KLIMA-LUFT

Mixing Box

MBE / MBP

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Mixing Box Model MBE / MBP

Contents

Mixing Box Model MBE / MBP

Description

The mixing box type MBE/MBP consists of a housing with two round connection pipes and an integrated silencer unit for reducing flow generated noise. Two volumetric flow controllers are integrated, in order to allow the volumetric flow in ducts to be kept constant or variable or to be regulated using positive control V_{min}, V_{max} or "CLOSED". It is used in two-duct air-conditioning systems, in which control and mixing can be carried out electrically or pneumatically, as desired. The measuring sensor used in the cold-air connection pipe and in the silencer unit is a flow-resistant measuring cross on which 12 measuring points have been distributed by the median line method, to allow a precise air flow measurement. A control flap is integrated in the round connection spigot to dampen and shut off. The first setting of values is done in-factory. With this factory setting, all mixing boxes are checked for correct functioning. The maximum deviation of the volumetric flows is +/- 5%, relative to the nominal volumetric flow V_{nenn}, based on a calibration curve of 12 m/sec. At lower flow rates, the deviation in percent may increase.
For the calibration of the controllers, a curve with a flow rate of 12 m/sec. is available. For constant-volume volumetric flow controllers, the V_{min} value will be set to the desired constant-volume value.
If the calibration curve must be changed on site, the controllers must either be recalibrated in-factory or the calibration curve must be changed on site by the customer service of Schako.

For the measurement of the effective pressure, Schako is using its measuring principle by means of a double measuring cross made of extruded aluminium profile, to which 12 measuring points have been attached on the pressure and suction side, respectively, by the median line method, in order to determine average values. In comparison with measuring rods or measuring orifices having fewer measuring points, this gives higher accuracy, allowing the inflow area required in front of the volumetric flow controller to be minimised (see page 5 - Installation Information).

When using the controllers in systems with heavy dust contamination, suitable filters must be connected upstream. For polluted air, use static membrane pressure sensors as transmitters. In this case, it is imperative to observe the notice sign regarding the mounting position. The mixing boxes are not suitable for air containing sticky and oily particles.

In all controller brands, the direction of rotation for opening is clockwise.

For maintenance, service, retrofitting, etc., inspection openings in sufficient number and size must be provided on site.

Field of application

- for supply air systems
- for constant or variable volumetric flows
- Positive control V_{min}, V_{max}, or "CLOSED"
- Differential pressure range 250 - 1000 Pa
- for duct velocities:
  - MBE (electric) = 4 - 12 m/s
  - MBP (pneumatic) = 4 - 12 m/s
- for ambient temperatures of 0 - 50°C
  - Measuring air condition 0 - 50°C
  - 5 - 95% r.h., non-condensing
- Supply voltage for MBE (electric):
  24 V AC (19.2...28.8V) or 24 V DC (21.6...28.8V)
- Feed pressure for MBP (pneumatic): 1.2 ± 0.1 bar
- Design for spiral duct connection to DIN 24145
- With integrated silencer to reduce flow generated noise
- Additional acoustic cladding to reduce radiated noise available at an extra charge
- Additional silencer for further reduction of the flow generated noise available at an extra charge.
  Only possible in connection with a connection frame (-AR)

Attention:
The cold air connection piece must be insulated on site if there is a risk of condensate formation.

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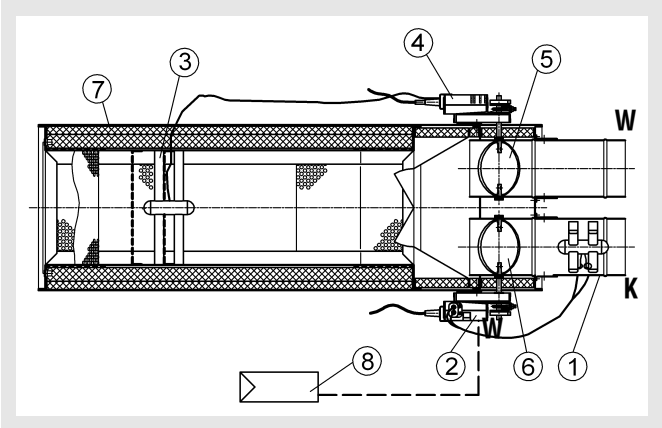
Regulation

Mixing boxes are used in twin-duct air-conditioning systems. The unit mixes cold and hot air in such a way that the difference between the highest and the lowest temperature at the outlet of the device (low-pressure side) is less than 10%. Two control circuits independent of one another are formed, which allow the supply air to be controlled at a constant or variable flow rate. The differential pressure sensor for the cold air, with a measuring cross in the connection pipe (1), together with the cold air controller (2), forms a control circuit which is managed by the room temperature control (8) via a 0(2) - 10 V DC signal. The hot air control circuit comprising a differential pressure sensor, measuring cross (3) in the rectangular silencer unit (7) and hot air controller (4) is set to "constant" as standard and controls the total air volume by admixing the amount of hot air necessary for the sum of cold air and hot air to reach the total air volume. If the cold air volume exceeds the total air volume, the hot air control damper (5) will be completely closed. When cooling air demand decreases, the cold air control damper (6) is closed. The actual throughput of the air volume can be measured and evaluated via the U_5 signal of the controllers (in the case of electric mixing boxes).

Pneumatic mixing box MBP: Unlike the electronic mixing box MBE, this mixing box does not require a measuring cross (1) mounted in the round cold air connection pipe. A volumetric flow controller (PI or I controller) for activating the pneumatic actuators is adequate for control.



W = Hot air

K = Cold air

Cold air either left or right as desired (shown on the left)

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Installation

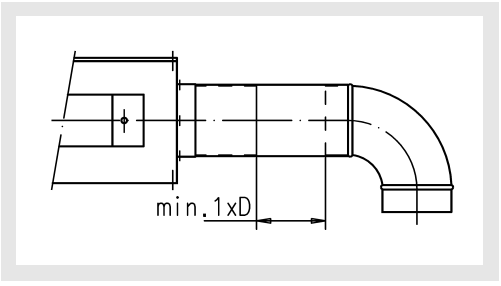
Installation information

To avoid unnecessary controller errors, the min. distances according to the following table / drawings must be observed. For combinations of several connection pieces or pieces with fire dampers or silencers, the larger minimum distances must be observed.

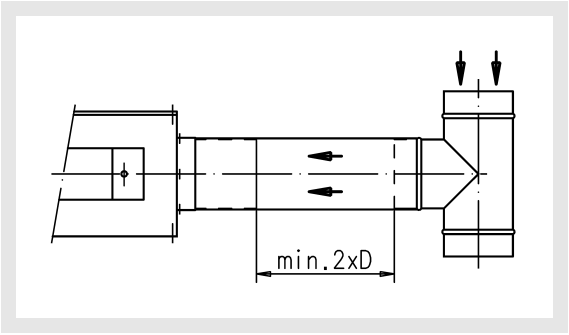
Distance to:

Connection piece with bend:	1 x D
Other connection pieces: (e.g. T-junction, branching piece, reduction piece, etc.)	2 x D
Fire dampers:	2 x D
Silencers:	2 x D

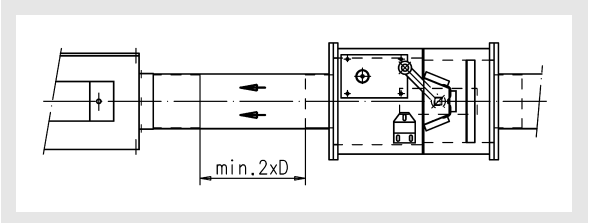
Distance to a bent connection piece



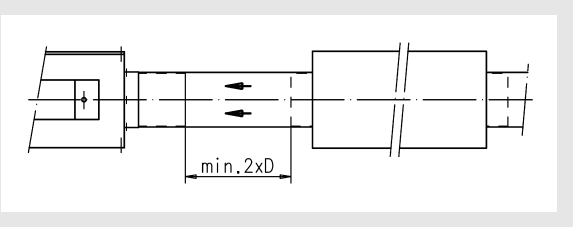
Distance to other connection pieces
(e.g. branching piece, reduction piece, T-junction, etc.)



Distance to a fire damper



Distance to a silencer



Construction

Housing

- Galvanised sheet steel
- abrasion-resistant up to a duct velocity of 20 m/s
- Lined with mineral wool, perforated sheet cover.

Damper leaf seal

- made of PUR, silicone-free
- for airtight design to DIN EN 1751 Class 2 (NW100 only), Class 3 (NW125 - 400 only).

Guide baffle

- Galvanised sheet steel, perforated

Measuring cross

- Blades made of extruded aluminium profile
- Blade mount made of plastic (PA 6).

Silencer unit

- Lined with mineral wool, perforated sheet cover.

Hot and cold air control damper

- galvanised sheet steel

Model

MBE	-	With electric control
MBP	-	With pneumatic control
...-KR	-	Cold air right in air flow direction
...-KL	-	Cold air left in air flow direction (standard)

Accessories

Connection frame (-AR)

- Galvanised sheet steel

Acoustic cladding (-DS)

- Galvanised sheet steel, with mineral wool lining

Rubber lip seal (-GD)

- Special rubber

Additional silencer (-ZS)

- Galvanised sheet steel, baffle with mineral wool lining (MWK) and optionally with perforated sheet cover (MLK).

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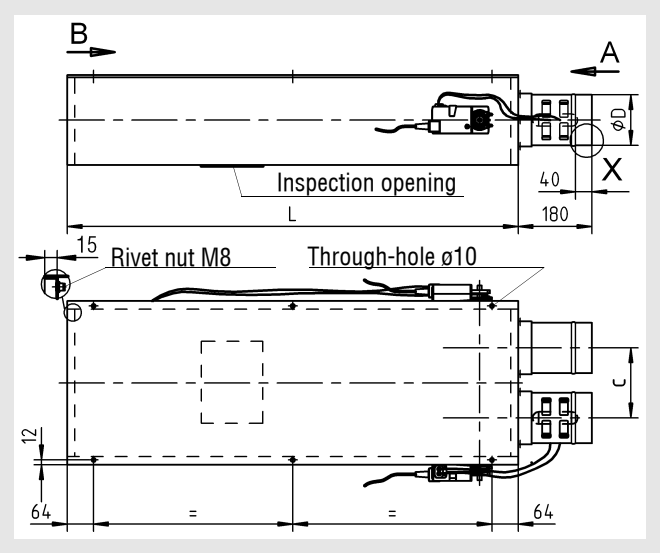
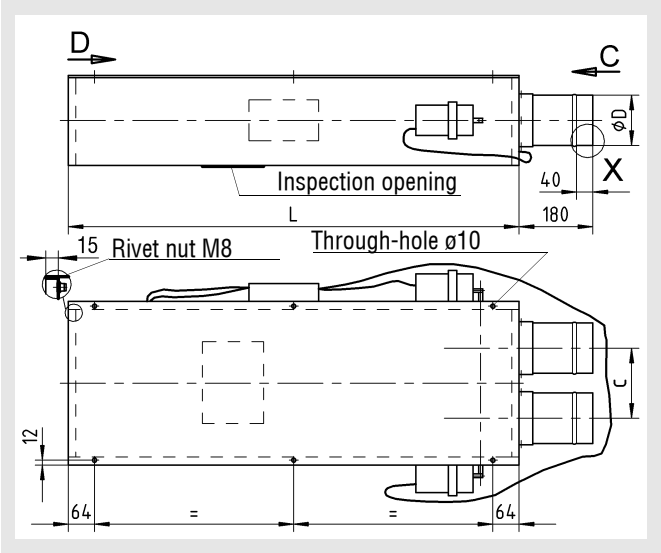
Models and dimensions

Dimensions

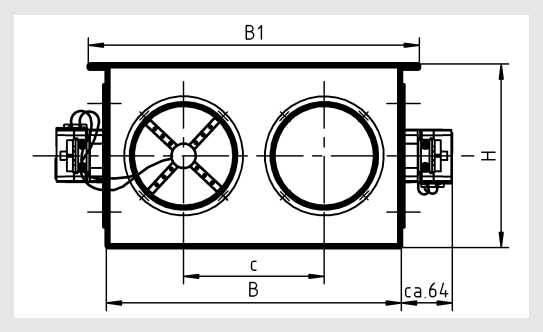
MBE



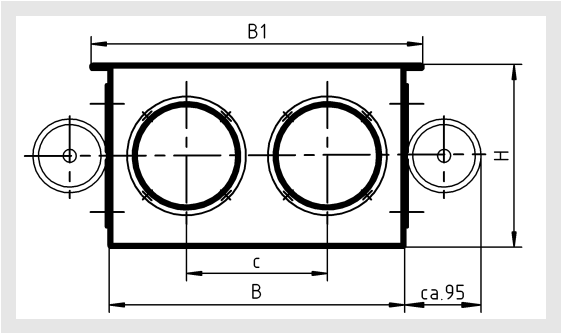
MBP



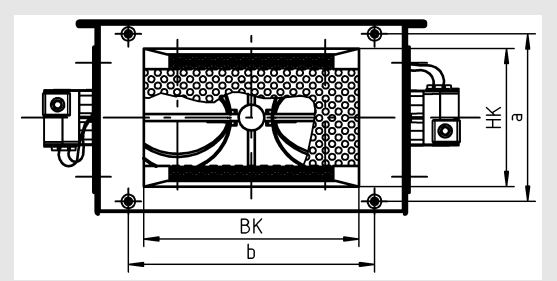
View A



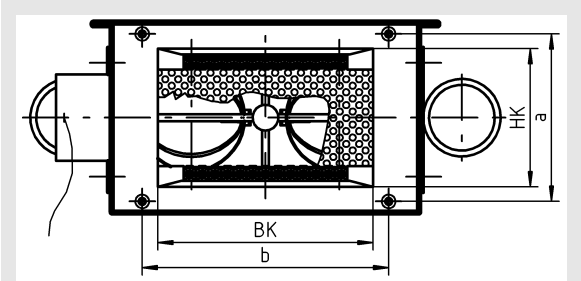
View C



View B



View D



Available sizes

NW	B	B1	BK	H	HK	L	øD	a	b	c
100	360	400	250	220	160	1100	98	194	286	178
125	480	520	370	230	170	1100	123	204	399	238
160	580	620	470	260	200	1400	158	234	504	288
200	700	740	590	290	230	1500	198	259	624	348
250	880	920	770	340	280	1500	248	309	804	438
315	1000	1040	890	440	385	1835	313	409	924	498
400	1400	1440	1290	490	430	1835	398	459	1324	698

For sizes 315 and 400, the housing consists of two parts mounted ex works.

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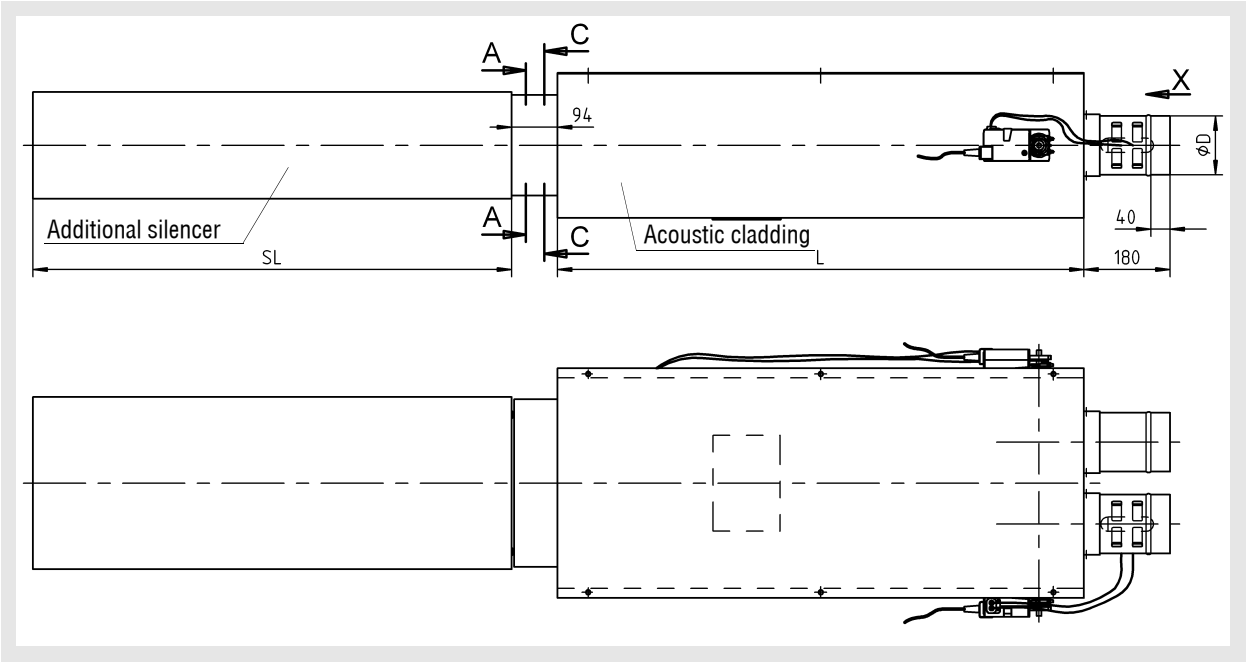
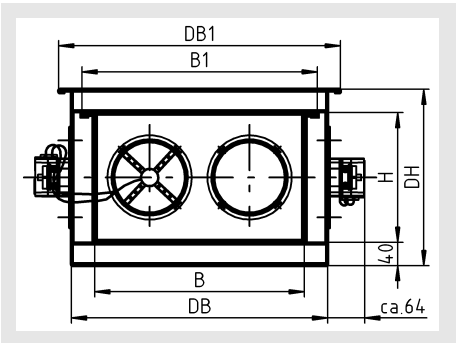
Dimensions of accessories

Acoustic cladding (-DS) and additional silencer (-ZS)

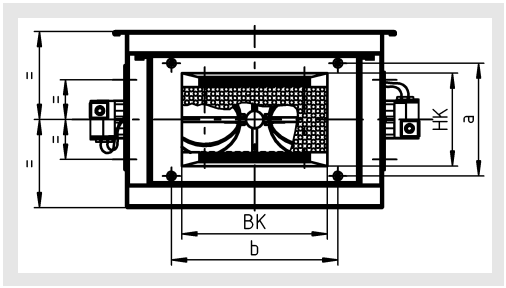


View X



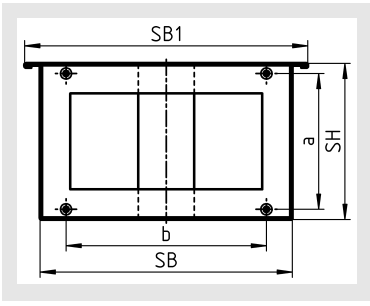
Section A-A

shown without connection frame

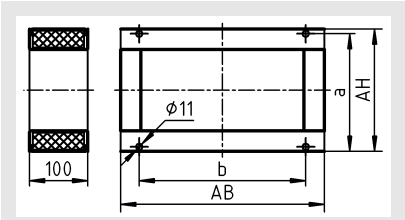


Section C-C

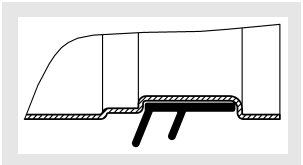
shown without connection frame



Connection frame (-AR)



Rubber lip seal (-GD)
Detail X



Available sizes

NW	B = SB	B1 = SB1	DB	DB1	BK	H = SH	DH	HK	AH	AB	L	SL	øD	a	b
100	360	400	440	480	250	220	300	160	209	352	1100	1000	98	194	286
125	480	520	560	600	370	230	310	170	219	465	1100		123	204	399
160	580	620	660	700	470	260	340	200	249	570	1400		158	234	504
200	700	740	780	820	590	290	370	230	274	690	1500		198	259	624
250	880	920	960	1000	770	340	420	280	324	870	1500	1500	248	309	804
315	1000	1040	1080	1120	890	440	520	385	424	990	1835		313	409	924
400	1400	1440	1480	1520	1290	490	570	430	474	1390	1835		398	459	1324

For sizes 315 and 400, the housing consists of two parts mounted ex works.

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Technical data

Volumetric flow range

for MBE (constant or min/max)

NW ø (mm)	V	Hot air control Total air volume electrical		Cold air control variable electrical	
		v_{min} (4m/s)	v_{max} (12m/s)	v_{min} (2 m/s)	v_{max} (12 m/s)
100	m^3/h	106	319	53	319
	l/s	30	89	15	89
125	m^3/h	168	505	84	505
	l/s	47	140	23	140
160	m^3/h	279	836	139	836
	l/s	77	232	37	232
200	m^3/h	439	1317	219	1317
	l/s	122	366	61	366
250	m^3/h	690	2070	345	2070
	l/s	192	575	96	575
315	m^3/h	1101	3303	550	3303
	l/s	306	918	153	918
400	m^3/h	1783	5348	891	5348
	l/s	495	1486	248	1486

for MBP (constant or min/max)

NW ø (mm)	V	Hot air control pneumatic		Cold air control variable pneumatic	
		v_{min} (4m/s)	v_{max} (12m/s)	v_{min} (4 m/s)	v_{max} (12 m/s)
100	m^3/h	106	319	106	319
	l/s	30	89	30	89
125	m^3/h	168	505	168	505
	l/s	47	140	47	140
160	m^3/h	279	836	279	836
	l/s	77	232	77	232
200	m^3/h	439	1317	439	1317
	l/s	122	366	122	366
250	m^3/h	690	2070	690	2070
	l/s	192	575	192	575
315	m^3/h	1101	3303	1101	3303
	l/s	306	918	306	918
400	m^3/h	1783	5348	1783	5348
	l/s	495	1486	495	1486

Attention, the following specifications are important for programming the volumetric flow controllers:

- This table merely specifies the complete measuring range of the controller (volumetric flow range)
- If the customer wants a calibration curve different from 12 m/s, it must be specified!
- When the air volume drops below the V_{min} shown in the tables, the correct functioning of the volumetric flow controller is no longer guaranteed!
- If only one air volume is specified in the order (as V_{max} value), the volumetric flow controller will be delivered as variable volumetric flow controller. The V_{min} value will be set to the value specified in the catalogue.
- If only one air volume is specified in the order (as V_{min} or $V_{konstant}$ value or without specifying a value), then the volumetric flow controller will be delivered as a constant volumetric flow controller. The volume specified in the order is set to the V_{min} value, and the V_{max} value is set to 100%.
- The air volumes can be changed using setting devices specific of the controller make, depending on the calibration curve set ex works.
- For the parameter setting of the control components (all controllers), an air density of 1.2 kg/m³ has been taken into account.
- Belimo compact controllers are elevation-compensated. They are calibrated ex works to the specific system elevation of the specified installation site.
- If no system elevation is given in the order, the controllers will be calibrated to the elevation of the delivery address.

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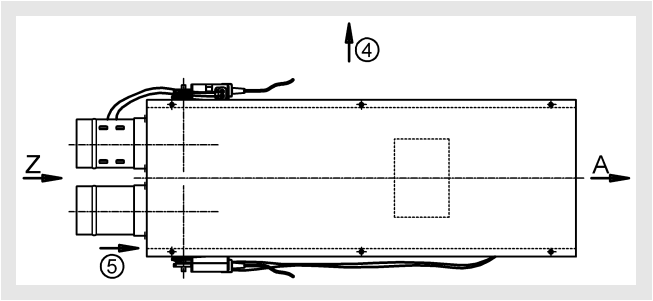
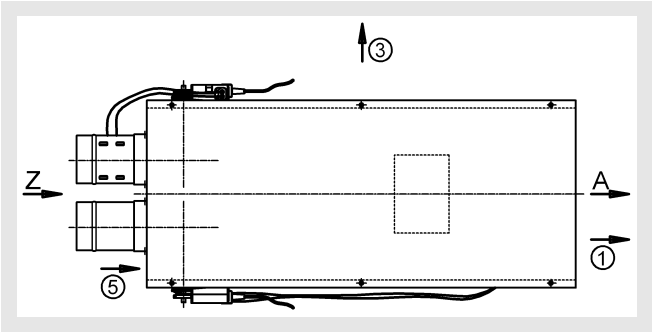
Sound values

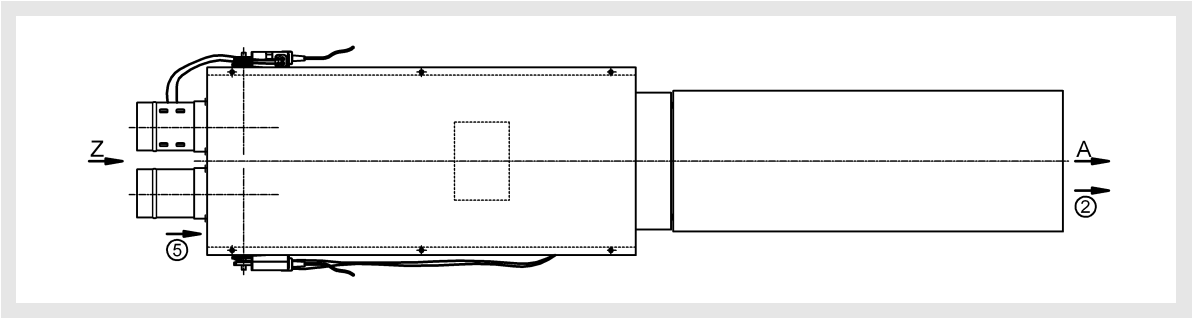
MBE / MBP, without acoustic cladding



MBE / MBP - DS, with acoustic cladding (-DS)



MBE / MBP-ZS, with additional silencer (-ZS)



Insertion loss MBE / MBP

	NW	D_e (dB/oct)						
		f_m (Hz)						
		125	250	500	1000	2000	4000	8000
without additional silencer	100	17	24	34	38	36	28	21
	125							
	160							
	200	22	28	40	41	40	34	28
	250							
	315							
	400							
with additional silencer	100	23	30	43	44	42	33	27
	125							
	160							
	200	29	33	48	49	47	42	35
	250							
	315							
	400							

Insertion loss as the difference of the sound power levels measured with and without the mixing box.

Z	Supply air
A	Return air
1	Supply air flow generated noise without silencer
2	Supply air flow generated noise with silencer
3	Radiated noise of supply air without acoustic cladding
4	Radiated noise of supply air with acoustic cladding
5	Flow generated noise in round duct for supply air

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Flow generated noise

with / without additional silencer (-ZS)

NW	v_k (m/s)	V (m^3/h)	V [l/s]	Static pressure difference 250 Pa L_{WA} [dB(A)]		500 Pa L_{WA} [dB(A)]		1000 Pa L_{WA} [dB(A)]	
				without additional silencer	**with** additional silencer	**without** additional silencer	**with** additional silencer	**without** additional silencer	**with** additional silencer
100	3	80	22	26	19	30	23	34	27
	6	160	44	29	22	33	26	37	30
	9	239	66	32	24	36	28	40	32
	12	319	89	38	30	42	34	46	38
125	3	126	35	32	24	36	28	40	32
	6	253	70	34	26	38	30	42	34
	9	379	105	37	31	41	35	45	39
	12	505	140	41	33	45	37	49	41
160	3	209	58	34	27	38	31	42	35
	6	418	116	38	30	42	34	46	38
	9	627	174	42	34	46	38	50	42
	12	836	232	44	36	48	40	52	44
200	3	329	91	35	26	39	30	43	34
	6	658	183	38	29	42	33	46	37
	9	988	274	43	34	47	38	51	42
	12	1317	366	47	38	51	42	55	46
250	3	517	144	36	26	40	30	44	34
	6	1035	288	39	29	43	33	47	37
	9	1552	431	44	33	48	37	52	41
	12	2070	575	49	38	53	42	57	46
315	3	826	229	37	26	41	30	45	34
	6	1651	459	40	29	44	33	48	37
	9	2477	688	45	34	49	38	53	42
	12	3303	918	50	39	54	43	58	47
400	3	1337	371	39	28	43	32	47	36
	6	2674	743	42	30	46	34	50	38
	9	4011	1114	46	34	50	38	54	42
	12	5348	1486	52	40	56	44	60	48

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Radiated noise

with / without acoustic cladding (-DS)

NW	v_k (m/s)	V (m^3/h)	V [l/s]	Static pressure difference					
				250 Pa		500 Pa		1000 Pa	
				L_{WA} [dB(A)]		L_{WA} [dB(A)]		L_{WA} [dB(A)]	
				without acoustic cladding 40 mm	**with** acoustic cladding 40 mm	**without** acoustic cladding 40 mm	**with** acoustic cladding 40 mm	**without** acoustic cladding 40 mm	**with** acoustic cladding 40 mm
100	3	80	22	35	26	40	31	45	36
	6	160	44	39	30	44	35	49	40
	9	239	66	41	32	46	37	51	42
	12	319	89	43	34	48	39	53	44
125	3	126	35	36	26	41	31	46	36
	6	253	70	40	30	45	35	50	40
	9	379	105	44	34	49	39	54	44
	12	505	140	46	36	51	41	56	46
160	3	209	58	38	30	43	35	48	40
	6	418	116	41	32	46	37	51	42
	9	627	174	45	36	50	41	55	46
	12	836	232	49	39	54	44	59	49
200	3	329	91	38	29	43	34	48	39
	6	658	183	42	33	47	38	52	43
	9	988	274	46	37	51	42	56	47
	12	1317	366	47	39	52	44	57	49
250	3	517	144	39	30	44	35	49	40
	6	1035	288	42	33	47	38	52	43
	9	1552	431	46	37	51	42	56	47
	12	2070	575	48	39	53	44	58	49
315	3	826	229	40	31	45	36	50	41
	6	1651	459	44	35	49	40	54	45
	9	2477	688	47	38	52	43	57	48
	12	3303	918	49	40	54	45	59	50
400	3	1337	371	41	32	46	37	51	42
	6	2674	743	45	36	50	41	55	46
	9	4011	1114	48	39	53	44	58	49
	12	5348	1486	50	41	55	46	60	51

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Technical data of the control components

Measured value collection and control function
The measured value collection is carried out via a flow-favouring double measuring cross. The measuring openings are distributed over the measuring cross according to the median line method. The pressure differential formed on the measuring cross is determined by means of a dynamic or static measuring sensor. The measured values are averaged to give an average value which represents a measuring quantity for the volumetric flow. The controller compares the actual value signal with the setpoint value and sends an output signal to the electric actuator which adjusts the controller deviation independent of pressure changes in the duct network.

The volumetric flow controllers of the Belimo make, types LMV-D3-MP Compact, VRD3-SO and VRP-VFP are delivered by SCHAKO as standard with the operating mode (Y signal, U_5 signal) 2-10 V DC. When activated by 2 V DC, the V_{min} volume is controlled, the smallest possible V_{min} volume that can be controlled can be seen from the "Volumetric Flow Range" tables. **When the air volume drops below the V_{min} shown in the tables, the correct functioning of the volumetric flow controller is no longer guaranteed!**

Positive control damper "CLOSED"
Airtight sealing is achieved on site either via a positive control "CLOSED" by means of a switch or a relay, or via an actuator signal of 0 V DC applied to the input Y (all compact controllers equipped with the operating mode 2-10V DC). Accordingly, the drive will likewise close the flap in operating range 2 - 10 V DC (however, this does not apply to the operating range 0-10 V DC), and the VAV control will be inactive. To do so, it must be ensured that the actuator signal is < 0.1 V DC. This is why in rooms where defined pressures are active (e.g. laboratories), the flap should be closed via a digital on site switching contact.

If the Compact controllers of the Belimo make must be delivered with the operating mode 0-10V DC on customer request, please note that a positive control "CLOSED" can only be effected via a switching contact with diode.

If the compact controllers of the Belimo make are used together with the type VRP-VFP-300 in the master/slave mode or in parallel mode, then only the 2-10 V DC operating mode is usually possible.

Positive control damper "OPEN"
Supports smoke extraction or is used as a safety position. The volumetric flow controller is in this case inactive, and the damper is driven to the mechanical open position. In this case, it is recommended using an actuator with spring return function (e.g. Belimo make, type VRD3, actuator type LF24-V). This ensures that the actuator flap will be driven into the defined "OPEN" end position also via an digital contact or in case of power failure.

V_{min} control to a minimum volumetric flow
Depending on requirement or by not assigning them, individual areas can be set to stand-by operation. In this way, minimum room flushing with greatly reduced energy expenditure is achieved.

V_{max} control to a max. volumetric flow
Individual or several rooms are supplied for a short period with a maximum volumetric flow. This allows, for example, a room through-ventilation or efficient heating to be effected.

Continuous operation
As a function of the continuous driving signal and the programmed operating range (0-10 V DC or 2-10 V DC), the volumetric flow controller will regulate the volumetric flow linearly between the setpoint values of V_{min} and V_{max}.

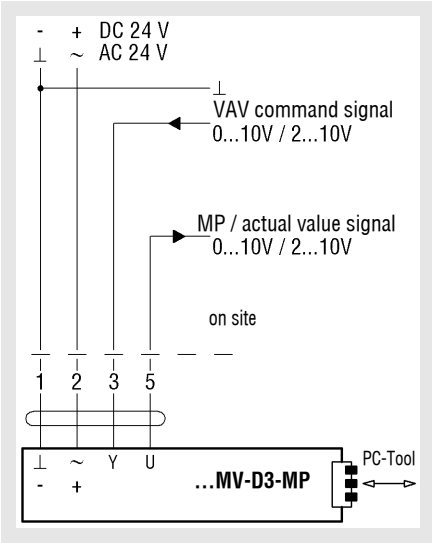
Constant operation
If terminal 3 (Y driving signal) has not been assigned, the air volume set on the V_{min} potentiometer will be set to a constant volume.

Mixing Box Model MBE / MBP

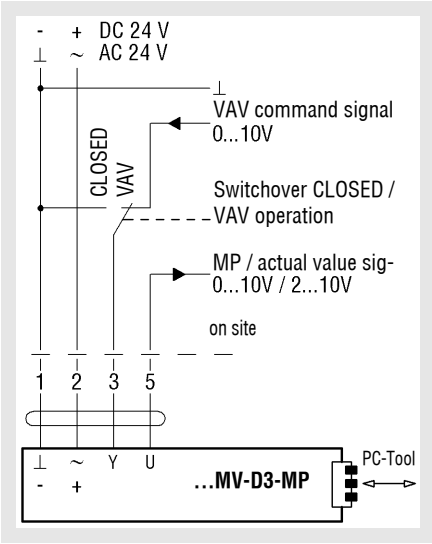
Circuit diagrams

Circuit diagram standard controller
Compact controller Belimo make LMV-D3-MP

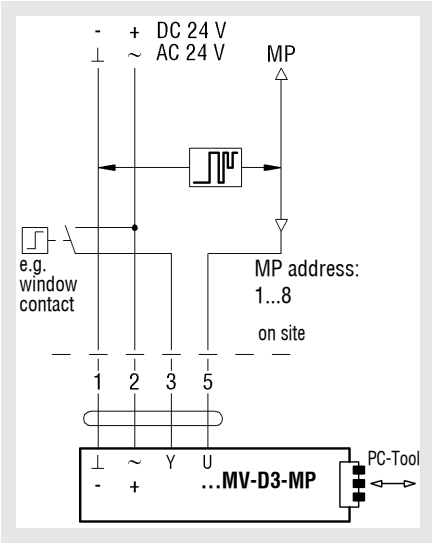
VAV with analogue command signal



VAV with lock (CLOSED) Mode 2-10V DC



MP bus activation with integrated switch



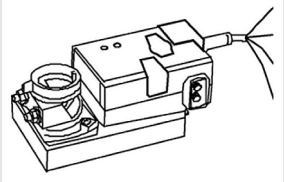
Lock mode (CLOSED)

In the 2 - 10 V mode, the following function can be carried with a 0 - 10 V signal:

Command signal Y	Volumetric flow	Function
< 0.1 V **	0	Damper CLOSED, VAV control inactive
0.2...2 V	V_{min}	V_{min} operating stage active
2...10 V	V_{min} ... V_{max}	Continuous operation V_{min} ... V_{max}

**Attention: Controller/DDC must be able to pull the command signal to 0 V.

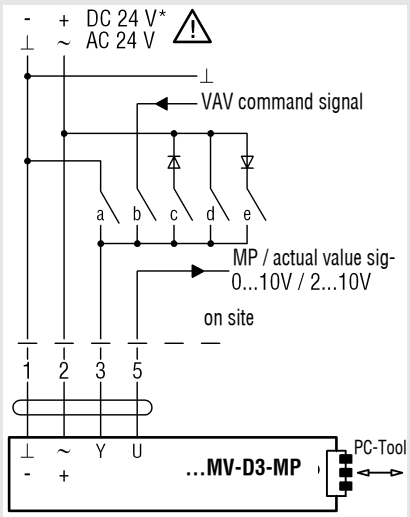
Cable designations



No.	Designation	Wire colour	Function
1	- ⊥	black	⊥ - } Feed AC/DC 24 V
2	+ ~	red	~ + } Feed AC/DC 24 V
3	Y	white	VAV / CAV command signal
5	U	orange	- Actual value signal - MP bus connection

Mixing Box Model MBE / MBP

CAV operation / positive contacts



Note: Please ensure mutual locking of the contacts!

CAV function for MV-D3-MP

Mode setting	---	0...10 V	0...10 V	0...10 V	0...10 V
	2...10 V	2...10 V	2...10 V	2...10 V	2...10 V
Signal	⊥ -	0...10 V 2...10 V	~	~ +	~
	3	3	3	3	3
Function					
Damper CLOSED	**a) CLOSED**		**c) CLOSED***		
V_{min}...V_{max}		**b) VAV**			
CAV - V_{min}	**everything open - V_{min} active**				
Damper OPEN					**e) OPEN***
CAV - V_{max}				**d) V_{max}**	

Contact closed, function active

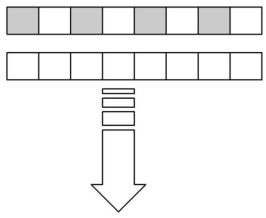
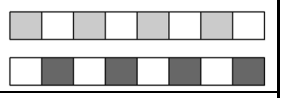
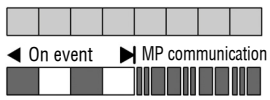
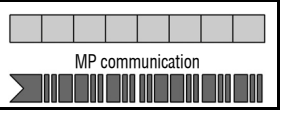
Contact closed, function active, in mode 2 ...10 V only

Contact open

* not available for DC 24 V supply

Mixing Box Model MBE / MBP

LED table of functions for LMV-D3-MP

Application	Function	Description / action	LED pattern Adaptation ⊕ LED 1 power Address ⊕ LED 2 status
N1 operation	Status display	- 24V power supply o.k. - VAV-Compact ready for operation	
S1 service function	Synchronisation	Synchronisation started by: a) Operating / service unit b) Manual trigger device at the VAV-Compact c) Power ON behaviour	
S2 service function	Adaptation	Adaptation started by: a) Operating / service unit b) Key on the VAV-Compact	
V1 VAV service	VAV service active	a) Press both keys «Adaptation» & «Address» simultaneously b) VAV service will be activated: - until 24V supply is switched off - until both keys are pressed again - after 2 hours have passed	
	Lack of air	Damper opens as actual volume is too low	
	Target volume reached	Control circuit balanced	
	Air excess	Damper closes as actual volume is too high	
B1 bus operation	Addressing via MP master (Acknowledgement at the VAV-Compact)	a) Addressing has been triggered at the MP master	
		b) Press addressing key LED will switch to the communication display as soon as the addressing process is complete.	
B2 bus operation	Addressing via MP master (with serial number)	Addressing at the MP master was triggered, LED will switch to the communication display as soon as the addressing process is complete.	
B3 bus operation communication	MP-PP display Communication	Communication display via MP master or operating / service unit	

green LED (power) is lit

yellow LED (status) is lit

yellow LED (status) is flashing

1.) Synch time

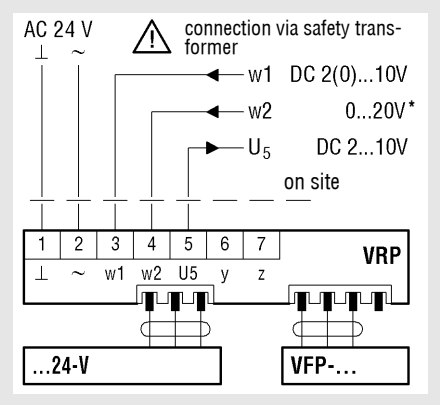
2.) Adaptation time

Mixing Box Model MBE / MBP

Wiring diagram of alternative controller

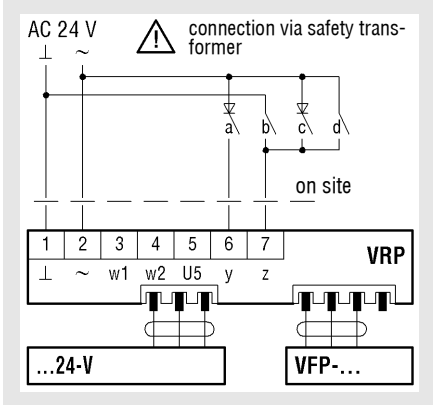
Universal controller Belimo make VRP-VFP300

Connection diagram VRP



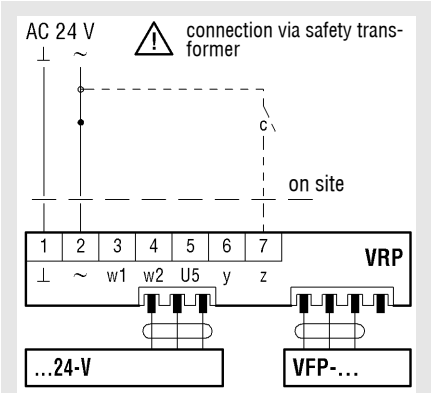
* Phase crossover

Positive control VRP



Function	a	b	c	d
CLOSED				
V_{min}				
V_{max}				
OPEN				

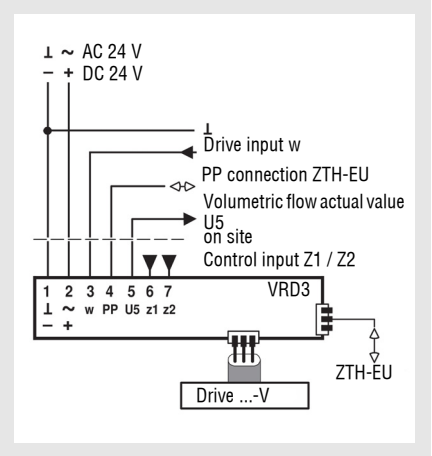
Two-stage volumetric flow rate control VRP



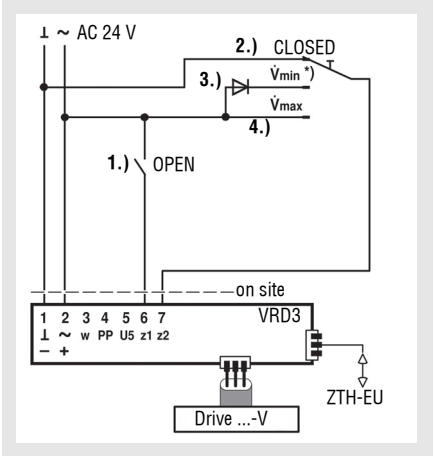
Function	a	b	c
V_{min}			
V_{max}			
V_{max}			
V_{max}			

Universal controller Belimo make VRD3-SO

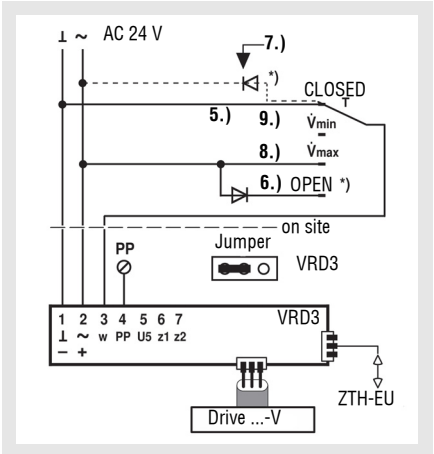
Connection diagram VRD3-SO



Positive control VRD3-SO



Two-stage volumetric flow rate control VRD3-SO



Overview control signals / functions

Signal terminal / Function	Priority	GND	pos HW	neg HW	24 VAC	open
Forced contact Z1 - Terminal 6	1	-	OPEN **1.)**	-	OPEN **1.)**	-
Forced contact Z2 - Terminal 7	2	CLOSED **2.)**	V_{min} **3.)**	-	V_{max} **4.)**	-
Tool (PP-Cmd) -> ZTH-EU	3	CAV stages (Auto, OPEN, CLOSED, V_{min}, V_{max}, Stop)				
Command signal w - Terminal 3 Jumper: VRD3	4	CLOSED **5.)** Mode: 2 ... 10 V	OPEN **6.)**	CLOSED **7.)** Mode: 0 ... 10 V	V_{max} **8.)**	V_{min} **9.)**

*) requires AC 24 V power supply

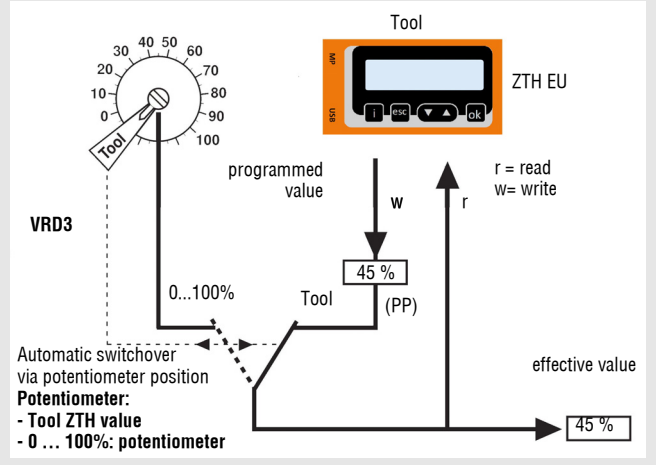
Mixing Box Model MBE / MBP

Setting V_{min} and V_{max}

The V_{min} and V_{max} operating volumetric flow settings can be made at the VRD3 in one of two ways.

a) directly on the setting potentiometer (as with the VRD2)
   V_{min} 0 … 100 % of V_{nenn}
   V_{max} 30 … 100 % of V_{nenn}
b) by means of the VAV setting device ZTH EU (PP Command)

To write a value to the VRD3 by PP Command, both V_{min} und V_{max} potentiometers must be in the Tool position. When the potentiometer(s) are set to «Tool», with the ZTH EU connected, it may be necessary to refresh the menu by pressing the ▼▲ keys. The function can be seen from the following figure:



The V_{max} value must always be set higher than the V_{min}; otherwise the VRD3 controller will run in the CAV mode with the V_{min} volume as setpoint.

Mixing Box Model MBE / MBP

Setting the operating potentiometers / calculation formulae

Set value for V_{max}

$$EW_{V_{max}} = \frac{V_{max}}{V_{nenn}} \times 100\%$$

The required volumetric flow that is to flow at the 10 V DC command signal at terminal 3 (w/Y) or with positive control V_{max} is set in % at the V_{max} potentiometer of the controller, the ZTH-EU device or PC-Tool. This value refers to the set $\mathbf{V_{nenn}}$ nominal volumetric flow.

Set value for V_{min}

$$EW_{V_{min}} = \frac{V_{min}}{V_{nenn} \text{ oder } V_{max}} \times 100\%$$

The required volumetric flow that is to flow at the 0 V DC command signal (operating mode 0-10 V DC) or at the 2 V DC command signal (operating mode 2 - 10 V DC) at terminal 3 (wY) or with positive control V_{min} is set in % at the V_{min} potentiometer of the controller, the ZTH-EU device or PC-Tool. This value refers to the set V_{nenn} or V_{max} volumetric flow (depending on controller type).

Information regarding the set value V_{min}

In the following controllers, V_{min} refers to V_{max}:

Make	Type
Belimo	VRP-VFP

in the following controllers, V_{min} refers to V_{nenn}:

Make	Type
Belimo	LMV-D3-MP, VRD3

Calculation of the U_5 voltage value

Operating mode: 2 - 10 V DC:

$$U_5 = \frac{V_{max}}{V_{nenn}} \times 8V + 2V$$ V_{max} values

$$U_5 = \frac{V_{min}}{V_{nenn}} \times 8V + 2V$$ V_{min} values

Operating mode: 0 - 10 V DC:

$$U_5 = \frac{V_{max}}{V_{nenn}} \times 10V$$ V_{max} values

$$U_5 = \frac{V_{min}}{V_{nenn}} \times 10V$$ V_{min} values

Calculation of the V_{nenn} volumetric flow

$$V_{nenn} = EK \times F \times 3600$$

Attention:
The V_{nenn} value changes as a function of the set calibration curve.

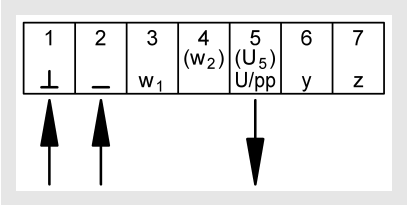
EW (%) = Set value
EK (m/s) = Calibration curve
U_5 (V DC) = U_5 signal
F (m^2) = Area

Depending on the required V_{max} volumetric flow, the calibration curve will be selected specifically by Schako during programming. This guarantees maximum accuracy of the actual value of the volumetric flow.

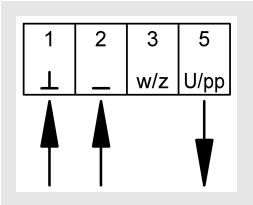
Mixing Box Model MBE / MBP

Actual value measurement via feedback signal U_5 using a voltmeter or PC-Tool

Terminal assignment
VRD3-SO / VRP-VFP



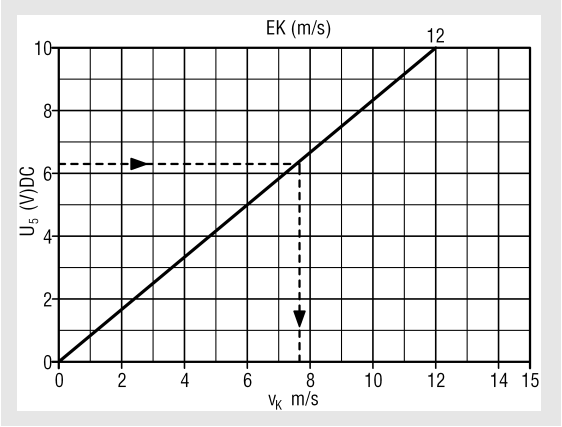
LMV-D3-MP



Supply voltage: 24 V AC/DC (terminals 1+2)
Measurement output 2 - 10 V DC (terminals 1+5)
Measurement output 0 - 10 V DC (terminals 1+5)

The actual value signal U_5 is a real feedback of the volumetric flow actual value for monitoring and controlling the air throughput volume.

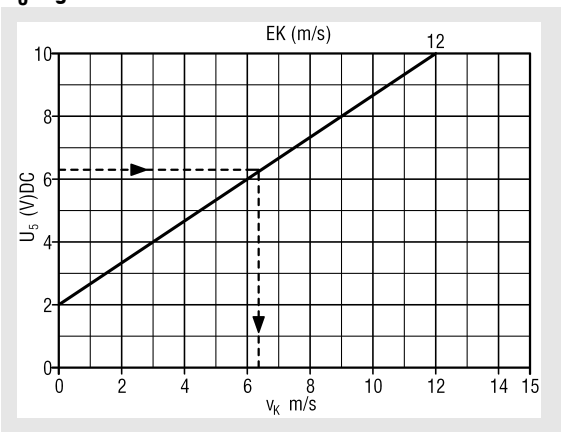
U_5 signal 0-10 V DC



Example

Assume:	Measurement output signal U_5 = 6.3 V DC Calibration value VRA-E = 12 m/sec
Measured value:	Duct velocity = 7.6 m/s
Air volume:	Duct velocity x area m² x 3600 = m³/h

U_5 signal 2-10 V DC



Example

Assume:	Measurement output signal U_5 = 6.3 V DC Calibration value VRA-E = 12 m/sec
Measured value:	Duct velocity = 6.3 m/s
Air volume:	Duct velocity x area m² x 3600 = m³/h

Mixing Box Model MBE / MBP

Technical data of controllers and motors

Controller standard

LMV-D3-MP (make Belimo)
Dynamic pressure sensor, digital VAV controller and damper drive as communication-capable VAV-Compact solution

Measuring principle:	Pressure reading with through-flow
Measuring range of the sensor :	2... ~ 450 Pa
Supply voltage:	AC 24 V 50/60 Hz; DC 24 V
Functional range:	AC 19.2...28.8 V; DC 21.6...28.8V
Power consumption:	2 W
Dimensioning:	3.5 VA
Torque:	min. 5 Nm at the rated voltage
Control function :	VAV/CAV/Open-Loop; Supply/return air or stand-alone operation; master/slave parallel circuit; Mixing box control
Setting range V_{min}/V_{max} :	V_{min} = 0...100 % of set V_{nenn} volumetric flow V_{max} = 20...100 % of set V_{nenn} volumetric flow
Command variable w/Y: (Input resistance min. 100 kΩ)	DC 2-10 V (4...20 mA with 500 Ω input resistance) DC 0-10 V (0...20 mA with 500 Ω input resistance) adjustable DC 0...10 V
Setting range actual value signal U_5 :	DC 2...10 V DC 0...10V
MP bus function	
Address in bus mode:	MP 1 ... 8 (traditional operation: PP)
LONWORKS® / Konnex EIB:	with BELIMO interface UK24LON / UK24EIB, 1 ... 8 BELIMO MP devices (VAV / flap drive/ valve)
DDC controller:	DDC controller / PLC from different manufacturers, with integrated MP interface
Fan Optimiser:	with BELIMO Optimiser COU24-A-MP
Sensor connection:	Passive (Pt1000, Ni1000, etc.) and active sensors (0...10 V), for example temperature, humidity, 2-point signal (switching power 16 mA @ 24 V), for example switch, presence detector
Protection class:	III (safety extra low voltage)
Protection type:	IP 54 (hose-connected)
EMC:	CE according to 39/336/EEC
Measuring air and ambient temperatures :	0° C...+50° C, 5...95% rH, non-condensing
Storage temperature:	-20° C...+80° C
Sound power level:	max. 35 dB (A)
Operation and service:	plug-in via service socket / PC-Tool (from V3.1) / ZTH-EU
Communication:	PP/MP bus, max. DC 15V, 1200 baud
Connection :	Cable, 4 x 0.75mm², terminals
Weight:	approx. 500 g

Controller alternatively

VRP-VFP (make Belimo)
For static differential pressure control with separately available sensors VFP-100, 300 or 600

Measuring principle:	Pressure measurement with metal membrane
Measuring range of the sensor :	0...100 Pa, 0...300 Pa or 0...600 Pa
Supply voltage:	AC 24 V 50/60 Hz;
Power consumption:	1.3 W (incl. sensor VFP-..., without actuator)
Dimensioning:	2.6 VA (incl. sensor VFP-..., without actuator)
Command variable w:	-
Command variable w1:	DC 2-10 V (input resistance 100 kΩ)
Command variable w2:	0-20 V phase crossover (input resistance 8 kΩ)
Operating range:	DC 2-10 V
Volumetric flow:	DC 2-10 V
Actual value signal U_5:	-
Torque:	-
Sound power level:	-

VRD3-SO (make Belimo)
with integrated dynamic differential pressure sensor

Measuring principle:	Pressure reading with through-flow
Measuring range of the sensor :	2... ~ 300 Pa
Supply voltage:	AC 24 V 50/60 Hz; DC 24 V
Power consumption:	2 W
Dimensioning:	3.5 VA (without damper drive)
Command variable w:	-
Command variable w1:	DC 0-10 V (input resistance 100 kΩ)
Command variable w2:	-
Operating range:	DC 2-10 V (0-10V switch over via ZEV)
Volumetric flow:	DC 0-10 V (for operating mode 0-10)
Actual value signal U_5:	DC 2-10 V (for operating mode 2-10)
Torque:	-
Sound power level:	-

Mixing Box Model MBE / MBP

Damper drives...24-
for VRP-VFP, VRD3-SO, VRP-STP, VRP-M

NM24A-V

Supply voltage:	AC 24V 50/50 Hz / DC 24V of VR..., ready to plug in
Power consumption/ Dimensioning:	3.5 W / 5.5 VA
Actuator signal:	DC 6.0 V± 4V (of VR...)
Torque at the rated voltage:	Min. 10 Nm
Running time for 90° (or 95°):	150 s.
Protection type:	IP 54
Protection class:	III (safety extra low voltage)
Sound power level:	max. 35 dB (A)

SM 24A-V

Supply voltage:	AC 24V 50/50 Hz / DC 24V of VR..., ready to plug in
Power consumption/ Dimensioning:	4 W / 6 VA
Actuator signal:	DC 6.0 V± 4V (of VR...)
Torque at the rated voltage:	20 Nm
Running time for 90° (or 95°):	150 s.
Protection type:	IP 54
Protection class:	III (safety extra low voltage)
Sound power level:	max. 45 dB (A)

LF24-V

Supply voltage:	AC 24V 50/50 Hz / DC 24V of VR..., ready to plug in
Power consumption/ Dimensioning:	6 W / 10 VA
Actuator signal:	DC 6.0 V± 4V (of VR...)
Torque at the rated voltage:	Min. 15 Nm
Running time for 90° (or 95°):	Drive 150 s, spring return =16 s
Protection type:	IP 54
Protection class:	III (safety extra low voltage)
Sound power level:	Drive max. 45 dB(A) / Spring max. 62 dB(A)

Mixing Box Model MBE / MBP

Functional check

VRD3-SO, VRP-VFP functional check
Electric connection :
Apply supply voltage 24 V AC (±10%) to terminals 1 + 2.
Is the polarity of the system neutral conductor correct?

⇒ **No:** Check the wiring according to the diagram. Check transformer power.
→ Example: VRD3-SO (2.9 VA), VRP-VFP (2.6 VA), NM24-V (4.0 VA)

⇒ **Yes: VR.. / drive ...24-V**

⇓

VR.. / drive ...24-V:
Connect terminals 1+7. Does the drive move to the "CLOSED" position?

⇒ **No:** Check the direction of rotation switch of the drive.
→ Switch on drive is marked L/R or A/B.

⇒ **Yes: V_{max}**

⇓

V_{max}:
Connect terminals 2+7. Does VR.. control to V_{max}?

⇒ **No:** Check and compare the setting of the V_{max} potentiometer with the technical data on the VAV machine.
→ If the drive moves to the "OPEN" position, and the maximum volume is not reached, then the duct pressure is too low.

⇒ **Yes: V_{min}**

⇓

V_{min} :
Interrupt the terminal 3 and/or 4 command variable. Does VR.. control to V_{min}?

⇒ **No:** Check and compare the setting of the V_{min} potentiometer with the technical data on the VAV machine.

⇒ **Yes:** If required, restore interrupted connections (terminals 3+4).

Functional check during startup and service
If required, easily accessible setting potentiometers and connections allow set values and the correct operation of the mixing box to be reliably and quickly checked on site.

LMV-D3-MP: Functional check
Electrical connection
Apply supply voltage 24 V AC (±10%) to terminals 1 + 2.
Is the polarity of system neutral conductor correct?

⇒ **No:** Check the wiring according to the diagram. Check transformer power.
→ LMV-D3-MP 5 VA

⇒ **Yes: LMV-D3-MP / ZTH-EU**

⇓

LMV-D3-MP / ZTH-EU :
Has the LMV-D3-MP been set to the correct operating mode? (Check using the connected ZTH-EU!)

⇒ **No:** Set operating mode on the selector switch of the ZTH-EU and save it in the LMV-D3-MP by pressing the Set key.
→ Operating modes: 0-10 V, 2-10 V

⇒ **Yes: Drive**

⇓

Drive:
Use the ZTH-EU to set operating mode 2-10 V and connect terminals 1+3 of the LMV-D3-MP.
Does the drive move to the "CLOSED" position?

⇒ **No:** Contact VRA manufacturer.

⇒ **Yes: V_{max}**

⇓

V_{max}:
Connect terminals 2+3 of the LMV-D3-MP and disconnect U_5 connection to the ZTH-EU.
If the LMV-D3-MP controls to V_{max} - Check actual value signal U_5.

⇒ **No:** Check the V_{max} potentiometer on the ZTH-EU and compare the settings with the technical data on the VAV device.
→ If the drive moves to the "OPEN" position, and the maximum volume is not reached, then the duct pressure is too low.

⇒ **Yes:** Set system-specific operating mode using the ZTH-EU.

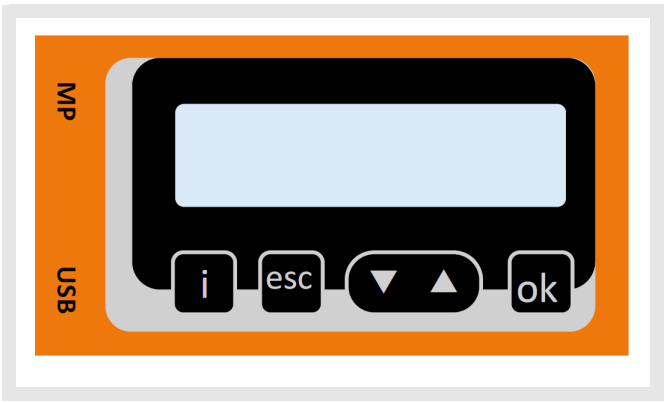
Functional check during startup and service
If required, easily accessible setting potentiometers and connections allow set values and the correct operation of the mixing box to be reliably and quickly checked on site.

Mixing Box Model MBE / MBP

Startup using PC-Tool

Direct connection in the switch cabinet or socket (traditional application)

ZTH EU as MP level converter



Description

The ZTH EU is also a potential-free interface between the USB port of a PC and the Belimo MP bus. It is used to connect the Belimo PC-Tool directly to the MP bus or directly to a programmable MFT drive.

Power supply

The ZTH EU is supplied with power by the USB port. The MP bus voltage is obtained internally by means of DC/DC converter. This is why no external power supply is necessary.

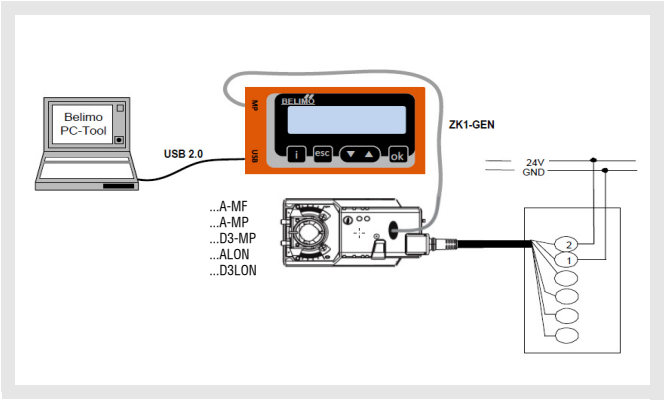
Driver

To be able to work with the ZTH EU, a suitable driver must be installed on the PC. The driver can be downloaded from the Belimo website (download section). After installation of the driver, the ZTH EU device will log in to the PC as a virtual COM interface.

Note

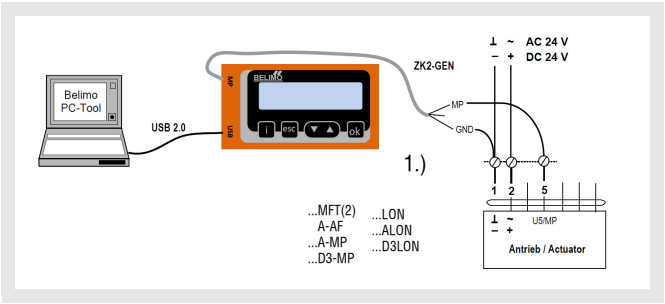
For connection to USB ports of PCs and BELIMO 24 V drives only (to safety extra low voltage SELV or US class 2 feeds).

Connection diagram 1



Local connection via a service socket of the MF/MP or LON drive using a ZK1-GEN cable.

Connection diagram 2



Local connection via a connecting cable of the MF/MP or LON drive using a ZK2-GEN cable.

1.) white = GND
green = MP
blue = not connected

Mixing Box Model MBE / MBP

Startup using the setting and diagnostic device ZTH EU (Belimo)

Short description
The VAV setting device ZTH EU allows efficient testing of VAV and CAV installations. Installations fitted with the Belimo VAV controller can be simply adapted to the room and user requirements.
The VAV setting device ZTH EU replaces the previous setting device ZTH-GEN (2007-2014).
All standard Belimo VAV controllers with integrated PP communication (from 1992) that are sold in the EU can be set using the ZTH EU.

Specifications:
easy, quick setting of the VAV boxes parameters
diagnostic function
one tool for all VAV units
voltage supplied by VAV controllers - no batteries required!
service socket VAV / CR24 controller, PP connection
includes connecting cable RJ12 6/4, 6-pin plug
New generation, MP bus tester
for functional test of MP bus
backward compatible with all Belimo PP / MP units from 1992
efficient handling, can be operated with one hand
Selection of stages for test (OPEN/CLOSE/MIN/MAX/STOP)
Damper position indicator for diagnostics
Display of the setpoint / actual volume and $V_{min/max}$ setting in m³/s (l/s).

Keys / Display:

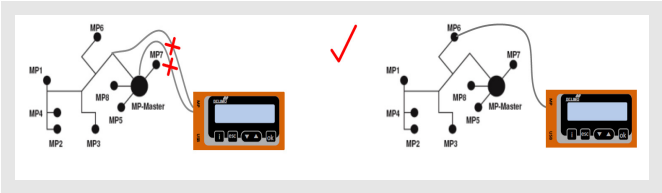
2 x 16-digit LCD with background lighting

▼▲	Forwards / Backwards Change value / status
OK	Confirm input
ESC	Cancel input/ Leave submenu/ Discard changes
i	shows additional information if available

Connection:
Locally via service socket

Dimensions:
85x65x23 (WxHxD)

Connection and supply
Stand-alone operation:
Connection including supply takes place via the service socket at the VAV controller or via the terminals.
Bus operation:
The ZTH EU can be used in the following units while the bus is running if it is connected via the local service socket: VAV-Compact L/N/SMV-D3-MP, NMVAX-D3-MP, L/NMV-D3LON.
With the VRP-M, L/NMV-D3-M and NMVAX-D3-MP, the MP-Bus must be disconnected when the service socket is used.



Restriction:
Direct connection in an MP network or via an MP-Bus master is not possible.

The ZTH EU comes with a quick start guide de/en to be affixed to the back of the unit.

Mixing Box Model MBE / MBP

Smartphone - Belimo Assistant App

The NFC antenna area of the VAV Compact is located between the Belimo or OEM logo and the NFC label.
Align NFC-capable android smartphone with loaded Assistant app on the VAV-Compact such that the two antennae are above one another.

The Belimo Assistant app can be downloaded from the Google Play Store.

NFC-capable devices:

- LMV-D3-MP, NMV-D3-MP, SMV-D3-MP and LHV-D3-MP with printed NFC label.

Non-NFC-capable devices:

- All devices without NFC label
- LMV-D3-MF
- LMV-D3LON and NMV-D3LON

Controller selection

Electric controller:	Actuator:
- 2x Belimo :	
- LMV-D3-MP	Compact (Standard)
- VRD3-SO	2x NM24A-V
- VRD3-SO	2x LF24-V
- VRP/VFP	2x NM24A-V
- VRP/VFP	2x LF24-V
The selection of each actuator (torque) depends on the housing dimensions.	

Pneumatic controllers:	Servo cylinder:
- 1x Sauter :	
- RLP100 F916	1x AK 31 P2 F001 and 1x AK 31 P3 F001
- RLP100 F918	2x AK 31 P1 F001

Accessories:
S1A/S2A, limit switch make Belimo, to fit all new compact controllers and actuators of make Belimo.
integrated potentiometer Belimo P1000 A
ZTH-EU for Belimo ...MV-D3-MP / PC-Tool for Belimo ...MV-D3-MP

Maintenance and service

Assembly and maintenance instructions

1. When the device is delivered, check whether the controllers are complete and delivered without damage. Complaints have to be communicated immediately and directly to the transporter and SCHAKO.
2. The mixing boxes must not be fastened to the regulation components, measuring crosses or the control dampers, but only to the housing.
3. The units must be carefully stored on site. They must be protected from dust, dirt and from direct weather effects.
4. The units must be assembled in a way in to allow inspection, meaning that the maintenance cover in the silencer part is freely accessible.
5. Assembly must be carried out by expert personnel, observing recognised technical rules and regulations.
6. **For polluted air, the mixing boxes must be used with an integrated controller with static membrane pressure sensors. In this case, it is imperative to observe the notice sign regarding the mounting position. The mixing boxes are not suitable for air with greasy and sticky components.**

Zero adjustment of the static pressure sensors VFP-…
The pressure probe is based on a static pressure meter. Great care must be taken to ensure correct transport and correct assembly. The mixing box has been adjusted in-factory by the OEM manufacturer according to their mounting position. If the controllers are installed in a different position, the sensors can be adjusted as follows.

1. Sensor VFP-... must be installed.
2. Connect VFP-... to VRP and supply VRP with 24 V AC mains voltage.
3. Remove lid from VFP... .
4. Move damper to the "OPEN" position.
5. Pull damper drive plug from the VRP.
6. Remove the pressure hoses from the connection pipes. **Attention!** Make a note of the (+) and (-) assignments.
7. The membrane position is considered balanced when both LEDs are dark (OFF). If the meter position is not balanced, one of the two LEDs will light up, and the position must be adjusted on the potentiometer in the VFP-...
8. Slowly turn the zero point adjustment of the potentiometer (non-painted potentiometer), until both LEDs are dark (OFF).
9. Assemble lid of VFP....
10. Reconnect pressure pipes as before (+) and (-).
11. Reconnect the plug of the damper drive.

Mixing Box Model MBE / MBP

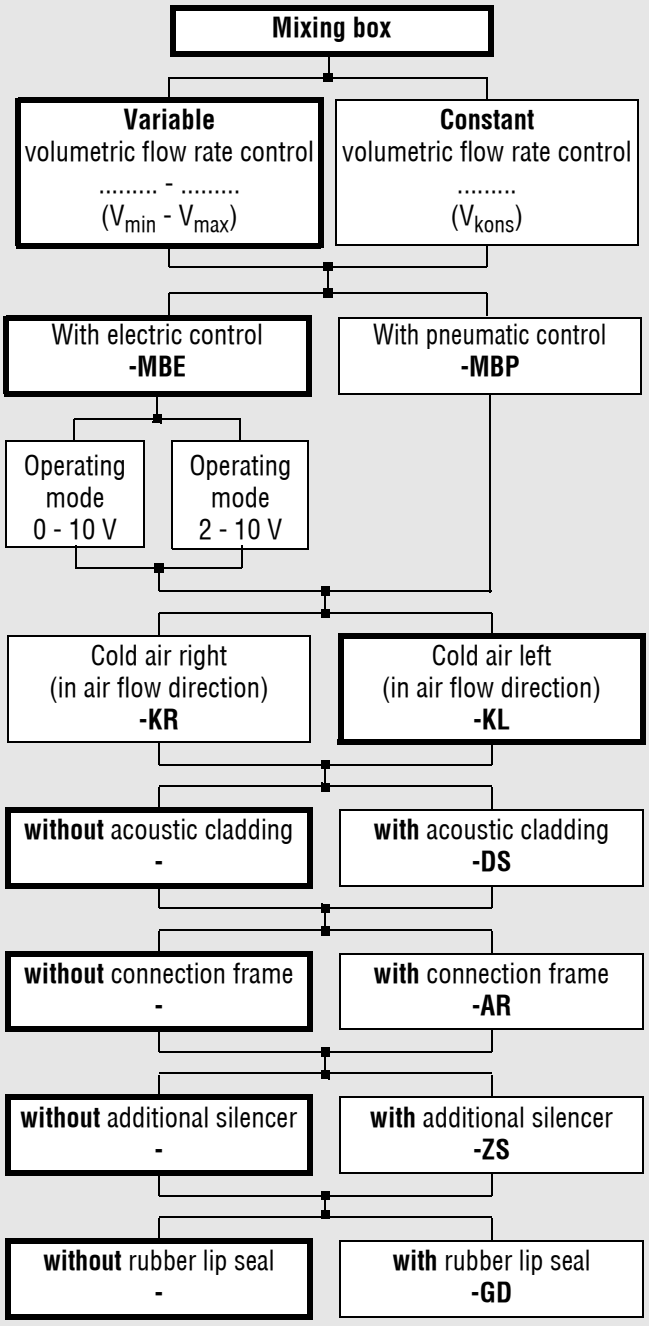
Cleaning of the dynamic differential pressure sensor
The dynamic differential pressure sensor integrated into the **LMV-D3-MP** and **VRD3-SO** requires little maintenance. However, if, depending on the degree of pollution of the air, unexpected volumetric flow deviations occur, then the following procedure is recommended.

1. Pull off the pressure hoses from the sensor connection pipe of the LMV-D3-MP or the VRD3.
   Attention! Make a note of the (+) and (-) assignments.
2. Using a suitable hand pump, blow air into the (-) connection piece of the sensor (this will blow any dirt deposited inside the sensor out of the (+) connection piece).
3. Remove any dirt that may have formed from the connecting pieces and hose ends.
4. Reconnect pressure hoses, (+) and (-) as before.
5. Carry out a functional check of the controller.

Legend

f_m	(Hz)	=	Octave centre frequency
D_e	[dB/Oct]	=	Insertion loss
L_{WA}	[dB(A)]	=	A-weighted sound power level
NW	(mm)	=	Nominal width
U_5	(V) DC	=	Measurement output (electric voltage)
v_K	(m/s)	=	Duct velocity
V	(m^3/h)	=	Air volume
V	[l/s]	=	Air volume
RE	(m/s)	=	Controller calibration value

Order details



Order example:
MBE-V_{min}-V_{max}-KL-200-LMV-D3-MP

Unless stated otherwise, the thick-frame model will be delivered!

Mixing Box Model MBE / MBP

Specification texts

Mixing box for use in twin-duct air-conditioning systems, for spiral duct connection to DIN 24 145 with integrated volumetric flow controller for use in constant and variable volumetric flow, room and duct pressure regulation. With positive control V_{min}, V_{max} or "CLOSED".
Consisting of a housing made of galvanised sheet steel lined with mineral wool, with a guide baffle made of perforated galvanised sheet steel. Housing containing two volumetric flow controllers, consisting of a round connection piece made of galvanised sheet steel with damper leaf made of galvanised sheet steel and silicone-free damper leaf seal for airtight design to DIN EN 1751, Class 2 (NW100 only), Class 3 (NW125 - 400 only), with measuring cross blades made of extruded aluminium profile, blade mount made of plastic (PA6). A special measuring cross allows position-independent mounting.
With electric control, control voltage 24 V AC, 50 / 60 Hz, temperature compensation of 10-40°C, wired and adjusted in-factory.
Product: SCHAKO **type MBE**

- With pneumatic control
  Feed pressure 1.2 ± 0.1 bar
  - Depressurised "CLOSED"
  - Depressurised "OPEN"
  Temperature compensation of 0 - 50° C
  Product: SCHAKO **type MBP**

Model
- Cold air right (-KR), in air flow direction
- Cold air left (-KL) in air flow direction (standard)

Accessories (at an extra charge):
- Acoustic cladding (-DS) for reducing the radiated noise made of insulating material with sheet metal casing made of galvanised sheet steel.
- Galvanised sheet steel connection frame (-AR).
- Additional silencer (-ZS) made of galvanised sheet steel and baffle with mineral wool lining (MWK) and optionally with perforated sheet cover (MLK).
- Rubber lip seal (-GD), made of special rubber.