the reference volume flow $V_{ref}$ for reference signal** w*):
    $V_{ref}$ [m³/h] = $V_{min}$ [m³/h] + ($V_{max}$ [m³/h] – $V_{min}$ [m³/h]) • (w [V] - UG [V]) / (OG [V] - UG [V]) [3]

*) Volume in [% $V_{nom}$] instead of in [m³/h] can also be used. ⇒ see examples on pages 20 and 21
The results of the equation apply for $V_{ref} > V_{limit}$.

# VRpro volume flow controller

## Operation modes (2) / ACTUAL volume

- **3-stage:**

  The 3-stage operation is a straightforward alternative to the constant or variable operation, especially with analogue controlled volume controllers. Three volume can be and maintained constant with $V_{min}$, $V_{mid}$ and $V_{max}$. The value for $V_{min}$ can also be set to 0 m³/h for full closing.
  This mode requires the corresponding actuator settings and special 24 V AC/DC connections. ⇒ see page 22

**Override**

Overrides require electrical connections at terminals 6 and 7 with 24 V AC/DC voltage signals. Analogue and bus controls can be used.

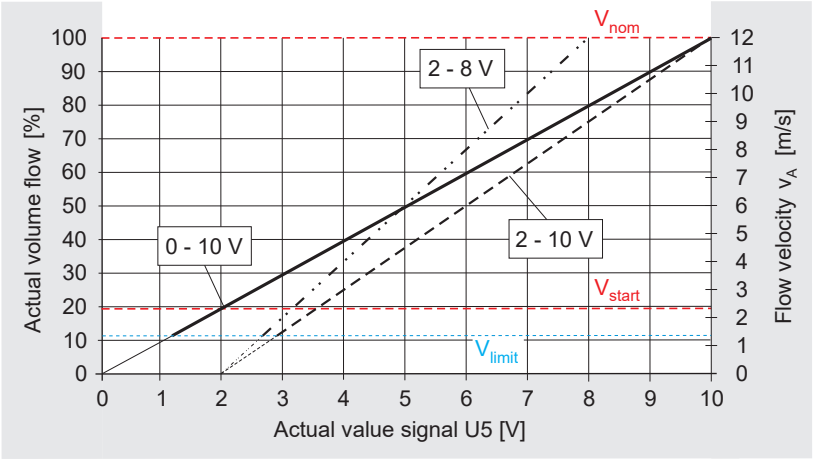
The signals override all operation modes and allow the damper blade to be fully opened or closed. The operating stage $V_{max}$ can also be enforced during constant operation, and the operating stages $V_{min}$ and $V_{max}$ can be enforced during variable operation. ⇒ see page 23

**Actual value signal U5**

For analogue operation of the volume controller, an actual value signal U5 which is proportional to the actual volume $V_{act}$ is available for external volume display and as reference signal for sequential circuits and is applied at terminal 5.

It is proportional to the maximum volume $V_{nom}$ and does not depend on the settings at the volume controller.

The voltage range is adjustable from UG = 0 to 8 V DC up to OG = 2 to 10 V DC.




The following fundamentally applies:

$$V_{act}\ [m^3/h] = V_{nom}\ [m^3/h] \bullet (U\ [V] - UG\ [V]) : (OG\ [V] - UG\ [V]) \quad [1a]$$

$$U5\ [V] = UG\ [V] + (OG\ [V] - UG\ [V]) \bullet V_{act}\ [m^3/h] : V_{nom}\ [m^3/h] \quad [1b]$$

The following applies for volume control in the voltage ranges 0 – 10 V and 2 – 10 V:

- For constant operation, the actual value signal U5 can be ordered in these two settings.
- The voltage range of the actual value signal U5 is adapted to the reference signal w for variable operation.

The formulas [1a] and [1b] are used in both cases:

0 – 10 V:

$$V_{act}\ [m^3/h] = V_{nom}\ [m^3/h] \bullet U\ [V] : 10\ V \quad [2a]$$

$$U5\ [V] = 10\ V \bullet V_{act}\ [m^3/h] : V_{nom}\ [m^3/h] \quad [2b]$$

2 – 10 V:

$$V_{act}\ [m^3/h] = V_{nom}\ [m^3/h] \bullet (U\ [V] - 2\ V) : 8\ V \quad [3a]$$

$$U5\ [V] = 2\ V + 8\ V \bullet V_{act}\ [m^3/h] : V_{nom}\ [m^3/h] \quad [3b]$$

The actual value signal U5 = 2 – 10 V is set in 3-stage operation; the formulas [3a] and [3b] apply.

# VRpro volume flow controller

Stand-alone operation, parallel operation and Master/Slave sequential operation, examples (1)

During **stand-alone operation**, the volume controller is operated in one of the available operation modes.

During **parallel operation** this two or more. The reference signals are always identical and electrically connected either individually or in parallel to terminal 3 (reference signal w). When connected in parallel, controllers operate independently of one another. Reference volume **$V_{min}$, $V_{mid}$, $V_{max}$** can be adjusted independently of one another, and according to the size and operation modes of the controller. If changes are made to one controller, this does not the others.

During **Master/Slave sequential operation**, the actual volume $V_{act}$ of one controller guides the reference volume $V_{ref}$ of another.

With analogue control, the **actual value signal U5** at terminal 5 of the Master controller is fed to terminal 3 of the Slave controller as **reference signal w**.

If "Variable 0 – 10 V", "Variable 2 – 10 V" or "Variably adjustable" is set at the Master, the same mode must be set at the Slave. If a Master is operating in the "Constant" operation mode, the Slave must be operated in the "Variable" operating mode and adapted to the output signal of the Master (0 – 10 V or 2 – 10 V). If the operation mode is set to "3-stage" at the Master, "Variable 2 – 10 V" must be set at the Slave.

## Example 1: Stand-alone operation of volume flow controller and parallel operation with identical volume flow

If the "Variably adjustable" operation mode is set at 2 to 8 V, the control range is controlled with w = 2 to 8 V as reference signal.

A reference volume range is with $V_{min}$ = 35% $V_{nom}$ and $V_{max}$ = 70% $V_{nom}$.

According to the formula [3] on page 18, the reference signal obtained with w = 2 V is:

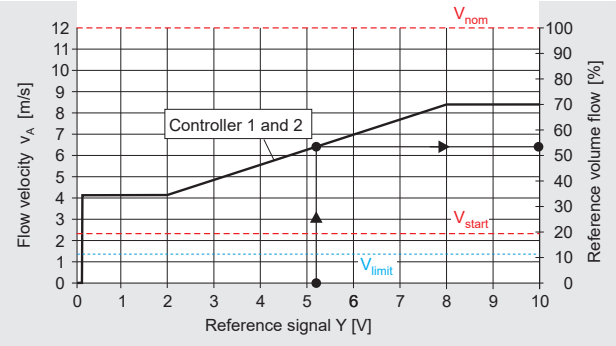
$V_{ref}$ [%] = 35% + (70% - 35%) • (2 V - 2 V) : (8 V - 2 V) = 35% $V_{nom}$

With w = 5.2 V as the selected reference signal between 2 and 8 V:

$V_{ref}$ [%] = 35% + (70% - 35%) • (5.2 V - 2 V) : (8 V - 2 V) = 54% $V_{nom}$

With w = 8 V as the largest reference signal:

$V_{ref}$ [%] = 35% + (70% - 35%) • (8 V – 2 V) : (8 V - 2 V) = 70% $V_{nom}$




## Example 2: Parallel operation of volume flow controllers with constant volume flow differential

If the "Variably adjustable" operation mode is set at 2 to 8 V, the control range is controlled with w = 2 to 8 V as reference signal.

A reference volume range with $V_{min}$ = 35% $V_{nom}$ and $V_{max}$ = 70% $V_{nom}$ is d at controller 1.

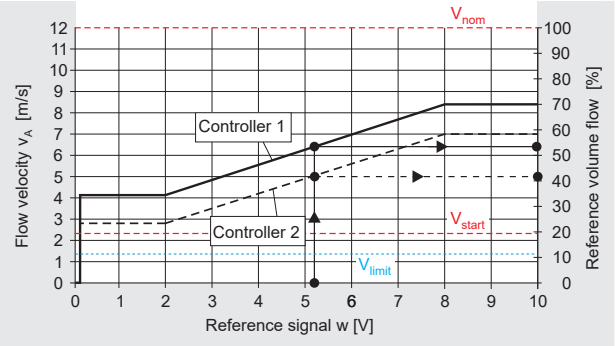
According to the formula [3] on page 18, with, for example, w = 5.2 V, the following is obtained as possible reference signal between 2 and 8 V:

$V_{ref}$ [%] = 35% + (70% - 35%) • (5.2 V - 2 V) : (8 V - 2 V) = 54% $V_{nom}$

If a constant volume which is 12% lower is to be established at controller 2, $V_{min}$ = 23% $V_{nom}$ and $V_{max}$ = 58% $V_{nom}$ must be set at this controller.

If w = 5.2 V then

$V_{ref}$ [%] = 23% + (58% - 23%) • (5.2 V - 2 V) : (8 V - 2 V) = 42% $V_{nom}$




## Example 3: Parallel operation of volume flow controllers with proportionally-equal volume flow differential

If the operation mode "Variable 0 – 10 V" is set at the controllers, the control range is controlled with w = 0 to 10 V as reference signal.

An initial reference volume range with $V_{min}$ = 0% $V_{nom}$ and $V_{max}$ = 100% $V_{nom}$ is at controller 1.

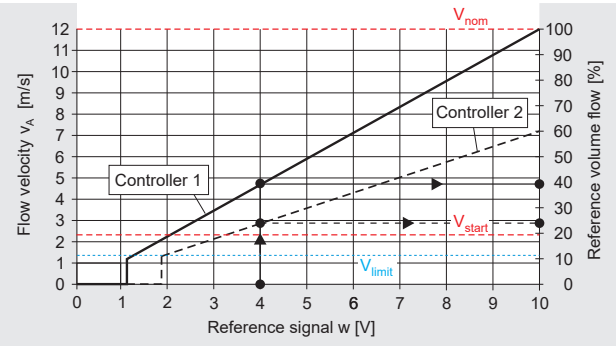
According to the formula [1] on page 18, with, for example, w = 4 V the following is obtained as possible reference signal between 0 and 10 V:

$V_{ref}$ [%] = 0% + (100% - 0%) • 4 V : 10 V = 40% $V_{nom}$

If a volume which is 40% lower is to be established at controller 2, $V_{min}$ = 0% $V_{nom}$ and $V_{max}$ = 60% $V_{nom}$ must be set at this controller.

If w = 4 V, on the other hand, then:

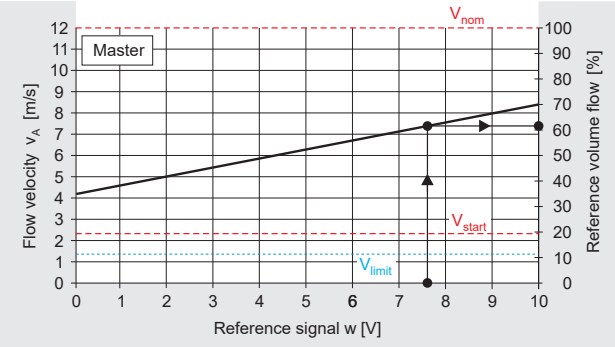
$V_{ref}$ [%] = 0% + (60% - 0%) • 4 V : 10 V = 24% $V_{nom}$

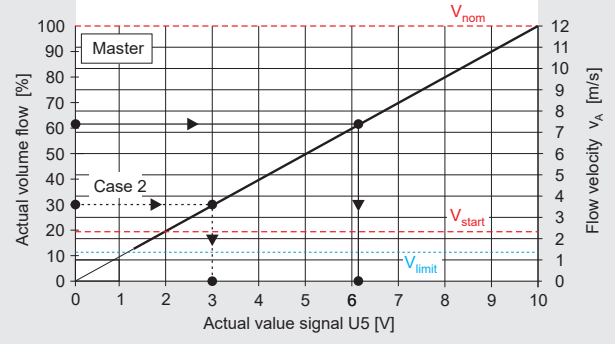


# VRpro volume flow controller

Stand-alone operation, parallel operation and Master/Slave sequential operation, examples (2)

## Example 4: Master/Slave sequential operation to volume flow controller with identical volume flow




The operation modes “Variable 0 – 10 V” are set at the **Master** and **Slave**. The Master is then controlled with w = 0 to 10 V.

According to page 18, formula [1], the following is obtained for $V_{min}$ = 35% $V_{nom}$ and $V_{max}$ = 70% $V_{nom}$, and also with, for example, w = 7.6 V:

$V_{ref}$ [%] = 35% + (70% - 35%) • 7.6 V : 10 V = 62% $V_{nom}$

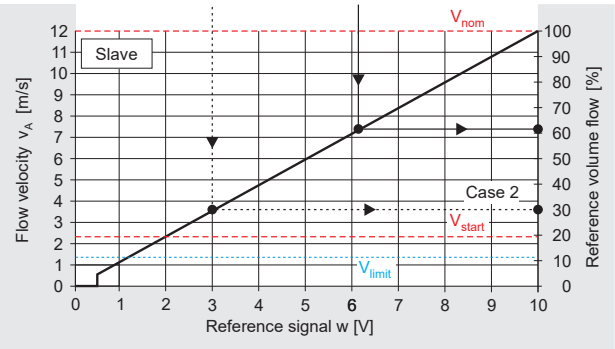
When $V_{act}$ = $V_{ref}$, according to formula [2b] on page 19, the actual value signal is:

U5 [V] = 10 V • $V_{act}$ : $V_{nom}$ = 10 V • 62% / 100% = 6.2 V

The Master a voltage of 6.2 V as reference signal w to the Slave. $V_{max}$ = 30% to 100% • $V_{nom}$ can be variably adjusted there.

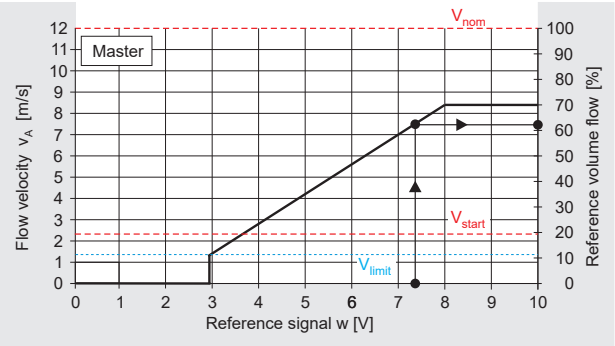
If $V_{max}$ = 100% $V_{nom}$ is set at the Slave, according to formula [1] on page 18:

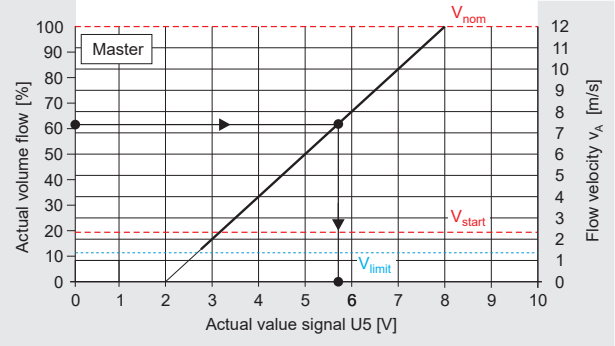
$V_{ref}$ [%] = 0% + (100% - 0%) • 6.2 V : 10 V = 62% $V_{nom}$




If the actual volume at the Master does not reach the reference volume , the Slave follows the actual volume ⇒ see case 2

## Example 5: Master/Slave sequential operation for volume flow controller with identical proportionally-equal volume flow




**Master** and **Slave** are set to 2 to 8 V in the “Variably adjustable” operation mode. The Master is set to $V_{min}$ = 0% $V_{nom}$ and $V_{max}$ = 70% $V_{nom}$ and controlled with w = 2 to 8 V.

If w = 7.3 V, according to formula [3] on page 18:

$V_{ref}$ [%] = 0% + (70% - 0%) • (7.3 V - 2 V) : (8 V - 2 V) = 62% $V_{nom}$

Where $V_{act}$ = $V_{ref}$, according to formula [1b] on page 19, the corresponding actual value signal is:

U5 [V] = 2 V + (8 V - 2 V) • 62% / 100% = 5.7 V

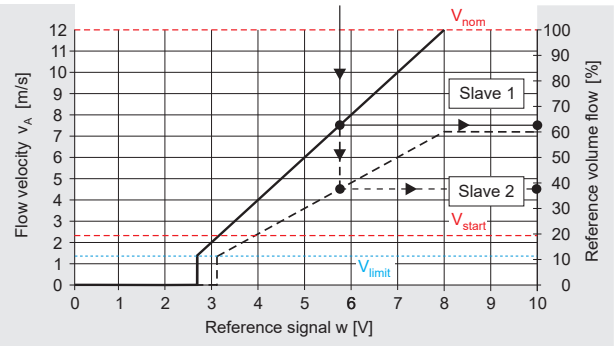
The Master a voltage of 5.7 V as reference signal w to the Slaves. $V_{max}$ = 30% to 100% • $V_{nom}$ can be variably adjusted there.

If $V_{max}$ = 100% $V_{nom}$ and $V_{min}$ = 0% $V_{nom}$ is set at **Slave 1**, according to formula [3] on page 18:

$V_{ref}$ [%] = 0% + (100% - 0 %) • (5.7 V - 2 V) : (8 V - 2 V) = 62% $V_{nom}$

If $V_{max}$ = 60% $V_{nom}$ and $V_{min}$ = 0% $V_{nom}$ is set at **Slave 2**, according to formula [3] on page 18:

$V_{ref}$ [%] = 0% + (60% - 0%) • (5.7 V – 2 V) : (8 V - 2 V) = 37% $V_{nom}$

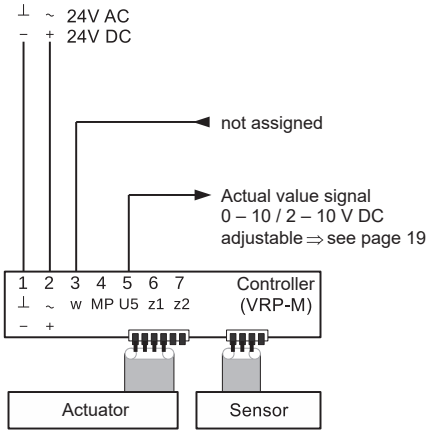


# VRpro volume flow controller

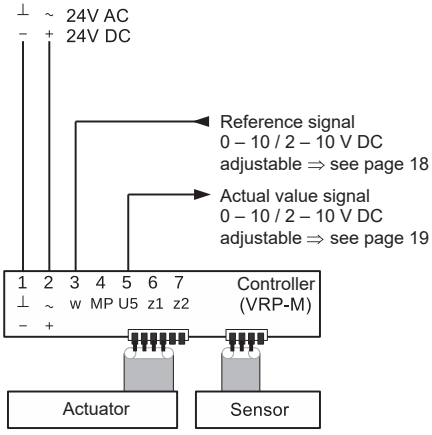
Electrical connections (1)

## Electrical connections

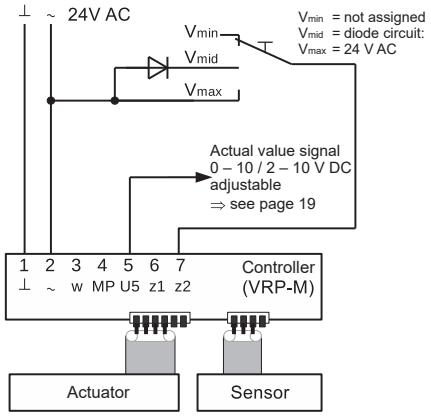
### Constant volume flow control



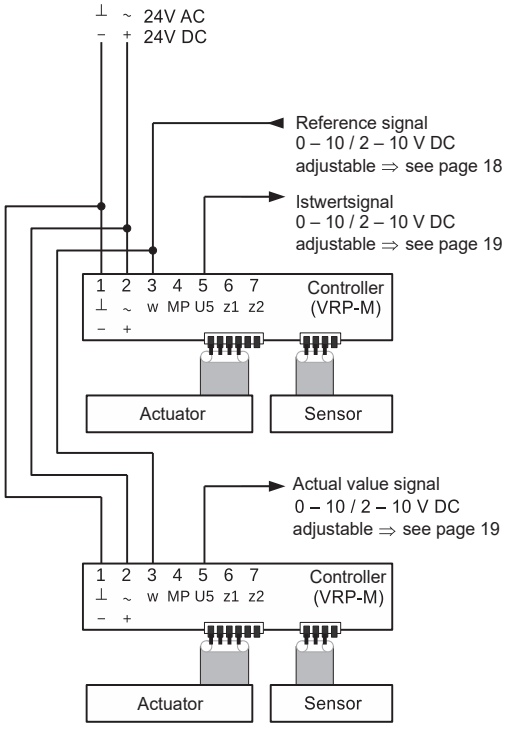

### Variable volume flow control



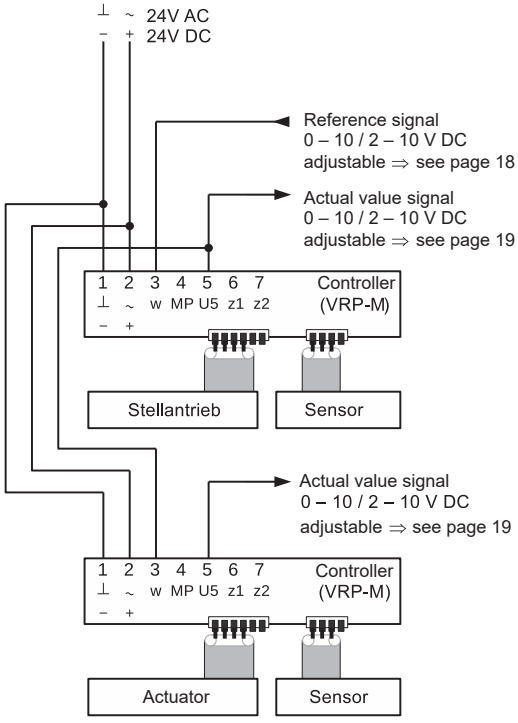

### 3-stage volume flow control:




### Connection in parallel




### Sequential circuit




Pay attention to mutual interlocking of the contacts!

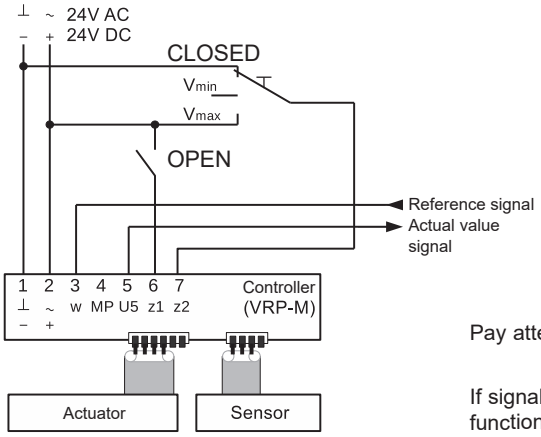
# VRpro volume flow controller

Electrical connections (2)/bus operation

## Electrical connections

### Overrides

**In “Constant”, “Variable” and 3-stage operation mode**

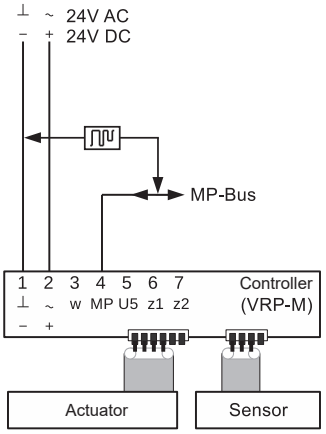



Pay attention to mutual interlocks!

If signals are applied simultaneously at terminals 6 and 7, the input at terminal 6 with the function “OPEN” has the overriding priority.

## Bus operation

The electronic VRpro volume controller can be incorporated into a higher-level building control system via the **MP**-Bus. The bus connection at the VRP-M controller is established using conventional 3-core installation cables at terminal 4 and terminal 1 (GND). The supply voltage and bus signal are transmitted.




**Function:** The bus operation starts automatically once an address has been assigned. The VRP-M controller at the VRpro volume controller represents one of a maximum of 8 possible slaves. They receive their digital reference signal from the MP master of the building control.

The bidirectional function of the MP-Bus transfers the address, commands, set points, overrides and settings such as $V_{min}$ and $V_{max}$ to each slave.

Each slave sends back its iden and settings, the actual volume , the damper blade setting, status messages and, if applicable, the value of a connected sensor.

The reference variable is d during MP-Bus operation in %. It is 0% = $V_{min}$, 100% = $V_{max}$.

The MP operation mode is therefore similar to the “Variable 0 – 10 V” operation mode, the only being that 0% to 100% is used instead of 0 V and 10 V.

⇒ see page 18

A parallel operation and a sequential circuit can also be put into via the MP-Bus control with identical or varying volume

⇒ see examples 1 to 5, pages 20 and 21

In MP bus operation, terminal 3 can be used for additional functions:

- For connection of analogue sensors or switches. In this case, the VRP-M controller performs the role of an A/D converter and delivers digitalised sensor or switching signals to the Master.
- For local overrides for complete opening and closing or for the operating stage $V_{max}$. The reference variable of the MP-Bus is overridden in this instance.

Further information ⇒ see operating instructions.

# VRpro volume flow controller

Operation



### Programming unit ZTH-EU

The VRpro volume controller can be adjusted and operated using the ZTH-EU programming unit.

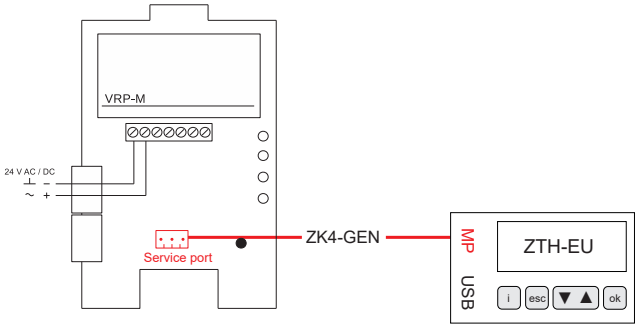
If voltage is supplied to the volume controller and the programming unit is connected with the corresponding cable, it is started and the data of the control component is read out.

Actual values, changes to the settings, e.g. $V_{min}$, $V_{max}$ can be displayed. The keyboard can be used for control, e.g. to override the VRpro volume controller.

To make settings or perform operations with the programming unit in MP-Bus operation, terminal 4 at the controller must be provisionally disengaged; the bus operation is interrupted during this procedure.

- **Connection to the service port**

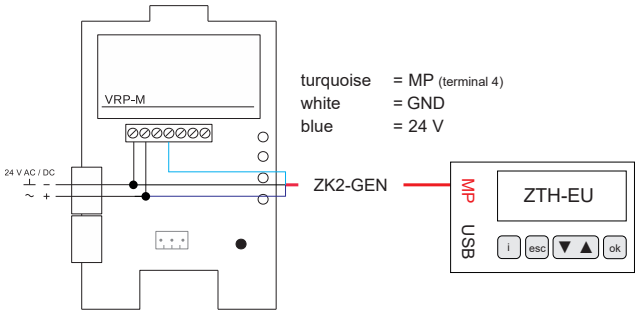
  Connect the ZK4-GEN connection cable (5 m) enclosed with the programming unit to the service port of the VRpro volume controller.




- **Connection to the connecting duct**

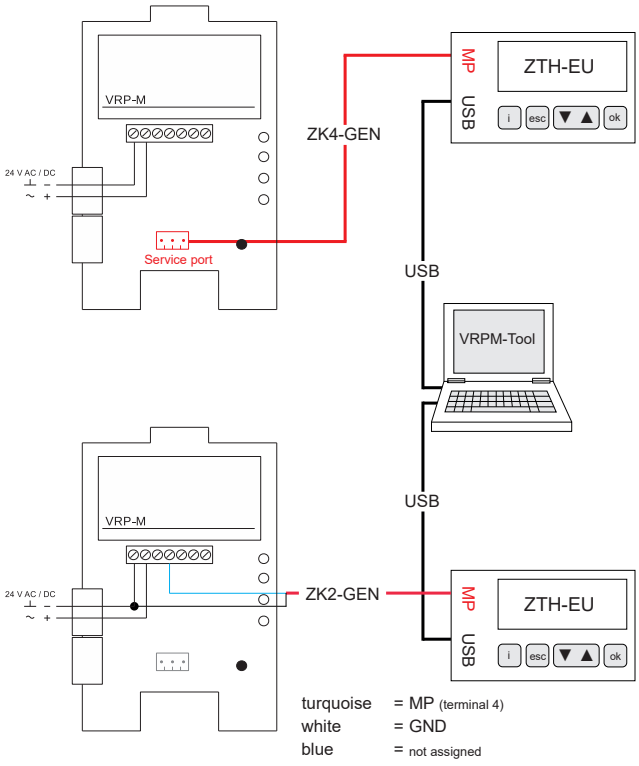
  Connect the ZK2-GEN connection cable (5 m) enclosed with the programming unit to the terminals on the VRP-M controller, or to the relevant terminals at the control cabinet.

  It is advisable to route the connection to an accessible location.




- **Connection of PC and ZTH-EU programming unit**

  A comprehensive range of settings can be made using the ZTH-EU programming unit and a PC. The programming unit serves as interface between the VRP-M controller and the PC. A USB cable is supplied with the programming unit.



# VRpro volume flow controller

## Order data

**VRpro -** ___ - ___ - ___ - ___ - ___ - ___ - ___ - ___ - ___ ___ - ___

**DN size**

**100 / 125 / 160 / 200 / 250 / 315 / 400**

**Control components**

**Actuator:** **Sensor:**

- Standard speed actuator 300 Pa dynamic **3DN**
- Spring return actuator 300 Pa dynamic **3DF**
- High speed actuator 300 Pa dynamic **3DQ**
- Standard speed actuator 300 Pa static **3SN**
- Spring return actuator 300 Pa static **3SF**
- High speed actuator 300 Pa static **3SQ**

**Spring effect** for spring return actuator

- currentless closed **NC**
- currentless open **NO**

*Option:* **Lip seal**

- with two lip seals **LD**

*Option:* **Acoustic insulation variants** ⇒ see page 17

- for on-site insulation **BD**
- with acoustic insulation **DS**

**Operation mode**

- constant (U5 = 0 – 10 V) **K01**
- constant (U5 = 2 – 10 V) **K21**
- 3-stage: **3P**
- variable, 0 – 10 V - **Standard** - **01**
- variable, 2 – 10 V **21**
- variable, adjustable **VA**
  - lower limit UG = 0 to 8 V **UG =**
  - upper limit OG = 2 to 10 V **OG =**

*Option:* **Factory presets**

for reference volume [m³/h] [1)]

- constant reference volume $\mathbf{V_{const}}$ **=**
- minimum reference volume $\mathbf{V_{min}}$ **=**
- average reference volume $\mathbf{V_{mid}}$ **=**
- maximum reference volume $\mathbf{V_{max}}$ **=**

*Option:* **Plant installation height** [1)]

values from 0 m to 3000 m **AH =**

**Duct silencer**
(attachment on site)

SRC 600 (up to DN 315)

SRC 900

⇒ see pages 5 and 17

[1)] The volume controllers are preset for a plant installation height of 120 m as **standard** and for:

$V_{const}$ = 50% $V_{nom}$; or for: $V_{min}$ = 25% $V_{nom}$ ; $V_{mid}$ = 50% $V_{nom}$; $V_{max}$ = 75% $V_{nom}$

Other **customer-specific** factory presettings are possible! The following limits must be observed, depending on the operation mode:

Constant: $V_{limit} \leq \mathbf{V_{const}} \leq V_{nom}$

Variable: $\mathbf{V_{min}}$ = 0 [m³/h] or $V_{limit} \leq \mathbf{V_{min}} < V_{max}$ and 30% $V_{nom} \leq \mathbf{V_{max}} \leq V_{nom}$

3-stage: $\mathbf{V_{min}}$ = 0 [m³/h] or $V_{limit} \leq \mathbf{V_{min}} < \mathbf{V_{mid}} < \mathbf{V_{max}} \leq V_{nom}$

# VRpro volume flow controller

text

**Electronic volume flow controller for constant and variable volume flow rates. Circular design for position-independent installation in circular ventilation ducts for supply and exhaust air ventilation and air conditioning systems. Duct casing, mounting consoles and damper blade made of galvanised sheet steel. Centrally supported damper blade for volume flow control with stainless steel bearing axes in special bushings. With peripheral seal on the damper blade to shut off the ventilation duct.**
**Measuring cross made of aluminium acting as a differential pressure sensor. High degree of accuracy throughout entire volume flow range. The volume flow must be kept constant at variable pressures between 5 and 1000 Pa.**
**24 V AC/DC** standard actuator/spring return actuator/high speed actuator **with LED status indicators,** dynamic/static **sensor and a controller for analogue and digital communication via MP-Bus®. Constant, variable or 3-stage operation modes, with 0 to 10 V, 2 to 10 V or adjustable.**
**Can be used for for higher-level overrides to open and close the damper blade and for parallel and sequential operation of several volume flow controllers. With output signal for actual volume flow,** with acoustic insulation and sheet metal jacket with lip seals.
**Leak tightness class C for the casing and leak tightness class 3 or 4 for the damper blade, each according to DIN EN 1751.**

..... **Pc**
**Volume flow:** ..... **m³/h to** ..... **m³/h**
**Maximum pressure loss:** ..... **Pa**
**Maximum sound power level**
**Flow noise** ..... **dB(A)**
including SRC duct silencer
**Radiated noise** ..... **dB(A)**
**Manufacturer:** **WILDEBOER**
**Type:** **VRpro**
**Size:** **DN** .....
**complete with fixings deliver:** .....
**install:** ..... .....

..... **pc SRC duct silencer** 600 / 900
**deliver:** .....
**install:** ..... .....

..... **pc ZTH-EU programming unit for adjustment and operation.**
**deliver:** .....
**install:** ..... .....

Select texts not highlighted in bold as required!

# VRup/VRpro volume flow controller

## Installation instructions

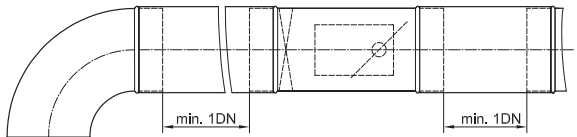
Installation instructions are enclosed with the VRup and VRpro volume controllers.
The operating instructions must also be observed.

- VRup and VRpro are designed for ventilation and air conditioning systems. Suitable air purity is a prerequisite.
- VRup and VRpro volume controllers are adjusted for the entire controllable volume range from $V_{start}$ to $V_{nom}$ and achieve the volume accuracy in this range. Greater deviations may occur at low volume
- For the VRup and VRpro volume controller to work , the oncoming must be extensively undisrupted. Downstream of disruption points (e.g. bends, branches), the straight inlet and outlet sections shown in the examples must be complied with; longer inlet sections may be required for a succession of several disruption points. Otherwise, deviations in the volume must be anticipated.
- VRup and VRpro volume controllers are position-independent. If the VRpro volume controller is mounted in combination with the static sensor VFP-300 with a t orientation to the diagram on the sticker indicating the installation position, this can be compensated for by carrying out a zero point calibration at the sensor.

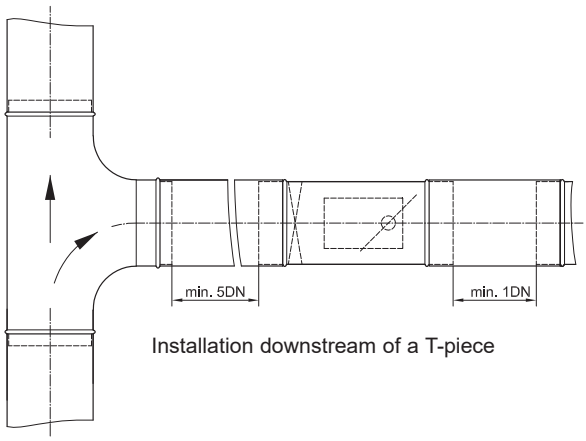
  ⇒ see operating instructions
- VRup and VRpro volume controllers and SRC duct silencers are supplied individually. Assembly on site.
- VRup and VRpro volume controllers are supplied ex works with the damper blade open and with the standard setting or presetting.

  ⇒ see pages 13 and 25
- If no system operating pressure is present, the damper blade opens. If the volume increases to the set point, the VRup and VRpro volume controllers start.

  ⇒ for limitations see pages 28 to 31
- The actuators are overload proof. Compact, standard and high speed actuators stop and remain in their current position in the event of a power failure. The emergency movement (closing or opening) in spring return actuators is via a spring. In this case, all settings are retained.
- Changes can be made on site with the ZTH-EU programming unit; also on a PC using suitable communication software.
- The factory settings of VRup volume controllers for $V_{min}$, $V_{mid}$ and $V_{max}$ can be restored if settings are on site.



Installation downstream of an elbow

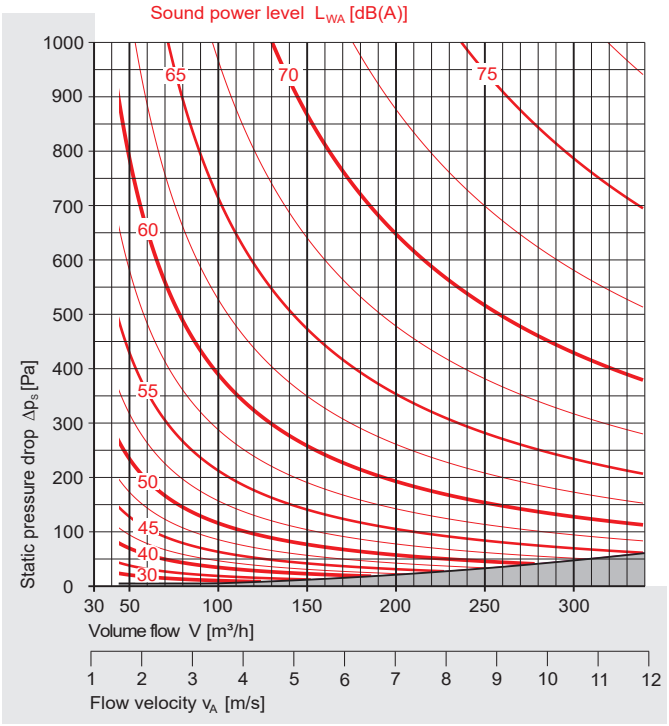


Installation downstream of a T-piece

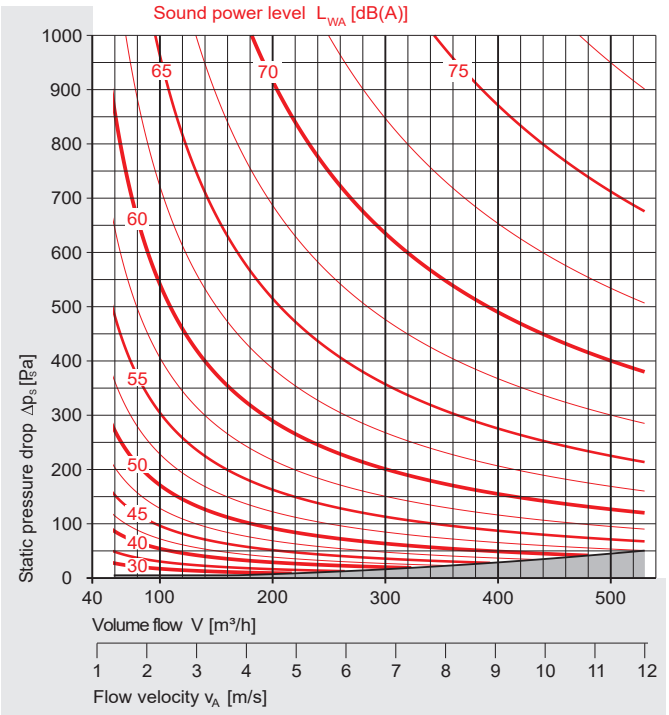
# VRup/VRpro volume flow controller

Sound power level inside the connecting duct – noise – (1)

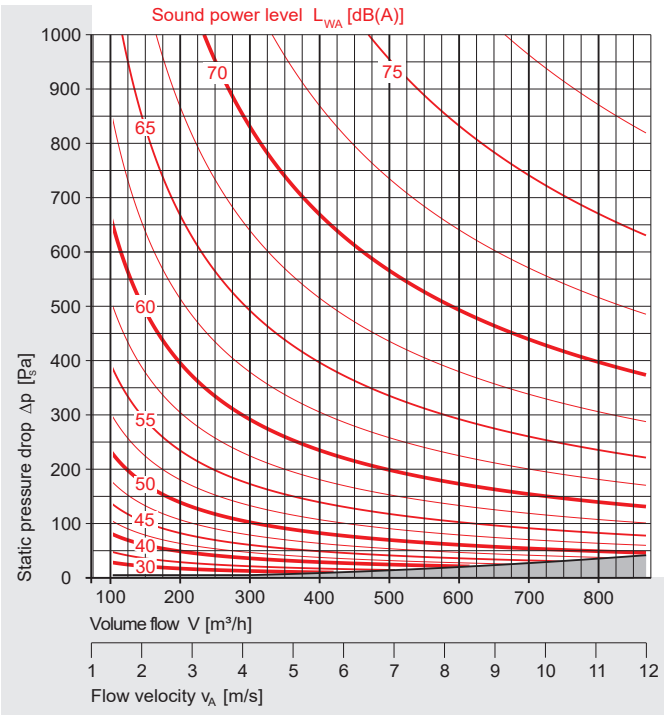
## Size DN 100



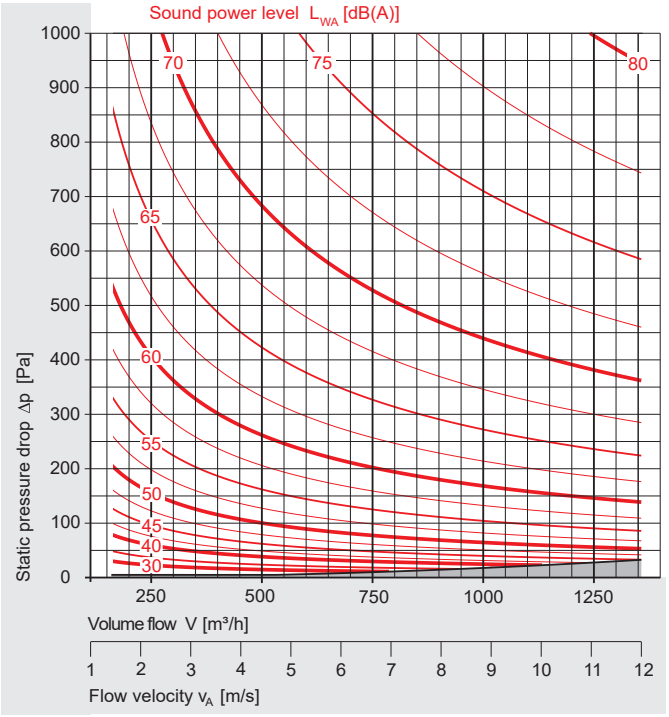

## Size DN 125




## Size DN 160




## Size DN 200



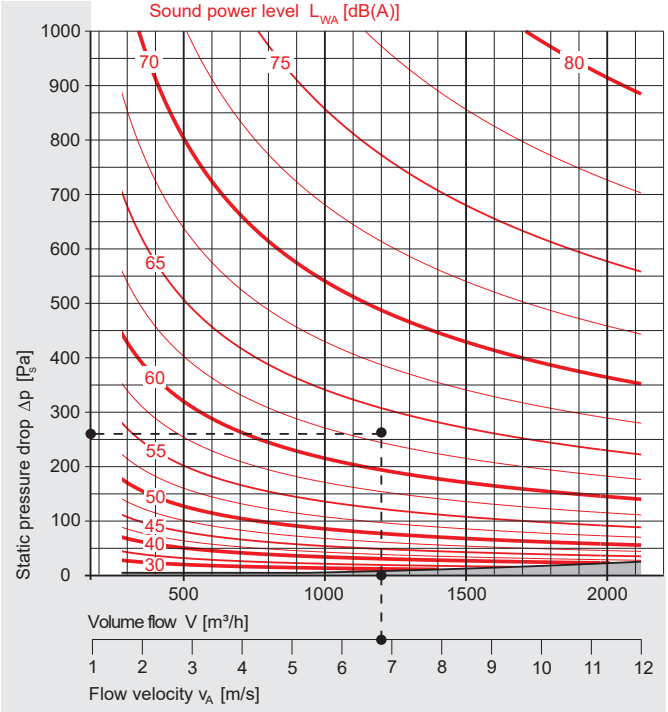

Observe limitations shaded in grey.

Nomenclature ⇒ see pages 4 and 16

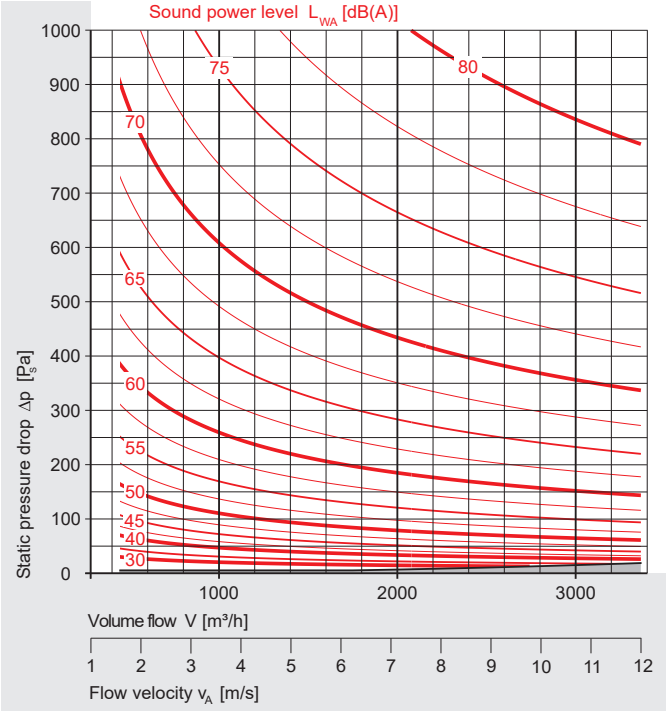
# VRup/VRpro volume flow controller

## Sound power level inside the connecting duct – noise – (2)

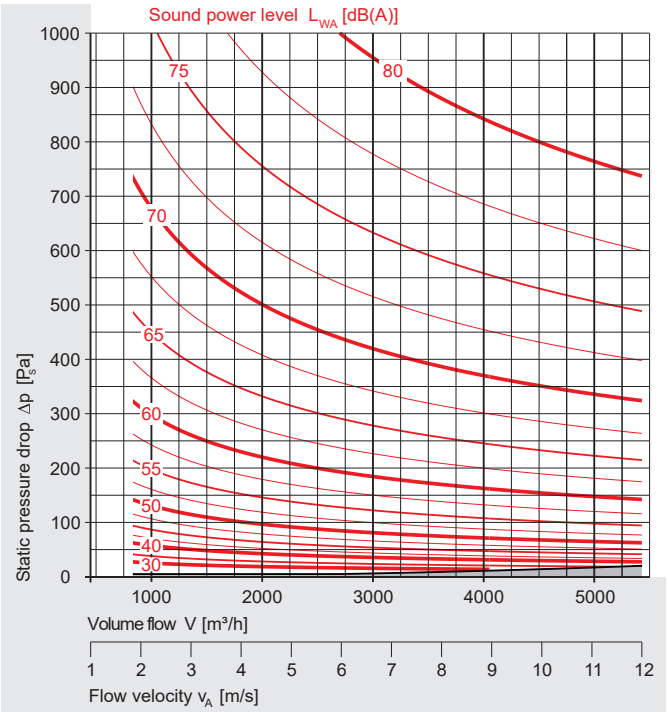
### Size DN 250




### Size DN 315




### Size DN 400




**Example:**

| | | |
|---|---|---|
| | Size | DN 250 |
| | Volume | V = 1200 m³/h |
| | Flow velocity | $v_A$ = 6.8 m/s |
| | static pressure drop | $\Delta p_S$ = 260 Pa |
| Result: | Flow noise | |
| | Sound power level | $L_{WA}$ = 63 dB(A) |

- The sound power level inside the connecting duct is calculated in the nomograms as an A-weighted overall level $L_{WA}$.
  Corresponding octave sound power levels $L_{W\text{-}Oct}$ can be calculated for every size and all operating points using the Wildeboer dimensioning software; also for designs with additional SRC duct silencers.
- With SRC duct silencers, the sound power levels $L_{WA}$ can be reduced by up to 31 dB.

Important: The sound levels indicated in the nomograms are **sound power levels**! The values represent the sound energy introduced into the duct system. They are to be used for acoustic calculations, e. g. when adding sound attenuators.

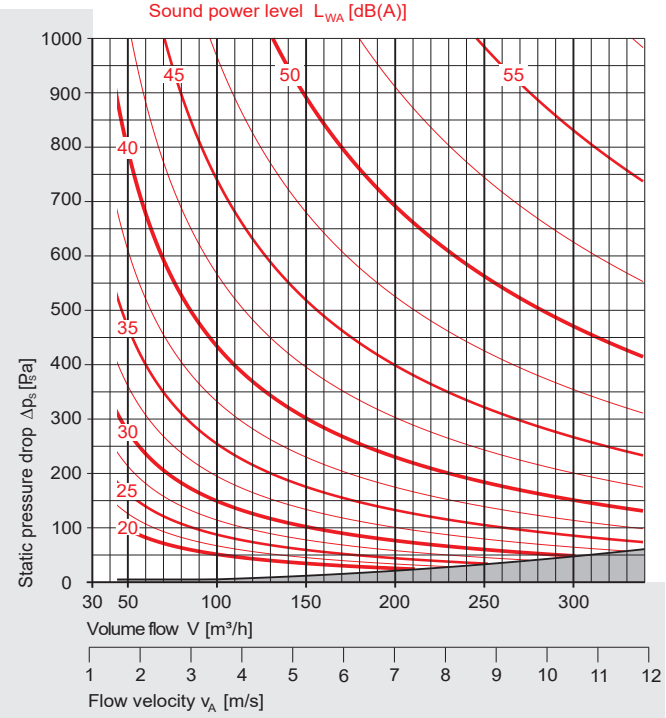
In other documents, **sound pressure levels** $L_p$ or $L_{pA}$ are often instead of sound power levels. They contain standardised attenuations of up to 18 dB. This distinction must be observed when comparing numeric values. Furthermore, the extent of these attenuations only becomes clear once the ducts, branches and spaces have actually been connected.

Further example ⇒ see page 31

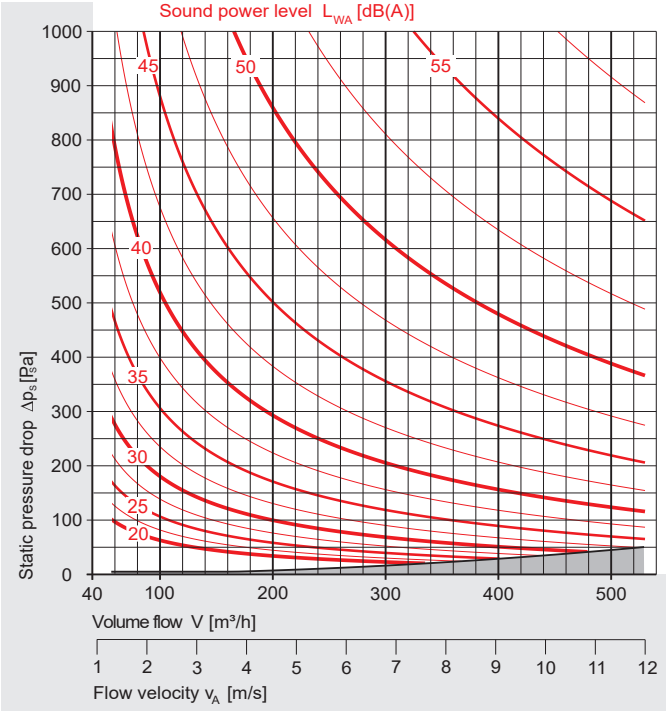
# VRup/VRpro volume flow controller

## Sound power level outside the connecting duct – radiated noise – (1)

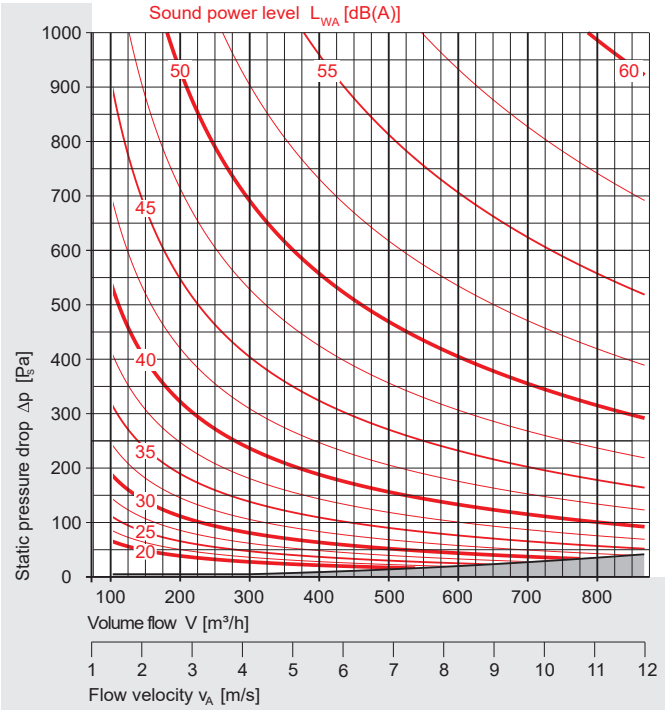
### Size DN 100



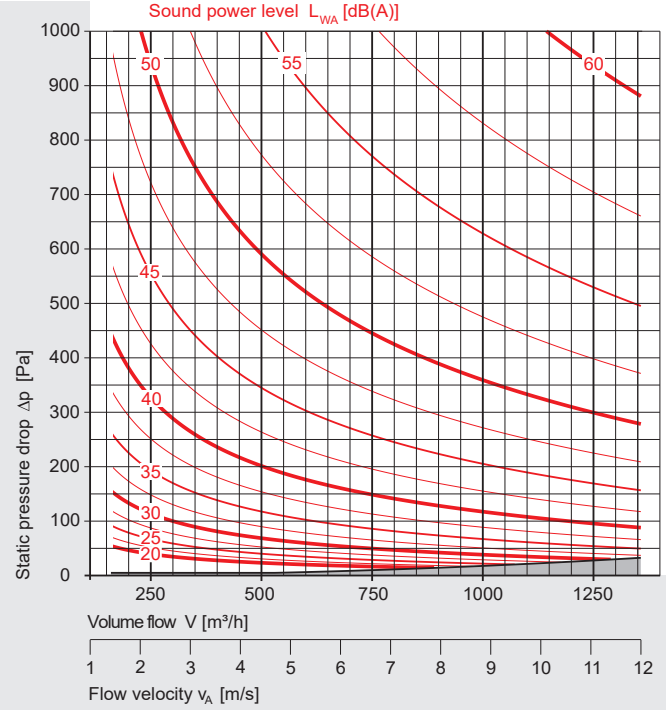

### Size DN 125




### Size DN 160




### Size DN 200



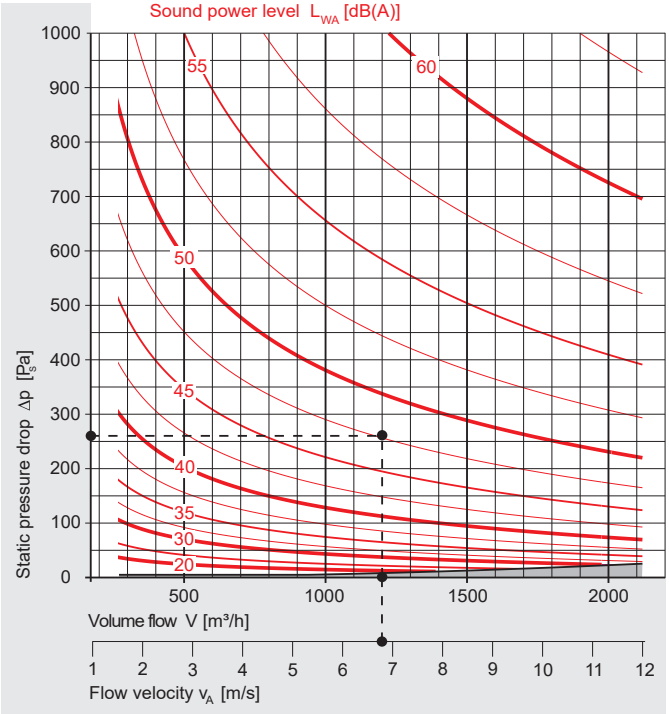

Observe limitations shaded in grey.

Nomenclature ⇒ see pages 4 and 16

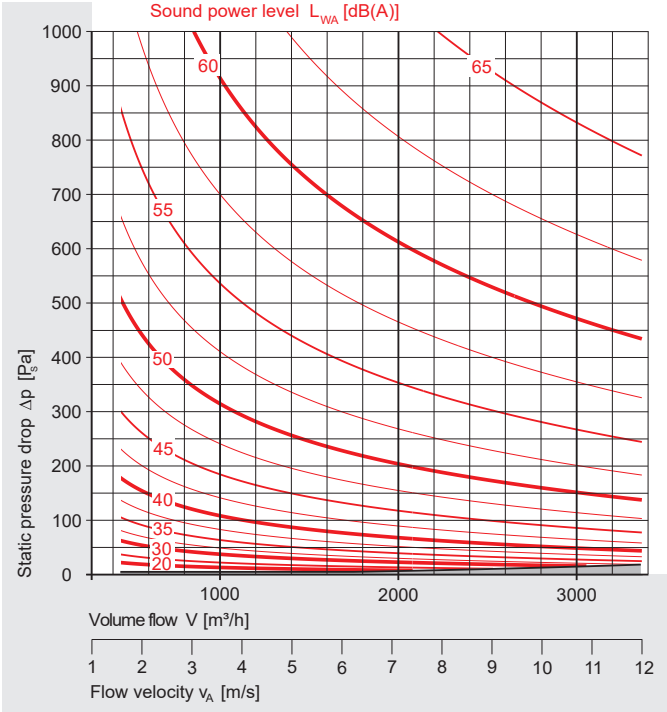
# VRup/VRpro volume flow controller

## Sound power level outside the connecting duct – radiated noise – (2)

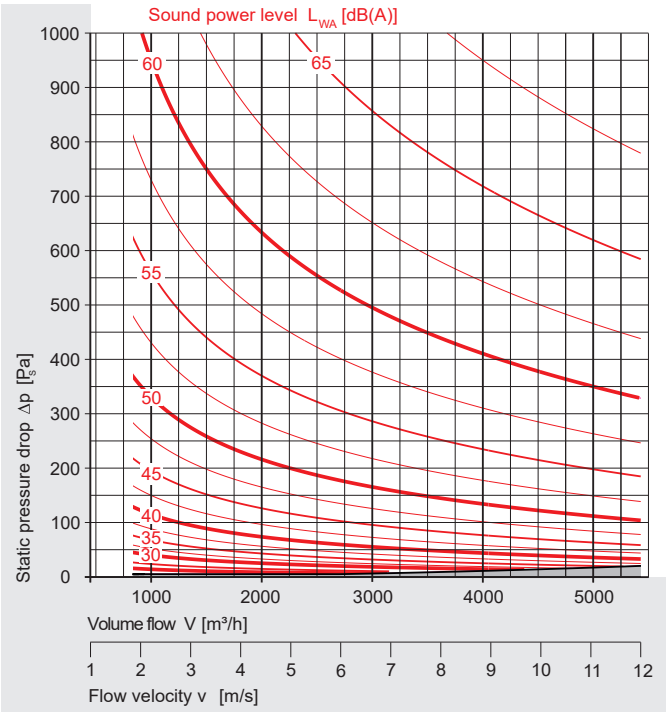
### Size DN 250




### Size DN 315




### Size DN 400




**Example**

| | | | | |
|---|---|---|---|---|
| | Size | DN 250 | | |
| | Volume | V | = 1200 | m³/h |
| | Flow velocity | $v_A$ | = 6.8 | m/s |
| | static pressure drop | $\Delta p_S$ | = 260 | Pa |
| Result: | Flow noise ⇒ see example on page 29 | | | |
| | Sound power level | $L_{WA}$ | = 63 | dB(A) |
| Result: | Radiated noise | | | |
| | Sound power level [1)] | $L_{WA}$ | = 47.5 | dB(A) |

[1)] The average **sound pressure level in the room** with the following equipment is

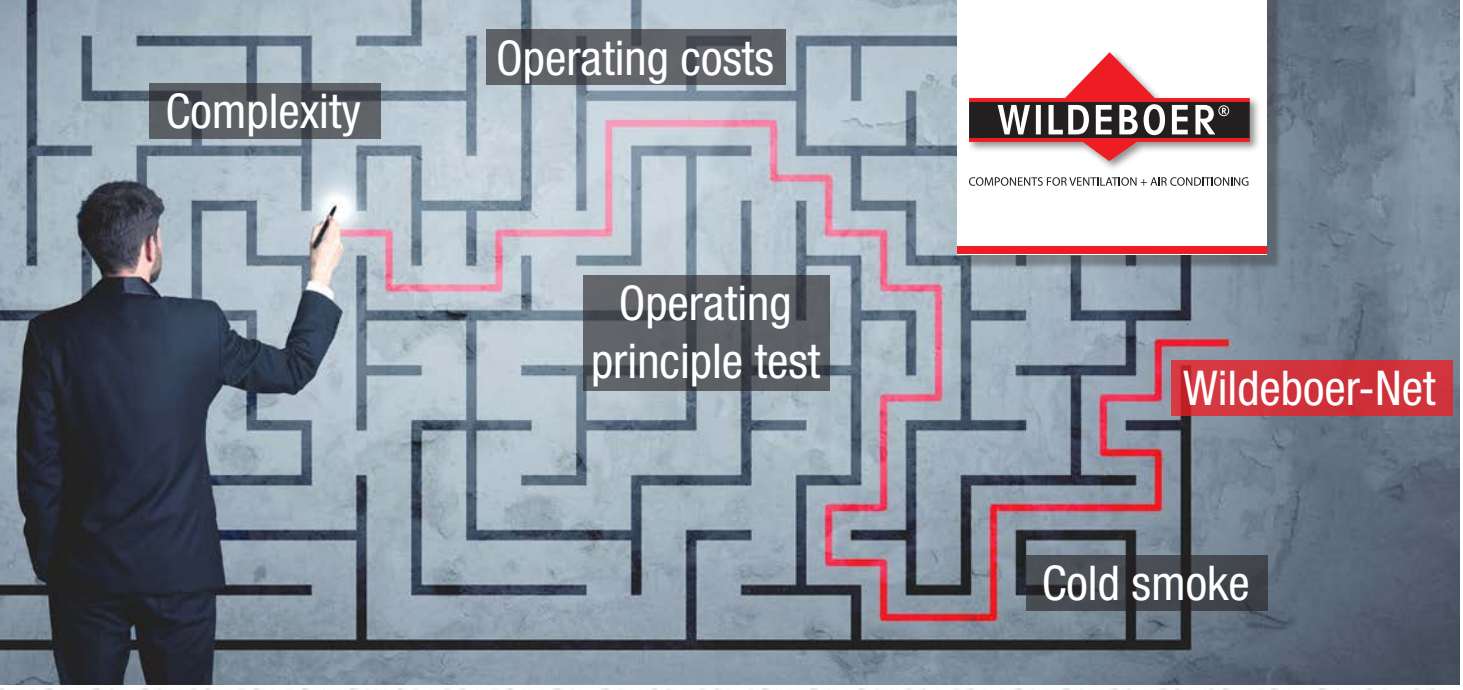
- **with acoustic insulation, 26 dB lower**
- **without acoustic insulation, 8 dB lower**

than the sound power levels $L_{WA}$ in the nomograms.

However, the acoustic insulation can only achieve the stated values if the connected circular ventilation ducts are sound-proofed (insulated) accordingly.

The sound pressure level can be further reduced by carrying out additional sound attenuation measures on site (suspended ceilings, high degree of room attenuation).

Further example ⇒ see page 29




WILDEBOER®

COMPONENTS FOR VENTILATION + AIR CONDITIONING

# Wildeboer-Net BS2 communication system V

AVAILABLE FROM END OF 2017

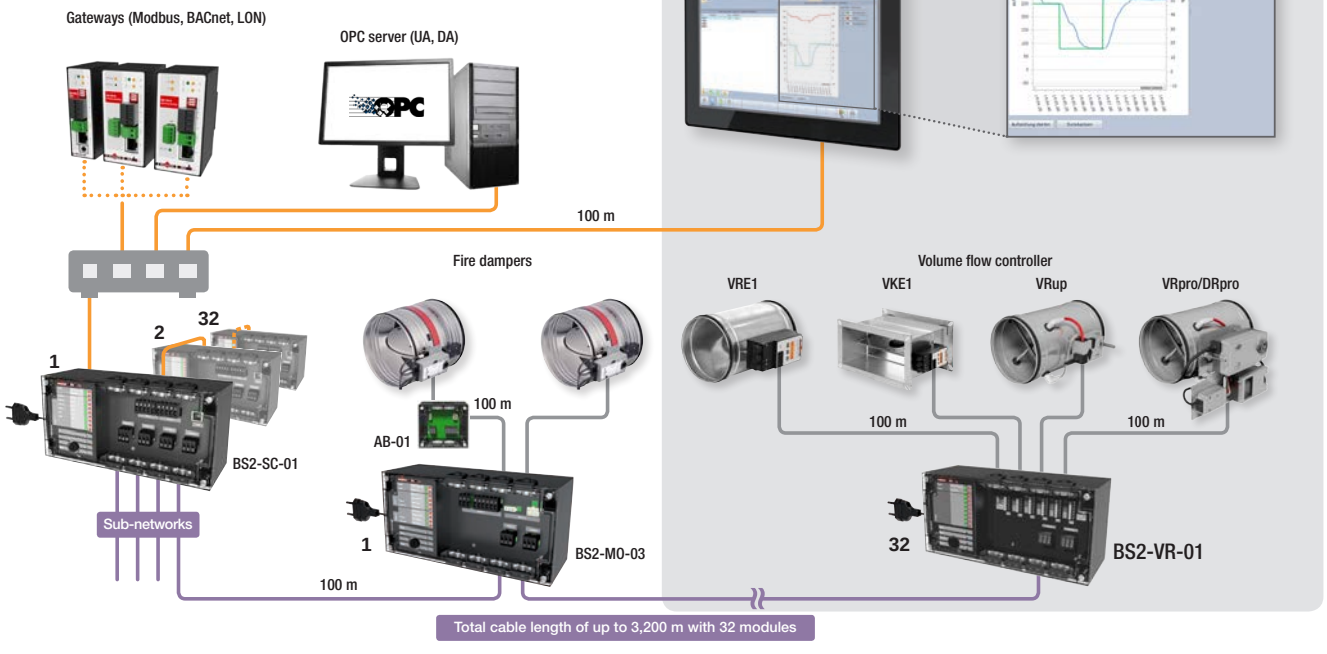
Network your fire protection and significantly minimise the cost of planning, installation and function testing. The Wildeboer-Net BS2 communication system lays all the groundwork for you.

The BS2-VR-01 module extends the scope of functions to include new options and allows up to four electronic VRE1, VKE1 and MP-BUS-compatible VRup, VRpro and DRpro controllers to be integrated into the Wildeboer-Net BS2 communication system.

Additional protection against cold smoke transfer in accordance with VDI Guideline 6010 by closing existing electronic volume flow and pressure controllers via programmable tripping groups.

Optimisation of air distribution via adjustment and visualisation of operating parameters, e.g. volume flows at the central BS2-ZB-01 control unit.

**Don't miss out on these benefits. Further information can be found in the user manual of the BS2 communication system. If you need advice, please do not hesitate to contact us.**



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Watch explanatory video on YouTube
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