Electronic

VRup/VRpro volume flow controller

for ventilation and air conditioning systems.

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, shut-off damper 3 and 4.
- Versatile variants for outstanding installation flexibility.
- Communication: analogue, with bus capability (MP-Bus, KNX, LonWorks, Modbus, BACnet).
- Differential pressure sensor: dynamic, static.
- Actuator: Standard speed, high speed, emergency operation via spring return.

VRup/VRpro volume flow controller

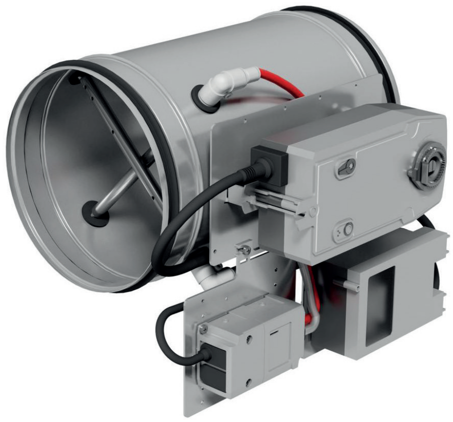
Overview

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

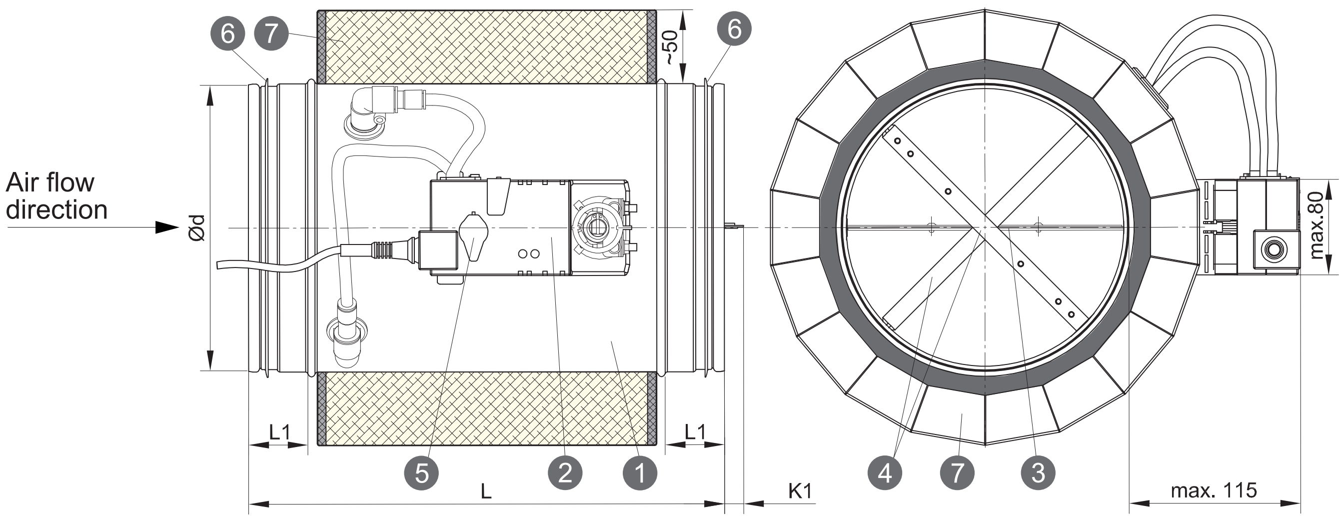


Product features		VRup	VRpro
Actuators	Standard speed (150 s)	●	●
	High speed (2.5 s or 4 s)		●
	Spring return (150 s, 20 s spring)		●
Communication	analogue	●	●
	MP-Bus*)	●	●
	KNX*)	●	
	LonWorks*)	●	
	Modbus*) RTU	●	
	BACnet*) MS/TP		
Sensors	dynamic (thermal measurement process) - comfort air - slightly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

*) Third-party brand

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 flows 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 galvanized sheet steel. The damper blade that regulates the volume flow 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 by 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.
- The MOD actuator can be activated using BACnet, Modbus, MP-Bus or with analogue technology.

Analogue actuators are compatible with the operating modes “Constant”, “Variable 0 – 10 V, 2 – 10 V and adjustable” and “3-stage”.

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

Size	V_{limit}	V_{start}	V_{nom}	∅d	L	A_A	K1
DN	[m³/h]	[m³/h]	[m³/h]	[mm]	[mm]	[m²]	[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

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 settings
  ⇒ see page 13
- SRC duct silencer, available in 600 mm and 900 mm lengths

VRup volume flow controller

Technical data, nomenclature

Technical data

- Nominal sizes: DN100, DN125, DN160, DN200, DN250, DN315, DN400
- Area of application:
  - Volume flow 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 differential pressure: 2000 Pa
- Leak tightness according to DIN EN 1751:
  - Casing: Class C
  - Damper blade: 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 effect 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, BACnet MS/TP
- Protection class: III protective extra-low voltage
- Protection rating: IP54
- Safety: EMC CE in accordance with 2014/30/EG

*) depends on size

Nomenclature

V	[m³/h]	Volume flow
V_{limit}	[m³/h]	Minimum volume flow to be specified
V_{start}	[m³/h]	Minimum adjustable volume flow
V_{nom}	[m³/h]	Maximum adjustable volume flow
V_{start} to V_{nom}		Operating range of volume flow controller
V_{ref}, V_{min}, V_{mid}, V_{max}	[m³/h]	Reference volume flows
V_{act}	[m³/h]	Actual volume flow
v_A	[m/s]	Flow velocity in A_A
A_A	[m²]	Inflow cross-section $A_A = \pi/4 \cdot DN^2$

Δp_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

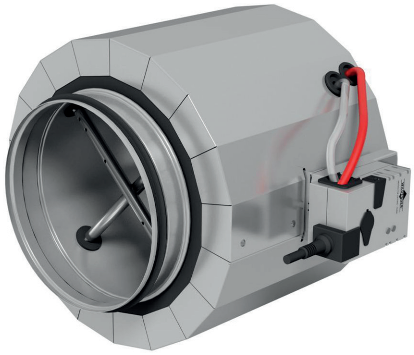
controls the volume flow via the differential pressure acting on the measuring cross assisted by a compact actuator which incorporates a sensor and the control technology, in addition to the actuator. Each actuator is equipped with LED status displays, an interlock bypass to allow manual adjustment and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

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

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**.

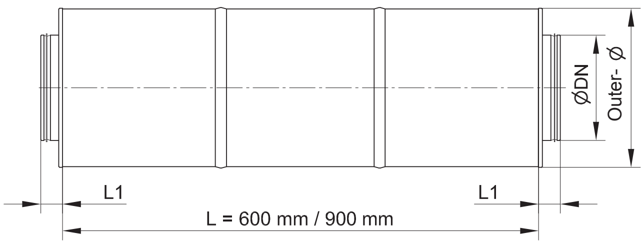
Option:
The VRup volume flow controller is **prepared for on-site insulation.** The actuator is positioned at a distance of roughly 50 mm from the duct casing for this purpose.



Option:
The VRup volume flow controller is equipped with an **acoustic insulation** for thermal insulation and reduction of external sound radiation.

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

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



Maximum reduction of flow noise with a

Size DN	Outer diameter Ø [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 specified. The volume flow control is applied as soon as the sensor in the actuator detects a differential pressure.

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

- **Constant:**

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

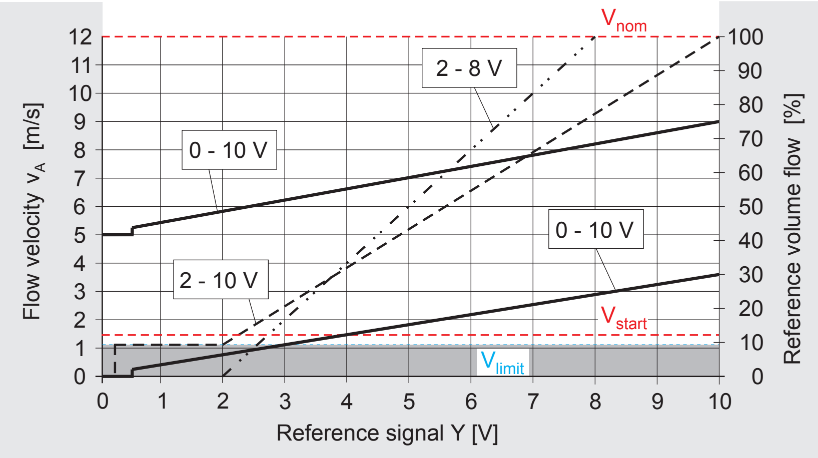
- **Variable:**

  A reference volume flow range with $V_{min} < V_{max}$ or V_{min} = 0 [m³/h] and $V_{max} \geq 20\%\ V_{nom}$ is set.

  Volume flows which are to be kept constant V_{ref} can be specified 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. Observe the switching threshold of 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 at least 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]

*) Instead of in [m³/h], volume flows can also be used in [% V_{nom}]. ⇒ 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 flow

- **3-stage:**

  The 3-stage operation is a straightforward alternative to the constant or variable operation, especially with analogue controlled volume flow controllers. Three volume flows can be specified 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

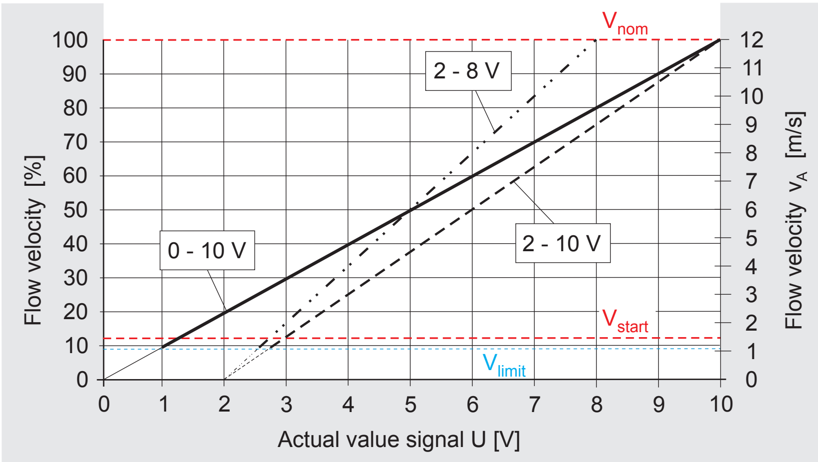
Actual value signal U

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

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

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

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



The following fundamentally applies:

V_{act} [m³/h]	= V_{nom} [m³/h] • (U [V] - UG [V]) : (OG [V] - UG [V])	[1a]
U [V]	= UG [V] + (OG [V] - UG [V]) • V_{act} [m³/h] : V_{nom} [m³/h]	[1b]

The following applies for volume flow 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} [m³/h]	= V_{nom} [m³/h] • U [V] : 10 V	[2a]
	U [V]	= 10 V • V_{act} [m³/h] : V_{nom} [m³/h]	[2b]
2 – 10 V:	V_{act} [m³/h]	= V_{nom} [m³/h] • (U [V] - 2 V) : 8 V	[3a]
	U [V]	= 2 V + 8 V • V_{act} [m³/h] : V_{nom} [m³/h]	[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 flow controller is operated in one of the available operation modes.

During **parallel operation**, this affects 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 flows $\mathbf{V_{min}}$, $\mathbf{V_{mid}}$, $\mathbf{V_{max}}$ 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 affect the others.

With **Master/Slave sequential operation**, the actual volume flow V_{act} of one controller controls the reference volume flow 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 flow range is specified 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:

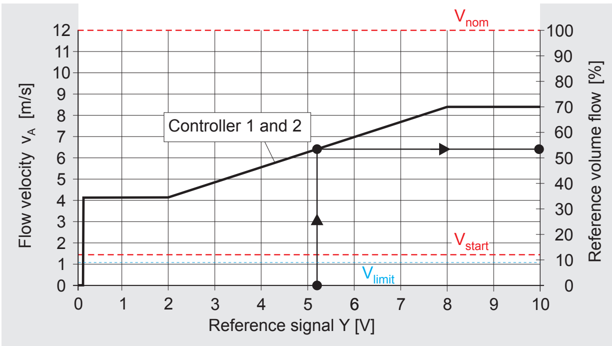
V_{ref} [%] = 35% + (70% - 35%) • (2 V - 2 V) : (8 V - 2 V) = 35% V_{nom}

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

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

With Y = 8 V as the largest reference signal:

V_{ref} [%] = 35% + (70% - 35%) • (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 to 2 to 8 V, the control range is controlled with Y = 2 to 8 V as reference signal.

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

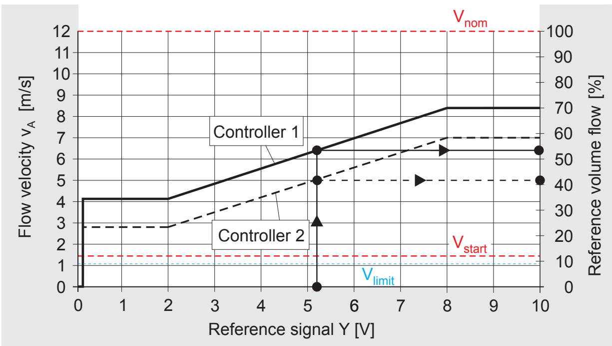
According to the formula [3] on page 6, with, for example, Y = 5.2 V, the following is obtained as possible reference signal between 2 and 8 V:

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

If a constant volume flow 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%) • (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 flow range with V_{min} = 0% V_{nom} and V_{max} = 100% V_{nom} is specified at controller 1.

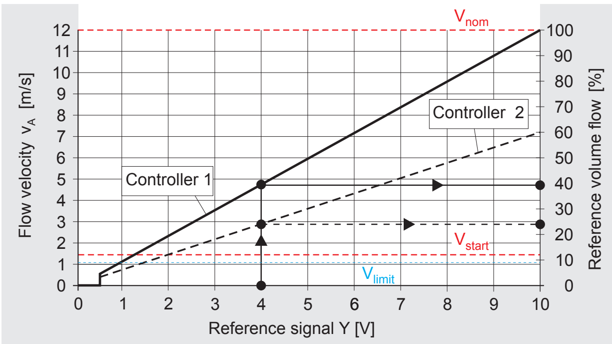
According to the formula [1] on page 6, with for example, Y = 4 V, the following is obtained as possible reference signal between 0 and 10 V:

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

If a volume flow 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:

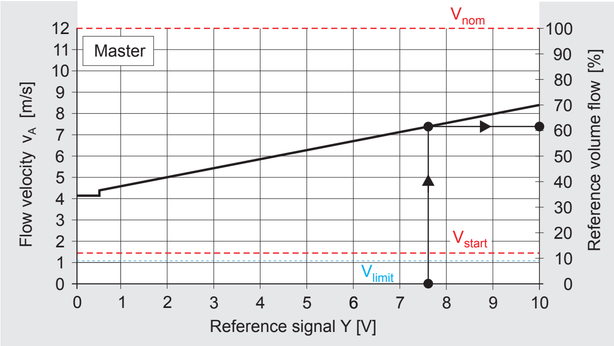
V_{ref} [%] = 0% + (60% - 0%) • 4 V : 10 V = 24% V_{nom}

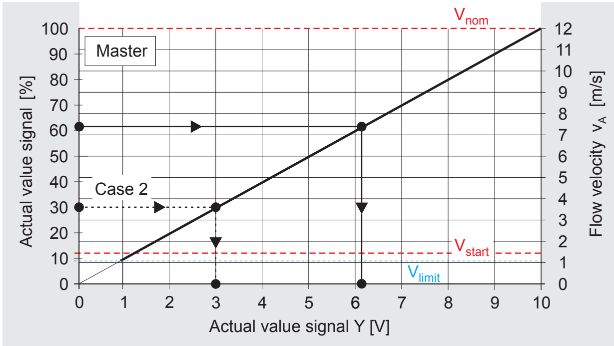


VRup volume flow controller

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 for example Y = 7.6 V:

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

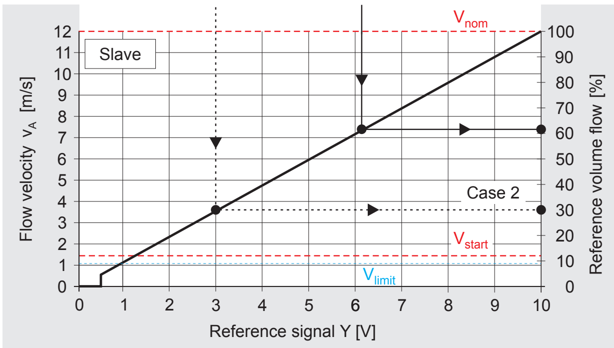
When V_{act} = V_{ref}, according to page 6, formula [2b] the actual value signal is:

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

The Master specifies 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.

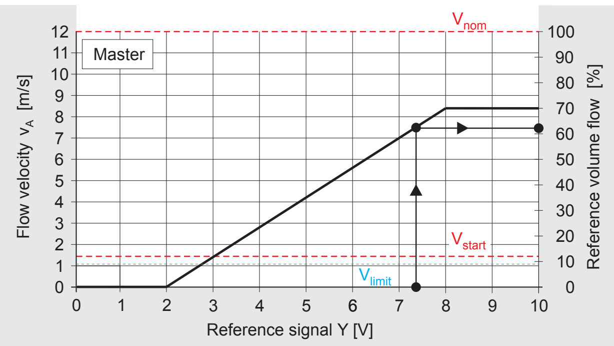
If V_{max} = 100% V_{nom} is set at the Slave, according to formula [1] on page 6:

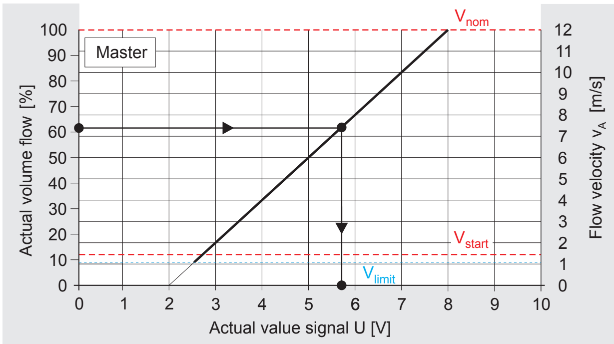
V_{ref} [%] = 0% + (100% - 0%) • 6.2 V : 10 V = 62% V_{nom}



If the actual volume flow at the Master does not reach the reference volume flow, the Slave follows the actual volume flow! ⇒ 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 specifies a voltage of 5.7 V as reference signal Y to the Slaves.

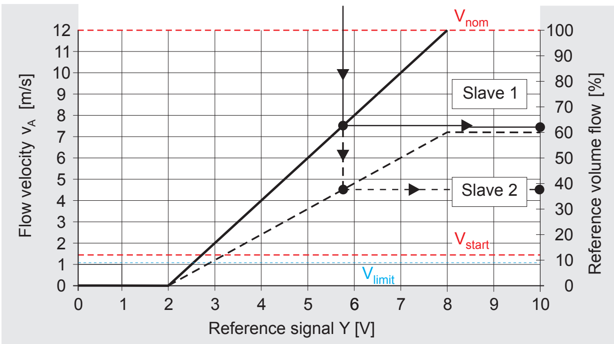
V_{max} = 20% to 100% • V_{nom} can be variably adjusted there.

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}

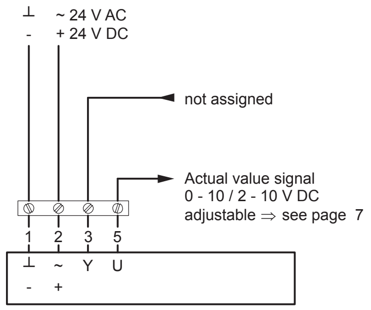


VRup volume flow controller

Electrical connections (1)

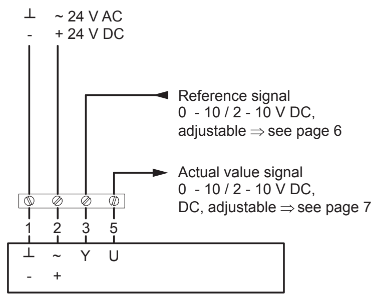
Electrical connections

Constant volume flow control



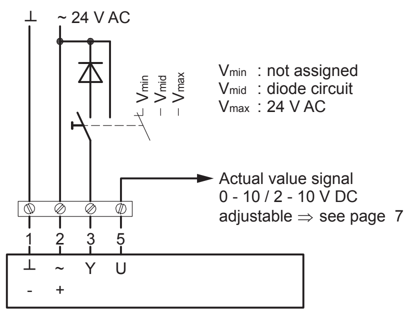
The “Standard” CAV function is preset

Variable volume flow control



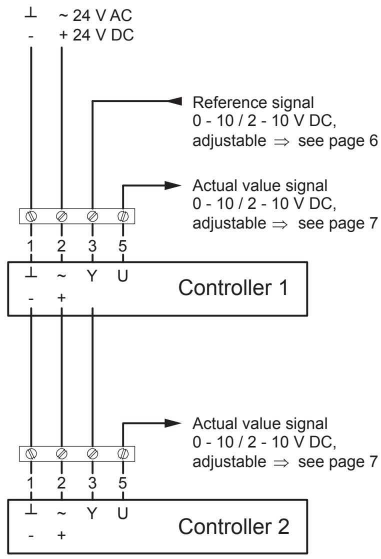
The “Standard” CAV function is preset

3-stage volume flow control:

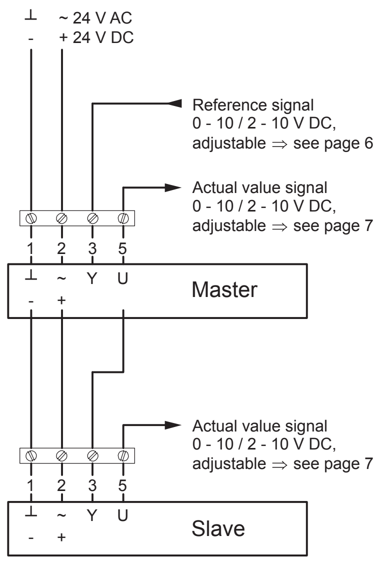


The “NMV-D2M compatible” CAV function is preset.
Pay attention to mutual interlocking of the contacts!

Connection in parallel



Sequential circuit



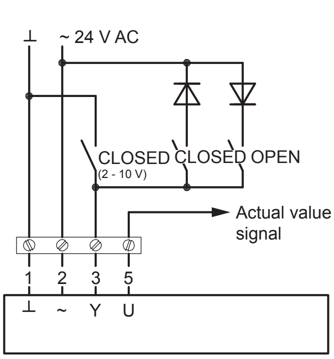
VRup volume flow controller

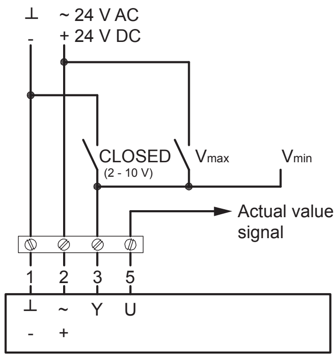
Electrical connections (2)/bus operation

Electrical connections

Overrides

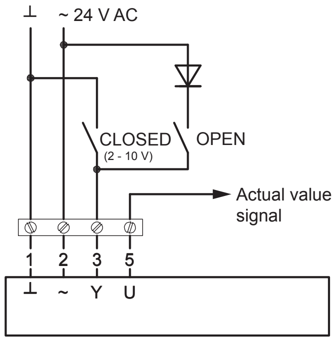
in the “Constant” or “Variable” operation mode





The “Standard” CAV function is preset.

In “3-stage” operation mode



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

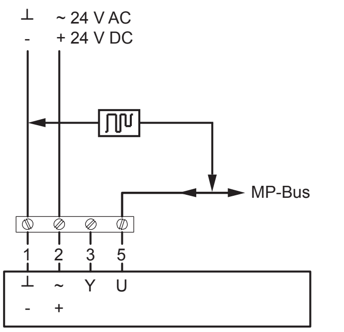
Circuits for override controls must be manufactured on site.

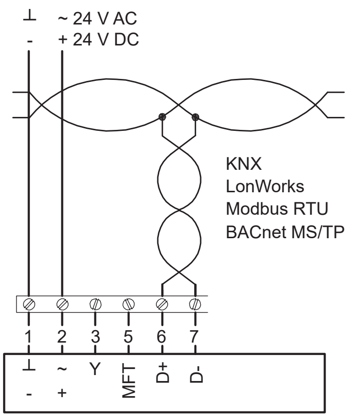
Pay attention to mutual locking of the respective override controls (CLOSED, V_{min}, V_{max}, OPEN) to avoid a short circuit!

The CAV function is set at the factory as specified in the order data; changes can be made via PC and software.

Bus operation

The VRup volume flow controller can be incorporated into a higher-level building control system via the **MP**-Bus. The bus connection to the MP actuator can be made via conventional 3-wire installation cables. The supply voltage is transmitted to line 1 (GND) and line 2 (24 V) and the bus signal to line 5.





Further information ⇒ see operating instructions.

Function: The bus operation starts automatically once an address has been assigned. The actuator MP at the VRup volume flow controller represents one of a maximum of eight possible slaves (MP nodes), attached to an MP master. These receive their digital command signal from the MP master of the building control system (PLC or DDC controller with MP interface).

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 identification and settings, the actual volume flow, the damper blade setting, status messages and, if applicable, the value (Ω, %, 0/1) of a connected sensor.

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

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

⇒ see formula [1]

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

⇒ see examples 1 to 5, pages 8 and 9

$$V_{ref}\,[m^3/h] = V_{min}\,[m^3/h] + (V_{max}\,[m^3/h] - V_{min}\,[m^3/h]) \cdot MP(\%) : 100\% \qquad [1]$$

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 flow 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.

The MOD actuator can be activated using BACnet, Modbus, MP-Bus or with analogue technology.

VRup volume flow controller

Operation

Programming unit ZTH-EU

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

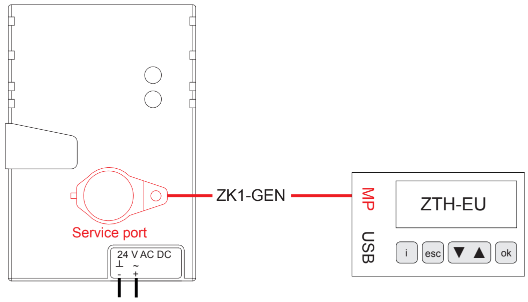
If voltage is supplied to the volume flow controller and the programming unit is connected with the corresponding cable, it is started and the data of the connected actuator is read out.

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 flow controller.

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

- **Connection to the service port**

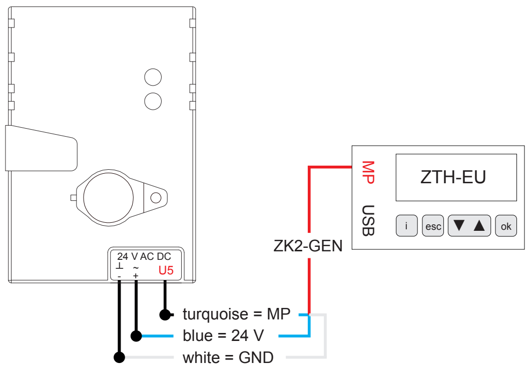
  Connect the ZK1-GEN connection cable (3 m) enclosed with the programming unit to the service port of the actuator.



- **Connection to the connecting duct**

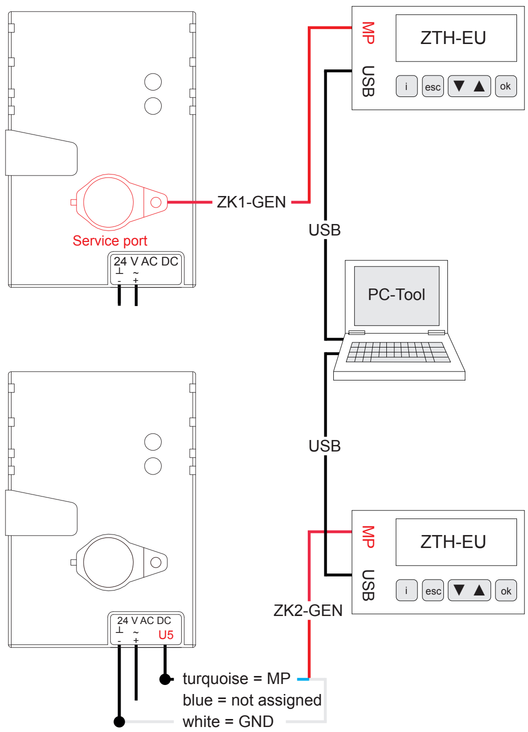
  Connect the ZK2-GEN connection cable (5 m) enclosed with the programming unit to the terminals on the actuator, or to the relevant terminals at the control cabinet.

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



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

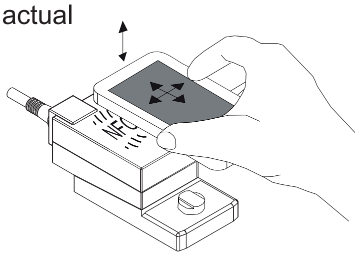
  A comprehensive range of settings can be made using the ZTH-EU programming unit and a PC. The programming unit serves as interface between the actuator and the PC. A USB cable is supplied with the programming unit.



- **NFC - interface**

  MP actuators can be operated via the NFC interface using an NFC-compatible Android Smartphone with an Assistant app. Settings can be modified 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, BACnet, MP-Bus	**MOD**

Option: **Lip seal**

- with two lip sealsn	**LD**

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

- for on-site insulationg	**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 [1]	**VA**
- lower limit UG = 0 to 30 V	**UG =**
- upper limit OG = 2 to 32 V	**OG =**

Option: **Factory presets** for reference volume flow [m³/h] [2]

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

Option: **Plant installation height** [2]

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] OG must be at least 2 V larger than UG.

[2] The volume flow 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 $V_{limit} \leq \mathbf{V_{min}} < V_{mid}$ and $V_{min} < \mathbf{V_{mid}} < V_{max}$ and 20% $V_{nom} \leq \mathbf{V_{max}} \leq V_{nom}$

The presettings are omitted with KNX, LON, MOD!

VRup volume flow controller

Specification 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 galvanized 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/Analogue activation and Modbus and BACnet and MP-Bus.
Constant/variable/3-stage operation modes, with 0 to 10 V, 2 to 10 V or adjustable.
Can be used 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: ....

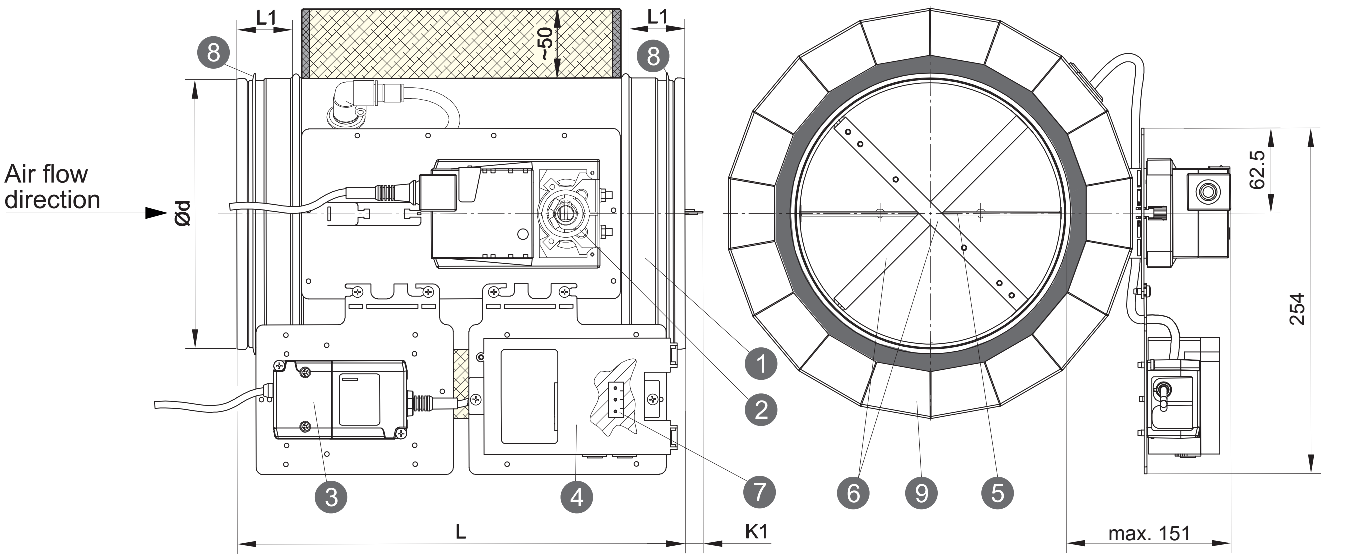
.... **pc SRC duct silencer** 600 / 900
deliver: ....
install: ....

.... **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 flows 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 galvanized sheet steel. The damper blade that regulates the volume flow 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 fitted to mounting consoles which can be manually folded or moved if space is restricted.

The control and electrical connection of the VRpro volume flow 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 flow controllers operate to a high degree of precision with roughly only a ± 5% to ± 20% deviation from the actual volume flow; thus maintaining constant volume flows 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 *(optional)*
9 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 25
- SRC duct silencer, available in 600 mm and 900 mm lengths

Size DN	V_{limit} [m³/h]	V_{start} 1) [m³/h]	V_{start} 2) [m³/h]	V_{nom} [m³/h]	Ød [mm]	L [mm]	A_A [m²]	K1 [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 flow 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 differential pressure:	2000 Pa
• Leak tightness according to DIN EN 1751:	
• Casing:	Class C
• Damper blade:	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 effect 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:	IP40
• Safety:	EMC CE in accordance with 2014/30/EG

*⁾ depends on size

Nomenclature

V	[m³/h]	Volume flow
V_{limit}	[m³/h]	Minimum volume flow to be specified
V_{start}	[m³/h]	Minimum adjustable volume flow
V_{nom}	[m³/h]	Maximum adjustable volume flow
V_{start} to V_{nom}		Operating range of volume flow controller
$V_{ref,}$ $V_{min,}$ V_{mid}, V_{max}	[m³/h]	Reference volume flows
V_{act}	[m³/h]	Actual volume flow
v_A	[m/s]	Flow velocity in A_A
A_A	[m²]	Inflow cross-section $A_A = \pi/4 \cdot DN^2$
Δp_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
w	[V]	Reference signal (variable set point input)
UG	[V]	Lower limit for w and U5
OG	[V]	Upper limit for w and U5
U5	[V]	Actual value signal

VRpro volume flow controller
Features

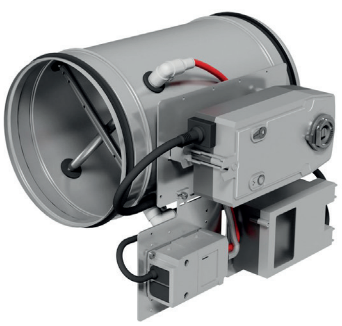
VRpro volume flow controller

Control the volume flow based on the differential 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.

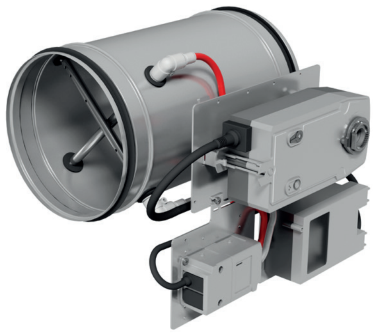
With the dynamic sensor, a small quantity of the air volume flow passes through the sensor, depending on the differential pressure drop at the measuring cross. This is proportional to the differential pressure and is detected thermally.

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

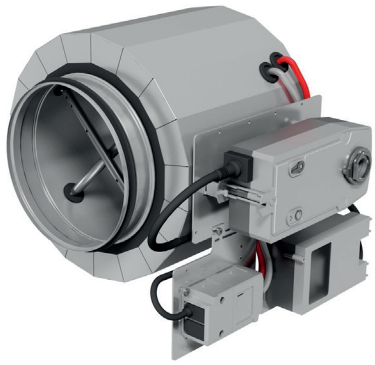
In addition to a range of sensors and actuators, lip seals on both sides and various insulation variants are available.



Basic version:
Control components and mounting consoles are mounted **close to the duct casing in a space-saving manner**.



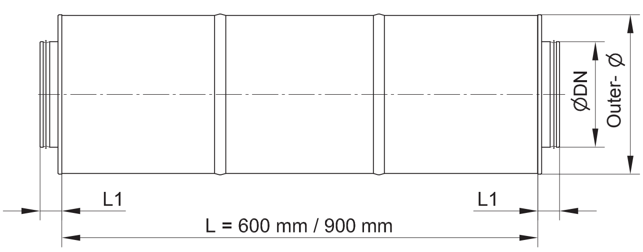
Option:
The VRpro volume flow controller is **prepared for on-site acoustic insulation.** Control components and mounting consoles are about 50 mm away from the pipe housing.



Option:
The VRpro volume flow controller is equipped with **acoustic insulation** for thermal insulation and reduction of external sound radiation.

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

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



Maximum reduction of flow 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

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 specified. The volume flow control is applied as soon as the sensor transmits a differential pressure above the leak low volume limit of 3 Pa; which corresponds to the volume flow V_{limit}.

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

- **Constant:**

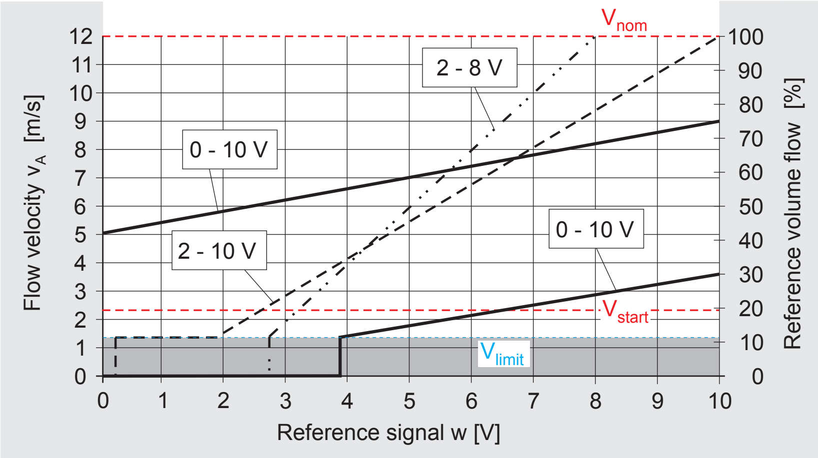
  A reference volume flow is set for $V_{min} < V_{nom}$ in order to keep the controller constant.

- **Variable:**

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

  Volume flows which are to be kept constant by the controller V_{ref} can be specified within 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 complete. The control function starts from w ≥ $V_{limit} : V_{max} \cdot 10$ 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 $V_{max} = 75\%$.
  - **For reference signal w, calculate the reference volume flow V_{ref} *):**

    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 $V_{min} = V_{limit}$, $V_{max} = V_{nom}$.
  - 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 complete. The control function starts from w ≥ $V_{limit} : V_{max} \cdot 8$ V + 2 V.
  - **For reference signal w, calculate the reference volume flow V_{ref} *):**

    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 at least 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 $V_{limit} : V_{max}$ • (OG - UG) + UG complete.

    The control function starts from w ≥ $V_{limit} : V_{max}$ • (OG - UG) + UG.

    Illustration based on example 2 to 8 V with $V_{min} = 0\%$ and $V_{max} = V_{nom}$
  - **For reference signal w, calculate the reference volume flow V_{ref} *):**

    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]

*) Instead of in [m³/h], volume flows can also be used in [% V_{nom}]. ⇒ 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 flow

- **3-stage:**

  The 3-stage operation is a straightforward alternative to the constant or variable operation, especially with analogue controlled volume flow controllers. Three volume flows can be specified 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.

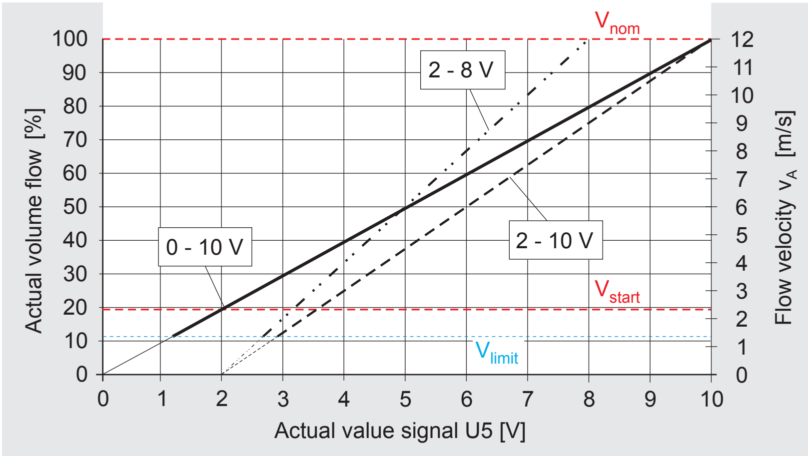
The signals override all operation modes and allow the damper blade to be fully opened or closed. The operating stage V_{max} can also be enforced during constant operation, and the operating stages V_{min} and V_{max} can be enforced during variable operation. ⇒ see page 23

Actual value signal U5

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

It is proportional to the maximum volume flow V_{nom} and does not depend on the settings at the volume flow 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} [m³/h] = V_{nom} [m³/h] • (U5 [V] - UG [V]) : (OG [V] - UG [V])		[1a]
U5 [V] = UG [V] + (OG [V] - UG [V]) • V_{act} [m³/h] : V_{nom} [m³/h]		[1b]

The following applies for volume flow 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} [m³/h]	= V_{nom} [m³/h] • U5 [V] : 10 V	[2a]
	U5 [V]	= 10 V • V_{act} [m³/h] : V_{nom} [m³/h]	[2b]
2 – 10 V:	V_{act} [m³/h]	= V_{nom} [m³/h] • (U5 [V] - 2 V) : 8 V	[3a]
	U5 [V]	= 2 V + 8 V • V_{act} [m³/h] : V_{nom} [m³/h]	[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 flow controller is operated in one of the available operation modes.

During **parallel operation**, this affects 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 flows $\mathbf{V_{min}}$, $\mathbf{V_{mid}}$, $\mathbf{V_{max}}$ 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 affect the others.

With **Master/Slave sequential operation**, the actual volume flow V_{act} of one controller controls the reference volume flow 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 flow range is specified 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:

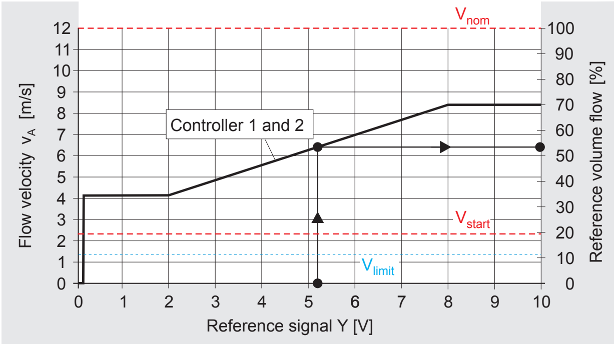
V_{ref} [%] = 35% + (70% - 35%) • (2 V - 2 V) : (8 V - 2 V) = 35% V_{nom}

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

V_{ref} [%] = 35% + (70% - 35%) • (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%) • (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 flow range with V_{min} = 35% V_{nom} and V_{max} = 70% V_{nom} is specified at controller 1.

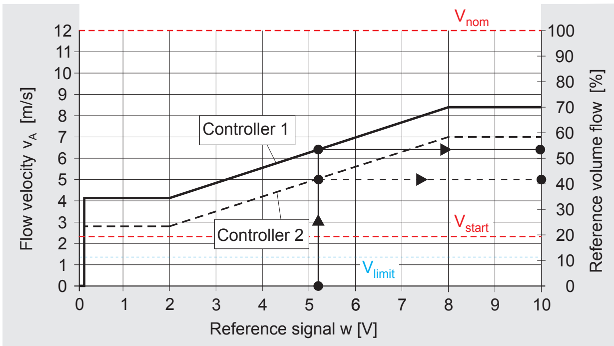
According to the formula [3] on page 18, with, for example, w = 5.2 V, the following is obtained as possible reference signal between 2 and 8 V:

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

If a constant volume flow 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%) • (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 flow range with V_{min} = 0% V_{nom} and V_{max} = 100% V_{nom} is specified at controller 1.

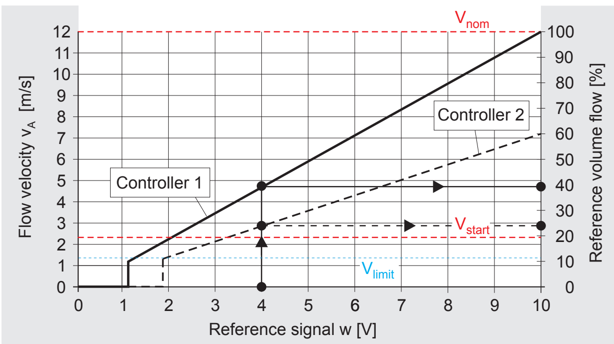
According to the formula [1] on page 18, with, for example, w = 4 V the following is obtained as possible reference signal between 0 and 10 V:

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

If a volume flow 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:

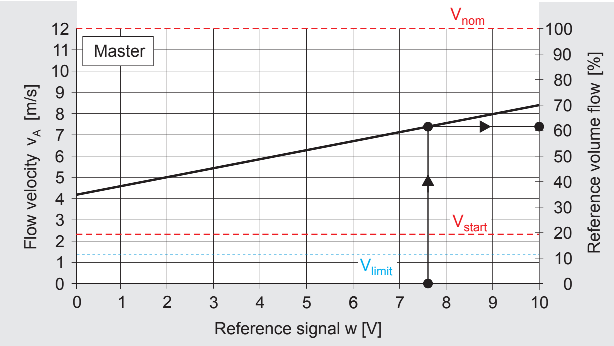
V_{ref} [%] = 0% + (60% - 0%) • 4 V : 10 V = 24% V_{nom}

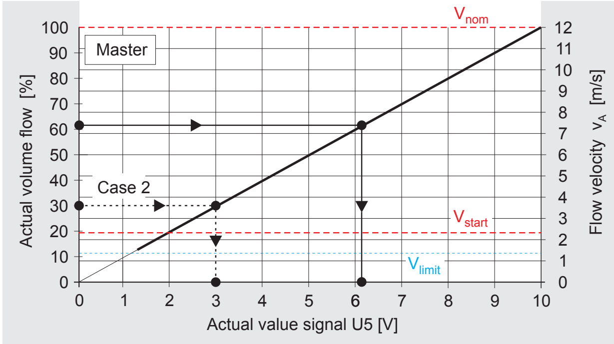


VRpro volume flow controller

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.

For V_{min} = 35% V_{nom} and V_{max} = 70% V_{nom}, and also with for example w = 7.6 V according to page 18, formula [1]:

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

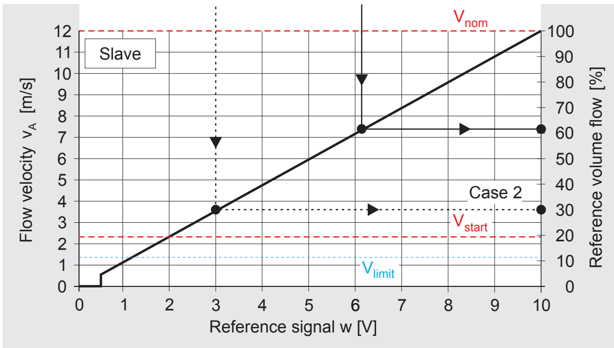
When V_{act} = V_{ref}, according to page 19, formula [2b] the actual value signal is:

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

The Master specifies 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.

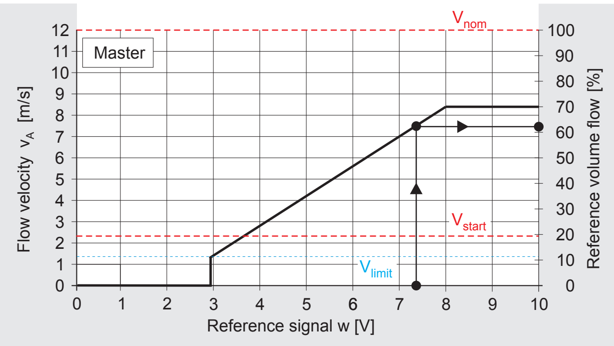
If V_{max} = 100% V_{nom} is set at the Slave, according to formula [1] on page 18:

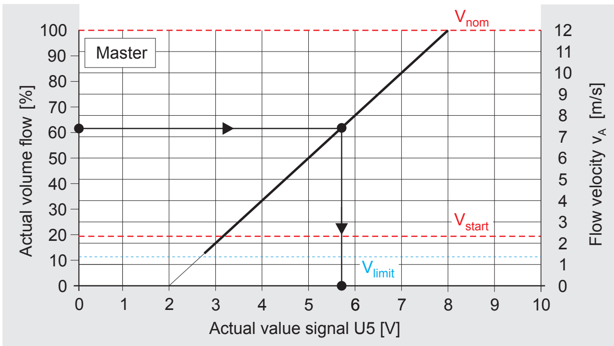
V_{ref} [%] = 0% + (100% - 0%) • 6.2 V : 10 V = 62% V_{nom}



If the actual volume flow at the Master does not reach the reference volume flow, the Slave follows the actual volume flow! ⇒ 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}

With 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

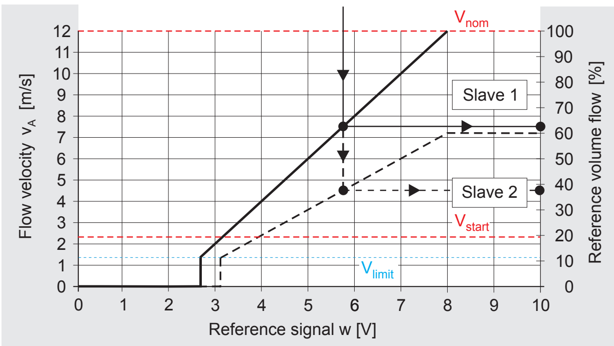
The Master specifies a voltage of 5.7 V as reference signal w to the Slaves. V_{max} = 30% to 100% • V_{nom} can be variably adjusted there.

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:

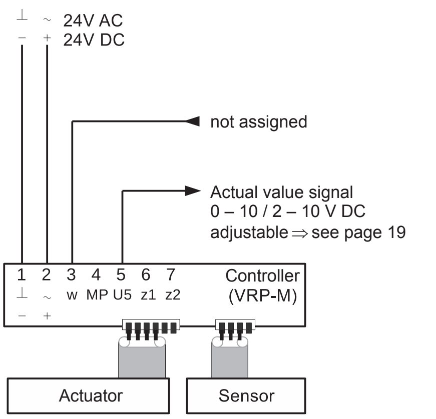
V_{ref} [%] = 0% + (60% - 0%) • (5.7 V – 2 V) : (8 V - 2 V) = 37% V_{nom}



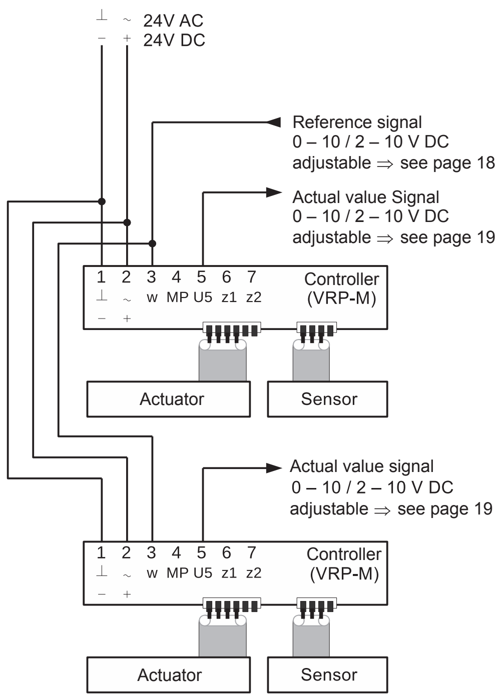
VRpro volume flow controller
Electrical connections (1)

Electrical connections

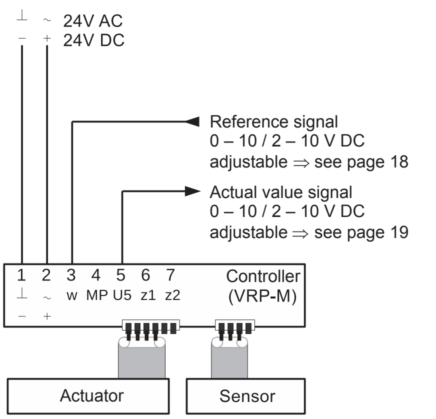
Constant volume flow control



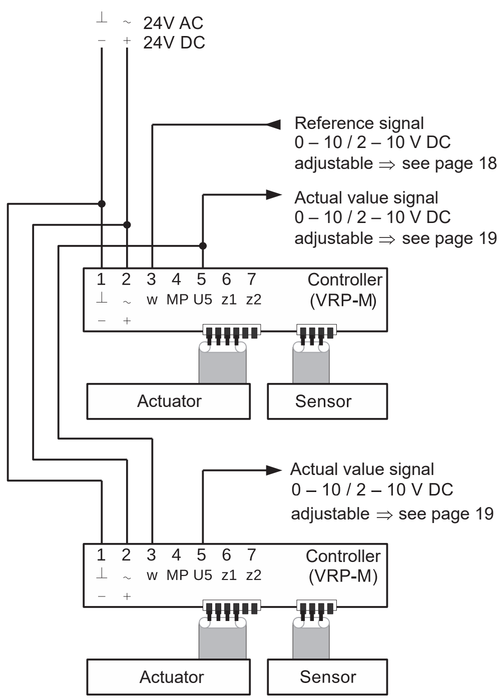
Connection in parallel



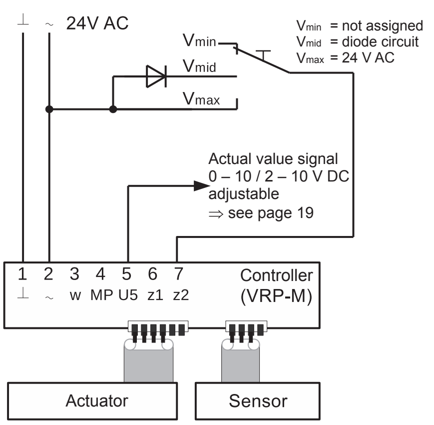
Variable volume flow control



Sequential circuit



3-stage volume flow control:



Pay attention to mutual interlocking of the contacts!

VRpro

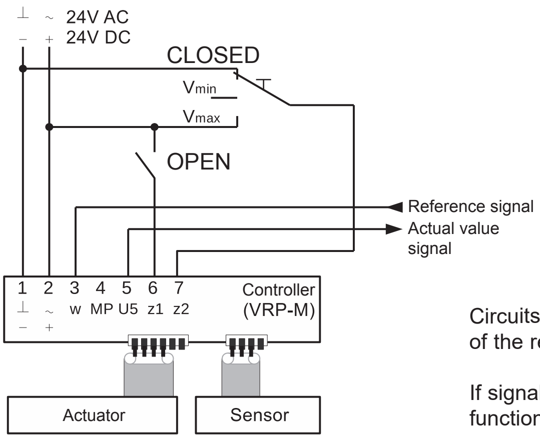
VRpro volume flow controller

Electrical connections (2)/bus operation

Electrical connections

Overrides

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

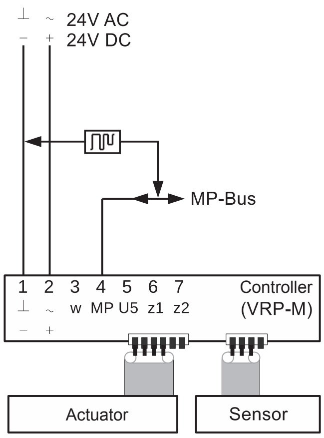


Circuits for override controls must be manufactured on site. Pay attention to mutual locking of the respective override controls (CLOSED, V_{min}, V_{max}) to avoid a short circuit!

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 VRpro volume flow controller can be incorporated into a higher-level building control system via the **MP**-Bus. The bus connection to the VRP-M controller can be made via conventional 3-wire installation cables. The supply voltage is transmitted to terminal 1 (GND) and terminal 2 (24 V) and the bus signal to terminal 4.



Function: The bus operation starts automatically once an address has been assigned. The VRP-M controller at the VRpro volume flow controller represents one of a maximum of eight possible slaves (MP nodes), connected to an MP master. These receive their digital command signal from the MP master of the building control system (PLC or DDC controller with MP interface).

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 identification and settings, the actual volume flow, the damper blade setting, status messages and, if applicable, the value (Ω, %, 0/1) of a connected sensor/switch.

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

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

⇒ see formula [1]

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

⇒ see examples 1 to 5, pages 20 and 21

$$V_{ref}\,[m^3/h] = V_{min}\,[m^3/h] + (V_{max}\,[m^3/h] - V_{min}\,[m^3/h]) \cdot MP(\%) : 100\% \qquad [1]$$

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.
- Terminals 6 and 7 override the MP-Bus for local overrides for complete opening and closing and for operating stage V_{max}.

Further information ⇒ see operating instructions.

VRpro volume flow controller

Operation

Programming unit ZTH-EU

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

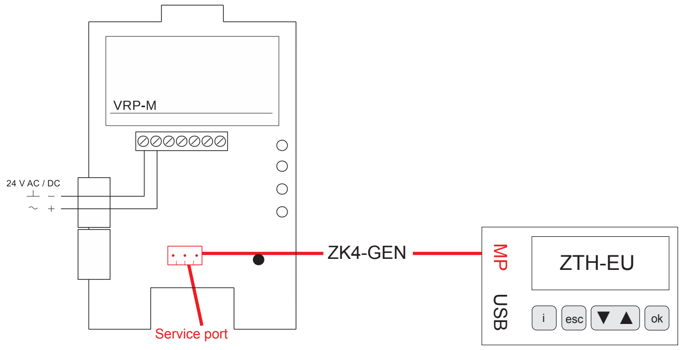
If voltage is supplied to the volume flow controller and the programming unit is connected with the corresponding cable, it is started and the data of the control component is read out.

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 flow 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**

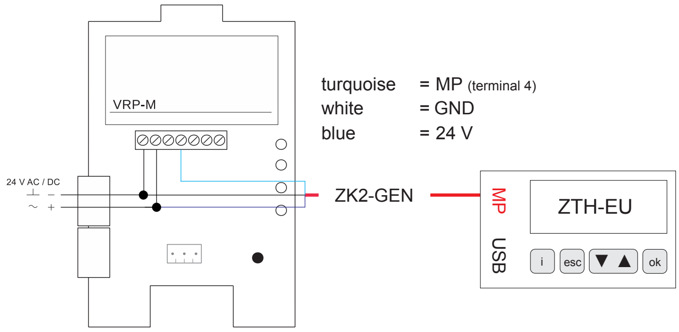
  Connect the ZK4-GEN connection cable (5 m) enclosed with the programming unit to the service port of the VRpro volume flow controller.



- **Connection to the connecting duct**

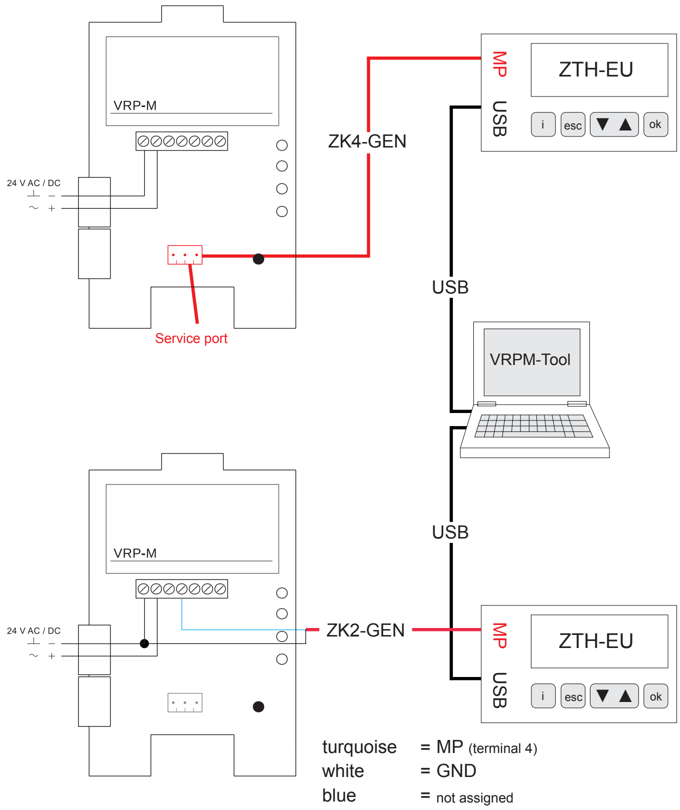
  Connect the ZK2-GEN connection cable (5 m) enclosed with the programming unit to the terminals on the VRP-M controller, or to the relevant terminals at the control cabinet.

  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 [1] **VA**
- lower limit UG = 0 to 8 V **UG =**
- upper limit OG = 2 to 10 V **OG =**

Option: **Factory presets**

for reference volume flow [m³/h] [2]
- constant reference volume flow $\mathbf{V_{const}}$ **=**
- minimum reference volume flow $\mathbf{V_{min}}$ **=**
- average reference volume flow $\mathbf{V_{mid}}$ **=**
- maximum reference volume flow $\mathbf{V_{max}}$ **=**

Option: **Plant installation height** [2]

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] OG must be at least 2 V larger than UG.

[2] The volume flow 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: $V_{limit} \le \mathbf{V_{const}} \le V_{nom}$

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

3-stage: $\mathbf{V_{min}}$ = 0 [m³/h] or $V_{limit} \le \mathbf{V_{min}} < V_{mid}$ and $< V_{min} < \mathbf{V_{mid}} < V_{max}$ and 30% $V_{nom} \le \mathbf{V_{max}} \le V_{nom}$

VRpro

VRpro volume flow controller

Specification 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 galvanized 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 higher-level overrides to open and close the damper blade and for parallel and sequential operation of several volume flow controllers. With an 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!

VRpro

VRup/VRpro volume flow controller

Installation instructions

Installation instructions are supplied with the VRup and VRpro volume flow controllers and must be observed.

- VRup and VRpro are designed for ventilation and air conditioning systems. Suitable air purity is a prerequisite for operation.
- VRup and VRpro volume flow controllers are adjusted for the entire controllable volume flow range from V_{start} to V_{nom} and achieve the specified volume flow accuracy in this range. Greater deviations may occur at low volume flows.
- For the VRup and VRpro volume flow controller to work efficiently, the oncoming flows must be extensively undisrupted. Downstream of flow 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, significant deviations in the volume flow must be anticipated.
- VRup and VRpro volume flow controllers are not position sensitive. If the VRpro volume flow controller is mounted in combination with the static sensor with a different 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

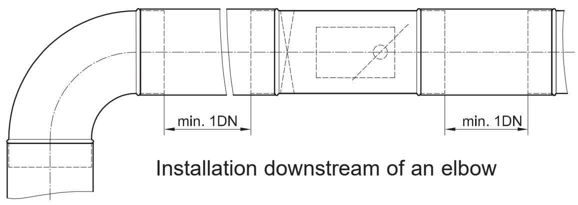
- VRup and VRpro volume flow controllers are supplied ex works with the damper blade open and with the standard setting or customer-specific presetting.

  ⇒ see pages 13 and 25

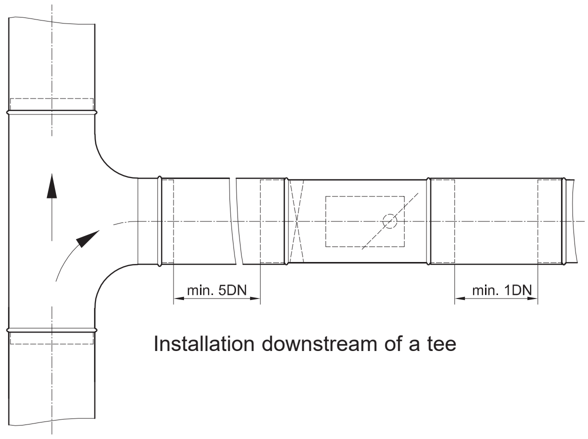
- If no system operating pressure is present, the damper blades are open. If the volume flow increases to the specified set point, the VRup and VRpro volume flow controllers start.

  ⇒ 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 effected 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 flow controllers for V_{min}, V_{mid} and V_{max} can be restored if settings are modified on site.
- VRup and VRpro volume flow controllers and SRC duct silencers are supplied individually. Assembly on site.



Installation downstream of an elbow

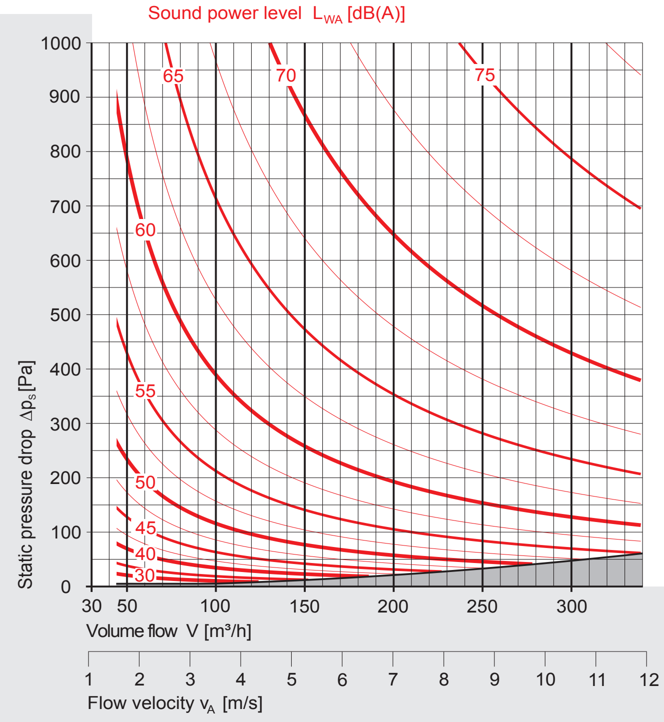


Installation downstream of a tee

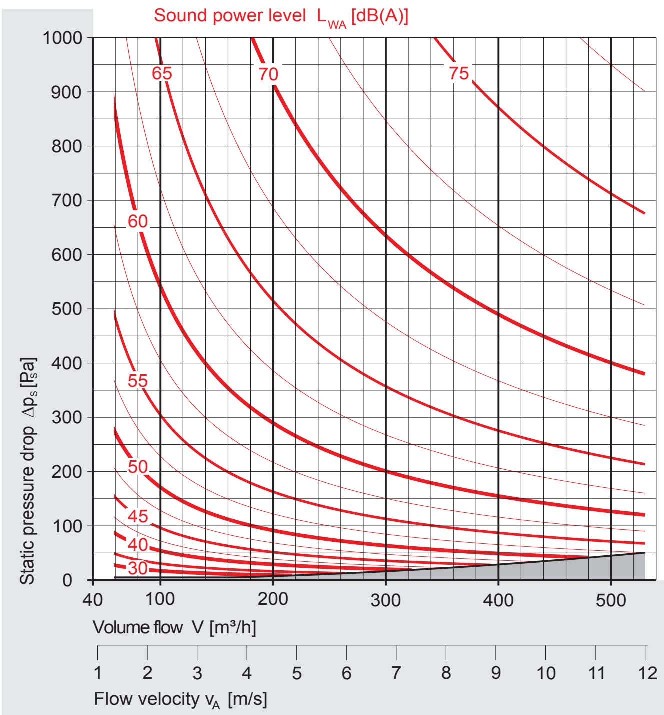
VRup/VRpro volume flow controller

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

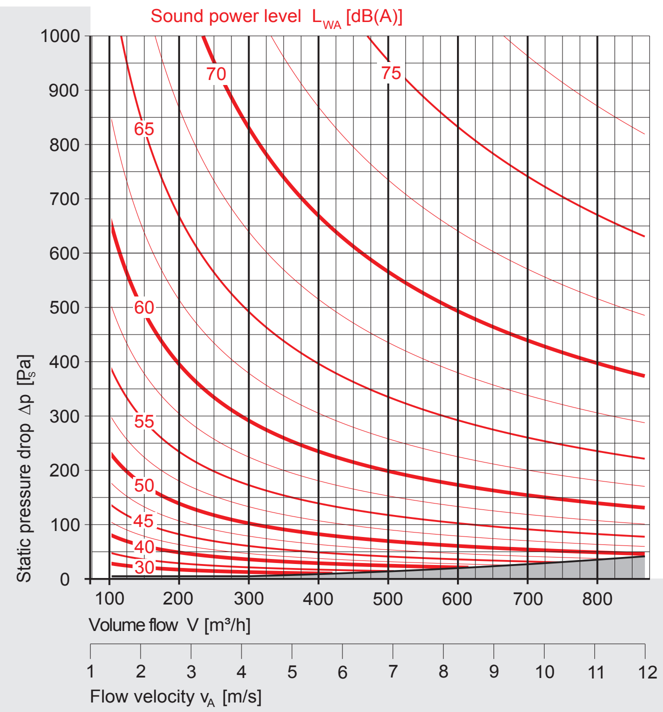
Size DN 100



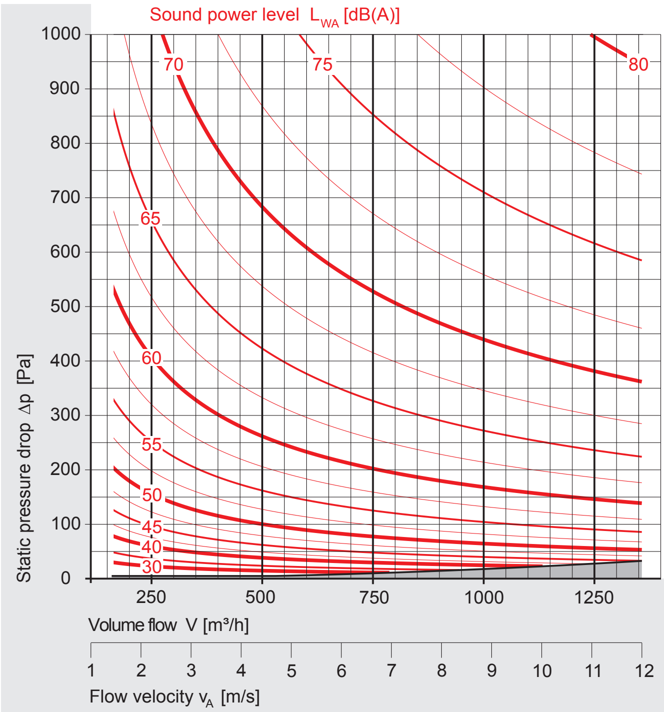
Size DN 125



Size DN 160



Size DN 200



VRup/VRpro

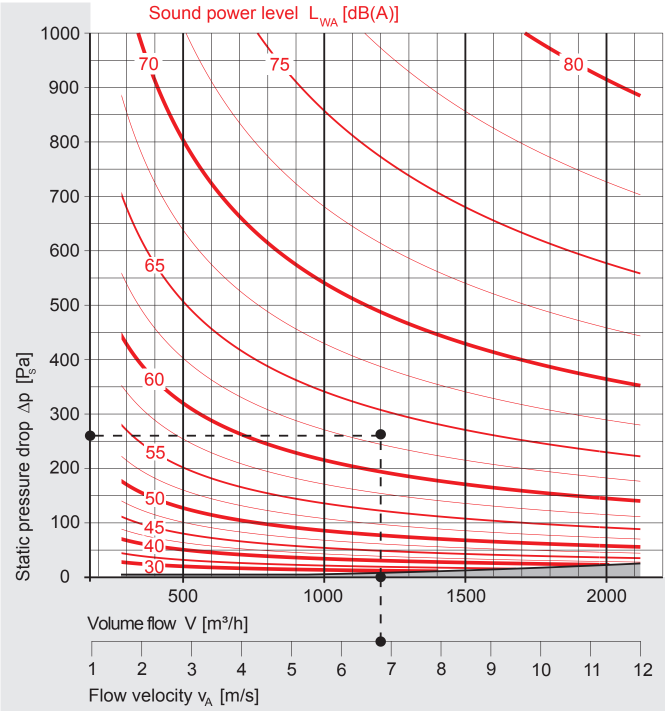
Observe limitations shaded in grey.

Nomenclature ⇒ see pages 4 and 16

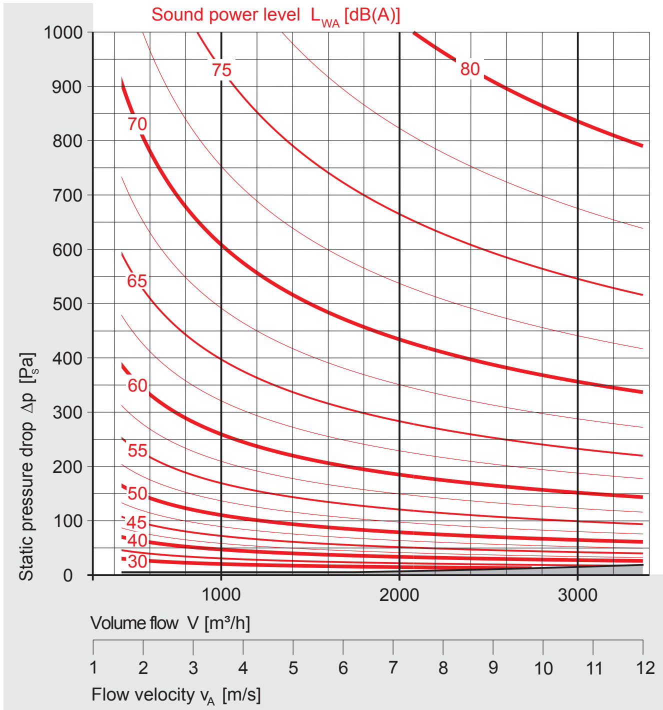
VRup/VRpro volume flow controller

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

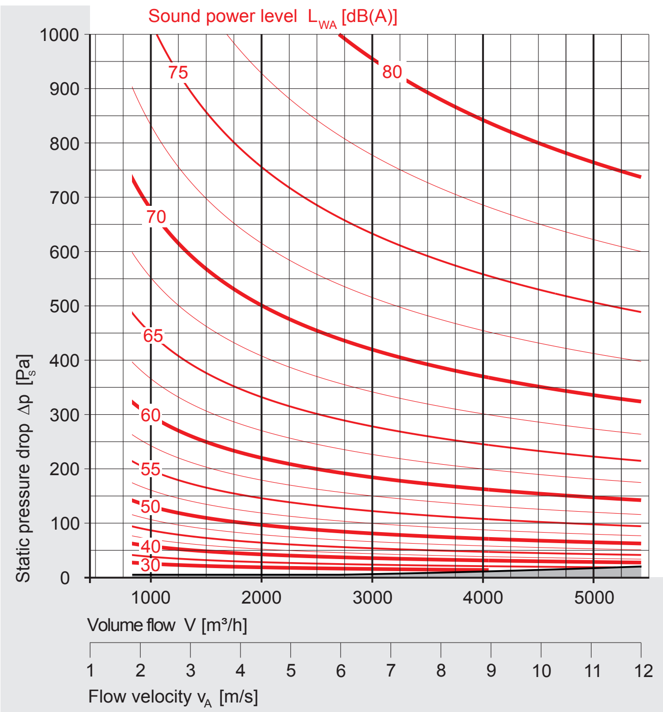
Size DN 250



Size DN 315



Size DN 400



Example:

Specified:	Size	DN 250			
	Volume flow	V	=	1200	m³/h
	Flow velocity	v_A	=	6.8	m/s
	Static pressure drop	Δp_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 should be applied for acoustic calculations, e.g. when adding sound attenuators.

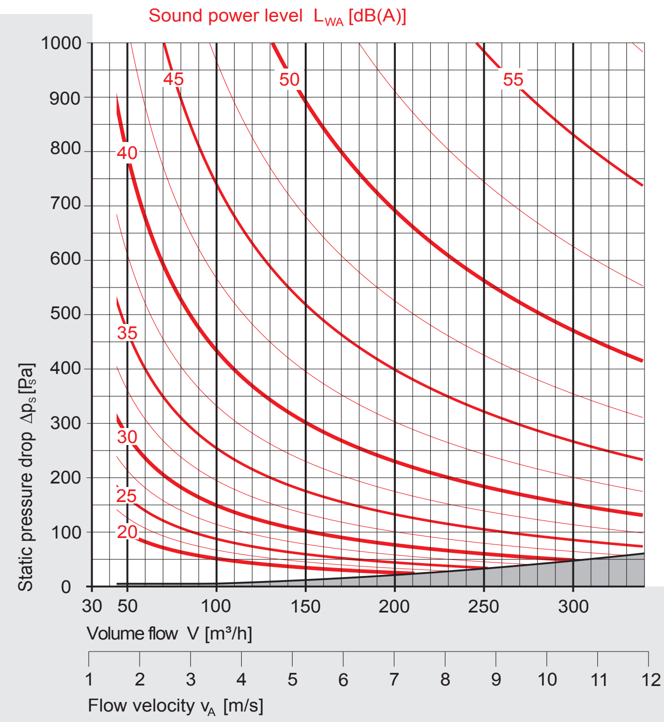
In other documents, **sound pressure levels** L_p or L_{pA} are **frequently specified** instead of sound power levels. They contain standardised attenuations of up to 18 dB. This distinction must be observed when comparing numeric values. Furthermore, the extent of these attenuations only becomes clear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

Further example ⇒ see page 31

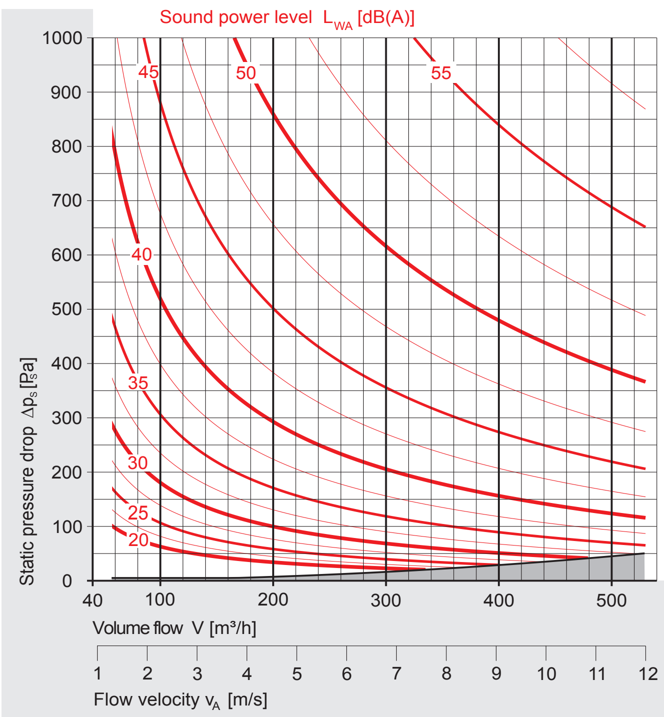
VRup/VRpro volume flow controller

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

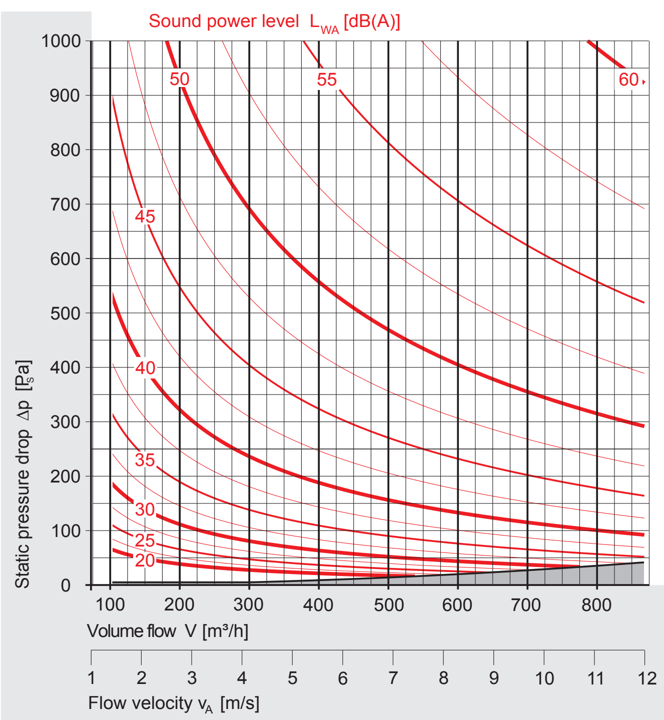
Size DN 100



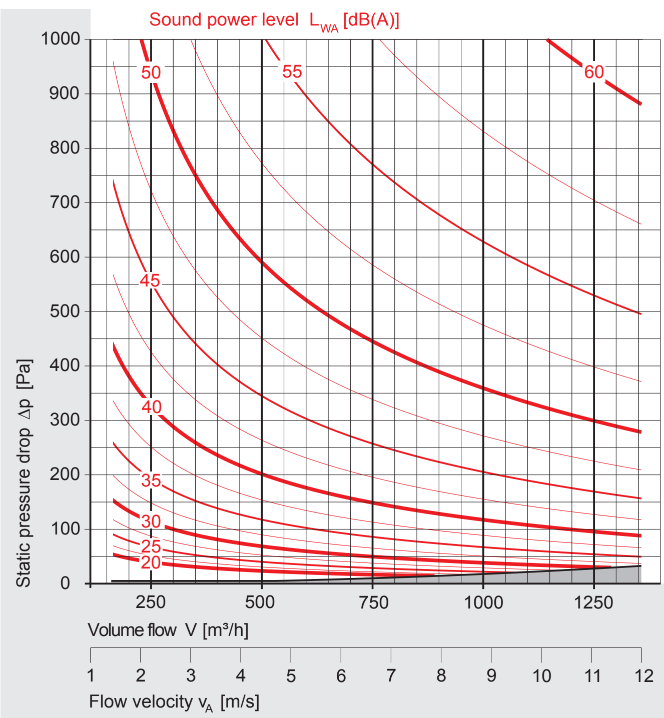
Size DN 125



Size DN 160



Size DN 200



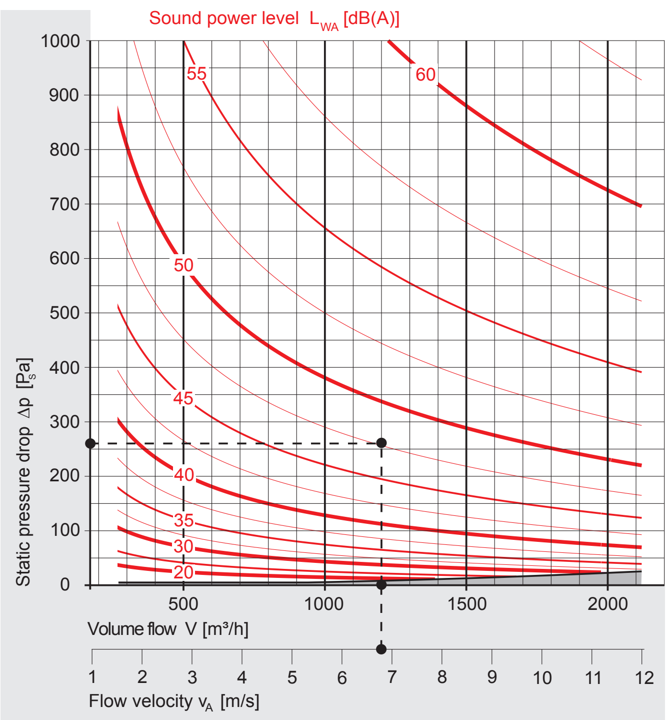
Observe limitations shaded in grey.

Nomenclature ⇒ see pages 4 and 16

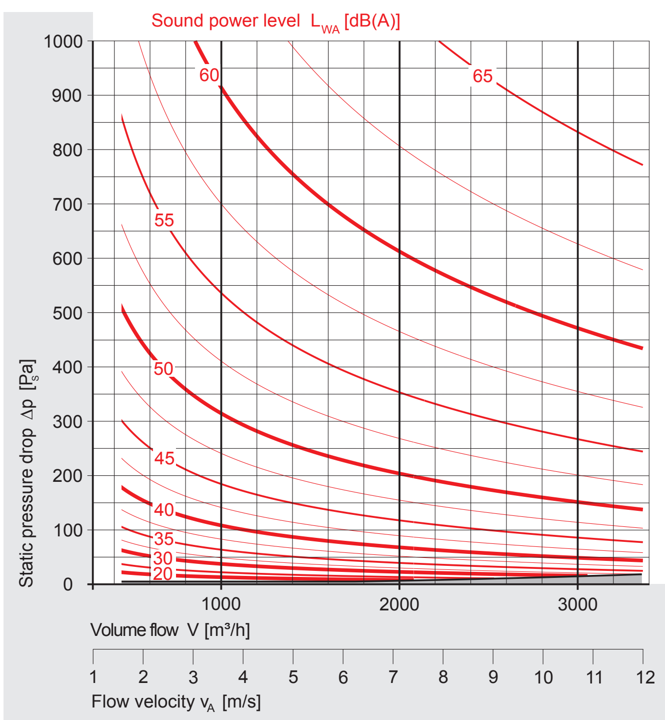
VRup/VRpro volume flow controller

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

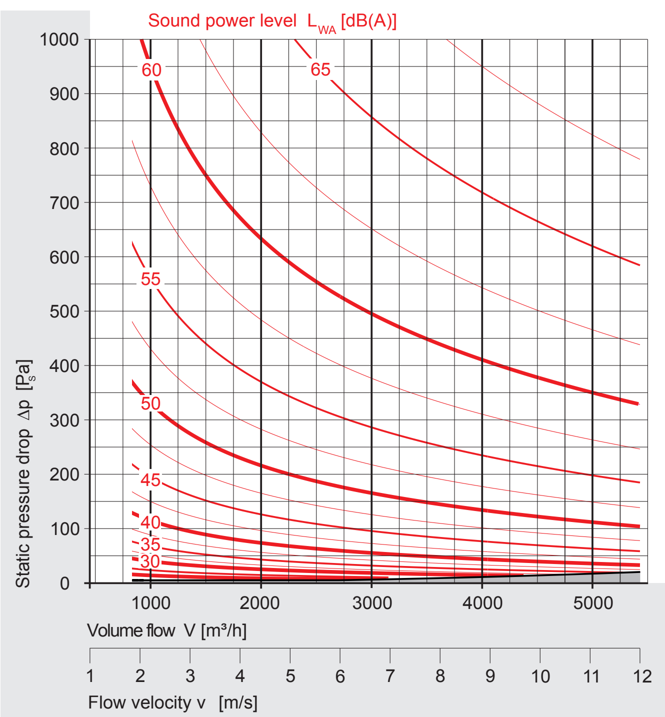
Size DN 250



Size DN 315



Size DN 400



Example

Specified:	Size	DN 250			
	Volume flow	V	=	1200	m³/h
	Flow velocity	v_A	=	6.8	m/s
	Static pressure drop	Δp_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

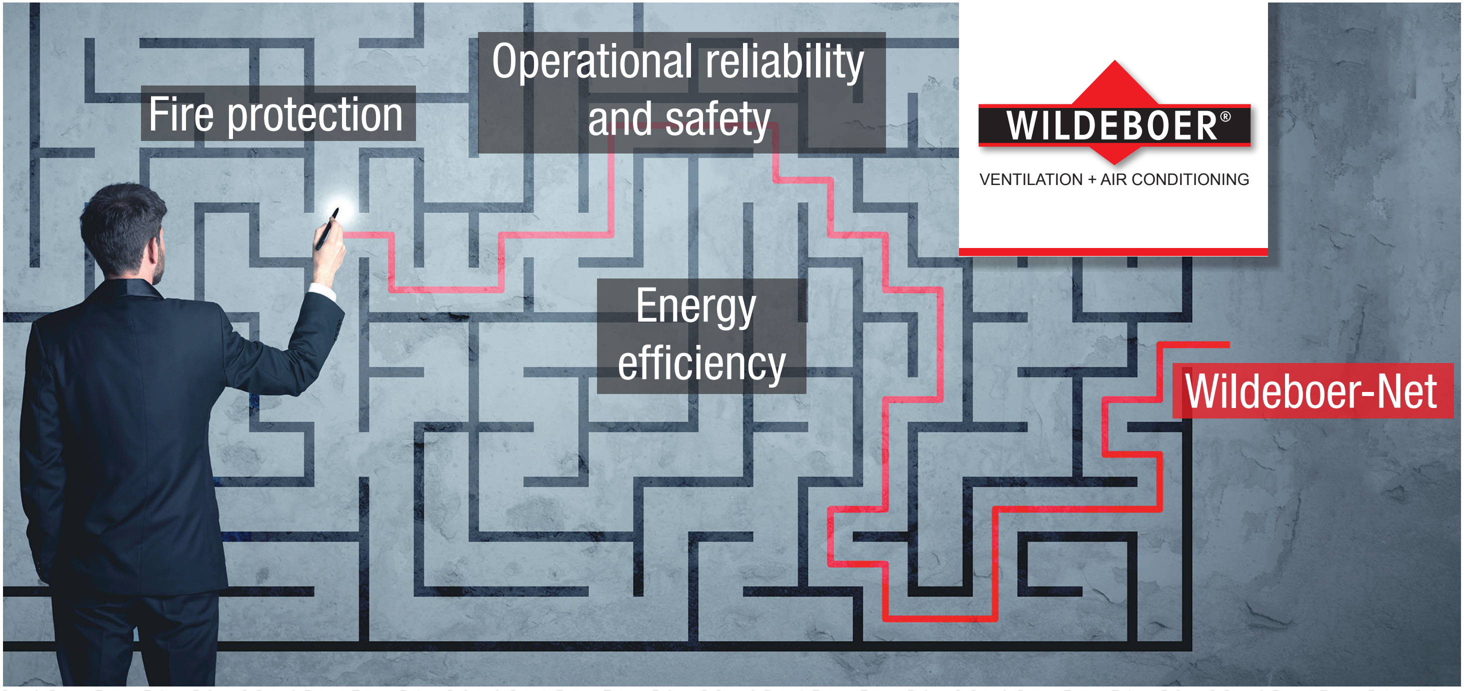
- **with acoustic insulation, 26 dB lower**
- **without acoustic insulation, 8 dB lower**

than the sound power level L_{WA} specified in the sound power levels.

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



Communication system Wildeboer-Net

BS2-VR-01 volume flow and pressure controller module

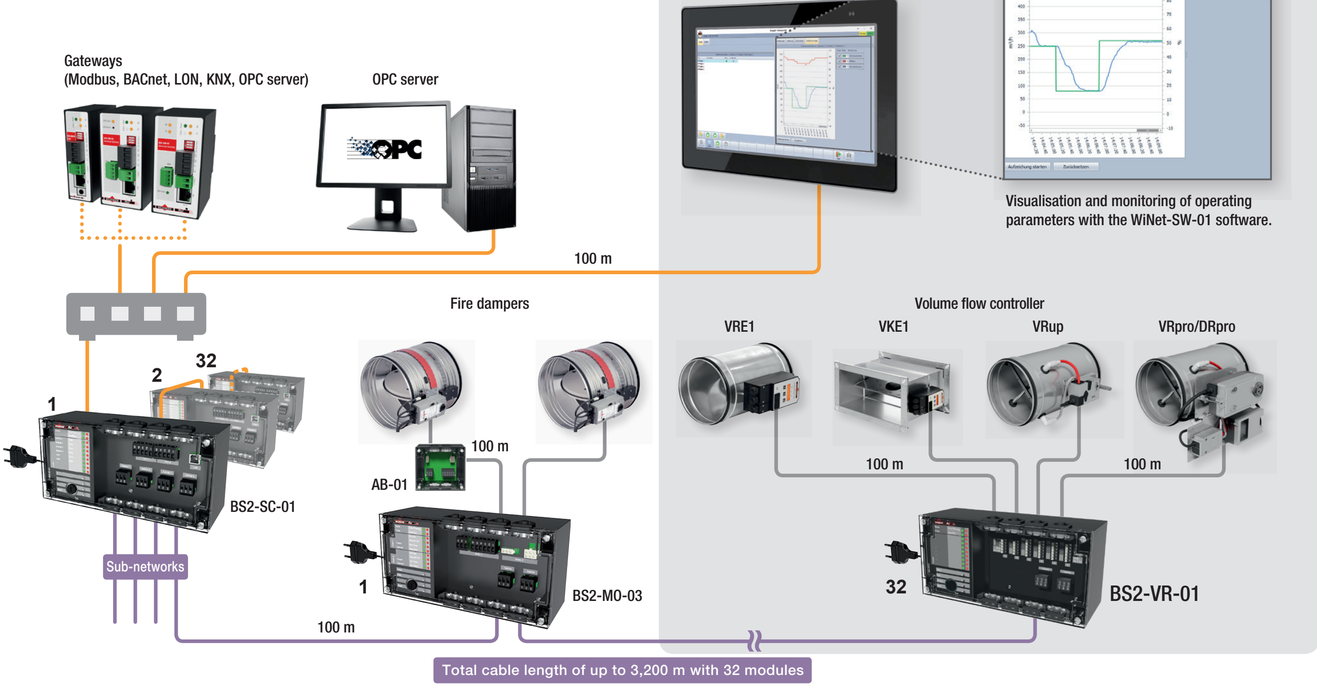
Link up your fire protection and air distribution and significantly minimise the cost of planning, installation and function testing of fire dampers. The communication system Wildeboer-Net lays all the groundwork for you.

The BS2-VR-01 volume flow and pressure controller module extends the scope of functions to include new options for control of the volumetric flow rates. Control is performed in accordance with thermal and material loads or to adjust the volume flows in accordance with time.

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.

Energy saving by reducing the mean outdoor air volume flow rate using requirement-based air volume flow rate control via parametrised calendar and sequence controls.

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



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