# MANDÍK®

## VARIABLE AIR VOLUME CONTROLLER

## RPM-V

**These technical specifications state a row of manufactured sizes and models of air volume controller (further only controller) RPM-V. It is valid for production, designing, ordering, delivery, assembly and operation.**

## I. CONTENT

## II. GENERAL INFORMATION

### 1. Description

**1.1.** The air volume controllers are meant for systems with a variable air volume that is used for input or output air. The required amount of air that is taken into the individual rooms or working areas is variable with respect to time and can be changed according to momentary need when the controllers are installed. Total power of air-conditioning system can be lower. This variable systems enable a more economical operation air-conditioning systems and while ensuring individual well-being on the premises setting.

The controller consists of the body of the controller with a control blade and pressure probes for determining the through-flow of air. An compact controller is affixed to the body for controlling the control blade.

**Fig. 1 Controller RPM-V Belimo**



**Fig. 2 Controller RPM-V MANDÍK PROFI-LINE (actuating mechanism Gruner)**



**1.2.** Controller characteristics

● Type of regulation:

  ○ control of air flow
  ○ control of pressure in the duct
  ○ control of pressure in the room

| | |
|---|---|
| ● Nominal size | DN 80 ÷ DN 630 |
| ● Length | L = 450 / 600 mm according to nominal size |
| ● Tightness acc. to EN 1751 | External casing leakage class ATC 3 (old marking "C")<br>Tightness through the damper blade: class 4 |
| ● Air flow volume | 18 ÷ 7 900 m³/h (for 12m/s is max. Air flow vol. 13 500 m³/h*) |
| ● Accuracy | ± 8 % for velocity up to 3 m/s and ± 5 % for higher velocity. |
| ● Air-velocity | Standard set-up is in range from min. 1 m/s to 7 m/s by Belimo, Gruner or Siemens actuators, see in 5.1.1. |

**1.3.** Working conditions

The faultless functioning of the controllers is ensured under the following conditions:
a) maximum speed of air flow 7 m/s*
b) maximum pressure in the duct 1000 Pa
c) the air circulation in the whole controller section must be secured as steady on whole surface - see point 4.1.

Controllers are designed for macroclimatic areas with mild climate according to EN 60 721-3-3.

Controllers are suitable for systems without abrasive, chemical and adhesive particles.

Temperature in the place of installation is permitted to range from 0°C to +50°C.

The controllers are supplied without insulation or in an insulated design. Insulation thickness is 50 mm.

**\* Set the controller to 12 m/s, it is necessary to discuss with the manufacturer!**

## 2. Design

**Fig. 3   Air flow control**



Actuating mechanism

flow direction

$\Delta p$ [Pa] — controller pressure loss
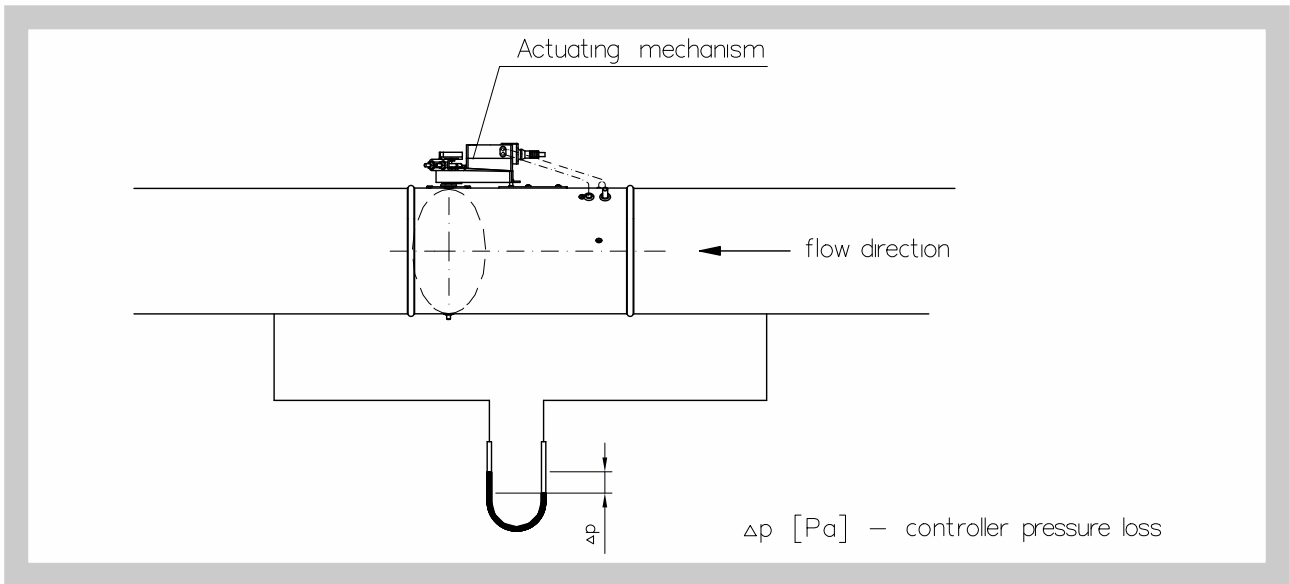
**Fig. 4   Pipe pressure control**



Pressure controller

Static pressure sensor

Actuating mechanism

flow direction

$\Delta p_s$ [Pa] — Static pressure difference between duct and surrounding environment

**Fig. 5   Room pressure control**



Pressure controller     Static pressure sensor

Actuating mechanism

air outlet

Room

$\Delta p_s$ [Pa] — Static pressure difference between room and surrounding environment

### 2.1. Compact regulator BELIMO - Air flow regulator

A pressure sensor, digital VAV controller and damper actuator all in one, providing a compact solution with a different communication possibilities.
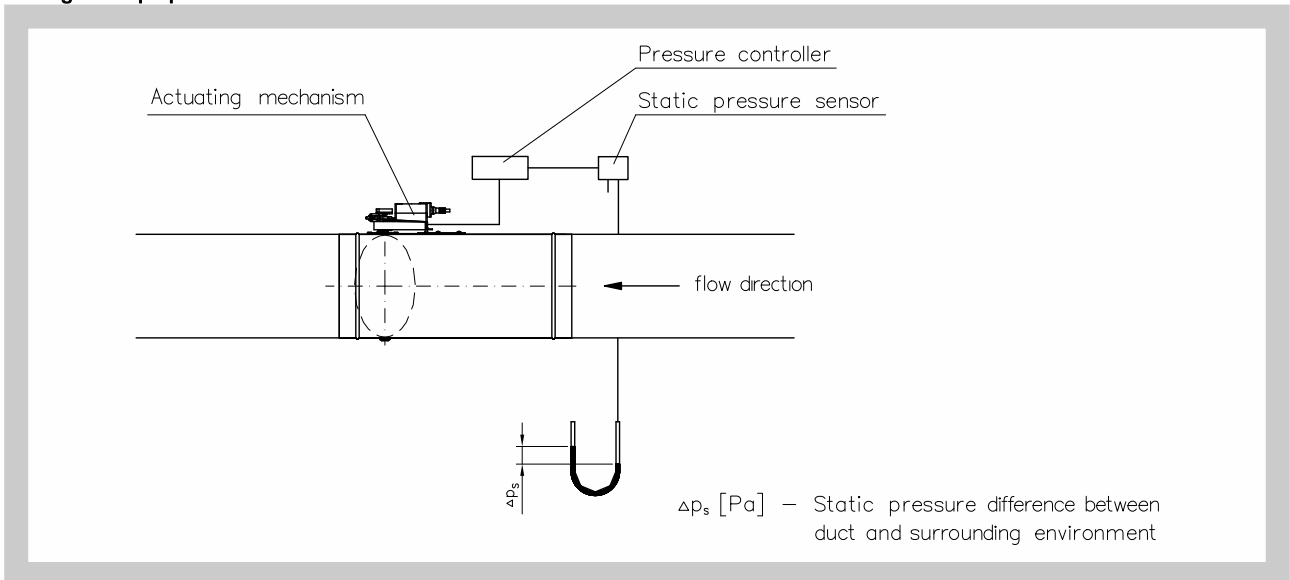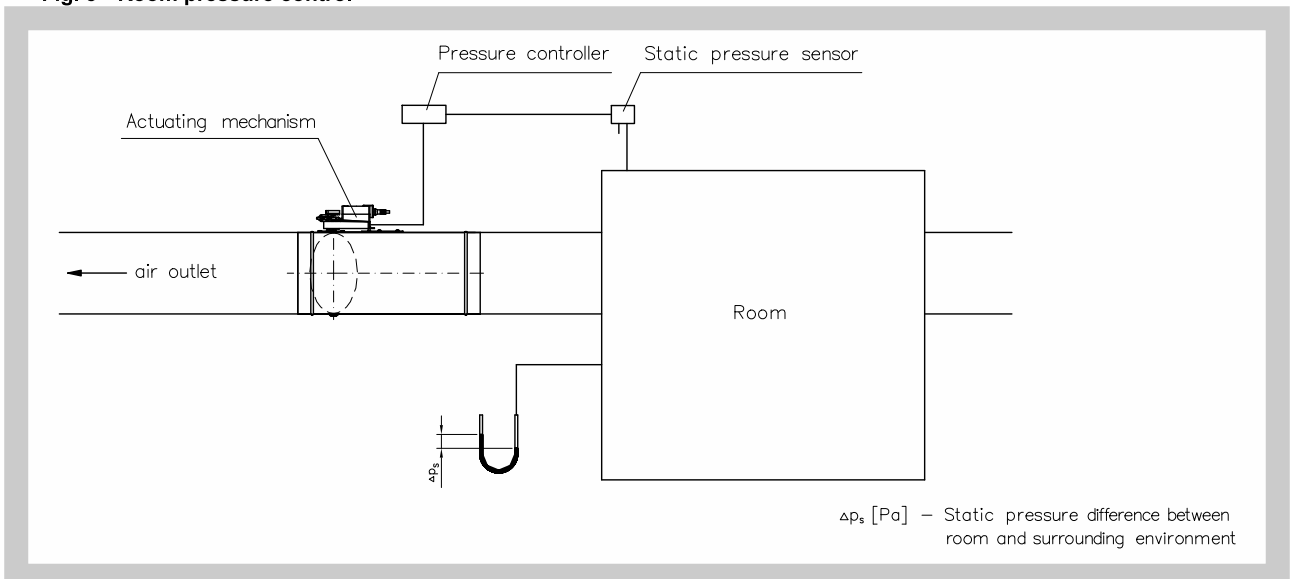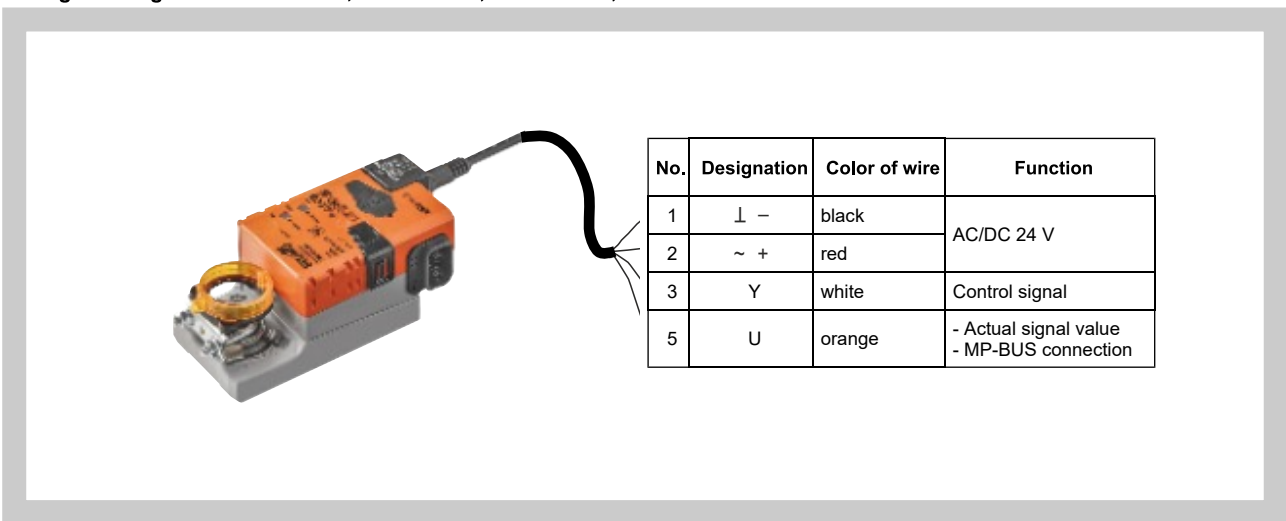
The regulator is used for regulation of air flow, it works on the principle of dynamic measurement. It compares the measured differential pressure with the set point, in case of deviation it rotates the damper blade until the set point is reached.

Regulators are divided in accordance with the type of control:

- LMV-D3-MP, NMV-D3-MP and SMV-D3-MP for control with signal 0(2)…10 V or protocol MP-BUS

- LMV-D3-MF.1 MDK* and NMV-D3-MF.1 MDK* for control with signal 0(2)…10 V

- LMV-D3-MOD and NMV-D3-MOD for control with signal 0(2)…10 V or using the protocol Modbus RTU, BACnet or MP-BUS

- LMV-D3-KNX and NMV-D3-KNX for control with signal 0(2)…10 V or using protocol KNX

**Fig. 6    Regulator LMV-D3-MP, NMV-D3-MP, SMV-D3-MP, LMV-D3-MF.1 MDK* and NMV-D3-MF.1 MDK***



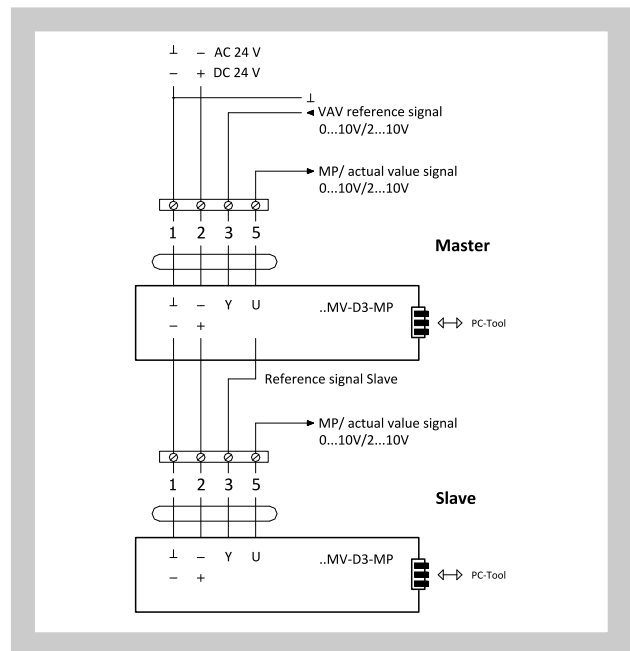| No. | Designation | Color of wire | Function |
|-----|-------------|---------------|----------|
| 1 | ⊥ − | black | AC/DC 24 V |
| 2 | ~ + | red | |
| 3 | Y | white | Control signal |
| 5 | U | orange | - Actual signal value<br>- MP-BUS connection |

**Fig. 7    Air flow control with LMV-D3-MP, NMV-D3-MP, SMV-D3-MP, LMV-D3-MF.1 MDK* and NMV-D3-MF.1 MDK***
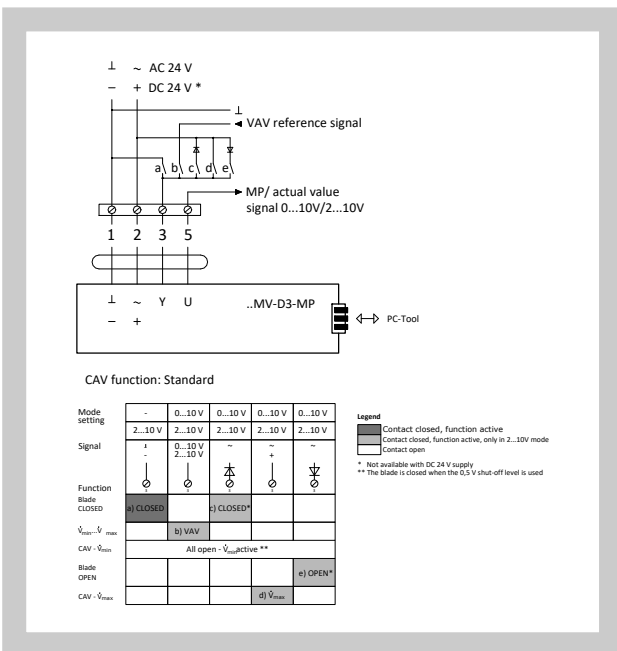


**Fig. 8    Master-slave flow control with actuators LMV-D3-MP, NMV-D3-MP, SMV-D3-MP, LMV-D3-MF.1 MDK* and NMV-D3-MF.1 MDK***



**\* MP-BUS protocol and service plug are not available**

**Fig. 9    Actuators LMV-D3-MOD, NMV-D3-MOD and SMV-D3-MOD**



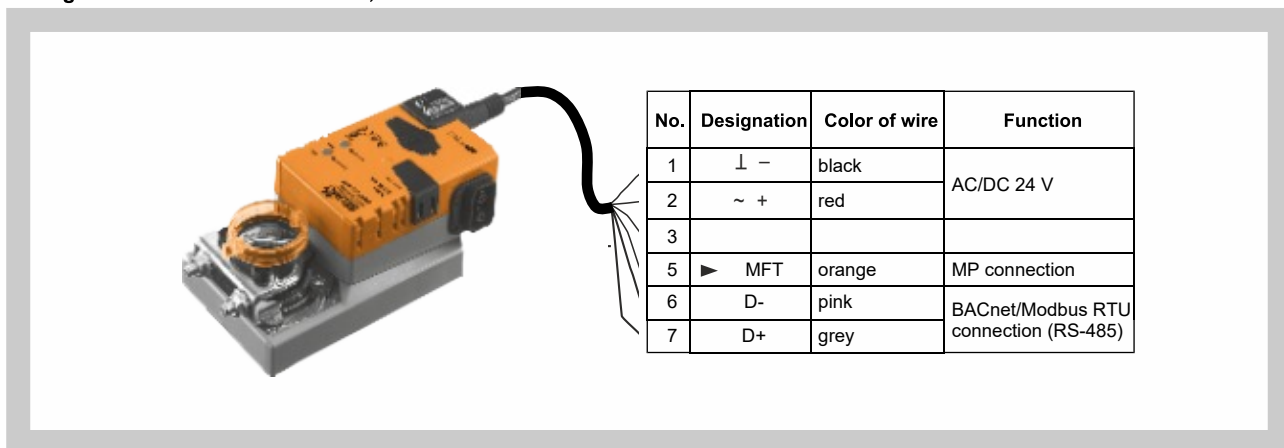| No. | Designation | Color of wire | Function |
|---|---|---|---|
| 1 | ⊥ − | black | AC/DC 24 V |
| 2 | ~ + | red | |
| 3 | | | |
| 5 | ► MFT | orange | MP connection |
| 6 | D- | pink | BACnet/Modbus RTU connection (RS-485) |
| 7 | D+ | grey | |

**Fig. 10   Wiring of LMV-D3-MOD, NMV-D3-MOD and SMV-D3-MOD on the serial line RS-485**
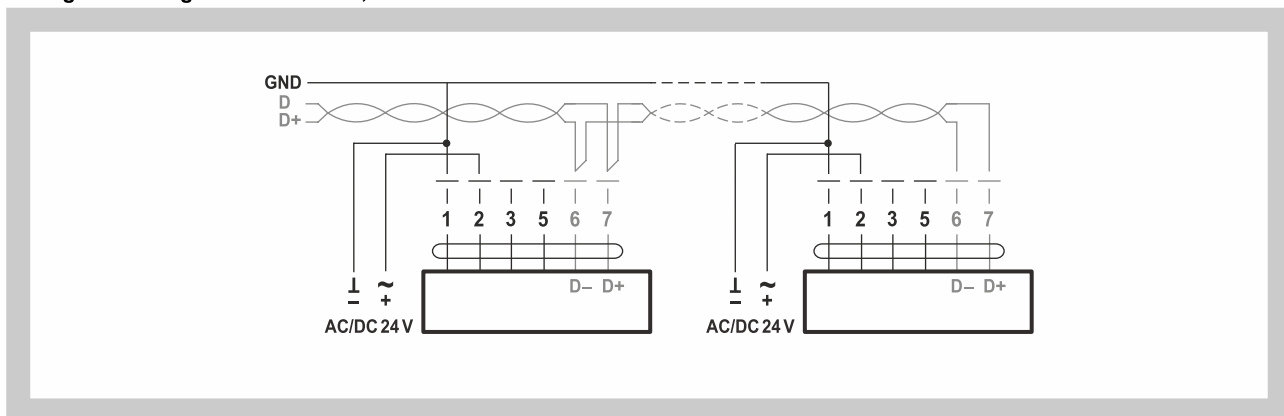


**Fig. 11   Actuators LMV-D3-KNX, NMV-D3-KNX**



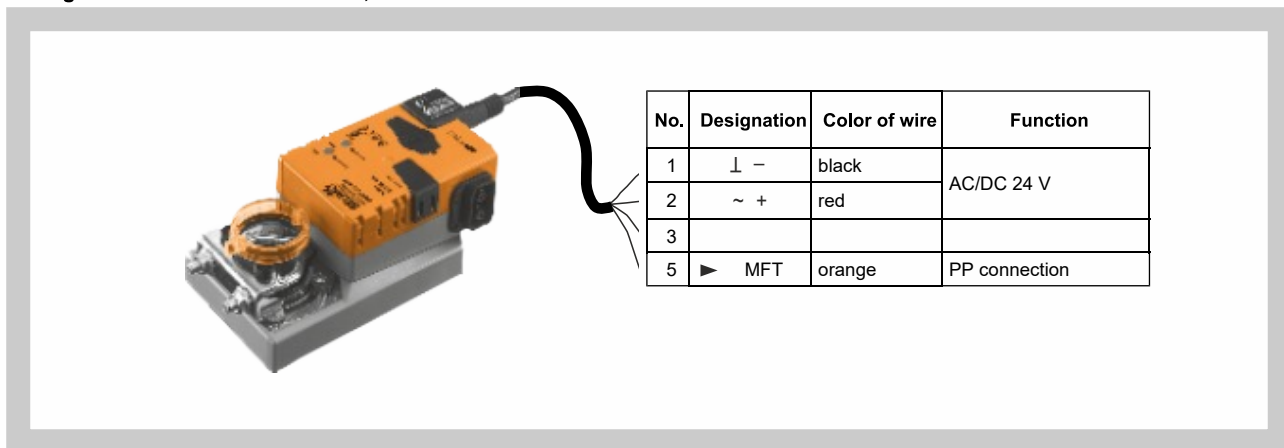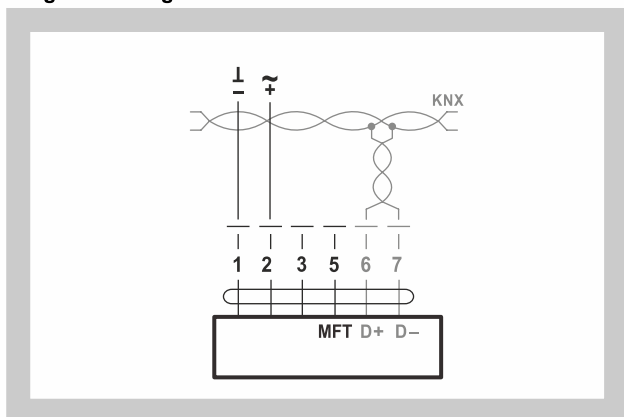| No. | Designation | Color of wire | Function |
|---|---|---|---|
| 1 | ⊥ − | black | AC/DC 24 V |
| 2 | ~ + | red | |
| 3 | | | |
| 5 | ► MFT | orange | PP connection |

**Fig. 12   Wiring of actuators LMV-D3-KNX and NMV-D3-KNX**

Tab. 2.1.1.  Technical parameters of actuators LMV-D3-MF.1 MDK/MP/MOD/KNX, NMV-D3-MF.1 MDK/MP/MOD/KNX and SMV-D3-MP/MOD

| VAV-Regulator | LMV-D3-… | | | | NMV-D3-… | | | | SMV-D3-… | |
|---|---|---|---|---|---|---|---|---|---|---|
| Communication | MF | MP | MOD | KNX | MF | MP | MOD | KNX | MP | MOD |
| Power voltage | AC/DC 24 V, 50/60 Hz | | | | | | | | | |
| Functional range | AC 19,2…28,8 V / DC 21,6…28,8 V | | | | | | | | | |
| Dimensioning | 3,5 VA | | 4 VA | | 5 VA | | | | 5,5 VA | |
| | (max. 8 A @ 5 ms) | | | | | | | | | |
| Power input | 2 W | | | | 3 W | | | | 3 W | |
| Torque | 5 Nm | | | | 10 Nm | | | | 20 Nm | |
| **Adjustment ranges** | | | | | | | | | | |
| $\mathring{V}_{nom}$ | OEM specific nominal volumetric flow setting, suitable for VAV unit | | | | | | | | | |
| $\mathring{V}_{max}$ | 20…100% z $\mathring{V}_{nom}$ | | | | | | | | | |
| $\mathring{V}_{min}$ | 0…100% z $\mathring{V}_{nom}$ | | | | | | | | | |
| **Standard control** | | | | | | | | | | |
| VAV mode for reference value input Y (connection 3) | - DC 2…10 V/ (4…20mA resistance 500Ω)  - DC 0…10 V/ (0…20mA resistance 500Ω)  - adjustable DC 0…10 V  } (Input impedance min. 100 kΩ) | | | | | | | | | |
| Mode for actual value signal $U_5$ (connection 5) | - DC 2…10 V  - DC 0…10 V  - adjustable: vol. flow, blade position or diff. pressure  } (max. 0,5 mA) | | | | | | | | | |
| CAV operating modes (constant volumetric flow) | CLOSED / $\mathring{V}_{min}$ / $\mathring{V}_{max}$ / OPEN* (* only with AC 24V supply) | | | | | | | | | |
| Connection | cable 6 x 0,75 mm² (for MP communication cable 4 x 0,75 mm²) | | | | | | | | | |
| Protective category | III (Safety extra-low voltage) | | | | | | | | | |
| Ambient humidity | 5 ... 95% r.h., non-condensing (in accordance with EN 60730-1) | | | | | | | | | |
| Non-operating temperature | -40°C…+80°C | | | | | | | | | |
| Weight | 0,5 kg | | | | 0,7 kg | | | | 0,83 kg | |

## 2.2. VRU regulator - regulation of air flow, pressure or pressure in the room

Universal VAV controller VRU and pressure sensor in one body (controlled by 0 / 2-10 V signal, MP-BUS, Modbus RTU, BACnet MS / TP) and actuator.

Depending on the type used, the controller works on the principle of dynamic or static measurement. It compares the measured differential pressure with the set value, in case of deviation it rotates the damper leaf until the set value is reached.

The regulators are divided according to the used pressure sensor:

- VRU-D3-BAC for control with 0/2…10V signal (optional MP-BUS, Modbus RTU, BACnet MS/TP), for measuring dynamic pressure in the range 0…500 Pa
- VRU-M1-BAC for control with 0/2…10V signal (optional MP-BUS, Modbus RTU, BACnet MS/TP), for measuring static pressure in the range 0…600 Pa
- VRU-M1R-BAC for control with 0/2…10V signal (optional MP-BUS, Modbus RTU, BAC net MS/TP), for measuring static pressure in the room in the range -75…+75 Pa

Further controllers are divided according to the type of actuator mechanism:

- LM24A-VST (5 N.m.), NM24A-VST (10 N.m.), SM24A-VST (20 N.m.) without return spring
- LF24-VST (4 N.m.), NF24-VST (10 N.m.), SF24A-VST (20 N.m.) with return spring
- LMQ24A-VST (4 N.m.), NMQ24A-VST 8 N.m) fast drives
- NKQ24A-VST (10 N.m) quick-release drives with return spring

Fig. 13    Regulators VRU-D3-BAC, VRU-M1-BAC, VRU-M1R-BAC



| No. | Designation | Function |
|---|---|---|
| 1 | ⏚ - | AC/DC 24 V |
| 2 | ~ + | |
| 3 | Y | VAV reference signal |
| 5 | U / MP | PP / MP communication |
| 6 | ⏚ | GND |
| 7 | D+ | Control bus BACnet MS/TP / Modbus RTU |
| 8 | D- | |

Tab. 2.2.1.    Technical parameters of regulators VRU-D3-BAC, VRU-M1-BAC, VRU-M1R-BAC

| Regulator | VRU-D3-BAC | VRU-M1-BAC | VRU-M1R-BAC |
|---|---|---|---|
| Power voltage | AC/DC 24 V, 50/60 Hz | | |
| Functional range | AC 19.2...28.8 V / DC 21.6...28.8 V | | |
| Dimensioning | 2 VA (without actuator VST) | | |
| Power input | 1.5 W | | |
| Control variable w1 | DC 0/2...10 V @ input resistance 100 kΩ | | |
| Working range | DC 2...10V | | |
| Actual value signal $U_5$ | 0 (2)...10V | | |
| Actuator connection | AC/DC 24V, PP-Link for VST- actuator | | |
| Types of communication | PP Bus, MP Bus, ModBus RTU, BACnet | | |
| **Pressure sensor** | | | |
| Measurement principle | Belimo D3 flow through sensor (dynamic measurement) | Belimo M1 membrane sensor | Belimo M1R membrane sensor |
| Mounting position | it is not position dependent, no reset is required | | |
| Sensor range | 0…500 Pa | 0...600 Pa | -75...75 Pa |
| Maximum pressure | 1500 Pa | 1500 Pa | +-7kpa |
| Differential pressure | ±1 Pa @ 0...20 Pa ±5% @ 20...500 Pa | – | – |
| Properties measured air | 0...50°C / 5...95% r.H., non-condensing | | |
| Pressure connection | hose ends for hose with inner 4… 6 mm | | |
| **Setting ranges** | | | |
| Connection | screw terminals for 2 x 1,5 mm$^2$ | | |
| Protection class | III (safe low voltage) | | |
| Degree of protection | IP 42 | | |
| Ambient temperature | 0...+50°C | | |
| Storage temperature | -20°C...+80°C | | |
| Paramaterization | Belimo Assisant App (NFC) / PC-Tool / ZTH EU | | |
| Weight | 0,34 kg (without actuator VST) | | |

Fig. 14    LM24A-VST, LMQ24A-VST, NM24A-VST, NMQ24A-VST, SM24A-VST
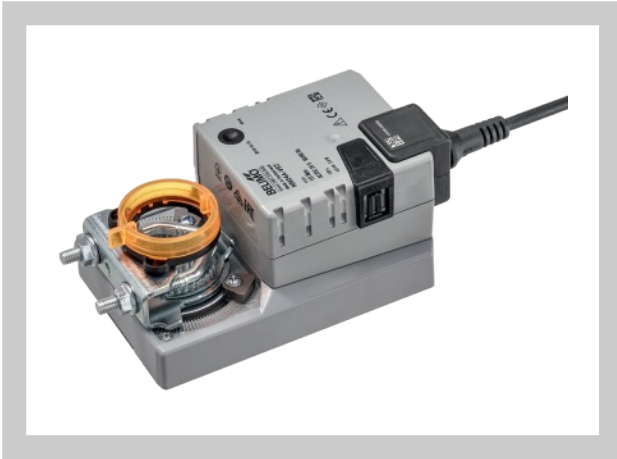


Fig. 15    NKQ24A-VST



Fig. 16    NF24A-VST, SF24A-VST



Tab. 2.2.2.    Technical parameters of actuators LM24A-VST, NM24A-VST, SM24A-VST, LMQ24A-VST,  NMQ24A-VST, NF24A-VST, SF24A-VST, NKQ24A-VST

| Actuator | LM24A-VST | NM24A-VST | SM24A-VST | LMQ24A-VST | NMQ24A-VST | NF24A-VST | SF24A-VST | NKQ24A-VST |
|---|---|---|---|---|---|---|---|---|
| Power voltage | AC/DC 24 V, 50/60 Hz (z VRU) | | | | | | | |
| Power input / Dimensioning | 1W / 2VA | 2W / 4VA | 2W / 4VA | 13W / 23VA | 13W / 23VA | 5W / 8VA | 8,5W / 11VA | 11W / 22VA |
| Torque at rated voltage | 5Nm | 10Nm | 20Nm | 4Nm | 8Nm | 10Nm | 20Nm | 6Nm |
| Sense of rotation | L / R (switch optional) | | | | | L / R | | L / R (switch optional) |
| Adjustment time for >90 (resp. 95°) | 120s | 120s | 120s | 2,5s | 4s | 120s return spring <20s | 120s return spring <20s | 4s return spring <4s |
| Degree of protection | IP 54 | | | | | | | |
| Protection class | III (safe low voltage) | | | | | | | |
| Ambient temperature | -30°C...+50°C | | | | | | | |
| Storage temperature | -40°C...+80°C | | | | | | | |
| Noise level | 35 dB(A) | 35 dB(A) | 45 dB(A) | 54 dB(A) | 56 dB(A) | 40 dB(A) | 40 dB(A) | 60 dB(A) |
| Weight | 0,56 kg | 0,78 kg | 0,98 kg | 0,56 kg | 0,78 kg | 2,3 kg | 2,3 kg | 1,4 kg |

### 2.3. PROFI-LINE regulator GRUNER - Air flow regulator / pressure regulator

A pressure sensor, digital VAV controller and damper actuator all in one, providing a compact solution with a different communication possibilities.

The regulator is used for regulation of air flow or pressure regulation (CCPC), it works on the principle of dynamic or static measurement.
It compares the measured differential pressure with the set point, in case of deviation it rotates the damper blade until the set point is reached.

Regulators based on the principle of dynamic measurement are divided in accordance with the type of control:

- 327VM-024-05(-MB), 327VM-024-10(-MB) or 327VM-024-15(-MB) for control with signal 0(2)…10 V, or 0(4)…20 mA, (optional Modbus RTU), with range 0…500 Pa

Regulators based on the principle of static measurement are divided in accordance with the type of control and sensor range:

- 327VM-024-05-DS4(-MB), 327VM-024-10-DS4(-MB) or 327VM-024-15-DS4(-MB) for control with signal 0(2)…10 V or 0(4)…20 mA (optional Modbus RTU), with range 0…400 Pa
- 327VM-024-05-DS6(-MB), 327VM-024-10-DS6(-MB) or 327VM-024-15-DS6(-MB) for control with signal 0(2)…10 V or 0(4)…20 mA (optional Modbus RTU), with range 0…600 Pa
- 327VM-024-05-DS10(-MB), 327VM-024-10-DS10(-MB) or 327VM-024-15-DS10(-MB) for control with signal 0(2)…10 V or 0(4)…20 mA (optional Modbus RTU), with range 0…1500 Pa

**Note:** Regulators marked at the end -MB, e.g. 327VM-024-05-MB or 327VM-024-05-DS4-MB, have the same functions as regulators without this designation, in addition they have the possibility of Modbus RTU communication.

**Fig. 17  Regulators 327VM-024-…**



| No. | Designation | Color of wire | Function |
|-----|-------------|---------------|----------|
| 1 | ⊥ − | Black | AC/DC 24 V |
| 2 | ~ + | Red |  |
| 3 | Y | White | Control signal 0(2)…10 V |
| 4 | U | Orange | Signal output value |
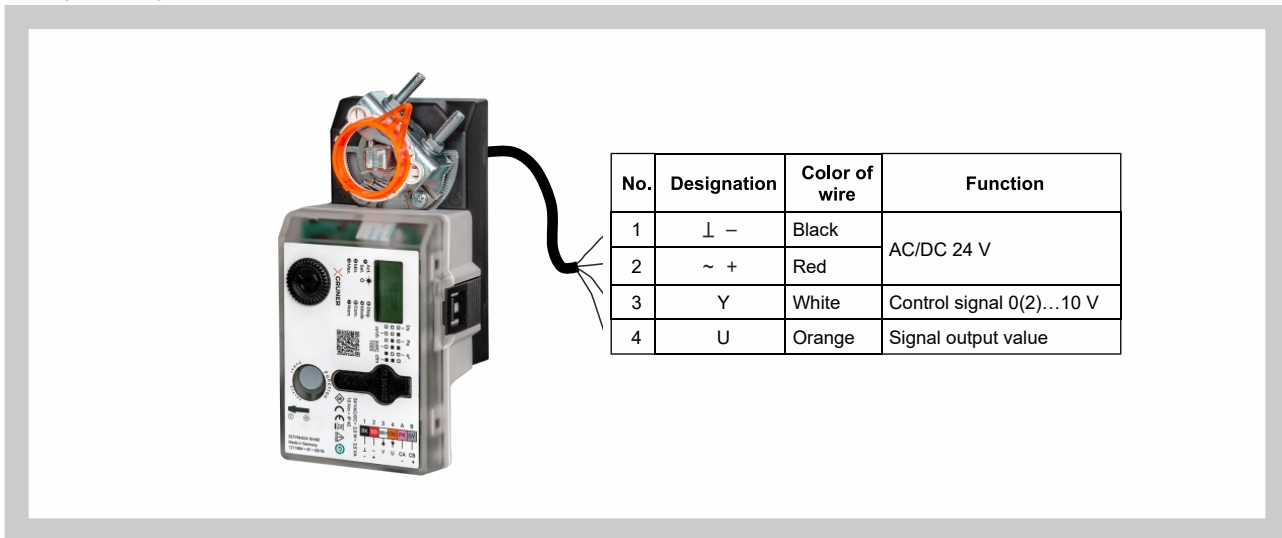
**Fig. 18  Regulators 327VM-024-… -MB**



| No. | Designation | Color of wire | Function |
|-----|-------------|---------------|----------|
| 1 | ⊥ − | Black | AC/DC 24 V |
| 2 | ~ + | Red |  |
| 3 | Y | White | Control signal 0(2)…10 V |
| 4 | U | Orange | Signal output value |
| A | CA - | Pink | Modbus RTU (Connection RS-485) |
| B | CB + | Gray |  |
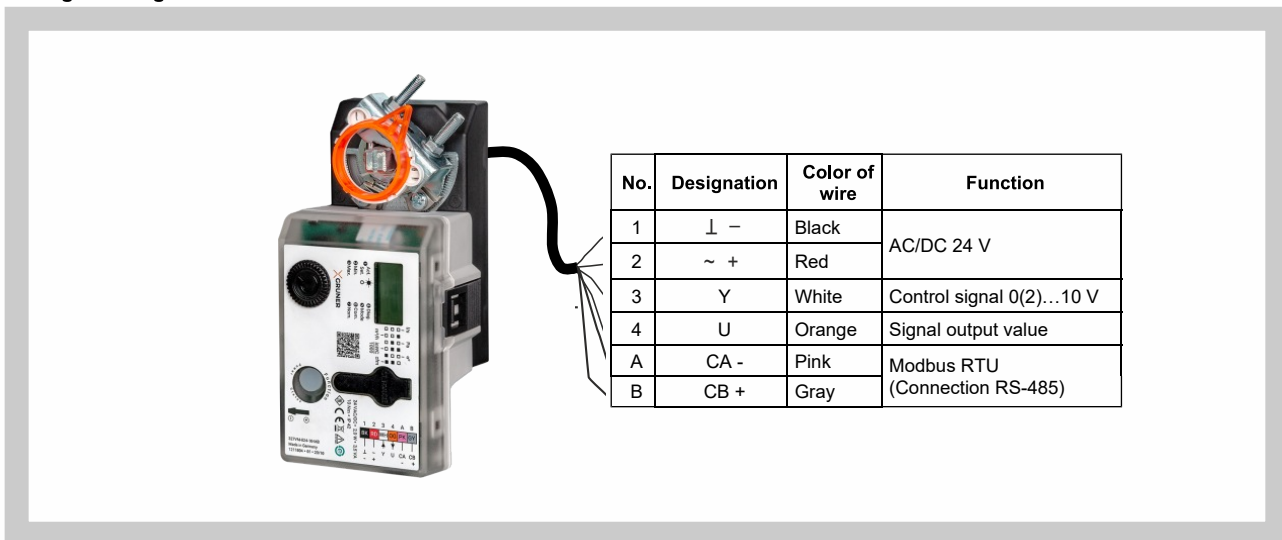
**Fig. 19   Regulator 327VM-024-…**
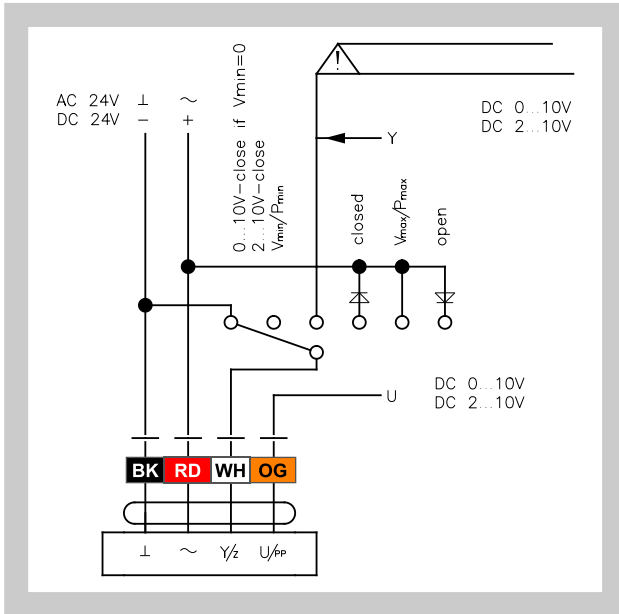
**Fig. 20   Regulator 327VM-024-…-MB**
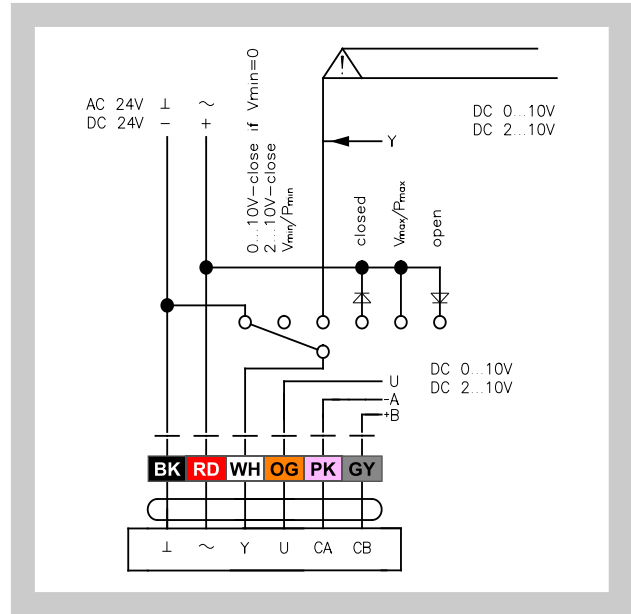


**Tab. 2.3.1.        Technical parameters of actuators 327VM-024-**

| | |
|---|---|
| **Power voltage** | AC/DC 24 V, 50/60 Hz |
| **Nominal voltage** | 19...29 VAC/DC |
| **Power input** | < 3,0 W |
| **Power input in a rest position** | < 2,0 W |
| **Torque** | 5\|10\|15 Nm |
| $\mathring{V}_{nom}$ | OEM specific nominal volumetric flow setting, suitable for VAV unit |
| $\mathring{V}_{max}$ | 30…100% z $\mathring{V}_{nom}$ |
| $\mathring{V}_{min}$ | 0…100% z $\mathring{V}_{nom}$ |
| **Input signal Y** | - DC 0(2)…10 V<br>- DC 0(4)…20 mA |
| **Output signal U** | - DC 0(2)…10 V, max. 0,5 mA |
| **Connection** | cable 1m, 4 x 0,75 mm$^2$ (for regulators with Modbus RTU 6 x 0,75 mm$^2$) |
| **Protective category** | III (Safety extra-low voltage) |
| **Ambient humidity** | 5...95% rH, non-condensing(in accordance with EN 60730-1) |
| **Ambient temperature** | 0…+50 °C |
| **Storage temperature** | -20…+80 °C |
| **Noise level** | < 35 dB |

**Note:** Tab. 2.3.1. apply to controllers operating on the principle of both dynamic and static measurement, as well as air flow control (Chapter 2.3.)

### 2.4.    Regulator GRUNER universal - Air flow regulator

GUAC controller and pressure sensor in one housing, plus separate actuator.

The regulator is used to control the air flow, in accordance with the connected sensor works on the principle of dynamic or static measurement.
It compares the measured differential pressure with the set point, in case of deviation it rotates the damper blade until the set point is reached.

Regulators are divided according to the type of pressure sensor and type of communication:

- GUAC-DM3(-MB) for control with signal 0(2)…10 V or 0(4)…20 mA (optional Modbus RTU), for dynamic pressure measurement in the range 0…300 Pa
- GUAC-SM3(-MB) for control with signal 0(2)…10 V or 0(4)…20 mA (optional Modbus RTU), for static pressure measurement in the range 0…300 Pa

Furthermore, the regulators are divided in accordance with the used actuator:

- 227C-024-05-V/ST06, 227C-024-10-V/ST06 and 227C-024-15-V/ST06 without return spring
- 341C-024-05-V/ST06, 361C-024-10-V/ST06 and 361C-024-15-V/ST06 with return spring

**Fig. 21   Regulatory GUAC-…**
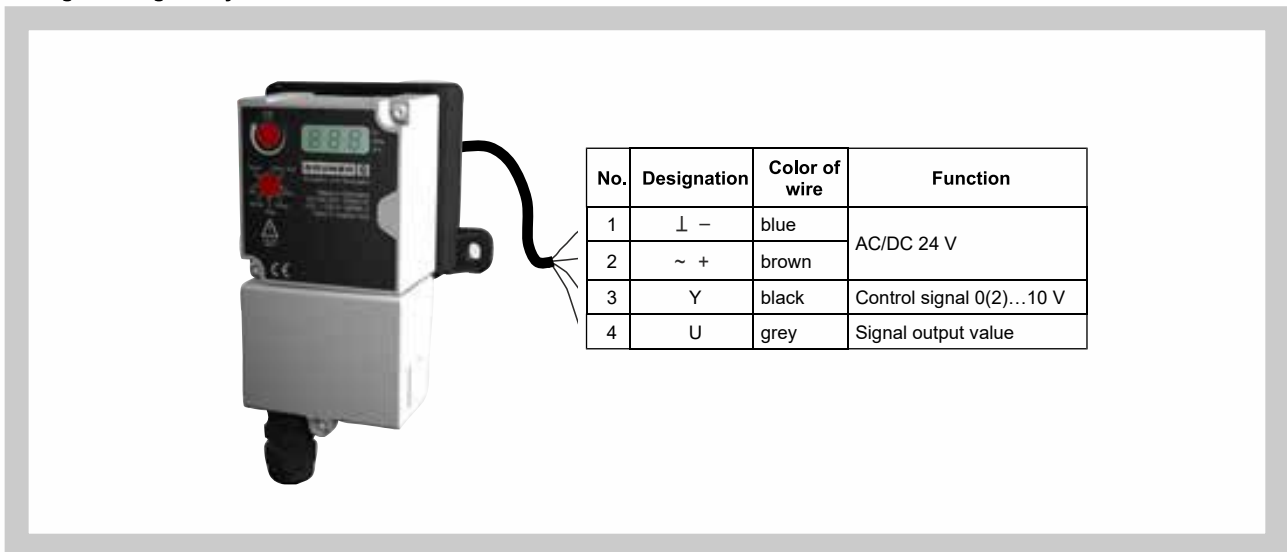


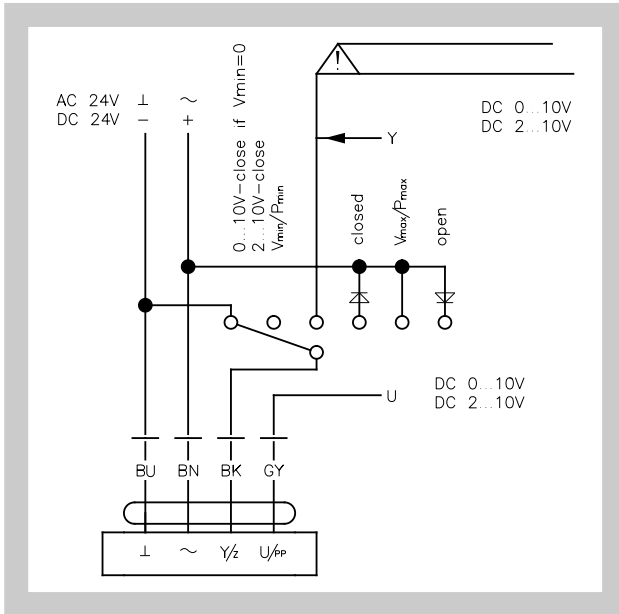| No. | Designation | Color of wire | Function |
|-----|-------------|---------------|----------|
| 1 | ⊥ − | blue | AC/DC 24 V |
| 2 | ~ + | brown | |
| 3 | Y | black | Control signal 0(2)…10 V |
| 4 | U | grey | Signal output value |

**Fig. 22 Regulators GUAC-…**



**Fig. 23 Regulators GUAC-…-MB**
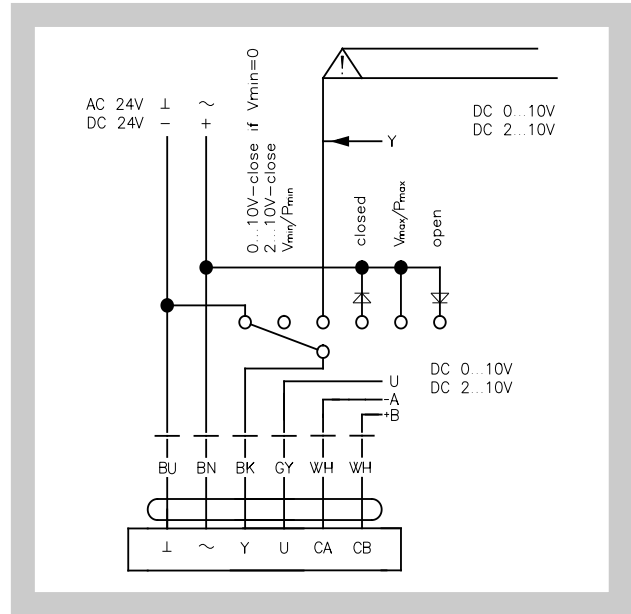


**Tab. 2.4.1. Technical parameters of regulators GUAC-…**

| Regulator | GUAC-… |
|---|---|
| Power voltage | AC/DC 24 V, 50/60 Hz |
| Dimensioning | 1,3 VA |
| Power input | 0,6 W |
| $\overset{\circ}{V}_{nom}$ | OEM specific nominal volumetric flow setting, suitable for VAV unit |
| $\overset{\circ}{V}_{max}$ | 0…100% z $\overset{\circ}{V}_{nom}$ |
| $\overset{\circ}{V}_{min}$ | 0…100% z $\overset{\circ}{V}_{nom}$ |
| Input signal Y | - DC 0(2)…10 V<br>- DC 0(4)…20 mA |
| Output signal U | - DC 0(2)…10 V, max. 0,5 mA |
| Connection | cable 1m, Lumberg connector |
| Protective category | III (Safety extra-low voltage) |
| Ambient humidity | 95% rH, non-condensing(in accordance with EN 60730-1) |
| Ambient temperature | 0…+50 °C |
| Storage temperature | -20…+80 °C |
| Weight | 0,38 kg |

**Fig. 24 Actuators 227C-024-…**



**Fig. 25 Actuators 341C-024-05-V/ST06 and 361C-024-…**
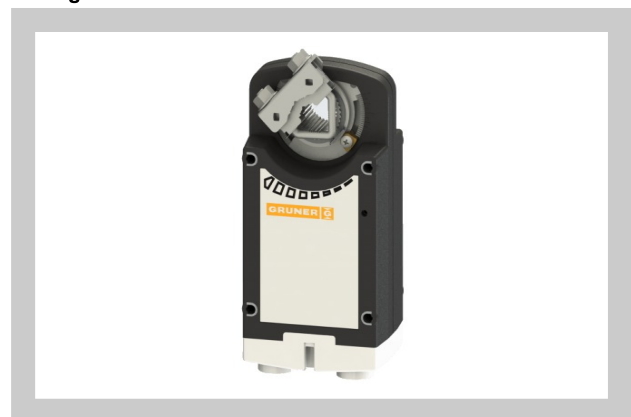
Tab. 2.4.2.    Technical parameters of actuators 227C-024-… , 341C-024-05-V/ST06 and 361C-024-…

| Regulator | 227C-024-05-V/ST06 | 227C-024-10-V/ST06 | 227C-024-15-V/ST06 | 341C-024-05-V/ST06 | 361C-024-10-V/ST06 | 361C-024-20-V/ST06 |
|---|---|---|---|---|---|---|
| Power voltage | AC/DC 24 V, 50/60 Hz | | | | | |
| Dimensioning | 3,5 VA | | | 6,5 VA | 8 VA | 11,5 VA |
| Power input | 2 W | | | 5 W | | 8 W |
| Power input in a rest position | 1 W | | | 2 W | | 2 W |
| Torque | 5 Nm | 10 Nm | 20 Nm | 5 Nm | 10 Nm | 20 Nm |
| Connection | cable 1m, Lumberg connector | | | | | |
| Adjustment time for > 90° | < 100 s | < 150 s | < 150 s | < 100 s, return spring 20 s | < 150 s, return spring 20 s | < 150 s, return spring 20 s |
| Protective category | III (Safety extra-low voltage) | | | | | |
| Ambient humidity | 95% rH, non-condensing (in accordance with EN 60730-1) | | | | | |
| Ambient temperature | -30…+50 °C | | | | | |
| Storage temperature | -30…+80 °C | | | | | |
| Noise level | < 35 dB | | | | | |
| Noise level of return spring | 0 | | | < 65 dB | | |
| Weight | 0,53 kg | | | 1,4 kg | | 1,7 kg |

## 2.5.    Regulator GRUNER universal - Pressure regulator

GUAC controller and pressure sensor in one housing, plus separate actuator.
The regulator is used for pressure regulation, in accordance with the connected sensor works on the principle of dynamic or static measurement.
It compares the measured differential pressure with the set point, in case of deviation it rotates the damper blade until the set point is reached.

Regulators are divided according to the type of pressure sensor and type of communication:

- GUAC-PM1(-MB) for control with signal 0(2)…10 V or 0(4)…20 mA (optional Modbus RTU), for static pressure measurement in the range 0…100 Pa

- GUAC-PM3(-MB) for control with signal 0(2)…10 V or 0(4)…20 mA (optional Modbus RTU), for static pressure measurement in the range 0…300 Pa

- GUAC-PM6(-MB) for control with signal 0(2)…10 V or 0(4)…20 mA (optional Modbus RTU), for static pressure measurement in the range 0…600 Pa

- GUAC-PM-DD3(-MB) for control with signal 0(2)…10 V or 0(4)…20 mA (optional Modbus RTU), for dynamic pressure measurement in the range 0…300 Pa

Furthermore, the regulators are divided in accordance with the used actuator:

- 227C-024-05-V/ST06, 227C-024-10-V/ST06 and 227C-024-15-V/ST06 without return spring
- 341C-024-05-V/ST06, 361C-024-10-V/ST06 and 361C-024-15-V/ST06 with return spring

**Similar to Chapter 2.4., and Tab. 2.4.1. and 2.4.2. apply to all these embodiments**

## 2.6.    Compact regulator Siemens - Air flow regulator

A pressure sensor, digital VAV controller and damper actuator all in one, providing a compact solution with a different communication possibilities.

The regulator is used for regulation of air flow, it works on the principle of dynamic measurement. It compares the measured differential pressure with the set point, in case of deviation it rotates the damper blade until the set point is reached.

Regulators are divided in accordance with the type of control:

- GDB181.1E/3 and GLB181.1E/3 for control with signal 0(2)…10 V

- GDB181.1E/BA and GLB181.1E/BA using the protocol BACnet

- GDB181.1E/KN and GLB181.1E/KN using the protocol KNX

- GDB181.1E/MO and GLB181.1E/MO using the protocol Modbus RTU
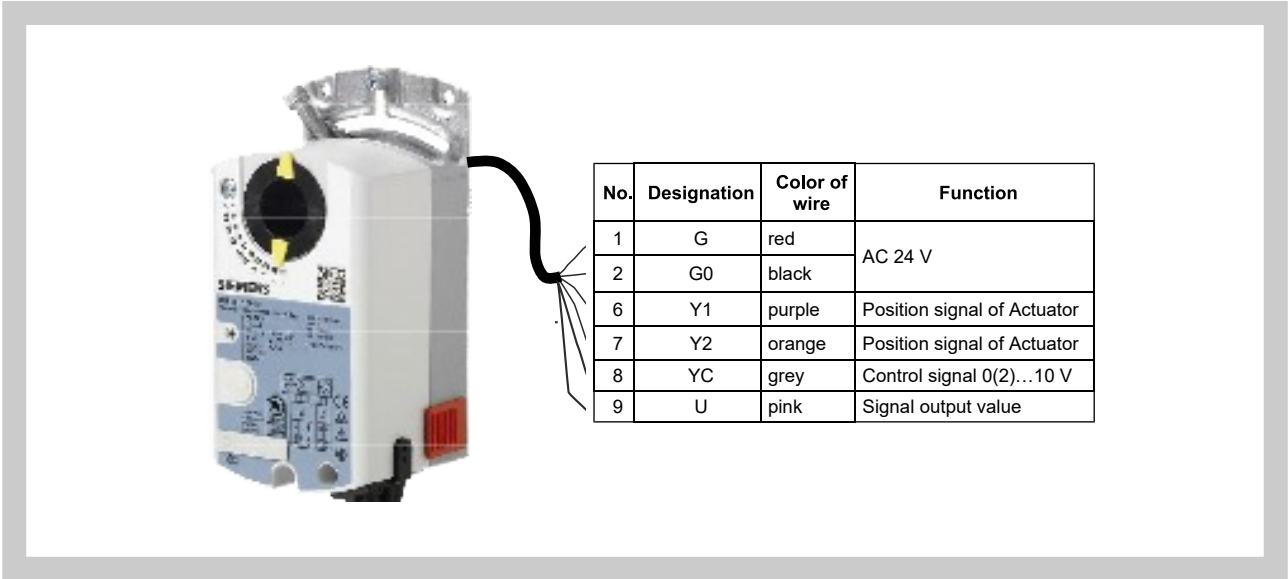
**Fig. 26   GDB181.1E/3 and GLB181.1E/3**



| No. | Designation | Color of wire | Function |
|-----|-------------|---------------|----------|
| 1 | G | red | AC 24 V |
| 2 | G0 | black | |
| 6 | Y1 | purple | Position signal of Actuator |
| 7 | Y2 | orange | Position signal of Actuator |
| 8 | YC | grey | Control signal 0(2)…10 V |
| 9 | U | pink | Signal output value |

**Fig. 27   GDB181.1E/BA, GLB181.1E/BA, GDB181.1E/MO and GLB181.1E/MO**



| No. | Designation | Color of wire | Function |
|-----|-------------|---------------|----------|
| 1 | G | red | AC 24 V |
| 2 | G0 | black | |

| No. | Designation | Color of wire | Function |
|-----|-------------|---------------|----------|
| 6 | REF | purple | Reference |
| 8 | + | grey | Modbus RTU / BACnet |
| 9 | - | pink | Modbus RTU / BACnet |

**Fig. 28   GDB181.1E/KN and GLB181.1E/KN**



| No. | Designation | Color of wire | Function |
|-----|-------------|---------------|----------|
| 1 | G | red | AC 24 V |
| 2 | G0 | black | |

| No. | Designation | Color of wire | Function |
|-----|-------------|---------------|----------|
| 1 | CE+ | red | KNX |
| 2 | CE- | black | KNX |
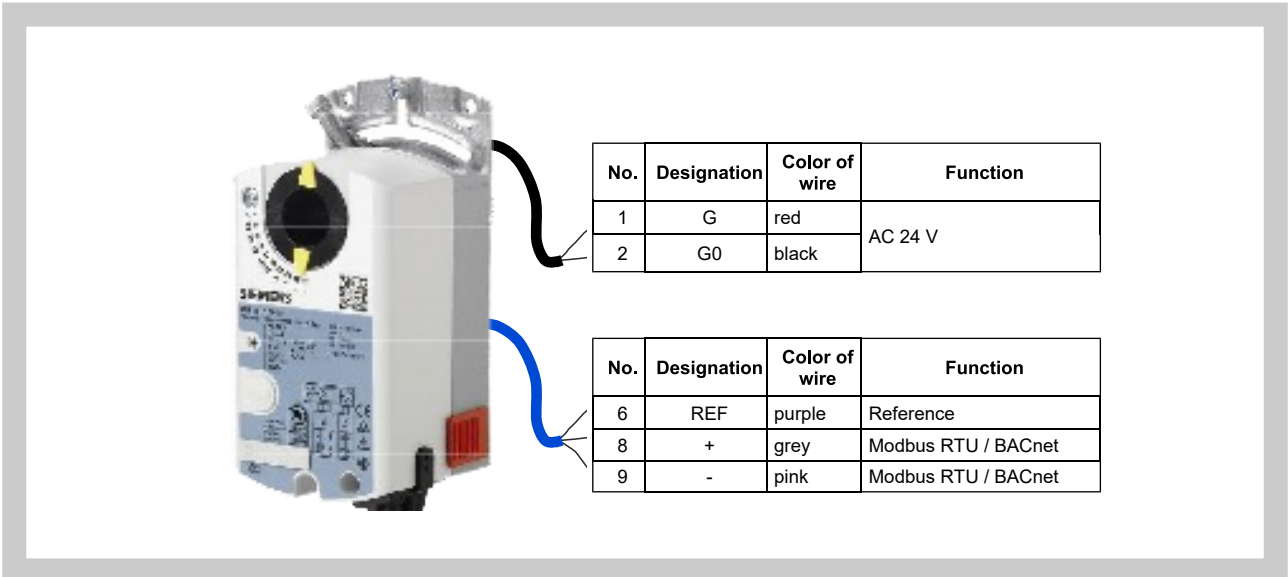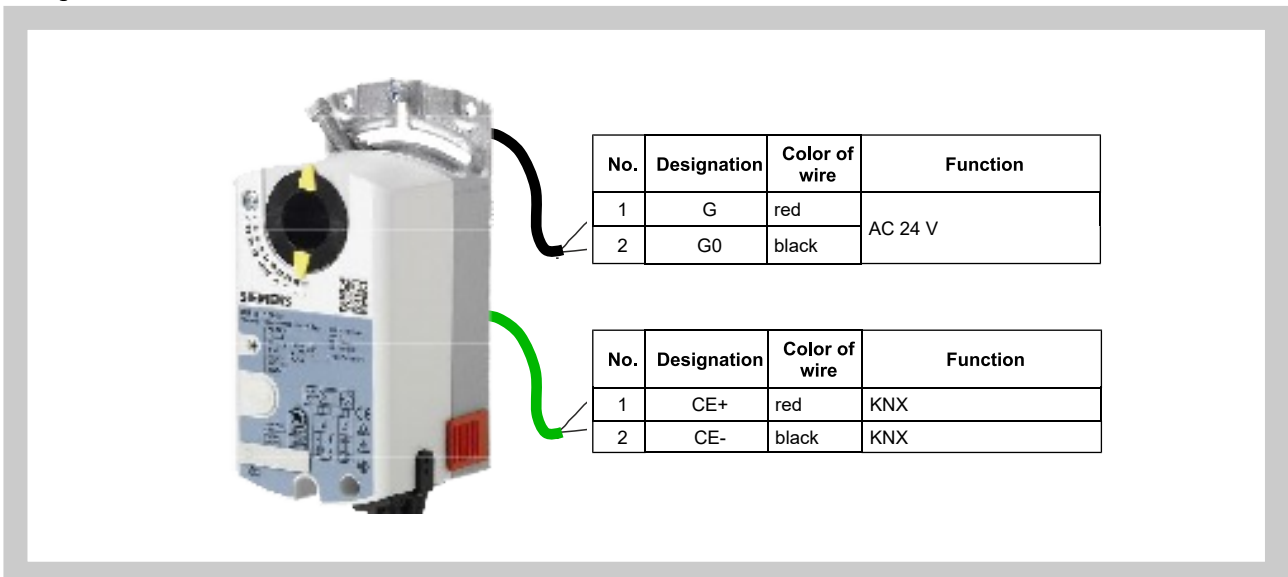
Tab. 2.6.1.    Technical parameters of actuators GDB181.1E/… and GLB181.1E/…

| VAV-Regulator | GDB181.1E/… | | | | GLB181.1E/… | | | |
|---|---|---|---|---|---|---|---|---|
| Communication | 3 (without) | MO | KN | BA | 3 (bez) | MO | KN | BA |
| Power voltage | AC 24 V, 50/60 Hz | | | | | | | |
| Functional range | +- 20% | | | | | | | |
| Dimensioning | 3 VA | | | | | | | |
| Power input | 2,5 W | | | | | | | |
| Torque | 5 Nm | | | | 10 Nm | | | |
| Adjustment ranges | | | | | | | | |
| $\mathring{V}_{nom}$ | OEM specific nominal volumetric flow setting, suitable for VAV unit | | | | | | | |
| $\mathring{V}_{max}$ | 20…120% z $\mathring{V}_{nom}$ | | | | | | | |
| $\mathring{V}_{min}$ | -20…100% z $\mathring{V}_{nom}$ | | | | | | | |
| Connection | cable 6 x 0,75 mm$^2$ | | | | | | | |
| Protective category | III (Safety extra-low voltage) | | | | | | | |
| Ambient humidity | 95% rH, non-condensing(in accordance with EN 60730-1) | | | | | | | |
| Storage temperature | -25…+70 °C | | | | | | | |
| Weight | 0,6 kg | | | | | | | |

## 3. Dimensions, weights

### 3.1.    Dimensions, weights

Tab. 3.1.1.  Main dimensions and weights

| Size | D [mm] | L [mm] | L$_1$ [mm] | Weight SPIRO [kg] | | Weight with flange [kg] | |
|---|---|---|---|---|---|---|---|
| | | | | without | with | without | with |
| | | | | insulation | | insulation | |
| 80 | 80 | 450 | 344 | 1,6 | 2,8 | 1,9 | 3,1 |
| 100 | 100 | 450 | 344 | 1,7 | 3,1 | 2,0 | 3,4 |
| 125 | 125 | 450 | 344 | 2,0 | 3,6 | 2,4 | 3,9 |
| 140 | 140 | 450 | 344 | 2,2 | 3,9 | 2,6 | 4,3 |
| 160 | 160 | 450 | 344 | 2,5 | 4,3 | 3,2 | 5,0 |
| 180 | 180 | 450 | 344 | 2,8 | 4,8 | 3,3 | 5,3 |
| 200 | 200 | 450 | 344 | 3,0 | 5,1 | 3,6 | 5,7 |
| 225 | 225 | 450 | 344 | 3,5 | 5,8 | 4,1 | 6,4 |
| 250 | 250 | 450 | 344 | 4,4 | 6,9 | 5,1 | 7,6 |
| 280 | 280 | 450 | 344 | 5,0 | 7,7 | 5,8 | 8,5 |
| 315 | 315 | 450 | 344 | 5,6 | 8,5 | 6,5 | 9,4 |
| 355 | 355 | 450 | 344 | 6,6 | 9,8 | 7,6 | 10,8 |
| 400 | 400 | 450 | 344 | 7,5 | 11,1 | 9,7 | 13,3 |
| 500 | 500 | 600 | 494 | 12,2 | 18,0 | 15,1 | 21,0 |
| 630* | 630 | 600 | 494 | 19,6 | 26,7 | 23,5 | 30,7 |

In the case of the "Belimo universal" controller design, the controller with sensor + actuator (acc. to design Tab. 14.1.1) is required to weight in Tab. 3.1.1 add weight of the VRU-xx-BAC controller (0.3 kg).

* For size 630 is controlling via MF not available.

**Tab. 3.1.2. Other dimensions and assignment of actuators**

| Size [mm] | N [mm] | $N_1$ [mm] | W [mm] | M [mm] | VAV controler BELIMO / GRUNER / SIEMENS |
|---|---|---|---|---|---|
| 80 | 179/165 | 22/23 | 66/65 | 71/76 | LMV-D3-xxx (LM24A-VST) / 327VM-024-05 / GDB181.1x |
| 100 | 179/165 | 22/23 | 66/65 | 71/76 | LMV-D3-xxx (LM24A-VST) / 327VM-024-05 / GDB181.1x |
| 125 | 179/165 | 22/23 | 66/65 | 71/76 | LMV-D3-xxx (LM24A-VST) / 327VM-024-05 / GDB181.1x |
| 140 | 179/165 | 22/23 | 66/65 | 71/76 | LMV-D3-xxx (LM24A-VST) / 327VM-024-05 / GDB181.1x |
| 160 | 179/165 | 22/23 | 66/65 | 71/76 | LMV-D3-xxx (LM24A-VST) / 327VM-024-05 / GDB181.1x |
| 180 | 179/165 | 22/23 | 66/65 | 71/76 | LMV-D3-xxx (LM24A-VST) / 327VM-024-05 / GDB181.1x |
| 200 | 179/165 | 22/23 | 66/65 | 71/76 | LMV-D3-xxx (LM24A-VST) / 327VM-024-05 / GDB181.1x |
| 225 | 179/165 | 22/23 | 66/65 | 71/76 | LMV-D3-xxx (LM24A-VST) / 327VM-024-05 / GDB181.1x |
| 250 | 179/165 | 22/23 | 66/65 | 71/76 | LMV-D3-xxx (LM24A-VST) / 327VM-024-05 / GDB181.1x |
| 280 | 179/165 | 22/23 | 66/65 | 71/76 | LMV-D3-xxx (LM24A-VST) / 327VM-024-05 / GDB181.1x |
| 315 | 179/165 | 22/23 | 66/65 | 71/76 | LMV-D3-xxx (LM24A-VST) / 327VM-024-05 / GDB181.1x |
| 355 | 187/165 | 25/23 | 80/65 | 72/76 | NMV-D3-xxx (NM24A-V) / 327VM-024-10 / GLB181.1x |
| 400 | 187/165 | 25/23 | 80/65 | 72/76 | NMV-D3-xxx (NM24A-V) / 327VM-024-10 / GLB181.1x |
| 500 | 187/165 | 25/23 | 80/65 | 72/76 | NMV-D3-xxx (NM24A-V) / 327VM-024-10 / GLB181.1x |
| 630 | 202/165 | 30/23 | 88/65 | 74/76 | SMV-D3-xxx (SM24A-V) / 327VM-024-15 / – |

**For design with quick drive, emergency function or quick drive with emergency function, the size of the actuator must be discussed with the manufacturer.**
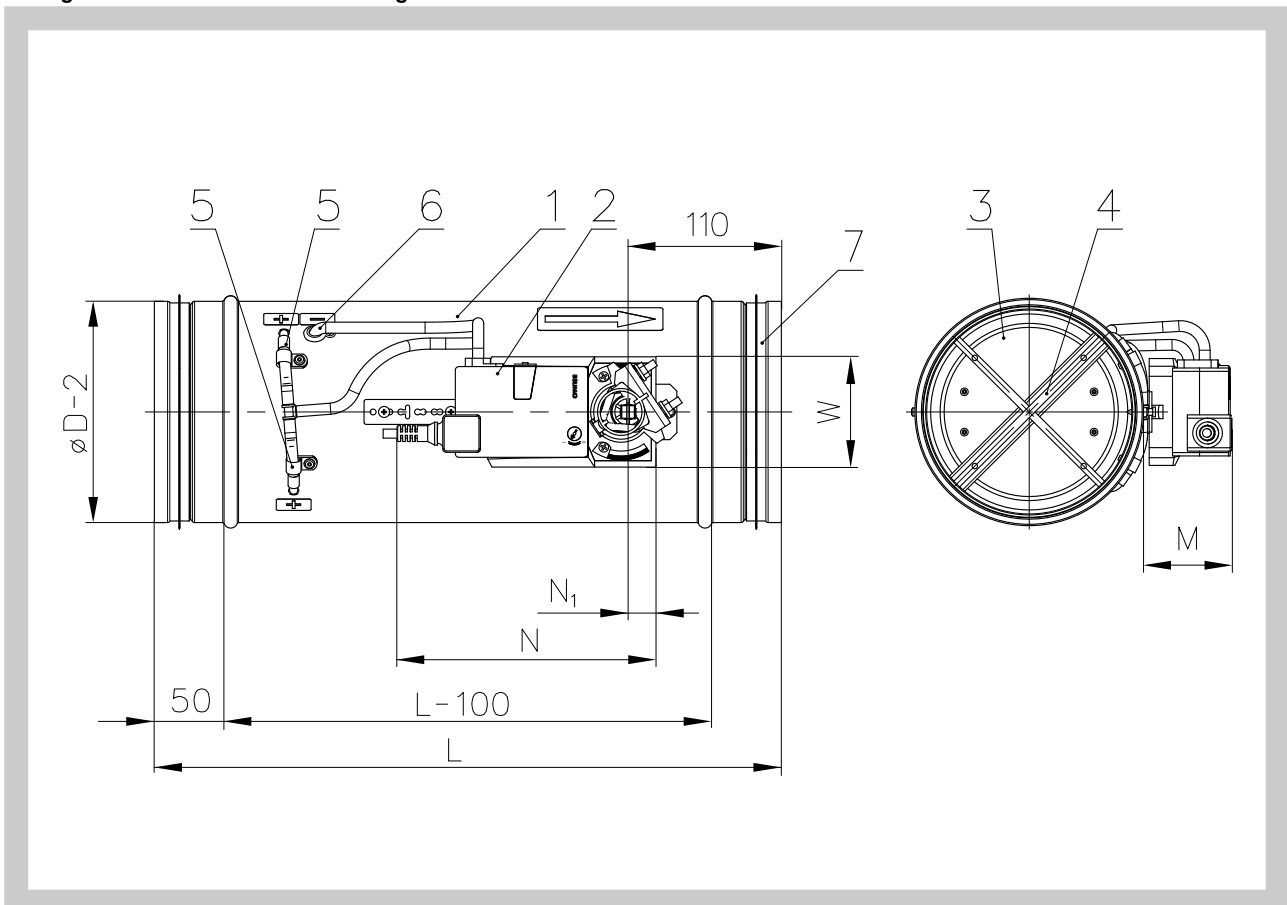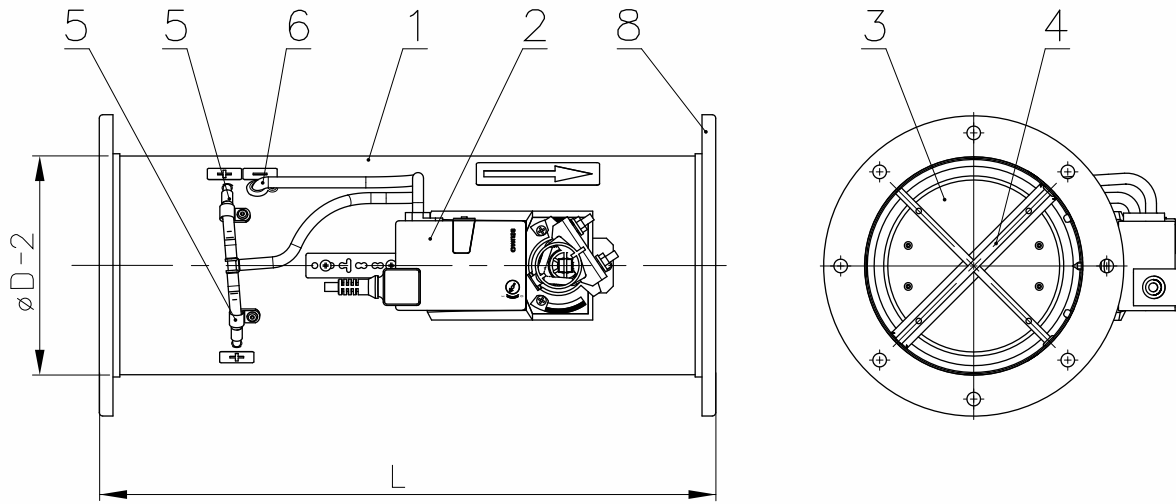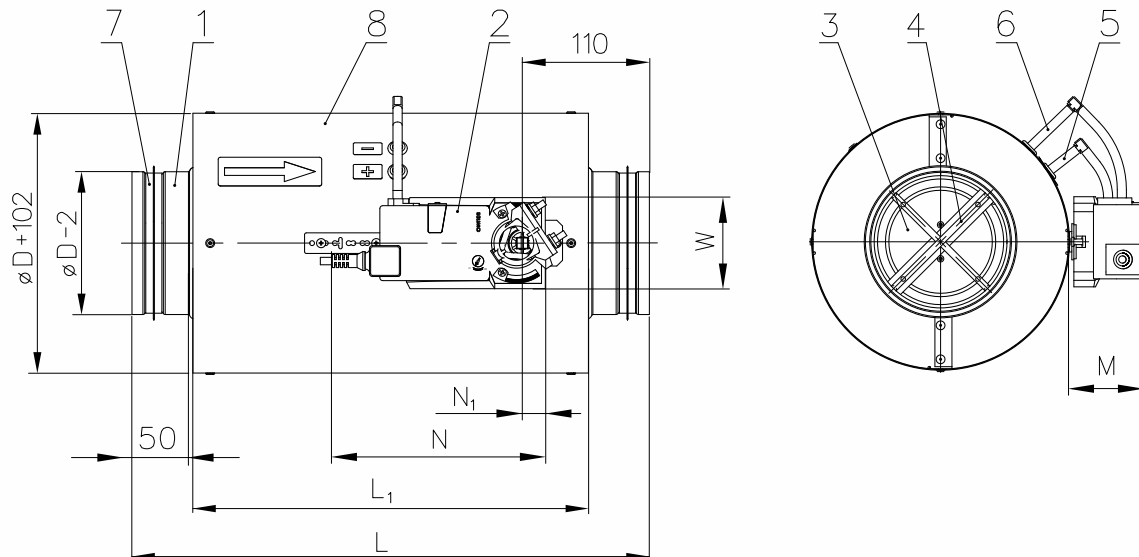
**Fig. 29 RPM-V - with rubber sealing**

**Fig. 30 RPM-V - with flanges**



**Flanges dimensions acc. EN 12 0505.**

**Fig. 31 RPM-V - with insulation**



**Position:**

| | | | | | |
|---|---|---|---|---|---|
| 1 | Controller body | 4 | Pressure sensors | 7 | Rubber sealing |
| 2 | Compact controller | 5 | Pressure sampling - $p_1$ | 8 | Flange |
| 3 | Controller blade | 6 | Pressure sampling - $p_2$ | 9 | Insulation cover |

## 4. Placement and Assembly

**4.1.** The controllers are meant for installation in duct. The operational position is optional. The direction of flow must be observed.

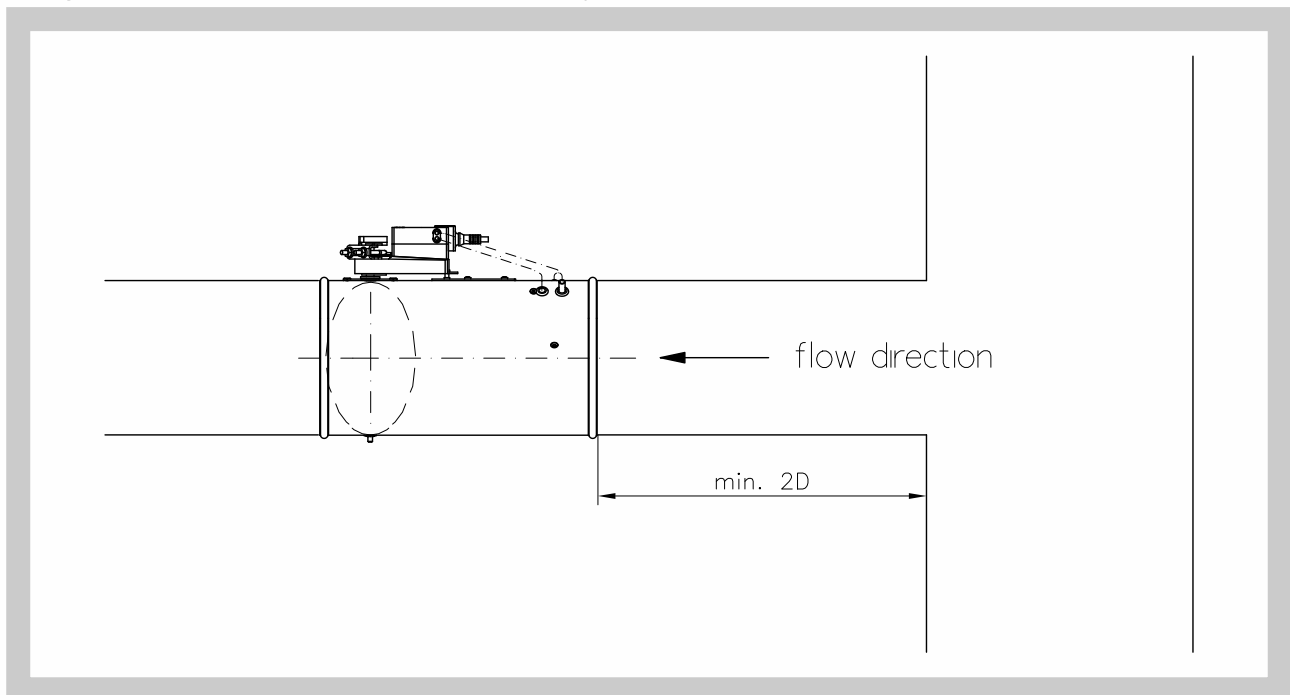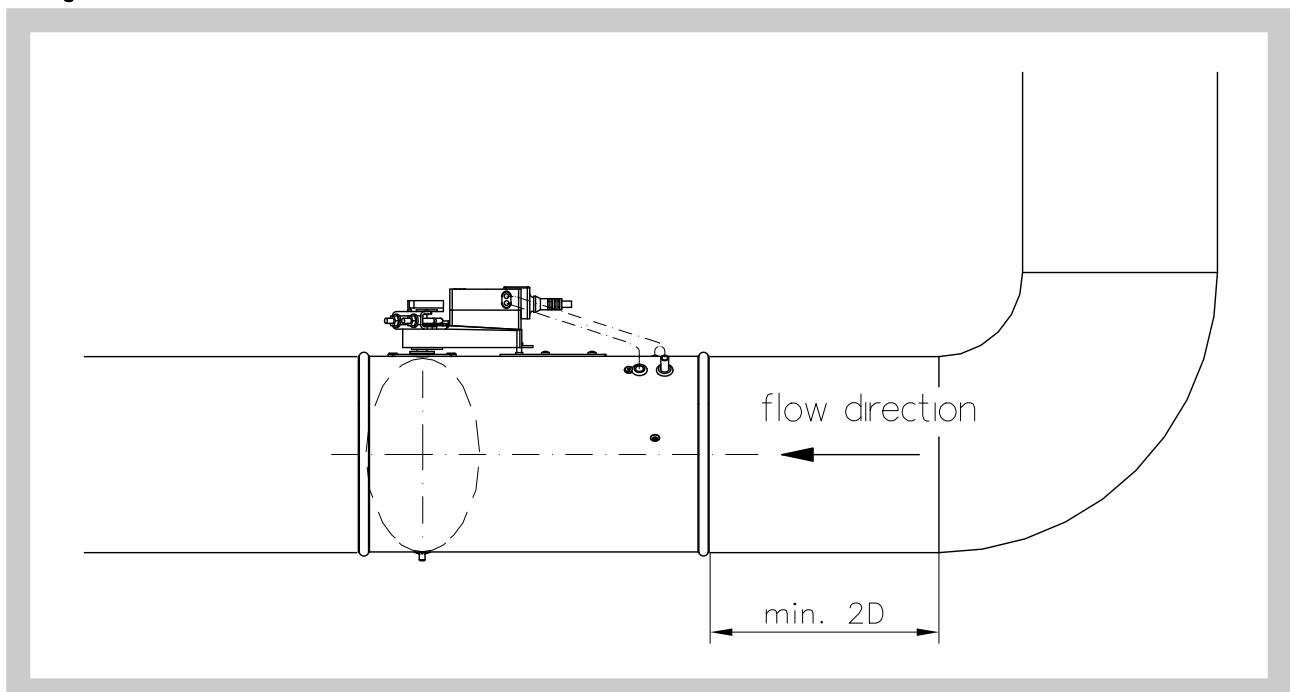**Fig. 32 Recommended distance from double branch joint**



flow direction

min. 2D

**Fig. 33 Recommended distance from bend**



flow direction

min. 2D

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## III. TECHNICAL DATA

## 5. Basic parameters

### 5.1. Air volume

**Tab. 5.1.1. Air volume**

| Size [mm] | Air volume [m³/h] | | | | | |
|---|---|---|---|---|---|---|
| | Standard values* | | | Maximum values | | |
| | Minimal (w ≈ 1m/s) | Maximal (w ≈ 7m/s) | $\dot{V}_{nom}$ | Minimal (w ≈ 1m/s) | Maximal (w ≈ 12m/s) | $\dot{V}_{nom}$ |
| 80 | 18 | 125 | 125 | 18 | 220 | 220 |
| 100 | 30 | 200 | 200 | 30 | 350 | 350 |
| 125 | 45 | 310 | 310 | 45 | 550 | 550 |
| 140 | 55 | 400 | 400 | 55 | 700 | 700 |
| 160 | 70 | 500 | 500 | 70 | 900 | 900 |
| 180 | 90 | 650 | 650 | 90 | 1200 | 1200 |
| 200 | 115 | 800 | 800 | 115 | 1400 | 1400 |
| 225 | 145 | 1000 | 1000 | 145 | 1800 | 1800 |
| 250 | 180 | 1250 | 1250 | 180 | 2200 | 2200 |
| 280 | 220 | 1550 | 1550 | 220 | 2800 | 2800 |
| 315 | 280 | 2000 | 2000 | 280 | 3500 | 3500 |
| 355 | 355 | 2500 | 2500 | 355 | 4500 | 4500 |
| 400 | 455 | 3200 | 3200 | 455 | 5800 | 5800 |
| 500 | 710 | 5000 | 5000 | 710 | 8500 | 8500 |
| 630 | 1120 | 7900 | 7900 | 1120 | 13500 | 13500 |

**\* Default controller settings - Belimo / Gruner / Siemens**

## 6. Determination of actual air volume

**6.1.**    Air volume value is determined by means of the computation from the measured value $U_5$.

**Sample for the operating mode 2...10 V**

$$\mathring{V} = \frac{U_5 - 2{,}0}{8} \cdot \mathring{V}_{nom}$$

**Sample for the operating mode 0...10 V**

$$\mathring{V} = \frac{U_5 \cdot \mathring{V}_{nom}}{10}$$

**Fig. 34  Determination of the actual value of $U_5$ by means of a voltage meter**



**Example: Operating mode 2…10 V**

Searched for: actual air volume
Voltage measured on $U_5$: 3,5 V
$$\mathring{V}_{nom} = 2800 \text{ m}^3.\text{h}^{-1}$$

$$\mathring{V} = \frac{3{,}5 - 2{,}0}{8} \cdot 2800 = 525$$
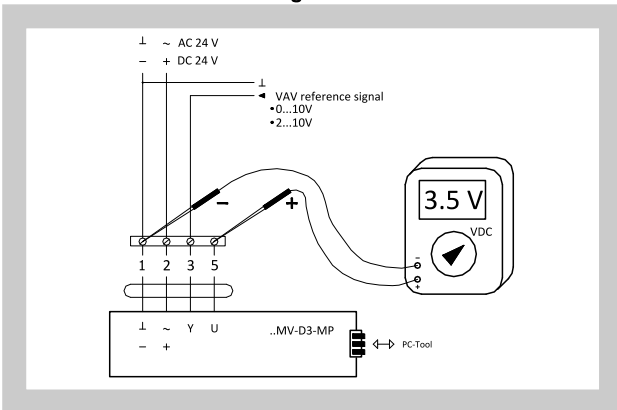
Actual air volume is 525 m³.h⁻¹.

**Example: Operating mode 0…10 V**

Searched for: actual air volume
Voltage measured on $U_5$ : 3,5 V
$$\mathring{V}_{nom} = 2200 \text{ m}^3.\text{h}^{-1}$$

$$\mathring{V} = \frac{3{,}5 \cdot 2200}{10} = 770$$

Actual air volume is 770 m³.h⁻¹

## 7. Pressure loss

**7.1.**    Pressure losses

**Diagram 7.1.1. Pressure losses  (the values are valid when the damper of the controller is completely open)**
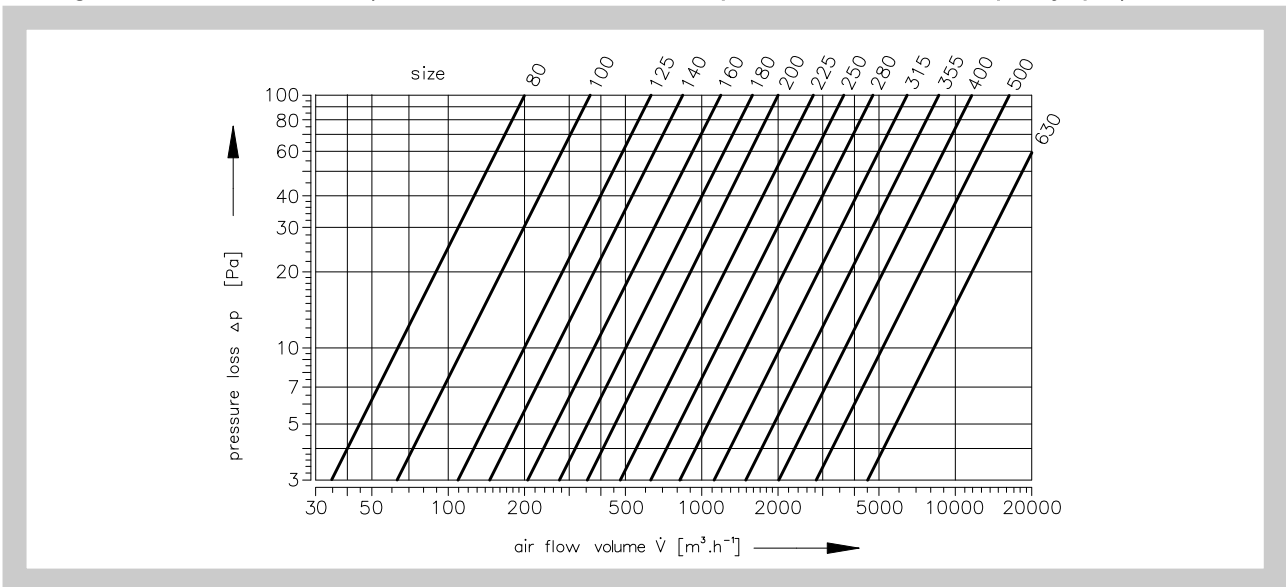


## 8. Noise data

**8.1.**    Air-regenerated Noise

The noise arising due to the flow of air volume controller is listed in the following tables Tab. 8.1.1. - Tab. 8.1.4.

$\mathring{V}$    [m³.h⁻¹]    - air flow volume

$\triangle p_{st}$  [Pa]      - pressure differential

$L_W$   [dB/Okt.]  - level of acoustic power in the octave band

$L_{WA}$  [dB(A)]  - total level of acoustic power corrected by filter A

$f_m$   [Hz]    - mean frequencies in the octave bands

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**Tab. 8.1.1. Sound power level inside the pipeline at pressure difference 50 Pa**

| Size [mm] | V̊ [m³.h⁻¹] | $\triangle p_{st}$ = 50 Pa | | | | | | | | $L_{WA}$ [dB(A)] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $L_W$ [dB/Okt] | | | | | | | | |
| | | $f_m$ [Hz] | | | | | | | | |
| | | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | |
| 80 | 18 | 40 | 31 | 31 | 25 | 28 | 24 | 18 | 7 | 32 |
| | 88 | 54 | 44 | 38 | 38 | 41 | 37 | 29 | 18 | 44 |
| | 154 | 59 | 49 | 43 | 43 | 46 | 43 | 35 | 23 | 49 |
| | 220 | 63 | 53 | 47 | 47 | 50 | 46 | 38 | 27 | 53 |
| 100 | 30 | 42 | 33 | 27 | 27 | 31 | 26 | 20 | 9 | 34 |
| | 140 | 58 | 49 | 45 | 45 | 43 | 39 | 39 | 22 | 48 |
| | 245 | 65 | 58 | 54 | 54 | 49 | 50 | 41 | 29 | 56 |
| | 350 | 69 | 63 | 59 | 59 | 51 | 53 | 42 | 31 | 60 |
| 125 | 45 | 44 | 34 | 28 | 28 | 31 | 28 | 20 | 10 | 34 |
| | 220 | 59 | 50 | 46 | 43 | 44 | 41 | 34 | 24 | 48 |
| | 385 | 64 | 56 | 52 | 48 | 47 | 43 | 40 | 28 | 52 |
| | 550 | 71 | 63 | 59 | 54 | 51 | 43 | 44 | 34 | 57 |
| 140 | 55 | 45 | 36 | 30 | 30 | 33 | 29 | 21 | 11 | 36 |
| | 280 | 61 | 52 | 49 | 45 | 43 | 40 | 36 | 25 | 49 |
| | 490 | 64 | 57 | 53 | 49 | 48 | 44 | 40 | 28 | 53 |
| | 700 | 72 | 64 | 60 | 55 | 52 | 48 | 45 | 35 | 58 |
| 160 | 70 | 48 | 39 | 32 | 32 | 36 | 32 | 23 | 14 | 39 |
| | 360 | 60 | 51 | 47 | 44 | 46 | 41 | 34 | 24 | 49 |
| | 630 | 66 | 58 | 54 | 50 | 49 | 45 | 41 | 30 | 54 |
| | 900 | 72 | 65 | 60 | 57 | 54 | 49 | 46 | 35 | 59 |
| 180 | 90 | 48 | 38 | 33 | 33 | 36 | 32 | 24 | 13 | 39 |
| | 480 | 60 | 51 | 47 | 45 | 45 | 42 | 35 | 24 | 49 |
| | 840 | 66 | 58 | 55 | 51 | 50 | 46 | 42 | 30 | 55 |
| | 1200 | 74 | 66 | 62 | 57 | 54 | 50 | 47 | 37 | 60 |
| 200 | 115 | 47 | 36 | 31 | 31 | 35 | 33 | 24 | 13 | 39 |
| | 560 | 60 | 51 | 47 | 45 | 46 | 42 | 35 | 24 | 49 |
| | 980 | 68 | 60 | 56 | 52 | 51 | 47 | 43 | 31 | 56 |
| | 1400 | 75 | 67 | 63 | 58 | 55 | 51 | 38 | 38 | 61 |
| 225 | 145 | 49 | 39 | 33 | 33 | 36 | 32 | 25 | 13 | 39 |
| | 720 | 60 | 51 | 47 | 45 | 46 | 42 | 35 | 24 | 49 |
| | 1260 | 68 | 60 | 56 | 52 | 51 | 47 | 43 | 32 | 56 |
| | 1800 | 75 | 67 | 63 | 59 | 56 | 52 | 49 | 38 | 61 |
| 250 | 180 | 48 | 36 | 32 | 32 | 34 | 31 | 23 | 12 | 38 |
| | 880 | 61 | 53 | 49 | 46 | 47 | 43 | 36 | 26 | 51 |
| | 1540 | 68 | 61 | 57 | 53 | 52 | 48 | 44 | 32 | 57 |
| | 2200 | 74 | 66 | 63 | 58 | 55 | 51 | 48 | 37 | 61 |
| 280 | 220 | 50 | 40 | 34 | 34 | 36 | 33 | 27 | 15 | 40 |
| | 1120 | 64 | 56 | 52 | 49 | 50 | 46 | 39 | 28 | 54 |
| | 1960 | 69 | 62 | 58 | 54 | 53 | 49 | 45 | 33 | 58 |
| | 2800 | 77 | 69 | 65 | 60 | 57 | 50 | 50 | 39 | 63 |
| 315 | 280 | 49 | 55 | 34 | 34 | 37 | 33 | 25 | 15 | 42 |
| | 1400 | 63 | 55 | 51 | 48 | 49 | 45 | 38 | 27 | 53 |
| | 2450 | 70 | 62 | 58 | 54 | 53 | 49 | 45 | 34 | 58 |
| | 3500 | 78 | 70 | 66 | 61 | 58 | 54 | 51 | 40 | 64 |
| 355 | 355 | 51 | 41 | 36 | 36 | 39 | 37 | 28 | 17 | 43 |
| | 1800 | 63 | 54 | 50 | 47 | 48 | 44 | 38 | 27 | 52 |
| | 3150 | 70 | 62 | 58 | 54 | 53 | 49 | 45 | 34 | 58 |
| | 4500 | 77 | 69 | 65 | 60 | 57 | 53 | 50 | 40 | 63 |
| 400 | 455 | 53 | 44 | 38 | 38 | 41 | 37 | 29 | 18 | 44 |
| | 2320 | 63 | 54 | 50 | 47 | 48 | 44 | 38 | 27 | 52 |
| | 4060 | 70 | 62 | 58 | 54 | 53 | 49 | 45 | 34 | 58 |
| | 5800 | 76 | 68 | 64 | 59 | 57 | 53 | 50 | 39 | 63 |
| 500 | 710 | 49 | 40 | 34 | 34 | 37 | 33 | 25 | 15 | 40 |
| | 4200 | 64 | 55 | 51 | 48 | 49 | 45 | 39 | 28 | 53 |
| | 6300 | 71 | 63 | 59 | 55 | 54 | 50 | 46 | 35 | 59 |
| | 8500 | 77 | 69 | 65 | 60 | 58 | 54 | 51 | 40 | 63 |
| 630 | 1120 | 52 | 44 | 38 | 38 | 41 | 37 | 30 | 20 | 44 |
| | 6700 | 66 | 57 | 53 | 50 | 51 | 47 | 40 | 30 | 55 |
| | 10000 | 73 | 65 | 61 | 57 | 56 | 52 | 48 | 37 | 61 |
| | 13500 | 78 | 70 | 66 | 62 | 60 | 56 | 53 | 42 | 65 |

**Tab. 8.1.2. Sound power level inside the pipeline at pressure difference 100 Pa**

| Size [mm] | V̇ [m³.h⁻¹] | $\triangle p_{st}$ = 100 Pa | | | | | | | | $L_{WA}$ [dB(A)] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $L_W$ [dB/Okt] | | | | | | | | |
| | | $f_m$ [Hz] | | | | | | | | |
| | | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | |
| 80 | 18 | 46 | 36 | 30 | 30 | 34 | 29 | 21 | 9 | 37 |
| | 88 | 59 | 49 | 43 | 43 | 46 | 42 | 34 | 22 | 49 |
| | 154 | 64 | 54 | 48 | 48 | 51 | 47 | 39 | 27 | 54 |
| | 220 | 68 | 58 | 52 | 52 | 55 | 51 | 43 | 31 | 58 |
| 100 | 30 | 48 | 38 | 32 | 32 | 35 | 31 | 23 | 12 | 38 |
| | 140 | 63 | 54 | 50 | 50 | 48 | 44 | 37 | 26 | 52 |
| | 245 | 70 | 62 | 59 | 59 | 53 | 49 | 45 | 33 | 60 |
| | 350 | 73 | 66 | 64 | 64 | 55 | 51 | 47 | 35 | 64 |
| 125 | 45 | 49 | 39 | 33 | 33 | 37 | 32 | 24 | 13 | 40 |
| | 220 | 65 | 56 | 52 | 50 | 49 | 45 | 39 | 28 | 53 |
| | 385 | 69 | 61 | 57 | 53 | 52 | 48 | 44 | 32 | 57 |
| | 550 | 76 | 68 | 64 | 59 | 56 | 52 | 49 | 38 | 62 |
| 140 | 55 | 51 | 41 | 35 | 35 | 38 | 34 | 26 | 14 | 41 |
| | 280 | 65 | 56 | 52 | 49 | 50 | 46 | 39 | 28 | 54 |
| | 490 | 70 | 62 | 58 | 54 | 53 | 49 | 45 | 33 | 58 |
| | 700 | 77 | 69 | 65 | 60 | 57 | 53 | 50 | 39 | 63 |
| 160 | 70 | 54 | 44 | 38 | 38 | 41 | 37 | 30 | 17 | 44 |
| | 360 | 65 | 56 | 52 | 49 | 50 | 46 | 39 | 28 | 54 |
| | 630 | 71 | 63 | 59 | 55 | 54 | 50 | 46 | 34 | 59 |
| | 900 | 78 | 70 | 66 | 61 | 58 | 54 | 51 | 40 | 64 |
| 180 | 90 | 54 | 44 | 38 | 38 | 41 | 37 | 29 | 17 | 44 |
| | 480 | 66 | 57 | 53 | 50 | 51 | 47 | 40 | 29 | 55 |
| | 840 | 72 | 64 | 60 | 56 | 55 | 51 | 47 | 35 | 60 |
| | 1200 | 79 | 71 | 67 | 62 | 59 | 55 | 52 | 41 | 65 |
| 200 | 115 | 54 | 44 | 38 | 38 | 42 | 37 | 29 | 18 | 45 |
| | 560 | 66 | 57 | 53 | 50 | 51 | 47 | 40 | 29 | 55 |
| | 980 | 73 | 65 | 61 | 57 | 56 | 52 | 48 | 36 | 61 |
| | 1400 | 80 | 72 | 68 | 63 | 60 | 56 | 53 | 42 | 66 |
| 225 | 145 | 55 | 45 | 39 | 39 | 43 | 38 | 29 | 18 | 46 |
| | 720 | 66 | 57 | 53 | 50 | 51 | 47 | 40 | 29 | 55 |
| | 1260 | 73 | 65 | 61 | 57 | 56 | 52 | 48 | 36 | 61 |
| | 1800 | 80 | 72 | 68 | 63 | 60 | 56 | 53 | 42 | 66 |
| 250 | 180 | 52 | 43 | 37 | 37 | 41 | 36 | 28 | 16 | 44 |
| | 880 | 67 | 58 | 54 | 51 | 52 | 48 | 41 | 30 | 56 |
| | 1540 | 73 | 65 | 61 | 57 | 56 | 52 | 48 | 36 | 61 |
| | 2200 | 79 | 71 | 67 | 62 | 59 | 55 | 52 | 41 | 65 |
| 280 | 220 | 55 | 45 | 39 | 39 | 43 | 39 | 31 | 19 | 46 |
| | 1120 | 70 | 61 | 57 | 54 | 55 | 51 | 44 | 33 | 59 |
| | 1960 | 74 | 66 | 62 | 58 | 57 | 53 | 49 | 37 | 62 |
| | 2800 | 81 | 73 | 69 | 64 | 61 | 57 | 54 | 43 | 67 |
| 315 | 280 | 56 | 46 | 41 | 41 | 44 | 41 | 32 | 20 | 47 |
| | 1400 | 69 | 60 | 56 | 53 | 54 | 50 | 43 | 32 | 58 |
| | 2450 | 75 | 67 | 63 | 59 | 58 | 54 | 50 | 38 | 63 |
| | 3500 | 82 | 74 | 70 | 65 | 62 | 58 | 55 | 44 | 68 |
| 355 | 355 | 58 | 48 | 42 | 42 | 46 | 41 | 33 | 31 | 49 |
| | 1800 | 69 | 60 | 56 | 53 | 54 | 50 | 43 | 32 | 58 |
| | 3150 | 75 | 67 | 63 | 59 | 58 | 55 | 51 | 39 | 63 |
| | 4500 | 82 | 74 | 70 | 65 | 62 | 58 | 55 | 44 | 68 |
| 400 | 455 | 58 | 49 | 42 | 42 | 46 | 42 | 34 | 22 | 49 |
| | 2320 | 69 | 60 | 56 | 53 | 54 | 50 | 43 | 32 | 58 |
| | 4060 | 76 | 68 | 64 | 60 | 59 | 55 | 51 | 39 | 64 |
| | 5800 | 82 | 74 | 70 | 65 | 62 | 58 | 55 | 44 | 68 |
| 500 | 710 | 56 | 46 | 40 | 40 | 43 | 39 | 31 | 21 | 46 |
| | 4200 | 69 | 60 | 56 | 53 | 54 | 51 | 44 | 33 | 58 |
| | 6300 | 77 | 69 | 65 | 61 | 60 | 56 | 52 | 40 | 65 |
| | 8500 | 82 | 74 | 70 | 65 | 62 | 59 | 56 | 45 | 68 |
| 630 | 1120 | 60 | 49 | 44 | 44 | 45 | 43 | 35 | 23 | 49 |
| | 6700 | 72 | 63 | 59 | 56 | 57 | 53 | 46 | 35 | 61 |
| | 10000 | 79 | 71 | 67 | 63 | 62 | 58 | 54 | 42 | 67 |
| | 13500 | 85 | 77 | 73 | 68 | 65 | 61 | 58 | 47 | 71 |

Tab. 8.1.3. Sound power level inside the pipeline at pressure difference 250 Pa

| Size [mm] | V̊ [m³.h⁻¹] | Δp_st = 250 Pa | | | | | | | | L_WA [dB(A)] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L_W [dB/Okt] | | | | | | | | |
| | | f_m [Hz] | | | | | | | | |
| | | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | |
| **80** | 18 | 54 | 44 | 38 | 38 | 41 | 37 | 29 | 17 | 44 |
| | 88 | 67 | 57 | 51 | 51 | 54 | 50 | 42 | 30 | 57 |
| | 154 | 72 | 62 | 56 | 56 | 59 | 55 | 47 | 35 | 62 |
| | 220 | 76 | 66 | 60 | 60 | 63 | 59 | 51 | 39 | 66 |
| **100** | 30 | 56 | 46 | 41 | 41 | 43 | 40 | 32 | 20 | 47 |
| | 140 | 70 | 61 | 57 | 57 | 55 | 52 | 44 | 33 | 60 |
| | 245 | 77 | 69 | 65 | 66 | 61 | 55 | 52 | 40 | 67 |
| | 350 | 83 | 75 | 71 | 72 | 63 | 59 | 56 | 45 | 72 |
| **125** | 45 | 58 | 48 | 42 | 42 | 45 | 41 | 33 | 21 | 48 |
| | 220 | 70 | 61 | 58 | 55 | 56 | 51 | 45 | 34 | 60 |
| | 385 | 77 | 69 | 65 | 61 | 60 | 55 | 51 | 39 | 65 |
| | 550 | 83 | 75 | 71 | 65 | 62 | 58 | 55 | 44 | 69 |
| **140** | 55 | 60 | 50 | 44 | 44 | 48 | 44 | 35 | 23 | 51 |
| | 280 | 72 | 63 | 59 | 56 | 57 | 53 | 46 | 35 | 61 |
| | 490 | 77 | 69 | 65 | 61 | 60 | 56 | 52 | 40 | 65 |
| | 700 | 83 | 75 | 71 | 66 | 63 | 59 | 56 | 45 | 69 |
| **160** | 70 | 61 | 51 | 45 | 45 | 49 | 44 | 36 | 24 | 52 |
| | 360 | 73 | 64 | 60 | 57 | 58 | 54 | 47 | 36 | 62 |
| | 630 | 78 | 70 | 66 | 62 | 61 | 57 | 53 | 41 | 66 |
| | 900 | 84 | 76 | 72 | 67 | 64 | 60 | 57 | 46 | 70 |
| **180** | 90 | 63 | 53 | 47 | 47 | 50 | 45 | 37 | 25 | 53 |
| | 480 | 73 | 65 | 62 | 59 | 58 | 55 | 47 | 36 | 63 |
| | 840 | 78 | 71 | 67 | 63 | 62 | 57 | 53 | 41 | 67 |
| | 1200 | 84 | 77 | 74 | 69 | 65 | 61 | 57 | 46 | 72 |
| **200** | 115 | 63 | 53 | 47 | 47 | 51 | 46 | 38 | 26 | 54 |
| | 560 | 74 | 65 | 61 | 58 | 59 | 55 | 48 | 37 | 63 |
| | 980 | 79 | 72 | 68 | 64 | 63 | 58 | 54 | 42 | 68 |
| | 1400 | 85 | 77 | 73 | 69 | 65 | 61 | 58 | 47 | 72 |
| **225** | 145 | 64 | 54 | 48 | 48 | 51 | 49 | 40 | 28 | 55 |
| | 720 | 74 | 65 | 61 | 58 | 59 | 55 | 48 | 37 | 63 |
| | 1260 | 80 | 72 | 68 | 64 | 63 | 59 | 55 | 43 | 68 |
| | 1800 | 86 | 78 | 74 | 69 | 66 | 62 | 59 | 48 | 72 |
| **250** | 180 | 64 | 55 | 48 | 48 | 50 | 47 | 40 | 27 | 54 |
| | 880 | 74 | 65 | 61 | 58 | 59 | 55 | 48 | 37 | 63 |
| | 1540 | 80 | 72 | 68 | 64 | 63 | 59 | 55 | 43 | 68 |
| | 2200 | 86 | 78 | 74 | 69 | 66 | 62 | 59 | 48 | 72 |
| **280** | 220 | 65 | 55 | 49 | 49 | 53 | 48 | 41 | 29 | 56 |
| | 1120 | 76 | 67 | 63 | 60 | 61 | 56 | 49 | 38 | 65 |
| | 1960 | 81 | 73 | 69 | 65 | 64 | 60 | 56 | 44 | 69 |
| | 2800 | 87 | 79 | 75 | 70 | 67 | 63 | 60 | 49 | 73 |
| **315** | 280 | 66 | 57 | 50 | 50 | 53 | 51 | 43 | 30 | 57 |
| | 1400 | 76 | 67 | 63 | 60 | 61 | 57 | 50 | 39 | 65 |
| | 2450 | 82 | 74 | 70 | 66 | 65 | 61 | 57 | 45 | 70 |
| | 3500 | 88 | 80 | 76 | 71 | 68 | 64 | 61 | 50 | 74 |
| **355** | 355 | 67 | 57 | 51 | 51 | 54 | 52 | 43 | 31 | 58 |
| | 1800 | 77 | 68 | 64 | 61 | 62 | 58 | 51 | 40 | 66 |
| | 3150 | 82 | 75 | 71 | 67 | 67 | 62 | 57 | 45 | 71 |
| | 4500 | 88 | 80 | 76 | 71 | 68 | 64 | 61 | 50 | 74 |
| **400** | 455 | 70 | 60 | 54 | 54 | 58 | 53 | 45 | 33 | 61 |
| | 2320 | 77 | 69 | 65 | 62 | 63 | 59 | 51 | 40 | 67 |
| | 4060 | 82 | 75 | 71 | 67 | 66 | 62 | 57 | 45 | 71 |
| | 5800 | 88 | 80 | 76 | 71 | 68 | 64 | 61 | 50 | 74 |
| **500** | 710 | 66 | 56 | 50 | 50 | 53 | 49 | 42 | 30 | 56 |
| | 4200 | 79 | 70 | 66 | 63 | 64 | 60 | 53 | 42 | 68 |
| | 6300 | 84 | 76 | 73 | 69 | 68 | 63 | 59 | 47 | 73 |
| | 8500 | 90 | 82 | 78 | 73 | 70 | 66 | 63 | 52 | 76 |
| **630** | 1120 | 68 | 58 | 50 | 50 | 52 | 50 | 43 | 31 | 56 |
| | 6700 | 81 | 72 | 68 | 65 | 66 | 62 | 55 | 44 | 70 |
| | 10000 | 86 | 79 | 75 | 71 | 70 | 65 | 61 | 49 | 75 |
| | 13500 | 92 | 84 | 80 | 75 | 72 | 68 | 65 | 54 | 78 |

**Tab. 8.1.4. Sound power level inside the pipeline at pressure difference 500 Pa**

| Size [mm] | V̊ [m³.h⁻¹] | △ pₛₜ = 500 Pa | | | | | | | | L_WA [dB(A)] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L_W [dB/Okt] | | | | | | | | |
| | | f_m [Hz] | | | | | | | | |
| | | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | |
| 80 | 18 | 61 | 51 | 45 | 45 | 48 | 46 | 37 | 25 | 52 |
| | 88 | 74 | 64 | 58 | 58 | 61 | 58 | 50 | 38 | 64 |
| | 154 | 79 | 70 | 63 | 63 | 66 | 62 | 54 | 42 | 69 |
| | 220 | 83 | 73 | 67 | 68 | 70 | 67 | 59 | 47 | 73 |
| 100 | 30 | 64 | 54 | 48 | 48 | 51 | 47 | 39 | 27 | 54 |
| | 140 | 77 | 68 | 64 | 64 | 62 | 58 | 51 | 40 | 66 |
| | 245 | 84 | 76 | 72 | 72 | 67 | 63 | 59 | 47 | 73 |
| | 350 | 90 | 82 | 78 | 78 | 70 | 66 | 63 | 52 | 78 |
| 125 | 45 | 66 | 54 | 50 | 50 | 54 | 50 | 41 | 29 | 57 |
| | 220 | 78 | 69 | 65 | 61 | 63 | 58 | 51 | 40 | 66 |
| | 385 | 83 | 75 | 71 | 67 | 66 | 63 | 59 | 47 | 71 |
| | 550 | 89 | 81 | 77 | 72 | 69 | 66 | 63 | 52 | 75 |
| 140 | 55 | 67 | 57 | 51 | 51 | 54 | 50 | 42 | 30 | 57 |
| | 280 | 79 | 70 | 66 | 63 | 64 | 60 | 53 | 42 | 68 |
| | 490 | 81 | 76 | 72 | 68 | 67 | 63 | 59 | 47 | 72 |
| | 700 | 89 | 81 | 77 | 72 | 69 | 65 | 62 | 51 | 75 |
| 160 | 70 | 69 | 59 | 53 | 53 | 56 | 52 | 44 | 32 | 59 |
| | 360 | 81 | 72 | 68 | 65 | 66 | 62 | 55 | 44 | 70 |
| | 630 | 86 | 78 | 74 | 70 | 69 | 65 | 61 | 49 | 74 |
| | 900 | 91 | 83 | 79 | 74 | 71 | 67 | 64 | 53 | 77 |
| 180 | 90 | 70 | 60 | 54 | 54 | 58 | 53 | 45 | 33 | 61 |
| | 480 | 81 | 72 | 68 | 65 | 66 | 62 | 55 | 44 | 70 |
| | 840 | 86 | 78 | 74 | 70 | 69 | 65 | 61 | 49 | 74 |
| | 1200 | 92 | 84 | 80 | 75 | 72 | 68 | 65 | 54 | 78 |
| 200 | 115 | 71 | 61 | 55 | 55 | 59 | 54 | 46 | 34 | 62 |
| | 560 | 81 | 72 | 68 | 65 | 66 | 62 | 55 | 44 | 70 |
| | 980 | 86 | 78 | 74 | 70 | 69 | 65 | 61 | 49 | 74 |
| | 1400 | 92 | 84 | 80 | 75 | 72 | 68 | 65 | 54 | 78 |
| 225 | 145 | 72 | 62 | 56 | 56 | 60 | 55 | 47 | 35 | 63 |
| | 720 | 81 | 72 | 68 | 65 | 66 | 62 | 55 | 44 | 70 |
| | 1260 | 86 | 78 | 74 | 70 | 69 | 65 | 61 | 49 | 74 |
| | 1800 | 91 | 83 | 79 | 74 | 71 | 67 | 64 | 53 | 77 |
| 250 | 180 | 72 | 62 | 56 | 56 | 59 | 55 | 47 | 35 | 62 |
| | 880 | 80 | 71 | 67 | 64 | 65 | 61 | 54 | 43 | 69 |
| | 1540 | 85 | 77 | 73 | 69 | 68 | 64 | 60 | 48 | 73 |
| | 2200 | 91 | 83 | 79 | 74 | 71 | 67 | 64 | 53 | 77 |
| 280 | 220 | 73 | 64 | 58 | 58 | 60 | 57 | 49 | 37 | 64 |
| | 1120 | 82 | 73 | 68 | 67 | 66 | 63 | 56 | 45 | 71 |
| | 1960 | 86 | 78 | 74 | 70 | 69 | 65 | 61 | 49 | 74 |
| | 2800 | 92 | 84 | 80 | 75 | 72 | 68 | 65 | 54 | 78 |
| 315 | 280 | 75 | 65 | 59 | 59 | 63 | 58 | 50 | 38 | 66 |
| | 1400 | 83 | 74 | 70 | 67 | 68 | 65 | 58 | 47 | 72 |
| | 2450 | 87 | 80 | 76 | 72 | 71 | 66 | 63 | 50 | 76 |
| | 3500 | 93 | 85 | 81 | 76 | 73 | 69 | 66 | 55 | 79 |
| 355 | 355 | 77 | 67 | 61 | 61 | 65 | 60 | 52 | 50 | 68 |
| | 1800 | 85 | 76 | 72 | 69 | 70 | 66 | 59 | 48 | 74 |
| | 3150 | 90 | 82 | 78 | 74 | 73 | 69 | 65 | 53 | 78 |
| | 4500 | 94 | 86 | 82 | 77 | 74 | 70 | 67 | 56 | 80 |
| 400 | 455 | 79 | 69 | 63 | 63 | 66 | 61 | 53 | 41 | 69 |
| | 2320 | 86 | 77 | 73 | 70 | 71 | 67 | 60 | 49 | 75 |
| | 4060 | 90 | 82 | 78 | 74 | 73 | 69 | 65 | 53 | 78 |
| | 5800 | 94 | 86 | 82 | 77 | 74 | 70 | 67 | 56 | 80 |
| 500 | 710 | 78 | 67 | 60 | 60 | 63 | 60 | 53 | 41 | 66 |
| | 4200 | 88 | 79 | 75 | 72 | 73 | 69 | 62 | 51 | 77 |
| | 6300 | 92 | 84 | 80 | 76 | 75 | 71 | 67 | 55 | 80 |
| | 8500 | 96 | 88 | 84 | 79 | 76 | 72 | 69 | 58 | 82 |
| 630 | 1120 | 80 | 70 | 65 | 65 | 68 | 63 | 55 | 43 | 71 |
| | 6700 | 90 | 81 | 77 | 74 | 75 | 71 | 64 | 53 | 79 |
| | 10000 | 94 | 86 | 82 | 78 | 77 | 73 | 69 | 57 | 82 |
| | 13500 | 98 | 90 | 86 | 81 | 78 | 74 | 71 | 60 | 84 |

**Diagram No. 1    Sound power level L<sub>WA</sub> [dB(A)] inside the pipeline DN80**
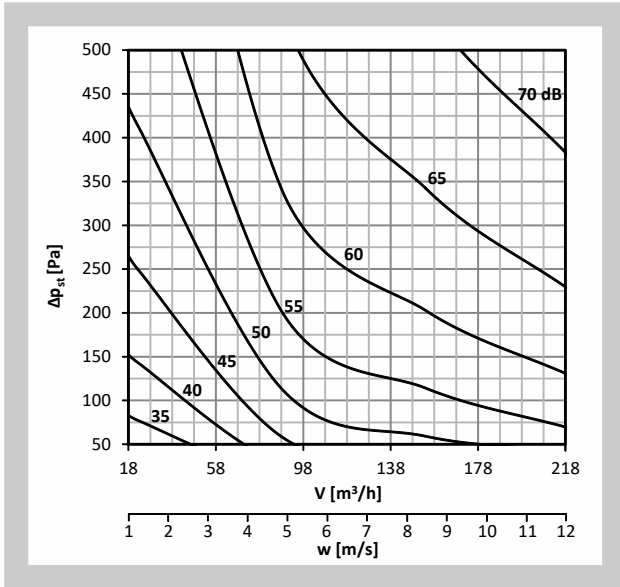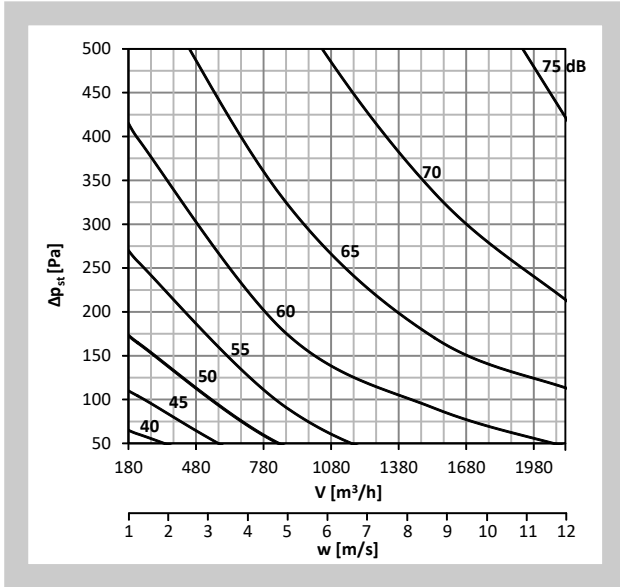


**Diagram No. 2    Sound power level L<sub>WA</sub> [dB(A)] inside the pipeline DN100**
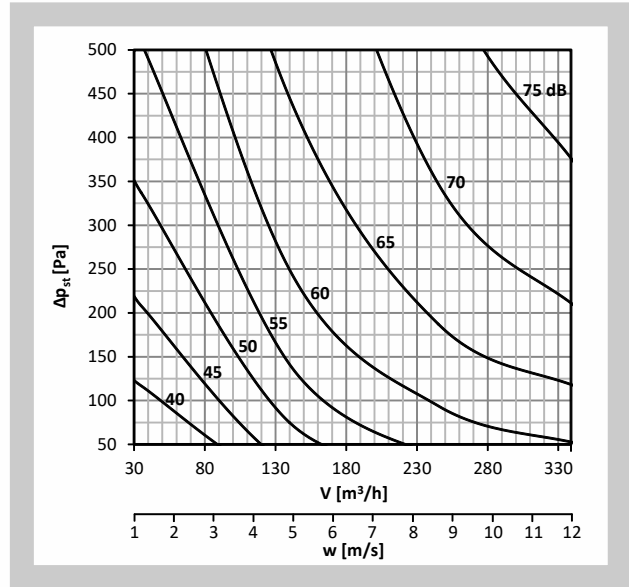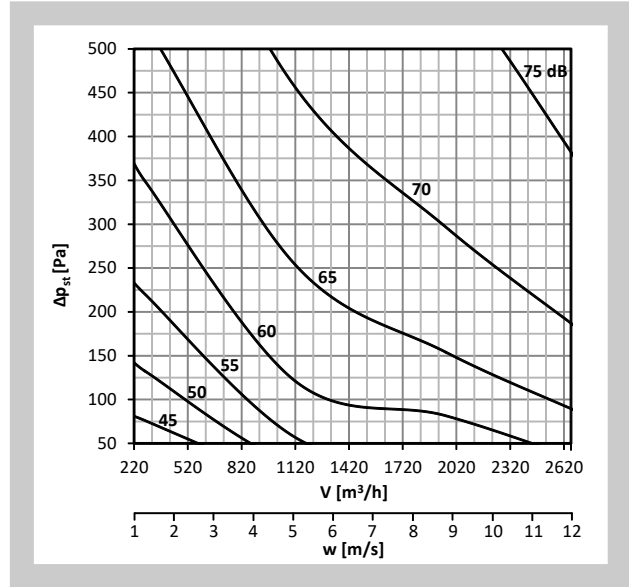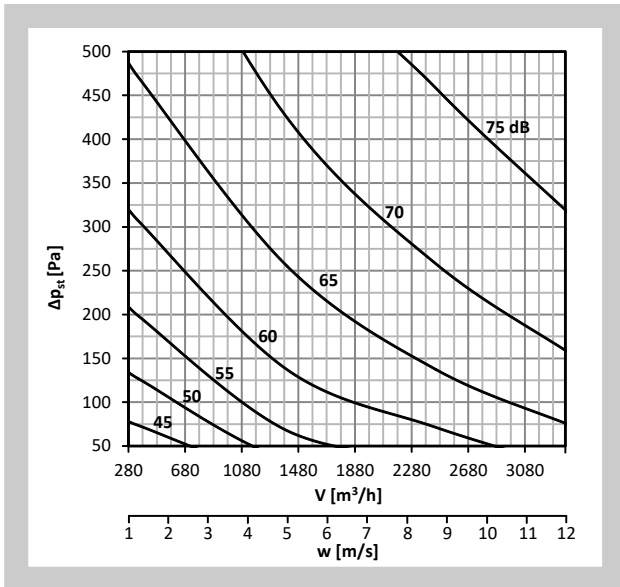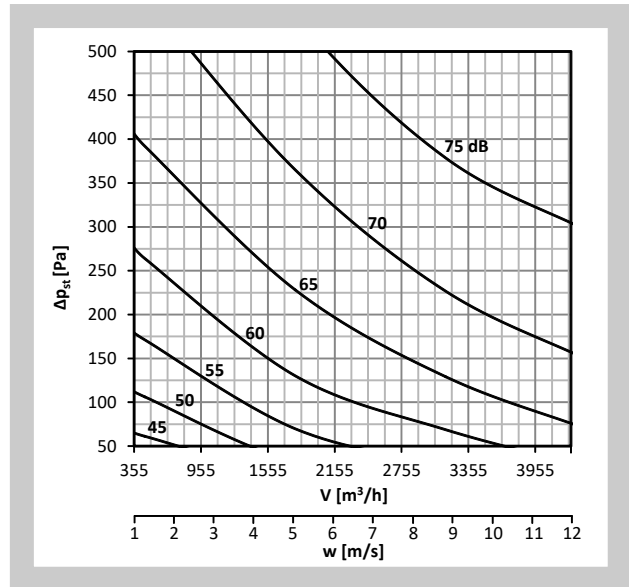


**Diagram No. 3    Sound power level L<sub>WA</sub> [dB(A)] inside the pipeline DN125**
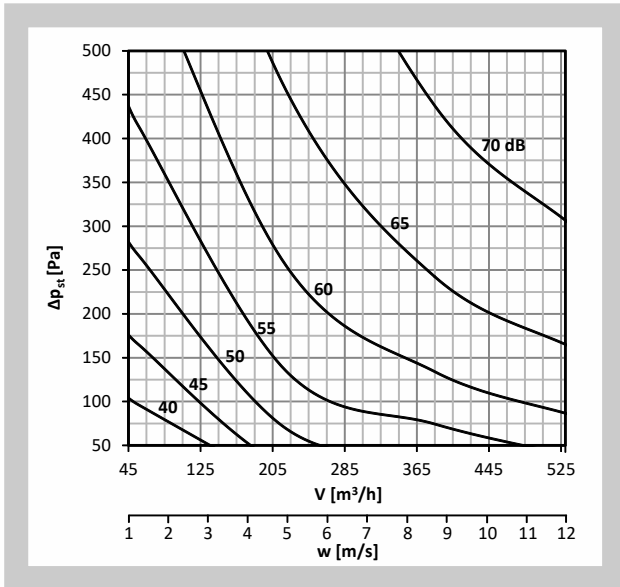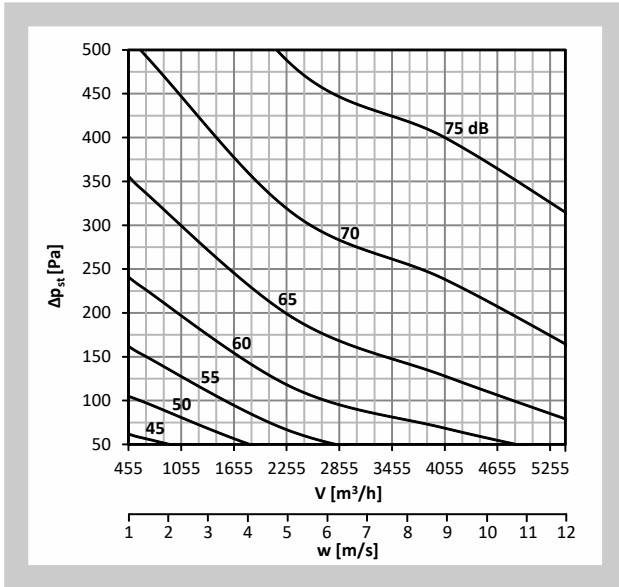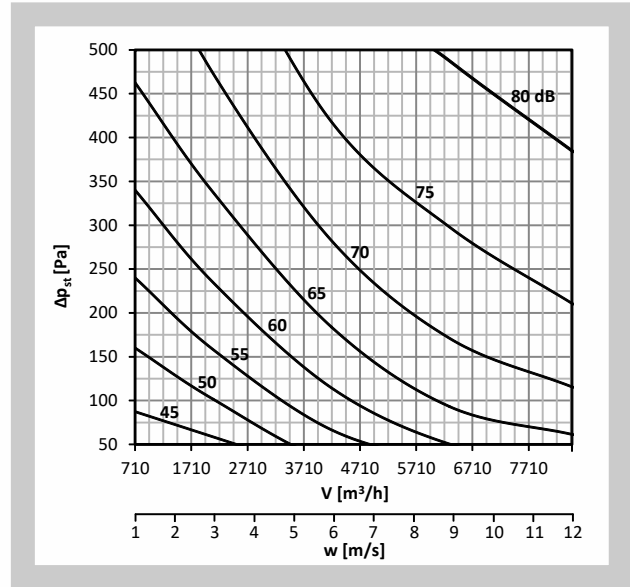


**Diagram No. 4    Sound power level L<sub>WA</sub> [dB(A)] inside the pipeline DN140**
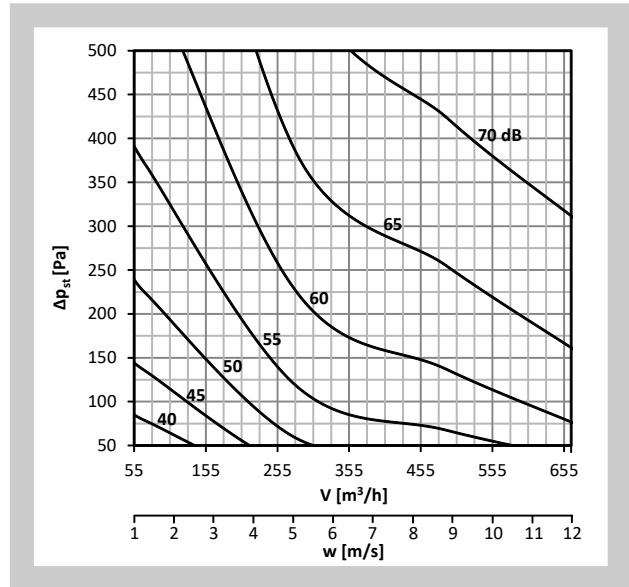


**Diagram No. 5    Sound power level L<sub>WA</sub> [dB(A)] inside the pipeline DN160**
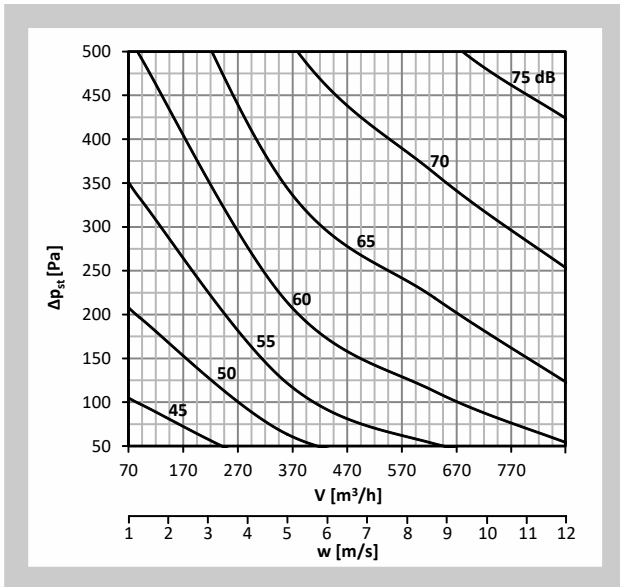


**Diagram No. 6    Sound power level L<sub>WA</sub> [dB(A)] inside the pipeline DN180**
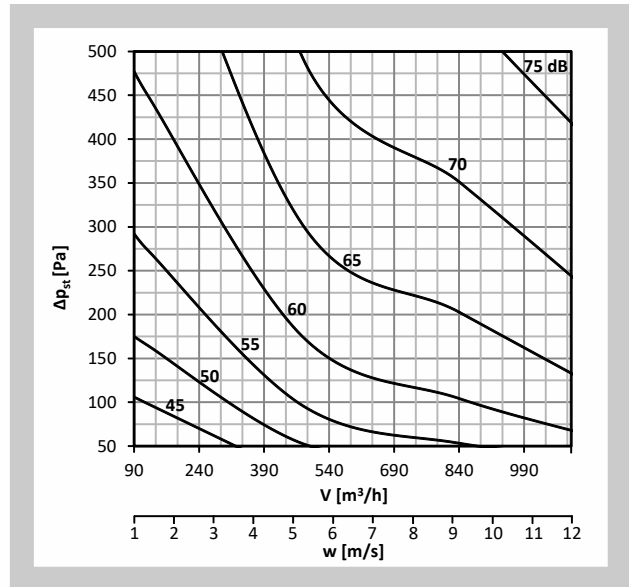
**Diagram No. 7** Sound power level L$_{WA}$ [dB(A)] inside the pipeline DN200
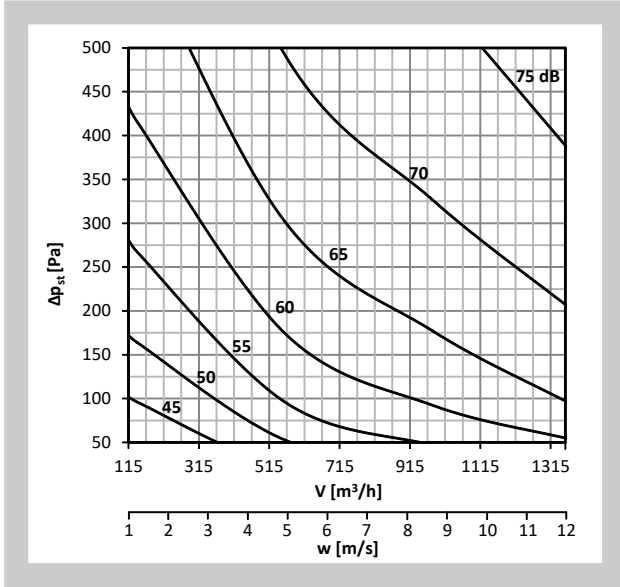


**Diagram No. 8** Sound power level L$_{WA}$ [dB(A)] inside the pipeline DN225
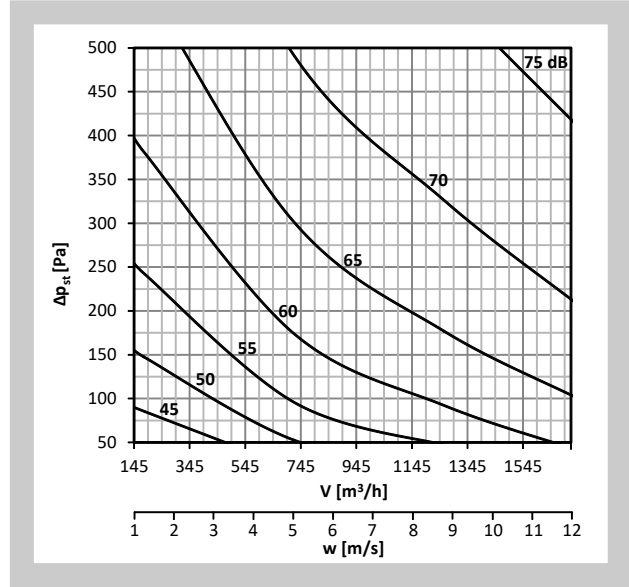


**Diagram No. 9** Sound power level L$_{WA}$ [dB(A)] inside the pipeline DN250



**Diagram No. 10** Sound power level L$_{WA}$ [dB(A)] inside the pipeline DN280



**Diagram No. 11** Sound power level L$_{WA}$ [dB(A)] inside the pipeline DN315



**Diagram No. 12** Sound power level L$_{WA}$ [dB(A)] inside the pipeline DN355

**Diagram No. 13** Sound power level L$_{WA}$ [dB(A)] inside the pipeline DN400



**Diagram No. 14** Sound power level L$_{WA}$ [dB(A)] inside the pipeline DN500



**Diagram No. 15** Sound power level L$_{WA}$ [dB(A)] inside the pipeline DN630
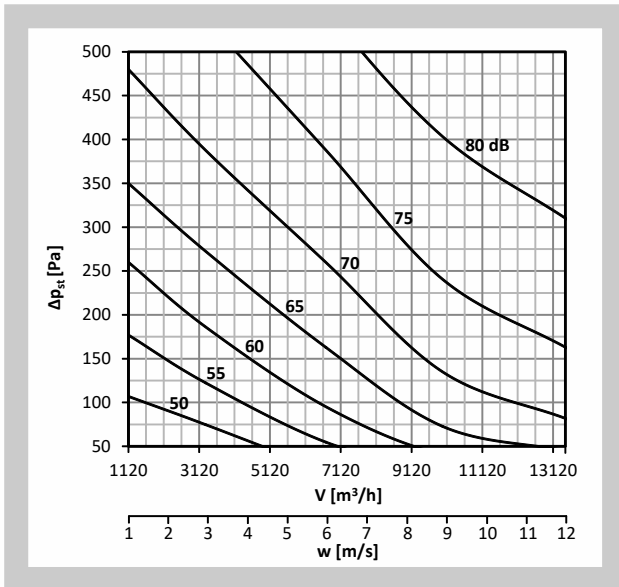


## 8.2.  Radiated noise

The radiated noise of air volume controller is listed in Tab. 8.2.1.

$\mathring{V}$    [m$^3$.h$^{-1}$]    - air flow volume

$\Delta p_{st}$    [Pa]    - pressure differential

L$_{WA}$    [dB(A)]    - total level of acoustic power corrected by filter A

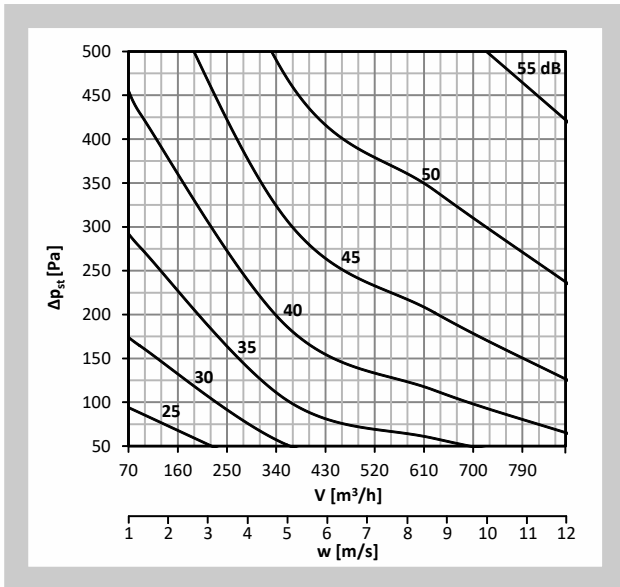**Tab. 8.2.1.  Sound power level radiated outside the pipeline - without insulation**

| Size [mm] | $\mathring{V}$ [m$^3$.h$^{-1}$] | L$_{WA}$ [dB(A)] $\Delta p_{st}$ = 50 Pa | L$_{WA}$ [dB(A)] $\Delta p_{st}$ = 100 Pa | L$_{WA}$ [dB(A)] $\Delta p_{st}$ = 250 Pa | L$_{WA}$ [dB(A)] $\Delta p_{st}$ = 500 Pa |
|---|---|---|---|---|---|
| 80 | 18 | 12 | 16 | 24 | 33 |
| | 88 | 24 | 29 | 38 | 47 |
| | 154 | 30 | 34 | 42 | 50 |
| | 220 | 35 | 39 | 47 | 54 |
| 100 | 30 | 14 | 18 | 27 | 37 |
| | 140 | 26 | 31 | 39 | 47 |
| | 245 | 33 | 38 | 45 | 52 |
| | 350 | 36 | 41 | 48 | 55 |

| Size [mm] | $\overset{\circ}{V}$ [m³.h⁻¹] | $L_{WA}$ [dB(A)] $\Delta p_{st} = 50$ Pa | $L_{WA}$ [dB(A)] $\Delta p_{st} = 100$ Pa | $L_{WA}$ [dB(A)] $\Delta p_{st} = 250$ Pa | $L_{WA}$ [dB(A)] $\Delta p_{st} = 500$ Pa |
|---|---|---|---|---|---|
| 125 | 45 | 15 | 19 | 28 | 38 |
| | 220 | 27 | 33 | 41 | 49 |
| | 385 | 33 | 38 | 45 | 52 |
| | 550 | 37 | 42 | 49 | 56 |
| 140 | 55 | 18 | 23 | 31 | 39 |
| | 280 | 29 | 34 | 42 | 50 |
| | 490 | 34 | 39 | 46 | 53 |
| | 700 | 39 | 44 | 50 | 56 |
| 160 | 70 | 21 | 26 | 33 | 42 |
| | 360 | 30 | 35 | 43 | 51 |
| | 630 | 34 | 39 | 47 | 54 |
| | 900 | 39 | 44 | 51 | 57 |
| 180 | 90 | 21 | 25 | 33 | 42 |
| | 480 | 31 | 36 | 44 | 52 |
| | 840 | 35 | 40 | 48 | 56 |
| | 1200 | 40 | 45 | 52 | 59 |
| 200 | 115 | 22 | 27 | 34 | 43 |
| | 560 | 31 | 36 | 44 | 52 |
| | 980 | 35 | 40 | 48 | 55 |
| | 1400 | 41 | 45 | 52 | 58 |
| 225 | 145 | 23 | 28 | 38 | 46 |
| | 720 | 33 | 38 | 46 | 53 |
| | 1260 | 37 | 42 | 49 | 56 |
| | 1800 | 42 | 46 | 53 | 59 |
| 250 | 180 | 25 | 30 | 39 | 47 |
| | 880 | 36 | 40 | 47 | 53 |
| | 1540 | 40 | 44 | 51 | 57 |
| | 2200 | 44 | 48 | 54 | 60 |
| 280 | 220 | 28 | 33 | 43 | 51 |
| | 1120 | 37 | 42 | 50 | 56 |
| | 1960 | 42 | 46 | 54 | 60 |
| | 2800 | 45 | 50 | 57 | 63 |
| 315 | 280 | 30 | 34 | 44 | 53 |
| | 1400 | 39 | 44 | 52 | 59 |
| | 2450 | 44 | 48 | 56 | 62 |
| | 3500 | 47 | 51 | 59 | 65 |
| 355 | 355 | 29 | 34 | 44 | 54 |
| | 1800 | 39 | 44 | 52 | 60 |
| | 3150 | 44 | 49 | 56 | 63 |
| | 4500 | 48 | 53 | 60 | 66 |
| 400 | 455 | 30 | 36 | 46 | 54 |
| | 2320 | 38 | 44 | 53 | 61 |
| | 4060 | 44 | 49 | 57 | 64 |
| | 5800 | 50 | 54 | 61 | 67 |
| 500 | 710 | 31 | 36 | 47 | 55 |
| | 4200 | 45 | 50 | 59 | 66 |
| | 6300 | 51 | 56 | 64 | 70 |
| | 8400 | 55 | 60 | 67 | 73 |
| 630 | 1120 | 40 | 44 | 52 | 60 |
| | 6700 | 52 | 57 | 64 | 70 |
| | 10000 | 56 | 61 | 68 | 74 |
| | 13300 | 59 | 64 | 71 | 77 |

**Diagram No. 16**  Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN80, without insulation
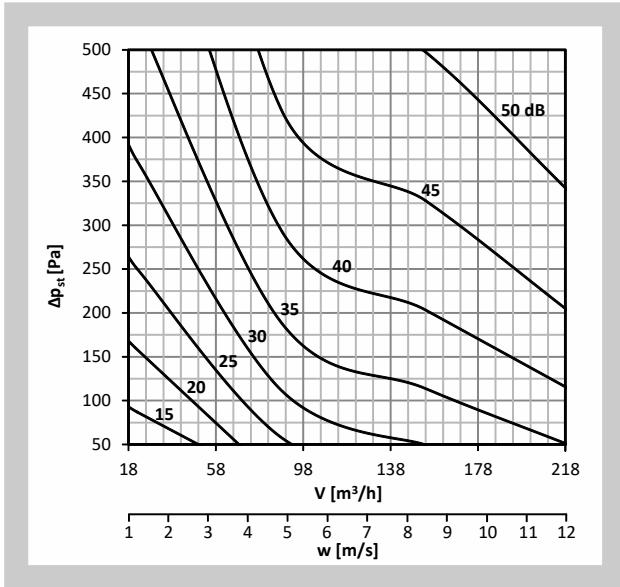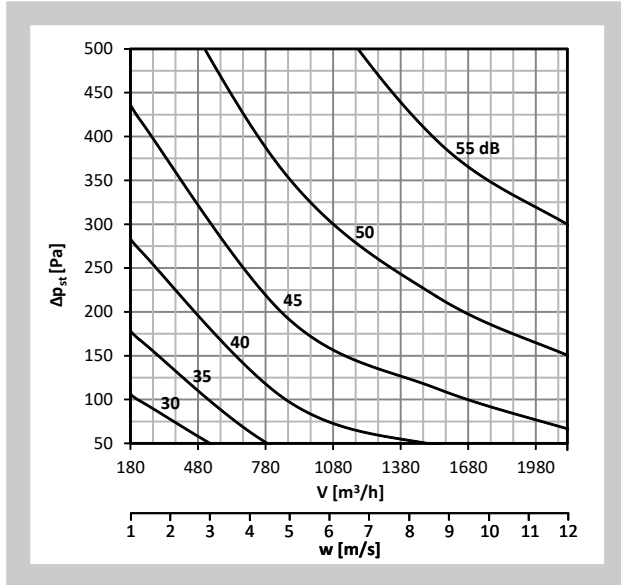


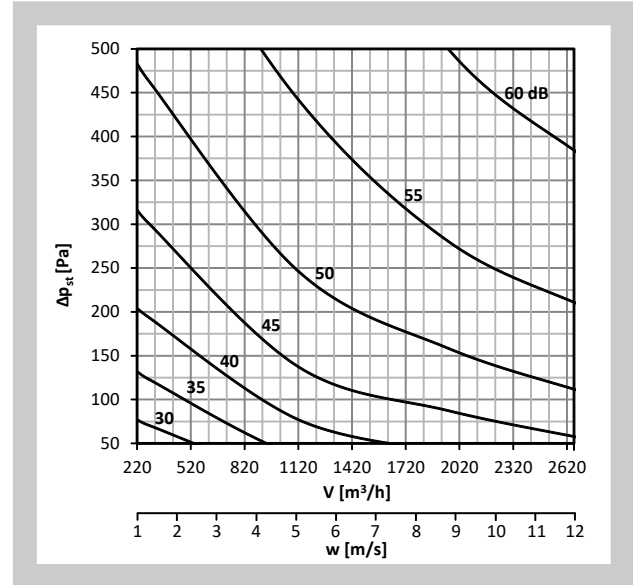**Diagram No. 17**  Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN100, without insulation
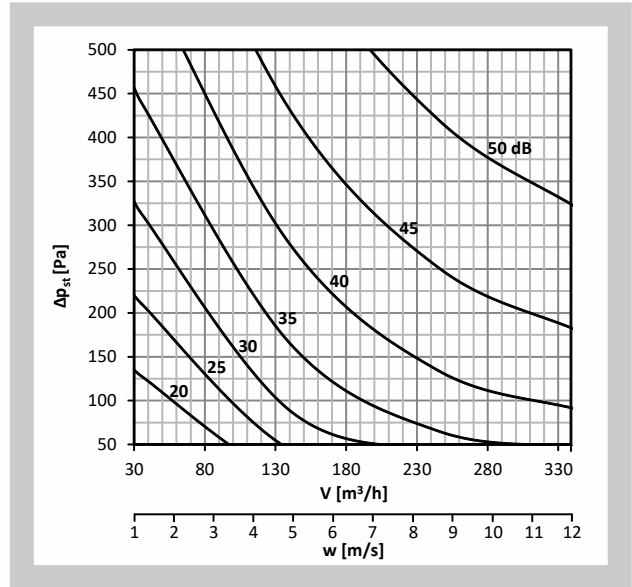


**Diagram No. 18**  Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN125, without insulation
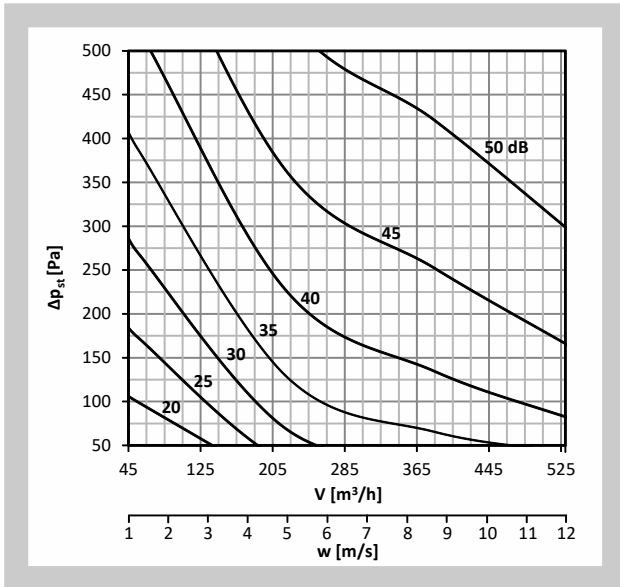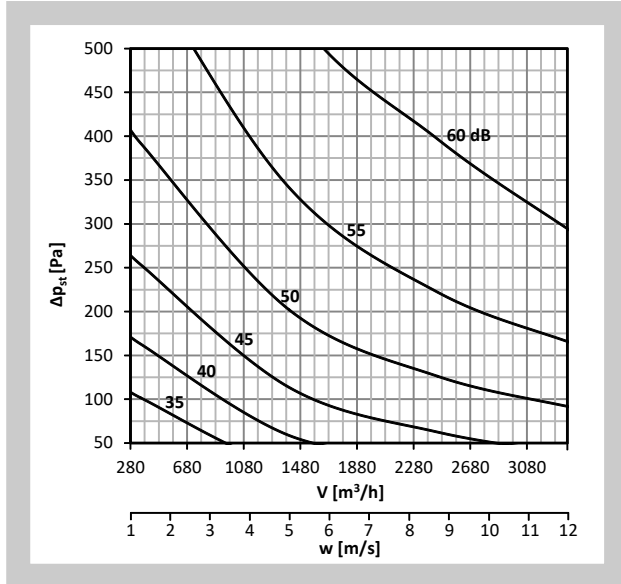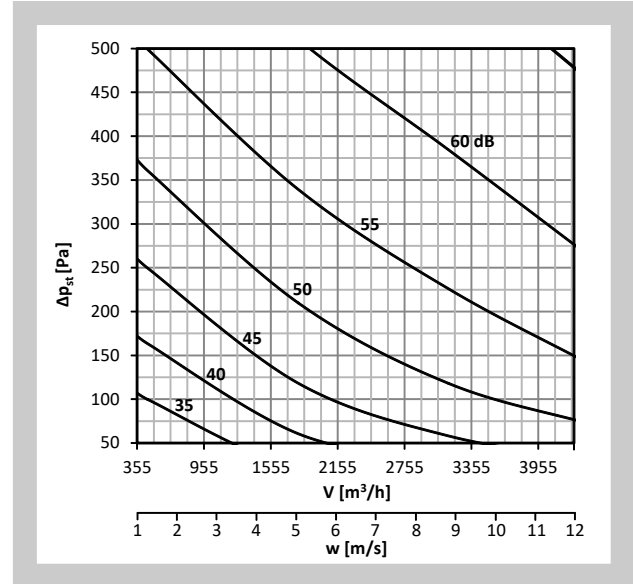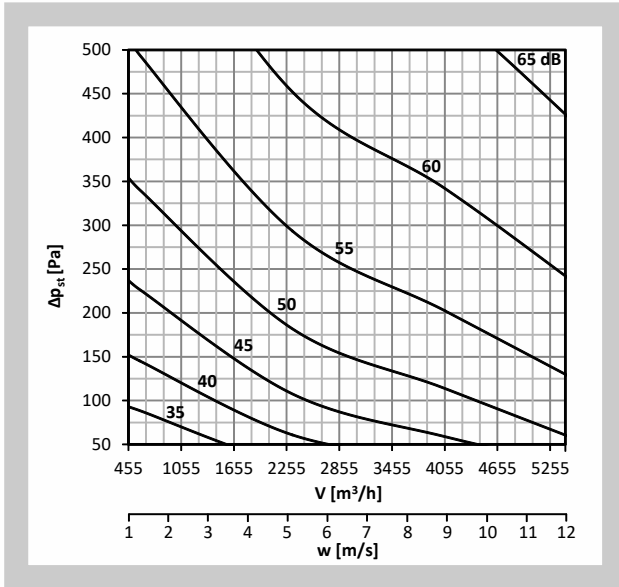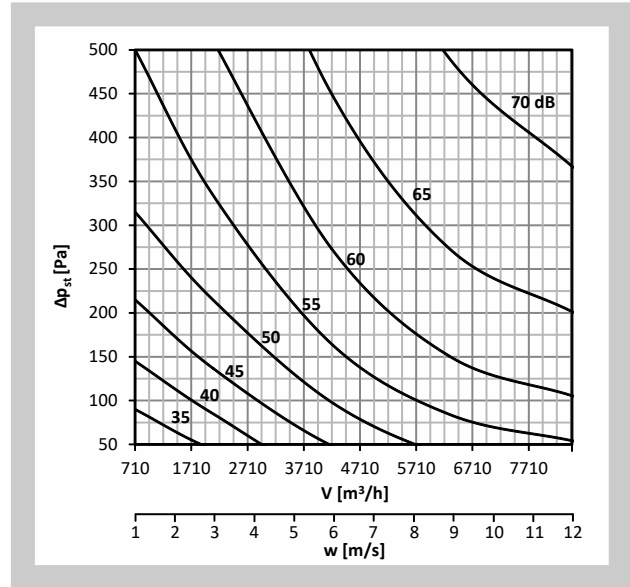


**Diagram No. 19**  Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN140, without insulation
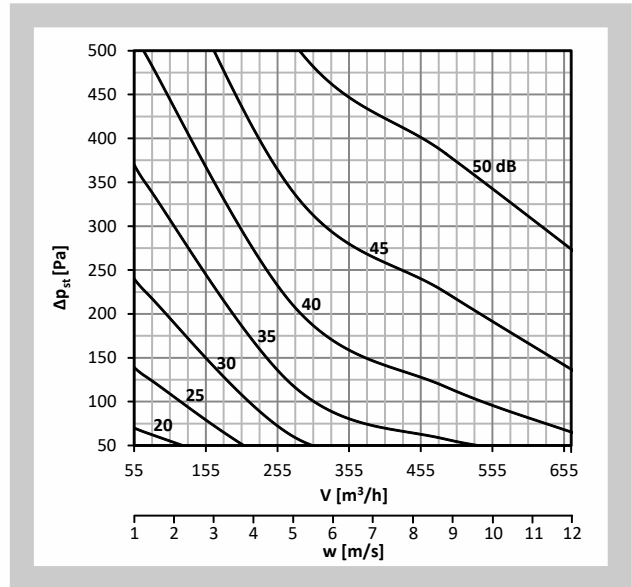


**Diagram No. 20**  Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN160, without insulation



**Diagram No. 21**  Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN180, without insulation
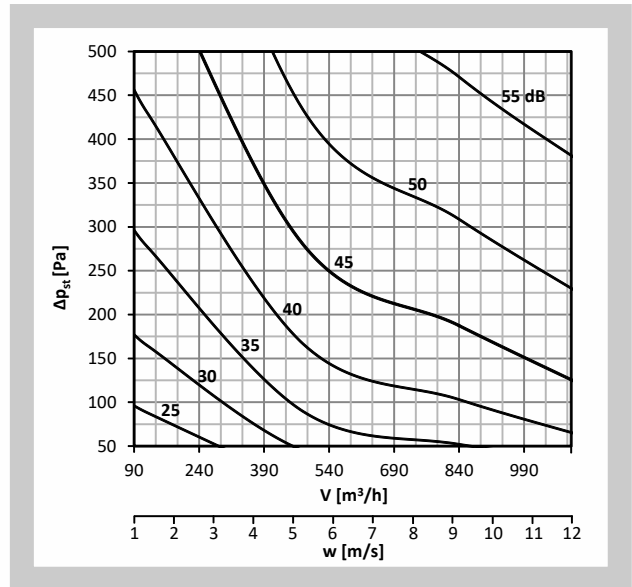
**Diagram No. 22** Sound power level L_WA [dB(A)] radiated outside the pipeline DN200, without insulation
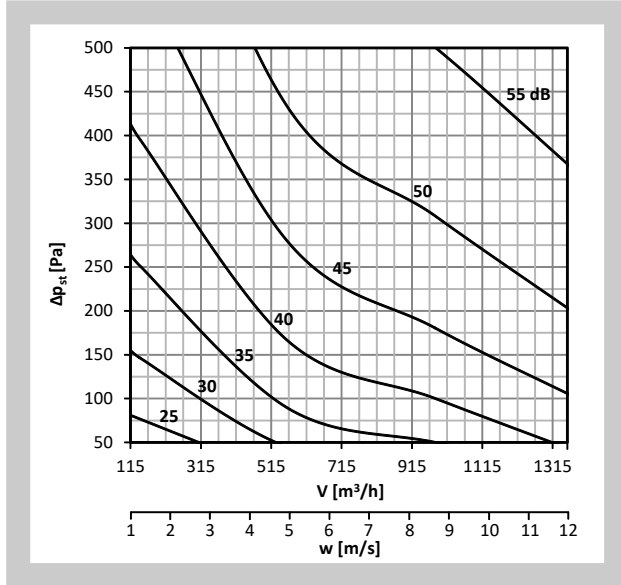


**Diagram No. 23** Sound power level L_WA [dB(A)] radiated outside the pipeline DN225, without insulation
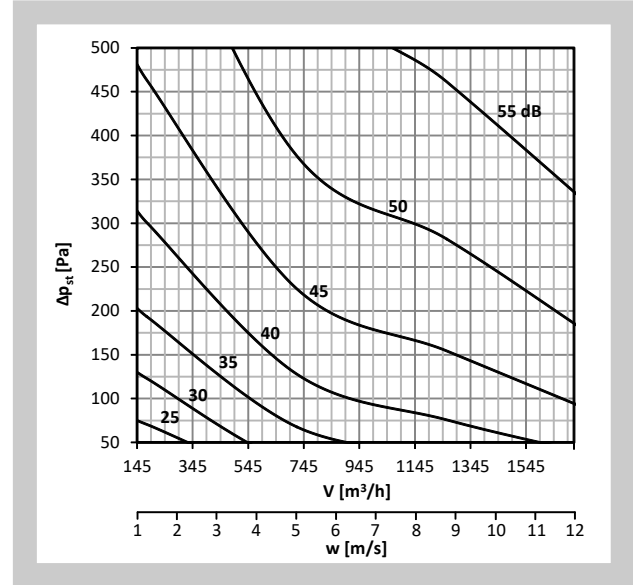


**Diagram No. 24** Sound power level L_WA [dB(A)] radiated outside the pipeline DN250, without insulation



**Diagram No. 25** Sound power level L_WA [dB(A)] radiated outside the pipeline DN280, without insulation



**Diagram No. 26** Sound power level L_WA [dB(A)] radiated outside the pipeline DN315, without insulation



**Diagram No. 27** Sound power level L_WA [dB(A)] radiated outside the pipeline DN355, without insulation

**Diagram No. 28** Sound power level L$_{WA}$ [dB(A)] radiated out-
side the pipeline DN400, without insulation



**Diagram No. 29** Sound power level L$_{WA}$ [dB(A)] radiated out-
side the pipeline DN500, without insulation



**Diagram No. 30** Sound power level L$_{WA}$ [dB(A)] radiated out-
side the pipeline DN630, without insulation
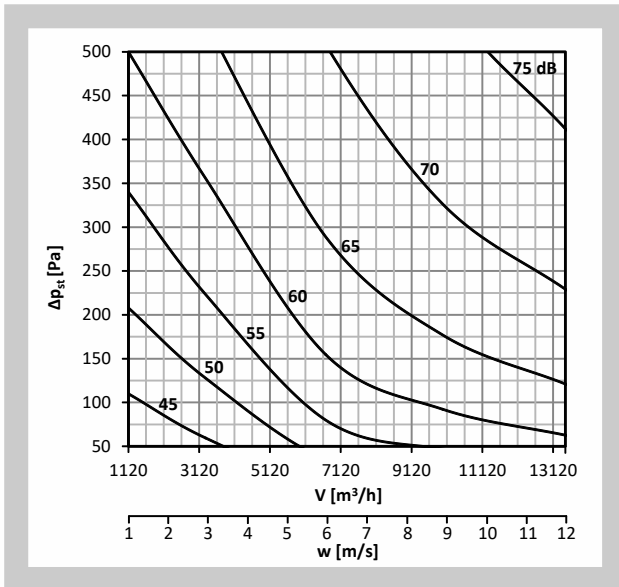


## 8.3. Radiated noise - with insulation

The radiated noise of air volume controller is listed in Tab. 8.3.1.

$\dot{V}$    [m$^3$.h$^{-1}$]    - air flow volume      L$_{WA}$   [dB(A)]   - total level of acoustic power

$\Delta p_{st}$   [Pa]       - pressure differential             corrected by filter A

**Tab. 8.3.1. Sound power level radiated outside the pipeline - with insulation**

| Size [mm] | $\dot{V}$ [m$^3$.h$^{-1}$] | L$_{WA}$ [dB(A)] $\Delta p_{st}$ = 50 Pa | L$_{WA}$ [dB(A)] $\Delta p_{st}$ = 100 Pa | L$_{WA}$ [dB(A)] $\Delta p_{st}$ = 250 Pa | L$_{WA}$ [dB(A)] $\Delta p_{st}$ = 500 Pa |
|---|---|---|---|---|---|
| 80 | 18 | 8 | 11 | 17 | 24 |
| | 88 | 17 | 20 | 26 | 32 |
| | 154 | 24 | 27 | 32 | 37 |
| | 220 | 26 | 29 | 34 | 39 |
| 100 | 30 | 10 | 13 | 19 | 26 |
| | 140 | 18 | 22 | 27 | 33 |
| | 245 | 24 | 28 | 33 | 39 |
| | 350 | 27 | 31 | 36 | 41 |

MANƆÍK®

| Size [mm] | V̇ [m³.h⁻¹] | $L_{WA}$ [dB(A)] $\Delta p_{st} = 50$ Pa | $L_{WA}$ [dB(A)] $\Delta p_{st} = 100$ Pa | $L_{WA}$ [dB(A)] $\Delta p_{st} = 250$ Pa | $L_{WA}$ [dB(A)] $\Delta p_{st} = 500$ Pa |
|---|---|---|---|---|---|
| 125 | 45 | 11 | 14 | 19 | 26 |
| | 220 | 19 | 22 | 27 | 32 |
| | 385 | 23 | 27 | 32 | 37 |
| | 550 | 26 | 29 | 34 | 39 |
| 140 | 55 | 13 | 16 | 22 | 27 |
| | 280 | 19 | 23 | 29 | 35 |
| | 490 | 25 | 29 | 35 | 41 |
| | 700 | 29 | 33 | 38 | 43 |
| 160 | 70 | 14 | 17 | 23 | 29 |
| | 360 | 20 | 24 | 30 | 36 |
| | 630 | 25 | 29 | 35 | 40 |
| | 900 | 29 | 33 | 38 | 43 |
| 180 | 90 | 12 | 15 | 18 | 23 |
| | 480 | 17 | 20 | 25 | 29 |
| | 840 | 22 | 25 | 30 | 34 |
| | 1200 | 26 | 29 | 33 | 37 |
| 200 | 115 | 12 | 15 | 19 | 24 |
| | 560 | 17 | 20 | 25 | 30 |
| | 980 | 23 | 26 | 31 | 35 |
| | 1400 | 27 | 30 | 34 | 38 |
| 225 | 145 | 13 | 16 | 21 | 26 |
| | 720 | 18 | 21 | 26 | 31 |
| | 1260 | 25 | 28 | 33 | 37 |
| | 1800 | 29 | 32 | 36 | 40 |
| 250 | 180 | 13 | 16 | 21 | 26 |
| | 880 | 20 | 23 | 28 | 32 |
| | 1540 | 26 | 29 | 34 | 38 |
| | 2200 | 31 | 34 | 38 | 42 |
| 280 | 220 | 15 | 18 | 23 | 28 |
| | 1120 | 21 | 24 | 29 | 33 |
| | 1960 | 27 | 30 | 35 | 39 |
| | 2800 | 31 | 34 | 39 | 43 |
| 315 | 280 | 16 | 19 | 24 | 28 |
| | 1400 | 22 | 25 | 30 | 35 |
| | 2450 | 31 | 34 | 39 | 43 |
| | 3500 | 38 | 41 | 46 | 50 |
| 355 | 355 | 15 | 18 | 24 | 31 |
| | 1800 | 24 | 27 | 33 | 38 |
| | 3150 | 33 | 36 | 41 | 46 |
| | 4500 | 37 | 40 | 45 | 49 |
| 400 | 455 | 17 | 20 | 26 | 31 |
| | 2320 | 25 | 28 | 34 | 39 |
| | 4060 | 32 | 36 | 41 | 46 |
| | 5800 | 36 | 40 | 45 | 49 |
| 500 | 710 | 20 | 24 | 31 | 36 |
| | 4200 | 32 | 36 | 43 | 48 |
| | 6300 | 38 | 43 | 49 | 54 |
| | 8400 | 43 | 47 | 52 | 57 |
| 630 | 1120 | 24 | 27 | 32 | 37 |
| | 6700 | 33 | 37 | 43 | 48 |
| | 10000 | 39 | 43 | 49 | 54 |
| | 13300 | 43 | 47 | 52 | 57 |

**Diagram No. 31** Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN80, with insulation
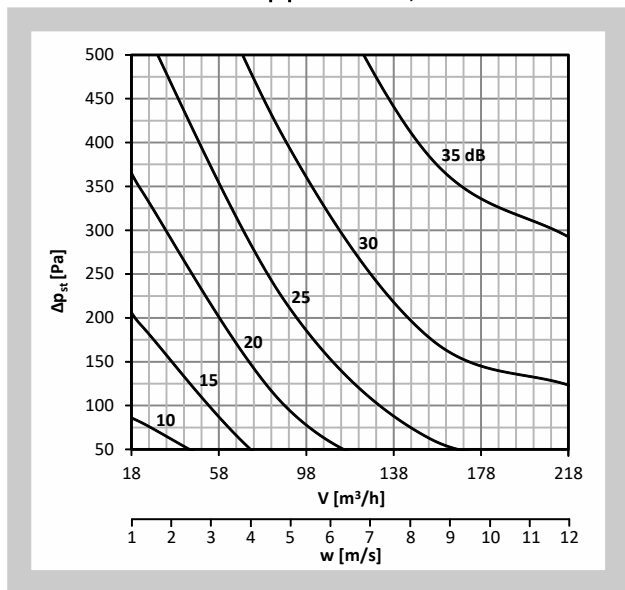


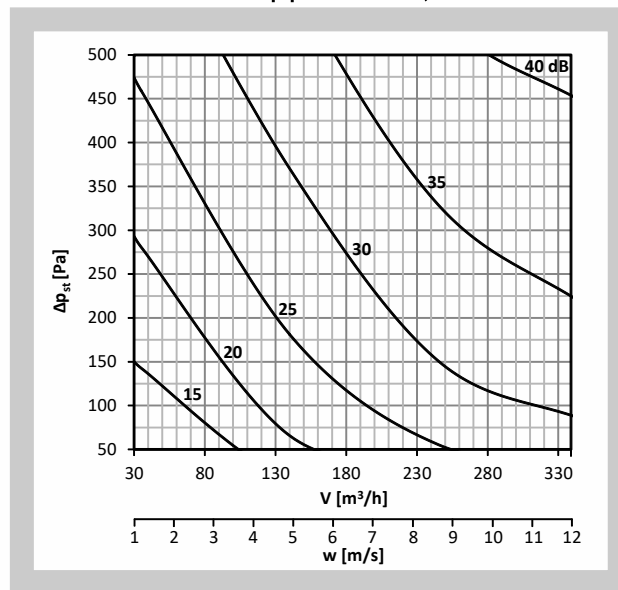**Diagram No. 32** Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN100, with insulation



**Diagram No. 33** Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN125, with insulation
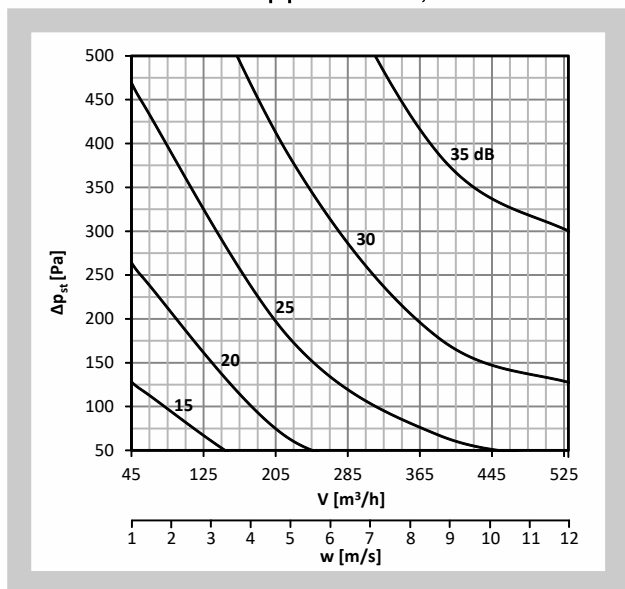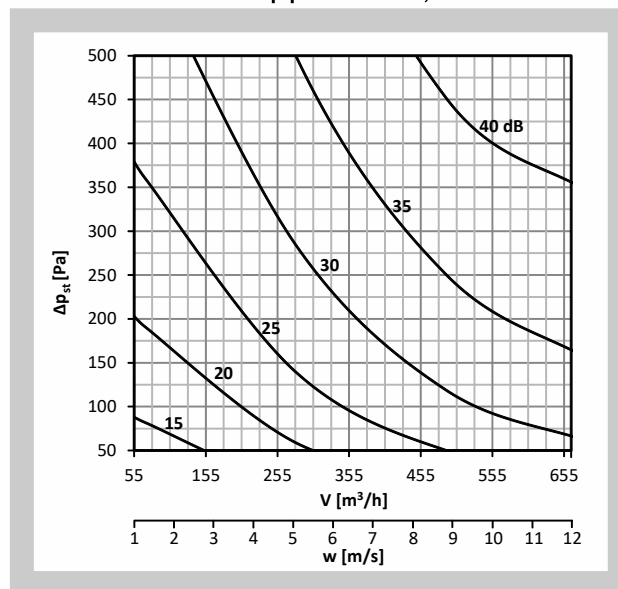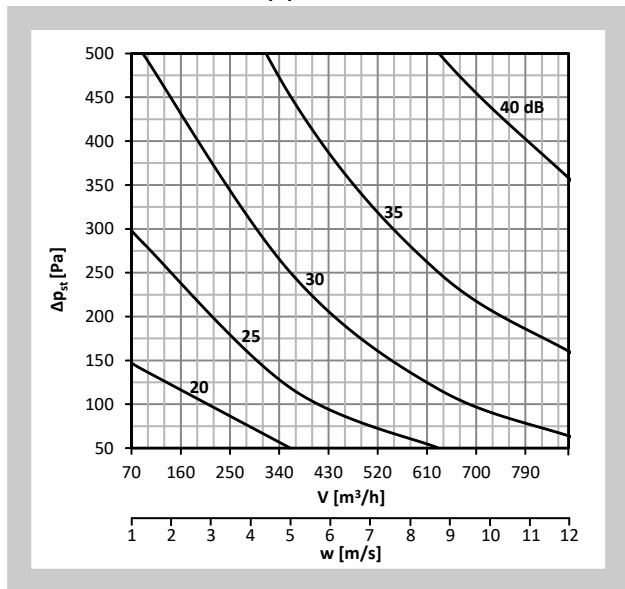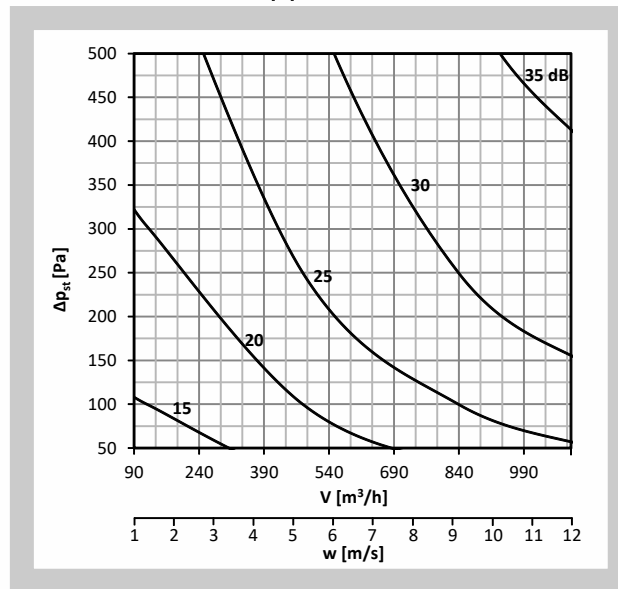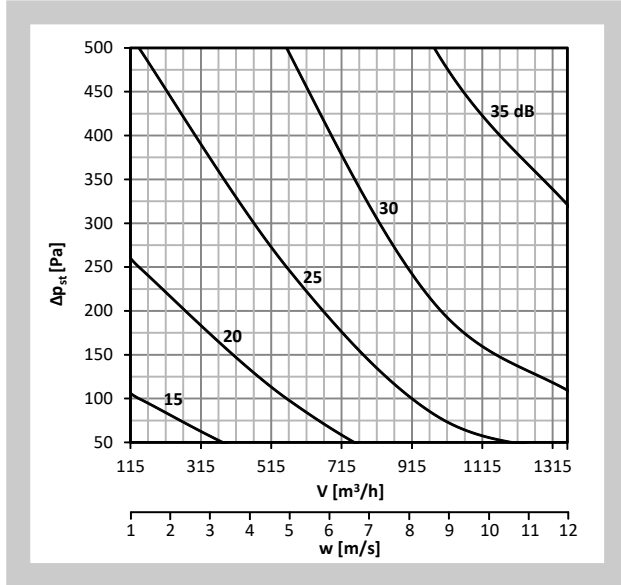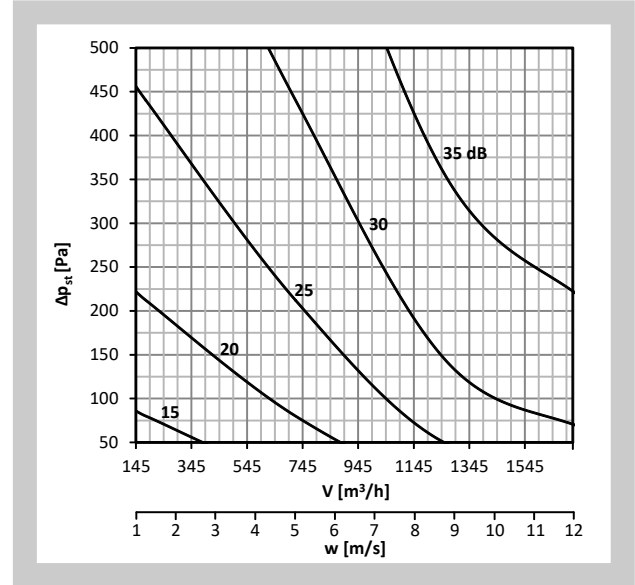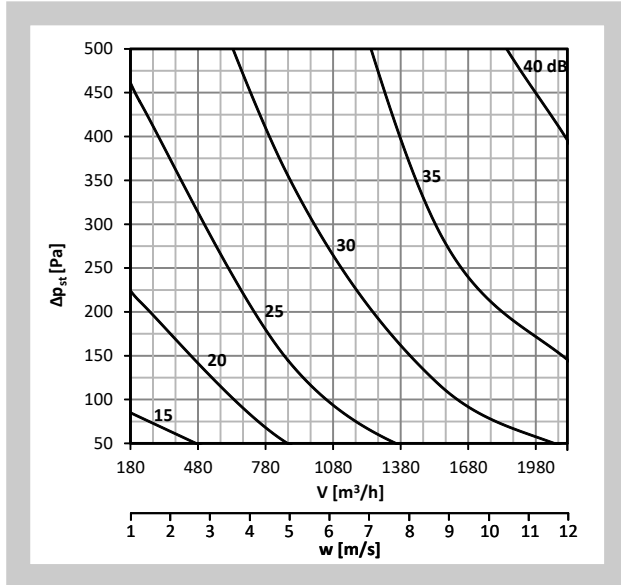


**Diagram No. 34** Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN140, with insulation



**Diagram No. 35** Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN160, with insulation
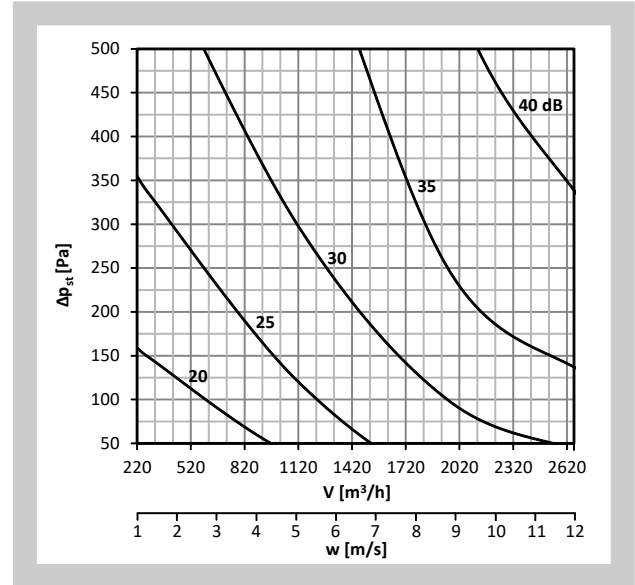


**Diagram No. 36** Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN180, with insulation

**Diagram No. 37**   Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN200, with insulation

**Diagram No. 38**   Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN225, with insulation
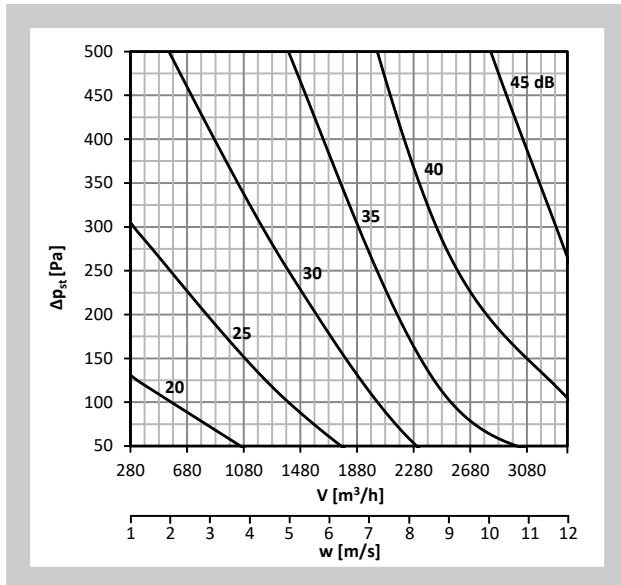
**Diagram No. 39**   Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN250, with insulation

**Diagram No. 40**   Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN280, with insulation

**Diagram No. 41**   Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN315, with insulation

**Diagram No. 42**   Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN355, with insulation

**Diagram No. 43**  Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN400, with insulation



**Diagram No. 44**  Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN500, with insulation



**Diagram No. 45**  Sound power level L$_{WA}$ [dB(A)] radiated outside the pipeline DN630, with insulation
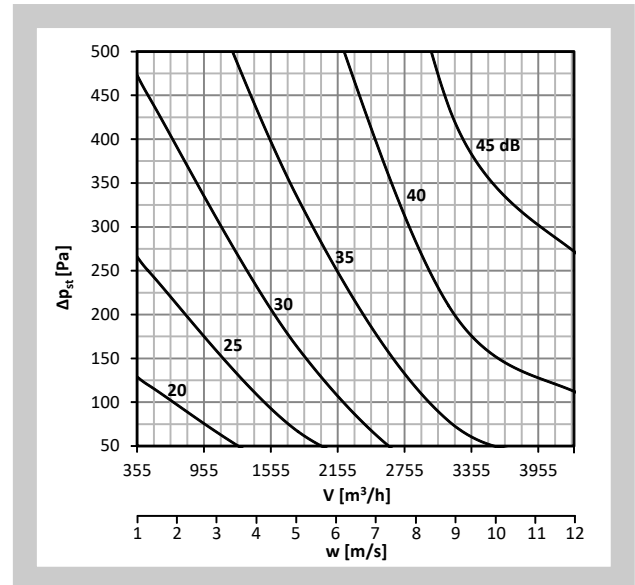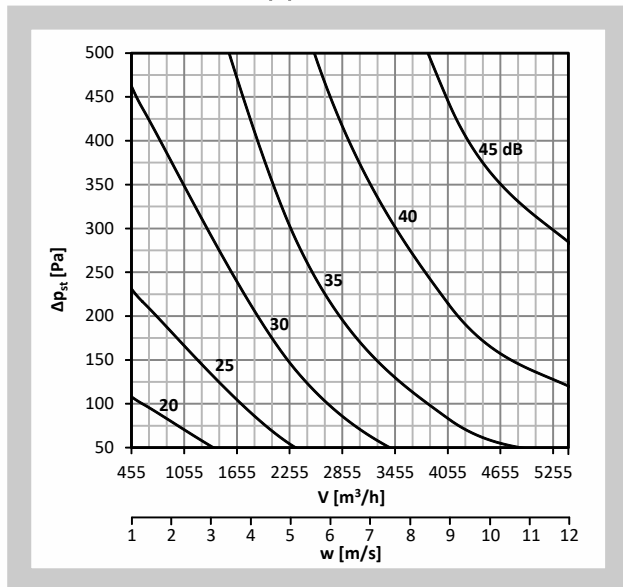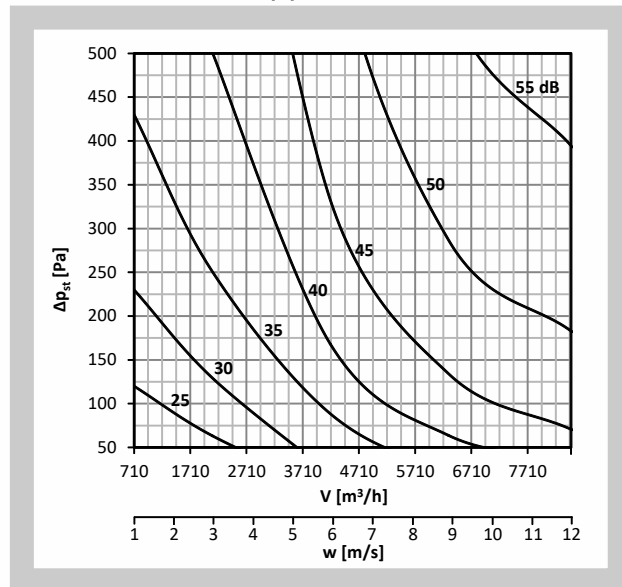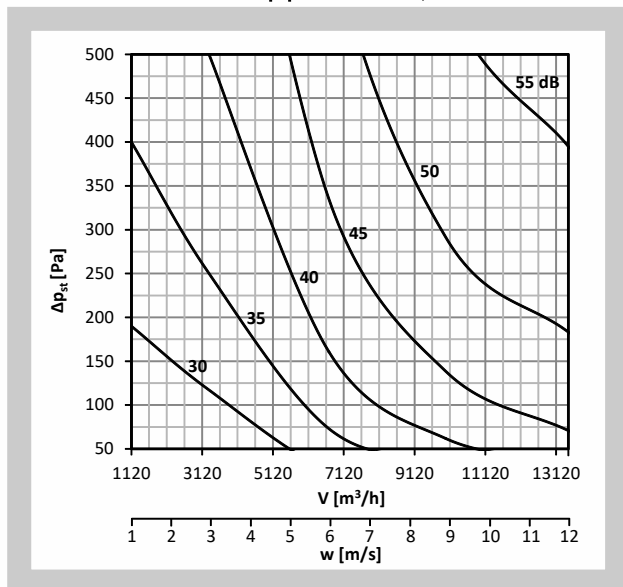


## IV. VENTILATION SYSTEMS

### 9. Ventilation systems with controllers RPM-V

**9.1.**  Flow control in the room using the Belimo wall-mounted device

**Fig. 35**  Device P-01RT-1x-0



**Fig. 36**  Device 22Rx-xx-x

**Tab. 9.1.1.**

| Wall device | 22RT-19-1 | 22RTM-19-1 | P-01RT-1x-0 |
|---|---|---|---|
| Measurement | Temperature | Temperature, relative humidity, Dew point, $CO_2$ | Temperature |
| Resetting values | PC BelimoAssistent NFC | PC BelimoAssistent NFC | Rotary wheel |
| Power voltage | AC 24V, +-20%, 0.5W DC 24V, +- 20%, 1VA | | |
| Connections | spring terminal block 0,25 ... 1,5 mm | | |
| Output | control signal Y: 0 ... 10V, max. 1 mA | | |
| Degree of protection | IP 30 | | |
| Protection class | III (Safety extra-low voltage) | | |
| Temperature / ambient humidity | 0...+50 °C / 20 ... Max 95% r.H. (non-condensing) | | |
| Temperature / storage humidity | -20...+70 °C / 20 ... Max 95% r.H. (non-condensing) | | |

**More sensor designs and information in the Belimo catalog.**

### 9.2. Ventilation systems HRSM, HRSM-K

Description

Mandík VAV regulating systems HRSM and HRSM-K are designed for simple and optimal regulation of air quality in family houses, apartments (including kitchen exhaust), office buildings with conference rooms or industrial premises with centralized ventilation systems.

The air regulating systems HRSM/ HRSM-K are designed as "demand-based control systems".
The VAV dampers are not depending on air pressure in the duct.
They can be used also as constant flow regulating dampers, when needed.
The HRSM/ HRSM-K systems are operated by electrical boxes DC1/respectively DC2 and controlled by 3 positions wall switch.

The HRSM-K is connectable to kitchen hood exhaust, which is equipped with micro switch.
The HRSM-K ("kitchen") allows to increase air volume in the supply ducts and consequently to decreases air volume in the exhaust ducts, when kitchen hood is in operation.
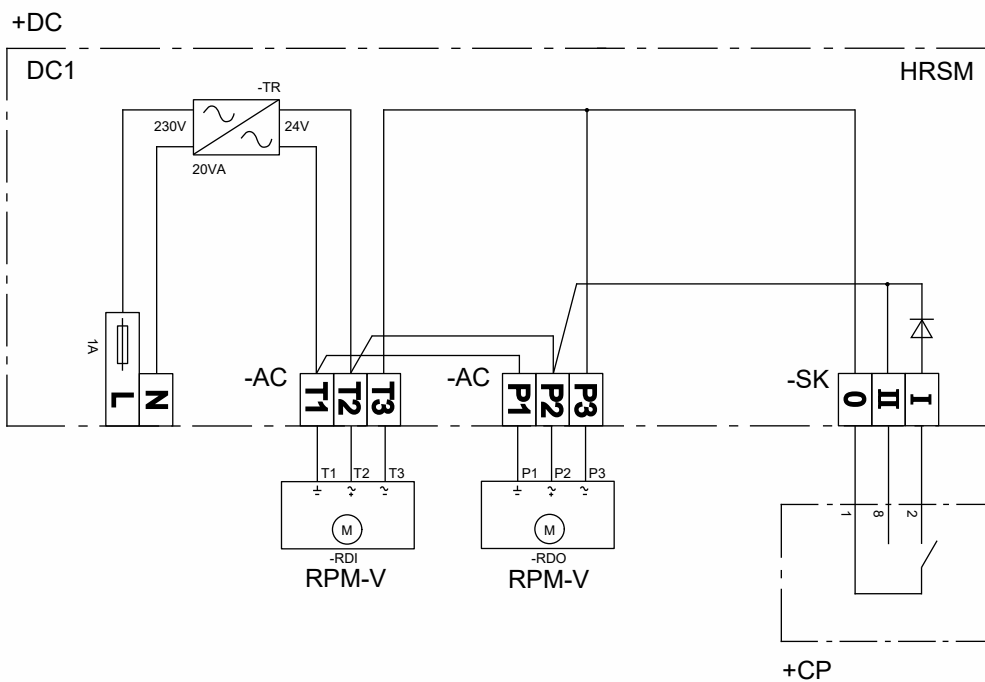It means that the kitchen hood is extracting the air with its own fan.

Switch positions:
● Damper´s blade in closed position
● Minimal air flow volume position
● Maximal air flow volume position

**Fig. 37   HRSM, HRSM-K**



Control box DC1/DC2

Wall switch

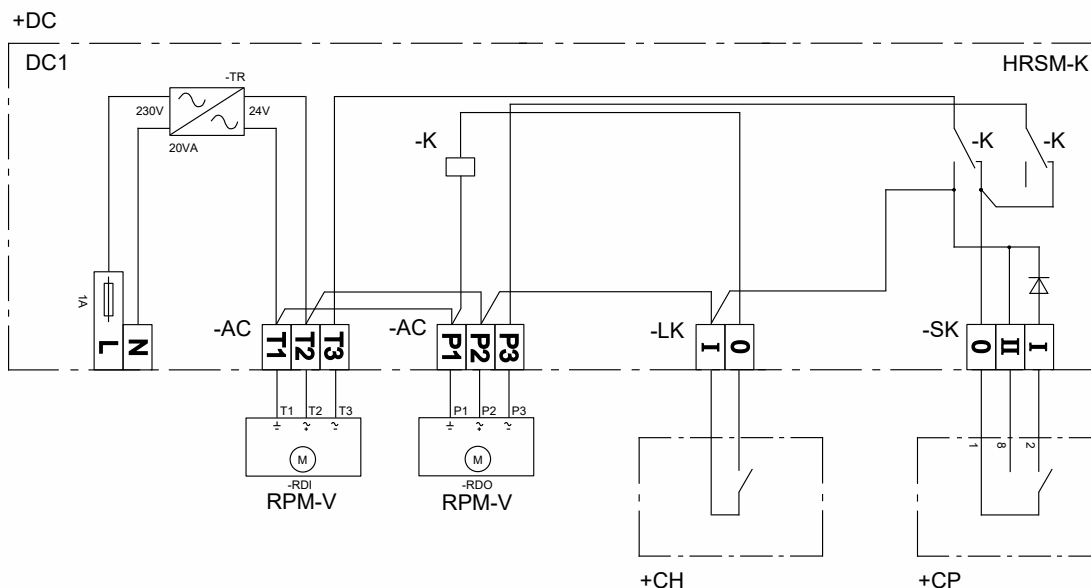**Fig. 38  Wiring diagram HRSM**



+CP - 3-position control panel
+DC - Connecting box with power supply
-RDI - Supply air damper with drive
-RDO - Exhaust air damper with drive

**Fig. 39  Wiring diagram HRSM-K**



+CH - Kitchen hood
+CP - 3-position control panel
+DC - Connecting box with power supply
-RDI - Supply air damper with drive
-RDO - Exhaust air damper with drive

## V. MATERIAL, FINISHING

### 10. Material

**10.1.** The body of the controller and the controller blade are made of galvanized sheet. The blade is furnished with a silicon seal along its periphery. Controllers are with rubber tightness and glued all the way around. The controller is delivered without further surface treatment.

**10.2.** According to the customer's requirements, damper can be made of stainless material.
Specifications for stainless-steel models – classification of stainless steel:
- Class A2 – Food-grade stainless steel (AISI 304 – EN 17240)
- Class A4 – Chemistry-grade stainless steel (AISI 316, 316L – EN 17346, 17349)

The indicated metal is used for all metal components of the damper except the servo drive and its adapters.
The following components, including the fasteners, are made from stainless steel at all times:
1) Damper body and all components permanently attached
2) Leaf pins, metal components of the leaf
3) Pressure sensors inside the damper
4) Controlling components outside the damper (levers, control levers, metal part of the pin or the entire pin)
5) Servo drive mount
6) Insulation sheeting, if the damper is insulated

Plastic, rubber and silicon components, sealants, servo drives, and end switches are identical for all material variants of the dampers.
Some fasteners and components are available in one class of stainless steel; the type will be used in all stainless-steel variants.
Any other requirements for the design shall be considered atypical and shall be addressed on an individual basis.

## VI. INSPECTION, TESTING

### 11. Inspection, testing

**11.1.** Dimensions are checked with standard gauges in accordance with the tolerated dimension standards used in air conditioning.

## VII. TRANSPORTATION AND STORAGE

### 12. Logistic terms

**12.1.** Regulators are transported by box freight vehicles without direct weather impact, there must not occur any sharp shocks and ambient temperature must not exceed +40°C. Regulators must be protected against mechanic damages when transported and manipulated. During transportation, the regulator blade must be in the "CLOSED" position.

**12.2.** Regulators are stored indoor in environment without any aggressive vapours, gases or dust. Indoor temperature must be in the range from -5°C to +40°C and maximum relative humidity 80%. Regulators must be protected against mechanic damages when transported and manipulated.

## VIII. ASSEMBLY, ATTENDANCE, MAINTENANCE AND REVISIONS

### 13. Assembly and set up

**13.1.** All effective safety standards and directives must be observed during air flow controller assembly.

The assembly consists of installing the controller in the air distribution system and if required, connecting the actuating mechanism to the electric net.

**13.2.** The reset of values $\mathring{V}_{min}$ a $\mathring{V}_{max}$ factory settings can be done in the following ways.

**<u>Belimo device</u>**

Using the adjustment by service tool ZTH-EU, which is designed for all Belimo actuators with interface contain PP (MP, …). Connection to actuator via service socket. Actuators can be adjusted and controlled over Plug and Play drives.

Setting can be made with the setup and programming software PC-Tool, that can be installed on a standard PC. The PC is connected to the actuator via the service socket.

Use the Belimo Assistant App, an app available for Android smartphones from version 4.4 and for iPhone devices with iOS 9 or later. This app can only be used with a Belimo device that has a built-in NFC interface.

The Iphone device requires a NFC converter ZIP-BT-NFC. This device can also be used for an Android device that does not support NFC.

**<u>Gruner device</u>**

Using the display on the actuator

**<u>Siemens device</u>**

Using the service tool AST20 (hand tool) or ACS941 (PC tool to be used with ATS 22).
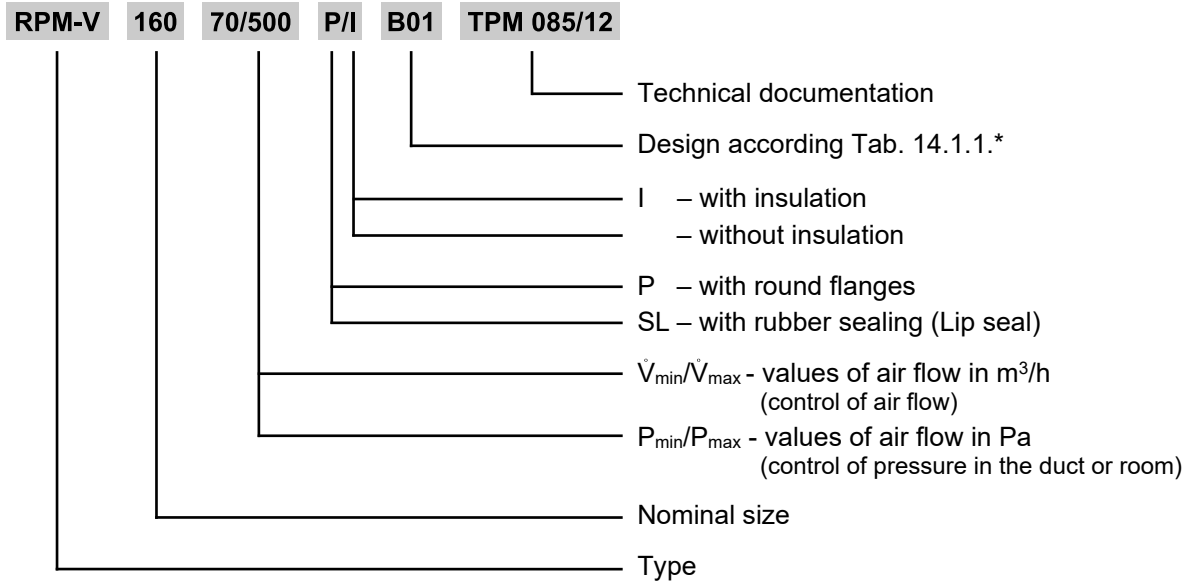
More detailed information on the stated adjustment methods is given in the catalog of the actuator / controller manufacturer (Belimo, Gruner, Siemens).

## IX. ORDERING INFORMATION

### 14. Ordering key

**14.1.**     Controller RPM-V

| RPM-V | 160 | 70/500 | P/I | B01 | TPM 085/12 |
|---|---|---|---|---|---|

Technical documentation

Design according Tab. 14.1.1.*

I    – with insulation
    – without insulation

P   – with round flanges
SL – with rubber sealing (Lip seal)

$\mathring{V}_{min}/\mathring{V}_{max}$ - values of air flow in m$^3$/h
       (control of air flow)

$P_{min}/P_{max}$ - values of air flow in Pa
       (control of pressure in the duct or room)

Nominal size

Type

The standard operating mode is set for DC 2...10 V. If is it requested by customer, it can be set for DC 0...10 V.

The values of air volume $\mathring{V}_{min}$ and $\mathring{V}_{max}$ will be set by the manufacturer according to the customer's order. The pressure values $P_{min}$ and $P_{max}$ will be set according to the customer's order. If the customer does not determine the required values, the values will be set according to TPM resp. at pressure $P_{min}$ to 0 Pa and $P_{max}$ to the maximum value of the pressure sensor. These values can be subsequently reset by means of the instrument ZTH-EU, or by the PC software PC-Tool or via the Belimo Assistant App. For Gruner actuators, it is possible to additionally reset the values of $\mathring{V}_{min}$, $\mathring{V}_{max}$ and the operating mode using a display on the actuator.
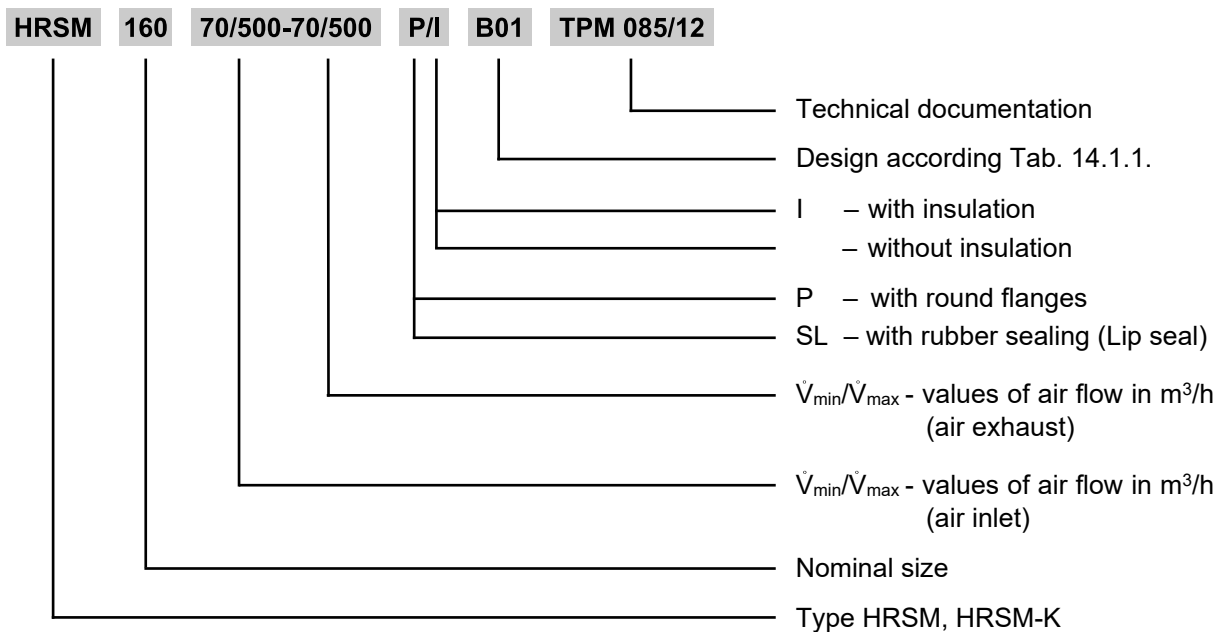
* You will find an extended overview of the design in the "Technical documentation" folder for the RPM-V product at www.mandik.cz

### Tab. 14.1.1. Dampers design

| Design list for variable airflow regulator- RPM-V | | | | | | Sensor range | Design |
|---|---|---|---|---|---|---|---|
| Air flow | BELIMO compact solution (sensor, controller and actuator in one box) | Without the sping | Dynamic | Analog MPBus | LMV-D3-MP (5 N.m, NMV-D3-MP 10 N.m, SMV-D3-MP 20 N.m) | 0...500Pa | B01 |
| | | | | Modbus RTU BACnet MPBus | LMV-D3-MOD (5 N.m, NMV-D3-MOD 10 N.m, SMV-D3-MOD 20 N.m) | 0...500Pa | B02 |
| | | | | KNX | LMV-D3-KNX (5 N.m, NMV-D3-KNX 10 N.m) | 0...500Pa | B04 |
| | GRUNER compact solution (sensor, controller and actuator in one box) | Without the sping | Dynamic | Analog PP-Bus | 327VM-024-05 (5 N.m, 327VM-024-10 10 N.m, 327VM-024-15 15 N.m.) | 0…500 Pa | G00 |
| | | | | Modbus RTU | 327VM-024-05-MB (5 N.m, 327VM-024-10-MB 10 N.m, 327VM-024-15-MB 15 N.m.) | 0…500 Pa | G02 |
| | SIEMENS compact solution (sensor, controller and actuator in one box) | Without the sping | Dynamic | Analog PP-Bus | GDB181.1E/3 (5 N.m, (GLB181.1E/3 10 N.m) | 0…500 Pa | S00 |
| | | | | Modbus RTU | GDB181.1E/MO (5 N.m, (GLB181.1E/MO 10 N.m) | 0…500 Pa | S02 |
| | | | | KNX | GDB181.1E/KN (5 N.m, (GLB181.1E/KN 10 N.m) | 0…500 Pa | S04 |
| | | | | BACnet | GDB181.1E/BA (5 N.m, (GLB181.1E/BA 10 N.m) | 0…500 Pa | S05 |
| Pressure | BELIMO sensor, controller and actuator all in separate boxes | Without the sping | Static | Analog MP-Bus | Controller VRU-M1-BAC (STP) + LM24A-VST (5 N.m., NM24A-VST 10 N.m, SM24A-VST 20 N.m) | 0…600 Pa | B75 |
| | | | | Modbus RTU BACnet | Controller VRU-M1-BAC (STP) + LM24A-VST (5 N.m., NM24A-VST 10 N.m, SM24A-VST 20 N.m) | 0…600 Pa | B78 |
| | | With the spring | Static | Analog MP-Bus | Controller VRU-M1R-BAC (STP) + LF24-VST (4 N.m, NF24A-VST 10 N.m, SF24A-VST 20 N.m) | 0…600 Pa | B75F |
| | | | | Modbus RTU BACnet | Controller VRU-M1R-BAC (STP) + LF24-VST (4 N.m, NF24A-VST 10 N.m, SF24A-VST 20 N.m) | 0…600 Pa | B78F |
| | | Speed actuator / With the spring | Static | Analog MP-Bus | Controller VRU-M1-BAC (STP) + LMQ24A-VST (4 N.m., NMQ24A-VST 8 N.m) | 0…600 Pa | B75Q |
| | | | | Modbus RTU BACnet | Controller VRU-M1-BAC (STP) + LMQ24A-VST (4 N.m., NMQ24A-VST 8 N.m) | 0…600 Pa | B78Q |
| | GRUNER compact solution (sensor, controller and actuator in one box) | Without the sping | Dynamic | Analog PP-Bus | 327VM-024-05/CCOL (5 N.m, 327VM-024-10/CCOL 10 N.m, 327VM-024-15/CCOL 15 N.m.) | 0…500 Pa | G50 |
| | | | | Modbus RTU | 327VM-024-05-MB (CCPC) (5 N.m, 327VM-024-10-MB (CCPC) 10 N.m, 327VM-024-15-MB (CCPC) 15 N.m.) | 0…500 Pa | G52 |
| | GRUNER sensor, controller and actuator all in separate boxes | Without the sping | Dynamic | Analog PP-Bus | Controller GUAC-PM-DD3 + 227C-024-05-V/ST06 (5 N.m, 227C-024-10-V/ST06 10 N.m, 227C-024-15-V/ST06 15 N.m, 363C-024-20-V/ST06 20N.m) | 0…300 Pa | G62 |
| | | | | Modbus RTU | Controller GUAC-PM-DD3-MB + 227C-024-05-V/ST06 (5 N.m, 227C-024-10-V/ST06 10 N.m, 227C-024-15-V/ST06 15 N.m, 363C-024-20-V/ST06 20N.m) | 0…300 Pa | G64 |
| | | | Static | Analog PP-Bus | Controller GUAC-PM1 + 227C-024-05-V/ST06 (5 N.m, 227C-024-10-V/ST06 10 N.m, 227C-024-15-V/ST06 15 N.m, 363C-024-20-V/ST06 20N.m) | 0…100 Pa | G70 |
| | | | | | Controller GUAC-PM3 + 227C-024-05-V/ST06 (5 N.m, 227C-024-10-V/ST06 10 N.m, 227C-024-15-V/ST06 15 N.m, 363C-024-20-V/ST06 20N.m) | 0…300 Pa | G71 |
| | | | | | Controller GUAC-PM6 + 227C-024-05-V/ST06 (5 N.m, 227C-024-10-V/ST06 10 N.m, 227C-024-15-V/ST06 15 N.m, 363C-024-20-V/ST06 20N.m) | 0…600 Pa | G72 |
| | | | | Modbus RTU | Controller GUAC-PM1-MB + 227C-024-05-V/ST06 (5 N.m, 227C-024-10-V/ST06 10 N.m, 227C-024-15-V/ST06 15 N.m, 363C-024-20-V/ST06 20N.m) | 0…100 Pa | G76 |
| | | | | | Controller GUAC-PM3-MB + 227C-024-05-V/ST06 (5 N.m, 227C-024-10-V/ST06 10 N.m, 227C-024-15-V/ST06 15 N.m, 363C-024-20-V/ST06 20N.m) | 0…300 Pa | G77 |
| | | | | | Controller GUAC-PM6-MB + 227C-024-05-V/ST06 (5 N.m, 227C-024-10-V/ST06 10 N.m, 227C-024-15-V/ST06 15 N.m, 363C-024-20-V/ST06 20N.m) | 0…600 Pa | G78 |
| | | With the spring | Dynamic | Analog PP-Bus | Controller GUAC-PM-DD3 + 341C-024-05-V/ST06 (5 N.m, 361C-024-10-V/ST06 10 N.m, 361C-024-20-V/ST06 20 N.m) | 0…300 Pa | G62F |
| | | | | Modbus RTU | Controller GUAC-PM-DD3-MB + 341C-024-05-V/ST06 (5 N.m, 361C-024-10-V/ST06 10 N.m, 361C-024-20-V/ST06 20 N.m) | 0…300 Pa | G64F |
| | | | Static | Analog PP-Bus | Controller+pressure sensor GUAC-PM1 + 341C-024-05-V/ST06 (5 N.m, 361C-024-10-V/ST06 10 N.m, 361C-024-20-V/ST06 20 N.m) | 0…100 Pa | G70F |
| | | | | | Controller+pressure sensor GUAC-PM3 + 341C-024-05-V/ST06 (5 N.m, 361C-024-10-V/ST06 10 N.m, 361C-024-20-V/ST06 20 N.m) | 0…300 Pa | G71F |
| | | | | | Controller+pressure sensor GUAC-PM6 + 341C-024-05-V/ST06 (5 N.m, 361C-024-10-V/ST06 10 N.m, 361C-024-20-V/ST06 20 N.m) | 0…600 Pa | G72F |
| | | | | Modbus RTU | Controller GUAC-PM1-MB + 341C-024-05-V/ST06 (5 N.m, 361C-024-10-V/ST06 10 N.m, 361C-024-20-V/ST06 20 N.m) | 0…100 Pa | G76F |
| | | | | | Controller GUAC-PM3-MB + 341C-024-05-V/ST06 (5 N.m, 361C-024-10-V/ST06 10 N.m, 361C-024-20-V/ST06 20 N.m) | 0…300 Pa | G77F |
| | | | | | Controller GUAC-PM6-MB + 341C-024-05-V/ST06 (5 N.m, 361C-024-10-V/ST06 10 N.m, 361C-024-20-V/ST06 20 N.m) | 0…600 Pa | G78F |
| Pressure in the room | BELIMO sensor, controller and actuator all in separate boxes | Without the sping | Static | Analog MP-Bus | Controller VRU-M1R-BAC (STP) + LM24A-VST (5 N.m, NM24A-VST 10 N.m, SM24A-VST 20 N.m) | -75…+75 | B91 |
| | | | | Modbus RTU BACnet | Controller VRU-M1R-BAC (STP) + LM24A-VST (5 N.m., NM24A-VST 10 N.m, SM24A-VST 20 N.m) | -75…+75 | B92 |
| | | With the spring | Static | Analog MP-Bus | Controller VRU-M1R-BAC (STP) + LF24-VST (4 N.m, NF24A-VST 10 N.m, SF24A-VST 20 N.m) | -75…+75 | B91F |
| | | | | Modbus RTU BACnet | Controller VRU-M1R-BAC (STP) + LF24-VST (4 N.m, NF24A-VST 10 N.m, SF24A-VST 20 N.m) | -75…+75 | B92F |
| | | Speed actuator With the spring | Static | Analog MP-Bus | Controller VRU-M1-BAC (STP) + LMQ24A-VST (4 N.m., NMQ24A-VST 8 N.m) | -75…+75 | B91Q |
| | | | | Modbus RTU BACnet | Controller VRU-M1-BAC (STP) + LMQ24A-VST (4 N.m., NMQ24A-VST 8 N.m) | -75…+75 | B92Q |

**\* You will find an extended overview of the design in the "Technical documentation" folder for the RPM-V product at www.mandik.cz**

**14.2.**    Ventilation systems HRSM, HRSM-K

| HRSM | 160 | 70/500-70/500 | P/I | B01 | TPM 085/12 |

Technical documentation

Design according Tab. 14.1.1.

I    – with insulation

– without insulation

P    – with round flanges

SL  – with rubber sealing (Lip seal)

$\mathring{V}_{min}/\mathring{V}_{max}$ - values of air flow in m$^3$/h (air exhaust)

$\mathring{V}_{min}/\mathring{V}_{max}$ - values of air flow in m$^3$/h (air inlet)

Nominal size

Type HRSM, HRSM-K