Pressure-Reducing Box

EBE / EBP

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Pressure-Reducing Box EBE / EBP

Contents

Pressure-reducing box EBE / EBP

Description

The pressure-reducing box type EBE / EBP consists of a **housing with round connection spigot and an integrated silencer unit** for reducing the flow generated noise. The integrated volumetric flow controller allows the volumetric flow in ducts to be kept constant or variable or to be regulated using positive control V_{min}, V_{max} or "CLOSED". The **integrated volumetric flow controller can also be used as a room or duct pressure regulator**. In VAV systems, the integrated volumetric flow controller can **regulate variable volumetric flows between V_{min} and V_{max} as a function of the supply air temperature**.

The volumetric flow setpoints V_{min} and V_{max} can also be altered at the controller at a later stage, even after installation. The actual throughput of the volumetric flow can be measured via the U5 signal. The first **setting of setpoint values is done in-factory** according to the customer's specifications. When these values are set in-factory, the functions of all pressure-reducing boxes are checked. 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/s 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 ex 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, based on 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.

When using the controllers in systems with heavy dust contamination, suitable filters must be connected upstream. For polluted air, the pressure-reducing boxes must be used with an integrated controller with static membrane pressure sensor. In this case, it is absolutely necessary to observe the mounting position. **These regulators are not suitable for air with greasy and sticky components.**

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

Field of application

- for supply and return air systems
- for constant or variable volumetric flows
- Positive control V_{min}, V_{max}, or "CLOSED"
- Suitable for constant and variable volumetric flow or duct pressure control
- Differential pressure range from 50 to 1000 Pa
- for duct velocities of 1 - 12 m/s with EBE or 3 - 12 m/s with EBP
- For temperature compensation:
  - EBE (electric) = from 10 to 40 °C
  - EBP (pneumatic) = from 0 to 50 °C
- for ambient temperatures of 0 - 55 °C
- Control voltage for EBE (electronic):
  24 V AC, -0 % +10 %, 50/60 Hz
- feed pressure for EBP (pneumatic): 1.2 + 0.1 bar
- round design for spiral duct connection according to DIN EN 1506.
- With integrated silencer to reduce flow generated noise
- Additional acoustic cladding to reduce radiated noise available at an extra charge

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Installation

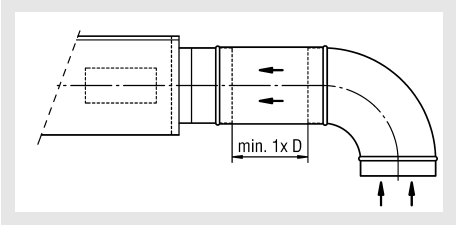
Installation information

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.

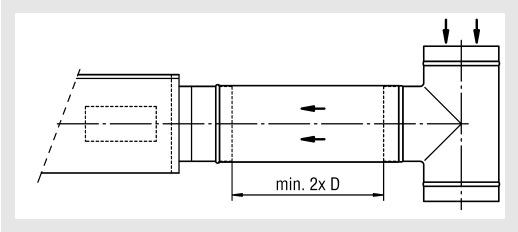
Distance to:

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

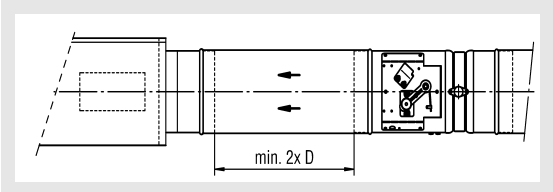
Distance to a bent connection spigot



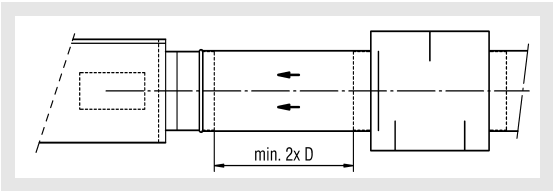
Distance to other connection pieces
(e.g. branching piece, reduction piece, T-junction, etc.)



Distance to a fire damper



Distance to a silencer



Construction

Housing
- Galvanised sheet steel
- Lined with mineral wool, perforated sheet cover.
- Abrasion-resistant up to a duct velocity of 20 m/s
- Housing leakage class B according to DIN EN 1751

Damper blade
- Galvanised sheet steel

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).

Model

EBE	-	With electric control
EBP	-	With pneumatic control
EBE / EBP-Z	-	Supply air
EBE / EBP-A	-	return air
EBE / EBP-...-R	-	right-hand design
EBE / EBP-...-L	-	left-hand design

Accessories

Connection frame (-AR)
- Galvanised sheet steel, for connecting EBE/EBP to additional silencer

Acoustic cladding (-DS)
- Galvanised sheet steel, with mineral wool lining

Rubber lip seal (-GD)
- Special rubber

Heating register (-H1/-H2)
- With 1 or 2 duct rows, external thread connection, operating pressure 8 bar, testing pressure 16 bar, consisting of:
- Galvanised sheet steel frame
- Copper pipes
- Steel collector
- Aluminium blades

Additional silencer (-ZS)
- Galvanised sheet steel with mineral wool lining and perforated cover

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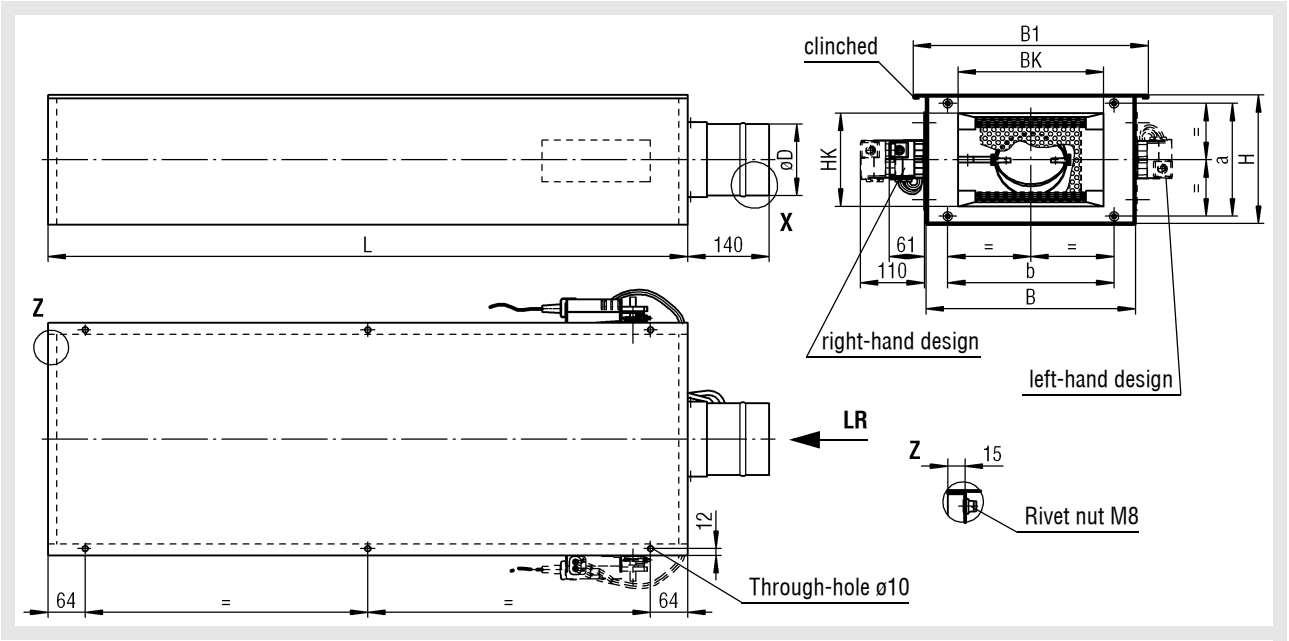
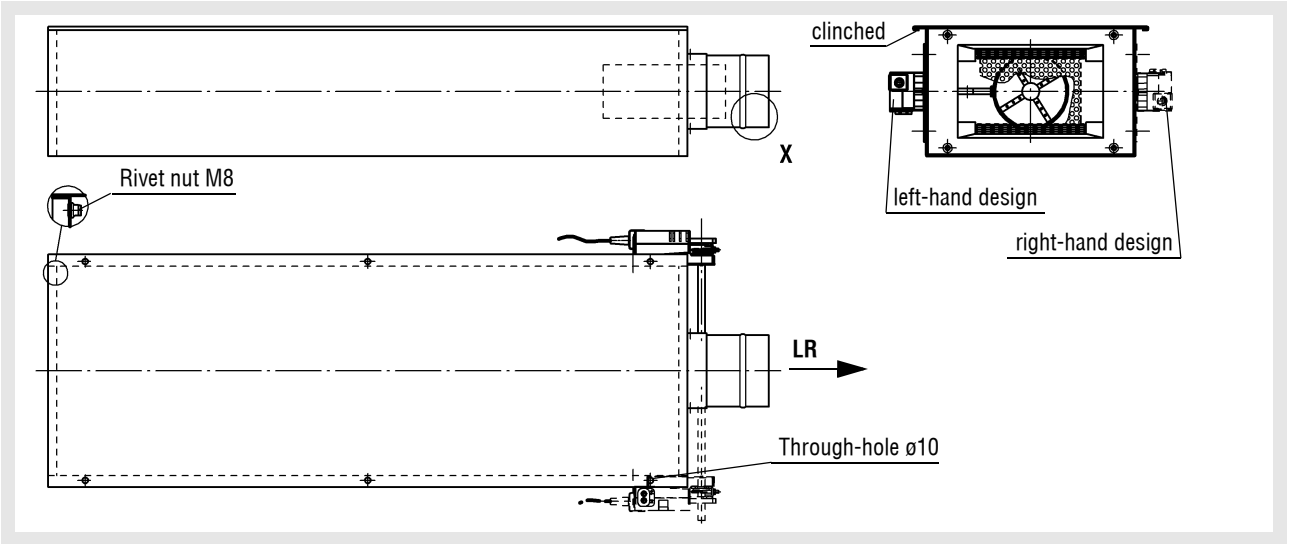
Models and dimensions

Dimensions

EBE / EBP-Z, for supply air



EBE / EBP-A for return air



Available sizes

NW	B	B1	BK	H	HK	L	øD	a	b
100	320	360	210	200	140	1100	98	174	244
125	360	400	250	220	160	1100	123	194	286
160	480	520	370	230	170	1100	158	204	399
200	580	620	470	260	200	1400	198	234	504
250	700	740	590	290	230	1500	248	259	624
315	880	920	770	340	280	1500	313	309	804
400	1000	1040	890	440	385	1835	398	409	924

For size 400, the housing consists of two joined parts.
LR = Air flow direction

Standard controller selection

with electric controller:

Attachment assembly	Controller / Drive	Actuator
-A003	LMV-D3-MP-F1	Compact

The listed Compact controller is compatible with the old generation of type LMV-D2M.

with pneumatic controller:

Attachment assembly	Controller / Drive	Actuator
-A106	RLP100 F003	AK31P1 F001

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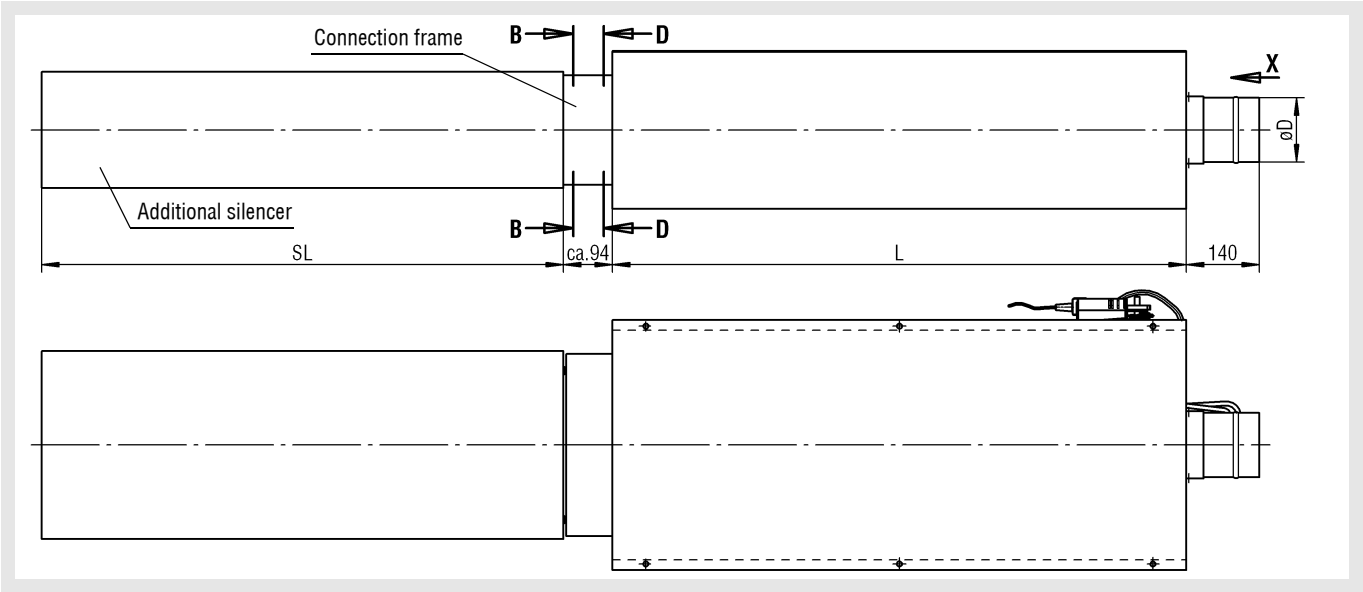
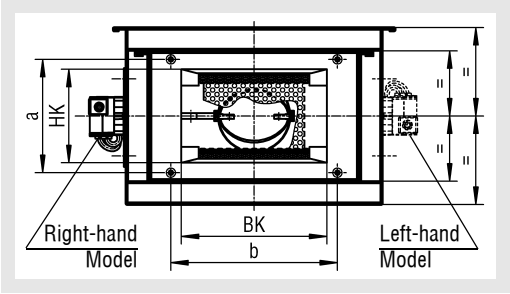
Dimensions of accessories

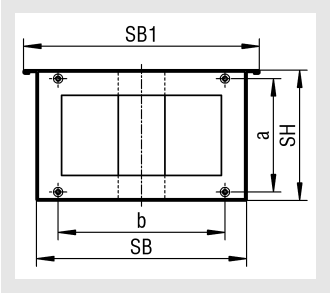
EBE/EBP-DS-ZS, with acoustic cladding and additional silencer



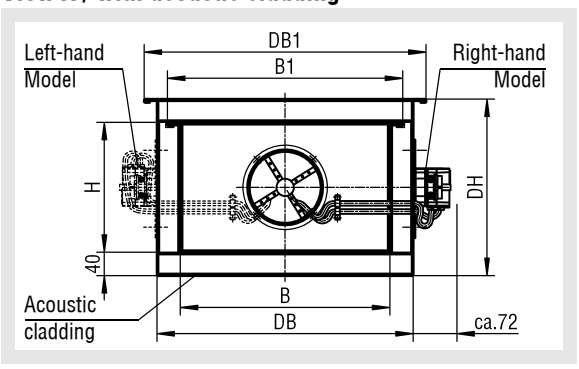
Section B-B / shown without connection frame



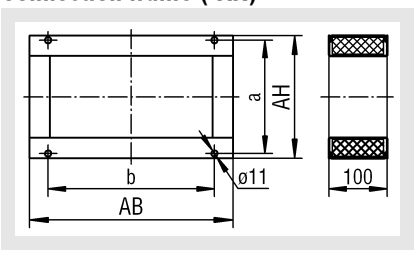
Section D-D / additional silencer (-ZS)



View X / with acoustic cladding



Connection frame (-AR)



Available sizes -DS / -ZS / -AR

NW	B = SB	B1 = SB1	DB	DB1	BK	H = SH	DH	HK	AH	AB	L	SL	øD	a	b
100	320	360	400	440	210	200	280	140	189	310	1100	1000	98	174	244
125	360	400	440	480	250	220	300	160	209	352	1100		123	194	286
160	480	520	560	600	370	230	310	170	219	465	1100		158	204	399
200	580	620	660	700	470	260	340	200	249	570	1400		198	234	504
250	700	740	780	820	590	290	370	230	274	690	1500	1500	248	259	624
315	880	920	960	1000	770	340	420	280	324	870	1500		313	309	804
400	1000	1040	1080	1120	890	440	520	385	424	990	1835		398	409	924

For size 400, the housing consists of two joined parts.

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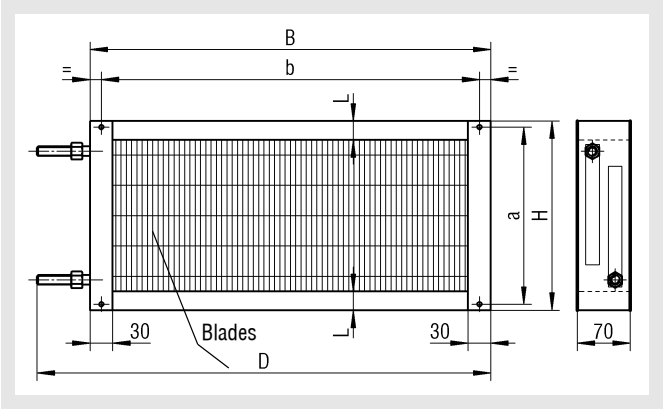
Heating register (-H1/-H2)

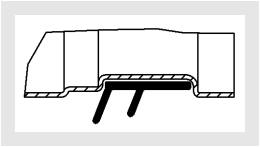


Available sizes of heating register (-H1/-H2)

NW	B	H	D	L	a	b	c
100	270	190	340	20	174	244	1/2“
125	310	211	380	18	194	286	1/2“
160	430	221	500	23	204	399	1/2“
200	530	250	600	25	234	504	1/2“
250	650	281	680	28	259	624	1/2“
315	830	331	860	28	309	804	1/2“
400	950	431	980	28	409	924	1/2“

Rubber lip seal (-GD)

Detail X



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Technical data

Volumetric flow range

EBE, with electric controller

NW (mm)	V	Belimo Compact	Belimo / Siemens / Gruner		Gruner (on request)	
		v_{min} (1 m/s)	v_{min} (2 m/s)	v_{max} (12 m/s)	v_{min} (1 m/s)	v_{max} (12 m/s)
100	m³/h	26	53	319	27	319
	l/s	7	15	89	8	89
125	m³/h	42	84	505	42	505
	l/s	11	23	140	12	140
160	m³/h	69	139	836	70	836
	l/s	19	39	232	19	232
200	m³/h	109	219	1317	110	1317
	l/s	30	61	366	31	366
250	m³/h	172	345	2070	172	2070
	l/s	48	96	575	48	575
315	m³/h	275	550	3303	275	3303
	l/s	76	153	918	76	918
400	m³/h	445	891	5348	446	5348
	l/s	124	248	1486	124	1486

EBP, with pneumatic controller

NW (mm)	V	Sauter RLP	
		v_{min} (3 m/s)	v_{max} (12 m/s)
100	m^3/h	80	319
	l/s	22	89
125	m^3/h	128	505
	l/s	36	140
160	m^3/h	209	836
	l/s	58	232
200	m^3/h	329	1317
	l/s	91	366
250	m^3/h	517	2070
	l/s	144	575
315	m^3/h	826	3303
	l/s	229	918
400	m^3/h	1337	5348
	l/s	371	1486

Information for parameterisation

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 absolutely wants a calibration curve different from 12 m/s, it must be specified! Once it is approved by the competent department, it can be adjusted correspondingly.
- When the air volume drops below the V_{min} shown in the chart, 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 value specification), 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 for the controller make, depending on the calibration curve set ex works.
- The Gruner controller, type 327VM-... Compact can be used with a sensor linearised to an air velocity of 1 m/s.
- 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 height-compensated. They are calibrated ex works to the system height in question of the specified installation site.
- If no system height is given in the order, the controllers will be set to the elevation of the delivery address.
- If the customer does not specify whether the "Parallel" or "Master/Slave" operating mode is desired, the controller is set for the parallel operation (Master/Slave mode only upon customer request).
- for alternative controller types, a V-min of 2 m/s or more can be set (pneumatic controller: 3 m/s or more)

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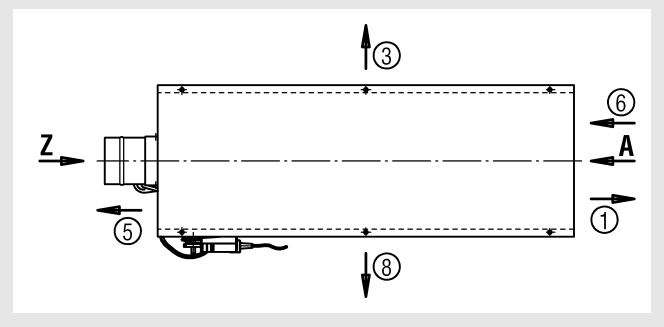
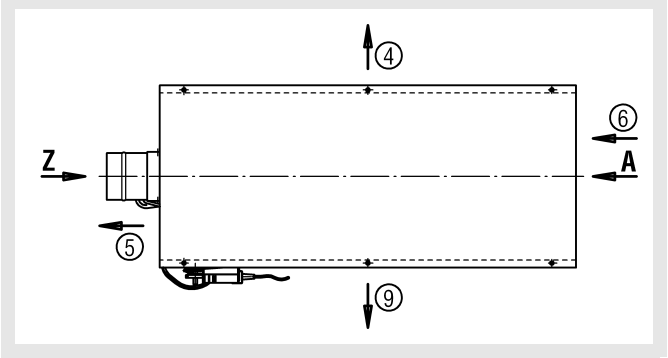
Sound values

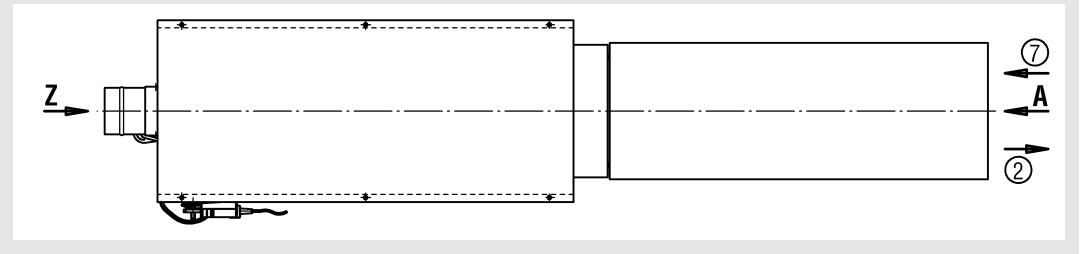
EBE/EBP, without acoustic cladding



EBE/EBP-DS, with acoustic cladding



EBE/EBP-ZS, with additional silencer



Insertion loss EBE / EBP

NW		D_e (dB/oct) at 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 with and without the additional silencer.

Z Supply air
A return air
1.) Flow generated noise of supply air without additional silencer
2.) Flow generated noise of supply air with additional 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 or return air
6.) Flow generated noise of return air without additional silencer
7.) Flow generated noise of return air with additional silencer
8.) Radiated noise of return air without acoustic cladding
9.) Radiated noise of return air with acoustic cladding

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1.) Flow generated noise of supply air, without additional silencer

NW			100				125				160				200				250				315				400			
v_K		(m/s)	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
V_{ZU}		[l/s]	22	44	66	89	35	70	105	140	58	116	174	232	91	183	274	366	144	287	431	575	229	459	688	917	371	742	1114	1485
		(m^3/h)	80	160	239	319	125	252	379	505	209	418	627	836	329	658	987	1317	517	1034	1552	2070	826	1651	2476	3303	1337	2672	4009	5348
Δp_t =250 Pa	L_{WA}[dB(A)]		<	**20**	**25**	**29**	**21**	**27**	**34**	**36**	**22**	**30**	**36**	**41**	**24**	**35**	**37**	**43**	**28**	**36**	**43**	**49**	**34**	**40**	**45**	**52**	**34**	**42**	**49**	**58**
	L_W [dB/oct]	8000	<	<	<	<	<	<	<	17	<	<	16	22	<	<	21	27	<	15	23	34	<	19	27	35	<	22	32	51
		4000	<	<	<	<	<	<	<	16	<	<	15	20	<	<	19	25	<	15	21	32	<	18	24	32	<	20	30	52
		2000	<	<	<	17	<	<	21	19	<	<	15	25	<	18	25	30	16	16	28	38	21	22	32	41	21	27	36	50
		1000	<	<	15	<	<	21	27	26	<	18	24	32	15	24	30	35	21	29	32	43	24	30	37	46	27	40	49	49
		500	<	18	21	29	18	25	33	34	19	28	34	37	20	34	36	40	26	34	42	48	33	39	44	51	33	41	46	48
		250	<	25	27	31	25	29	35	38	26	34	40	43	28	39	38	45	30	38	47	50	36	42	47	53	35	46	50	51
		125	<	31	38	38	32	36	42	48	34	40	46	52	36	44	45	54	37	45	51	55	44	50	53	59	42	49	59	60
		63	<	33	42	40	34	38	44	51	37	42	48	55	39	46	47	57	39	47	52	57	47	53	55	61	44	50	62	63
Δp_t =500 Pa	L_{WA}[dB(A)]		<	**21**	**29**	**32**	**26**	**34**	**39**	**44**	**27**	**35**	**43**	**46**	**27**	**36**	**42**	**49**	**34**	**39**	**45**	**53**	**37**	**43**	**55**	**58**	**39**	**45**	**58**	**62**
	L_W [dB/oct]	8000	<	<	<	15	<	<	23	21	<	15	23	24	<	<	22	32	<	24	30	39	17	25	32	43	24	27	43	62
		4000	<	<	<	16	<	<	21	20	<	15	21	23	<	<	19	30	<	22	28	37	15	19	30	41	22	21	41	62
		2000	<	<	<	16	<	19	26	22	<	16	26	27	<	18	29	36	21	29	34	42	22	38	37	47	29	40	47	53
		1000	<	<	16	16	16	23	31	32	17	24	34	36	16	27	33	40	24	31	38	46	26	26	47	51	31	32	51	53
		500	<	19	29	23	22	33	36	45	23	35	40	44	26	36	42	46	33	38	42	51	36	40	55	57	38	41	57	58
		250	<	26	30	35	29	38	41	47	30	37	46	50	30	38	44	50	36	40	46	55	42	46	57	61	40	47	60	62
		125	<	32	39	45	38	43	50	51	39	43	53	54	37	43	49	59	43	46	55	60	45	50	61	64	46	51	64	65
		63	<	34	42	48	41	45	53	52	42	45	55	55	39	45	51	62	45	48	58	62	46	52	65	65	48	52	65	66
Δp_t =1000 Pa	L_{WA}[dB(A)]		<	**29**	**35**	**42**	**27**	**34**	**40**	**45**	**28**	**39**	**46**	**49**	**30**	**42**	**48**	**51**	**35**	**43**	**53**	**55**	**40**	**52**	**58**	**62**	**51**	**55**	**65**	**67**
	L_W [dB/oct]	8000	<	<	17	20	<	<	22	25	<	18	24	28	<	22	32	34	<	23	39	38	21	30	43	50	32	38	56	66
		4000	<	<	15	19	<	<	20	22	<	17	23	24	<	19	30	32	<	21	37	36	18	25	41	48	30	36	56	66
		2000	<	<	15	22	<	21	25	30	15	20	27	36	<	29	36	37	18	28	42	42	27	41	47	54	35	42	55	64
		1000	<	18	22	32	21	27	32	42	15	29	36	37	20	33	40	44	24	32	46	47	30	45	51	56	49	47	54	57
		500	<	29	35	41	25	33	37	41	26	39	44	47	26	42	46	49	34	42	51	54	39	51	54	59	45	54	63	64
		250	15	31	36	46	29	35	43	46	30	41	51	53	33	44	50	54	39	47	56	57	42	54	60	64	49	57	64	66
		125	28	37	44	49	36	42	51	52	40	45	54	57	42	49	57	59	44	51	60	62	50	58	64	64	53	62	66	67
		63	32	39	47	50	38	44	54	54	43	46	56	58	45	51	59	61	46	52	61	64	53	59	65	66	54	64	67	67

Pressure-reducing box EBE / EBP

2.) Flow generated noise of supply air, with additional silencer (-ZS)

NW				100				125				160				200				250				315				400			
v_K			(m/s)	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
V_{ZU}			[l/s]	22	44	66	89	35	70	105	140	58	116	174	232	91	183	274	366	144	287	431	575	229	459	688	917	371	742	1114	1485
			(m^3/h)	80	160	239	319	125	252	379	505	209	418	627	836	329	658	987	1317	517	1034	1552	2070	826	1651	2476	3303	1337	2672	4009	5348
Δp_t =250 Pa	L_{WA}[dB(A)]			<	**15**	**20**	**28**	**15**	**19**	**25**	**30**	**16**	**23**	**29**	**34**	**18**	**27**	**28**	**36**	**25**	**27**	**37**	**46**	**26**	**32**	**36**	**46**	**26**	**37**	**42**	**55**
	L_W [dB/oct]	f_m (Hz)	8000	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	25	40	<	<	<	40	<	29	24	46
			4000	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	20	38	<	<	<	39	<	29	23	45
			2000	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	15	<	<	24	31	<	15	20	36	<	29	26	47
			1000	<	<	<	<	<	<	<	<	<	<	<	17	<	<	20	25	<	15	29	31	<	19	26	35	17	31	30	49
			500	<	<	<	22	<	<	18	19	<	<	19	22	<	19	21	25	15	19	27	39	21	27	32	40	23	33	36	50
			250	<	20	22	32	20	24	30	33	19	27	33	36	20	31	30	37	33	28	38	41	27	33	38	44	26	32	41	54
			125	<	27	34	40	28	32	38	44	30	36	42	48	32	40	41	50	33	41	49	58	40	46	49	55	38	39	55	57
			63	<	29	38	43	31	35	41	48	34	39	45	52	36	43	45	54	33	45	53	64	44	50	53	59	42	41	60	58
Δp_t =500 Pa	L_{WA}[dB(A)]			<	**16**	**21**	**27**	**20**	**25**	**32**	**34**	**21**	**32**	**35**	**38**	**19**	**27**	**39**	**41**	**30**	**37**	**42**	**52**	**29**	**40**	**46**	**49**	**31**	**37**	**47**	**59**
	L_W [dB/oct]	f_m (Hz)	8000	<	<	<	<	<	<	<	<	<	<	<	18	<	<	24	26	<	23	27	44	<	25	<	38	<	<	<	50
			4000	<	<	<	<	<	<	<	<	<	<	<	16	<	<	24	26	<	23	27	44	<	25	<	33	<	<	31	49
			2000	<	<	<	<	<	<	16	<	<	17	18	21	<	<	23	26	<	22	27	38	<	26	27	37	19	<	36	51
			1000	<	<	<	<	<	<	17	18	<	17	21	23	<	17	26	30	23	25	30	41	15	29	36	40	22	35	41	53
			500	<	<	<	<	<	18	21	30	<	19	24	32	<	21	29	31	23	28	33	44	24	30	43	45	28	31	45	54
			250	<	21	25	30	24	30	36	40	23	36	39	43	22	30	41	42	33	40	45	55	33	40	48	52	31	37	50	55
			125	<	28	35	41	34	38	46	44	35	46	49	50	33	39	52	55	41	50	53	60	41	53	57	60	42	45	54	61
			63	<	30	38	45	37	41	49	45	39	49	52	52	37	42	56	59	44	53	58	62	44	57	60	63	46	48	55	63
Δp_t =1000 Pa	L_{WA}[dB(A)]			<	**24**	**27**	**36**	**21**	**34**	**35**	**35**	**22**	**34**	**38**	**42**	**25**	**34**	**40**	**47**	**26**	**42**	**43**	**51**	**32**	**43**	**51**	**55**	**39**	**50**	**57**	**62**
	L_W [dB/oct]	f_m (Hz)	8000	<	<	<	<	<	<	<	<	<	<	<	31	<	<	26	39	<	<	25	41	<	<	34	38	18	45	50	53
			4000	<	<	<	<	<	<	<	<	<	<	<	29	<	<	25	38	<	33	23	40	<	30	32	36	17	43	49	53
			2000	<	<	<	<	<	<	<	<	<	18	21	23	<	15	22	36	<	24	28	38	<	28	37	42	20	36	47	54
			1000	<	<	<	30	<	<	18	24	<	22	22	30	<	19	26	40		25	31	41	15	31	44	47	29	40	50	57
			500	<	15	22	33	<	18	22	26	<	25	29	40	16	32	36	39	19	27	36	45	27	37	49	52	39	40	53	56
			250	<	31	31	40	24	41	42	41	23	38	44	46	25	36	42	46	29	41	46	56	30	45	53	56	41	50	59	60
			125	24	32	40	43	34	43	45	47	36	47	50	52	39	45	53	55	40	54	58	60	46	56	59	61	47	58	60	60
			63	29	32	43	44	37	44	46	49	40	50	52	54	44	48	57	58	44	58	59	61	51	60	61	63	49	61	60	63

Pressure-reducing box EBE / EBP

3.) Radiated noise of supply air, without acoustic cladding

NW			100				125				160				200				250				315				400			
v_K		(m/s)	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
V_{ZU}		[l/s]	22	44	66	89	35	70	105	140	58	116	174	232	91	183	274	366	144	287	431	575	229	459	688	917	371	742	1114	1485
		(m^3/h)	80	160	239	319	125	252	379	505	209	418	627	836	329	658	987	1317	517	1034	1552	2070	826	1651	2476	3303	1337	2672	4009	5348
Δp_t =250 Pa	L_{WA}[dB(A)]		<	**24**	**29**	**32**	**25**	**30**	**36**	**41**	**22**	**30**	**37**	**41**	**26**	**35**	**38**	**41**	**28**	**36**	**39**	**45**	**33**	**40**	**43**	**45**	**45**	**52**	**54**	**57**
	L_W [dB/oct]	8000	<	<	16	19	<	<	19	26	<	<	20	26	<	19	21	25	<	23	19	25	15	20	23	26	34	37	44	47
		4000	<	<	16	17	<	<	18	26	<	<	19	26	<	19	20	24	<	22	19	24	15	20	23	25	33	35	44	47
		2000	<	15	17	23	<	15	21	26	<	15	22	26	<	20	23	27	15	25	20	27	16	21	24	29	35	42	44	48
		1000	<	15	22	25	16	21	27	34	15	21	28	34	17	24	28	32	19	31	27	34	22	28	31	38	38	46	48	50
		500	<	21	27	31	22	28	33	40	20	28	34	40	23	30	34	38	25	33	34	42	29	36	39	40	42	50	51	54
		250	16	27	32	33	28	33	40	43	25	33	41	43	29	39	42	44	31	38	43	49	37	45	48	50	46	53	55	57
		125	20	34	35	39	36	40	46	48	31	40	47	48	37	45	47	52	39	41	51	56	44	50	53	55	49	55	56	60
		63	19	32	34	37	33	38	44	46	29	38	45	46	34	43	47	49	36	40	48	54	42	48	51	53	48	54	56	60
Δp_t =500 Pa	L_{WA}[dB(A)]		**17**	**27**	**35**	**39**	**32**	**38**	**45**	**47**	**26**	**33**	**43**	**47**	**28**	**36**	**42**	**48**	**35**	**40**	**43**	**50**	**36**	**41**	**48**	**51**	**51**	**57**	**58**	**60**
	L_W [dB/oct]	8000	<	<	20	23	19	21	26	25	<	19	24	27	<	19	25	28	19	22	23	29	23	22	27	30	43	46	49	50
		4000	<	<	20	22	19	20	25	23	<	19	24	26	<	19	24	27	19	21	23	28	22	21	26	28	43	46	50	50
		2000	<	<	21	25	20	23	28	29	15	20	25	29	15	20	28	30	20	24	24	32	25	24	30	33	42	45	47	51
		1000	<	18	27	30	23	28	36	41	19	23	36	40	19	26	33	41	25	30	31	42	31	31	38	42	44	51	48	49
		500	17	24	34	36	28	34	43	47	21	29	42	46	25	33	39	47	31	37	39	49	33	38	45	50	48	54	57	58
		250	20	30	38	42	35	42	49	48	30	36	45	50	31	41	44	51	39	43	48	53	38	44	52	54	48	59	58	60
		125	24	38	42	48	42	49	54	55	35	44	46	54	39	44	54	55	46	51	53	58	41	51	57	60	46	63	62	66
		63	23	35	41	46	40	47	52	53	33	41	46	53	36	43	51	54	44	48	51	56	40	49	57	58	47	62	62	64
Δp_t =1000 Pa	L_{WA}[dB(A)]		**22**	**35**	**40**	**44**	**32**	**40**	**46**	**49**	**30**	**40**	**49**	**53**	**31**	**44**	**47**	**52**	**37**	**45**	**52**	**53**	**46**	**50**	**55**	**55**	**55**	**59**	**60**	**62**
	L_W [dB/oct]	8000	<	20	23	24	19	20	29	30	<	20	29	30	15	26	26	30	19	25	30	30	26	29	40	42	46	48	49	53
		4000	<	20	22	23	17	20	27	30	<	19	28	29	15	25	26	29	19	24	29	29	25	28	38	40	45	47	47	52
		2000	<	21	26	25	23	21	32	31	15	22	31	33	16	29	27	33	20	27	33	33	28	31	45	47	48	51	52	54
		1000	15	27	31	29	25	28	37	41	21	30	40	43	22	36	30	43	26	34	43	43	37	40	49	50	49	52	51	52
		500	20	34	37	41	31	36	43	48	28	37	48	50	29	43	47	50	33	42	50	50	45	48	53	52	53	55	59	60
		250	25	38	43	48	33	45	49	50	33	43	53	56	34	47	51	56	41	49	56	56	50	54	57	55	51	60	60	61
		125	31	42	51	55	39	50	57	58	40	51	57	64	41	51	55	60	48	56	62	64	52	57	59	62	54	61	62	65
		63	29	41	48	53	37	48	54	55	38	48	56	62	39	50	54	60	46	54	60	62	52	56	58	60	54	61	65	66

Pressure-reducing box EBE / EBP

4.) Radiated noise of supply air, with acoustic cladding (-DS)

NW			100				125				160				200				250				315				400			
v_K		(m/s)	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
V_{ZU}		[l/s]	22	44	66	89	35	70	105	140	58	116	174	232	91	183	274	366	144	287	431	575	229	459	688	917	371	742	1114	1485
		(m^3/h)	80	160	239	319	125	252	379	505	209	418	627	836	329	658	987	1317	517	1034	1552	2070	826	1651	2476	3303	1337	2672	4009	5348
Δp_t =250 Pa	L_{WA}[dB(A)]		<	<	**21**	**27**	<	**22**	**29**	**35**	<	**22**	**29**	**35**	<	**26**	**30**	**35**	**18**	**28**	**31**	**38**	**23**	**30**	**35**	**37**	**26**	**33**	**38**	**42**
	L_W [dB/oct]	8000	<	<	<	<	<	<	<	23	<	<	<	17	<	<	<	<	<	<	<	<	<	<	17	19	<	16	16	21
		4000	<	<	<	<	<	<	<	23	<	<	<	17	<	<	<	<	<	<	<	<	<	<	16	18	<	16	15	19
		2000	<	<	<	16	<	<	18	23	<	15	15	18	<	<	<	<	<	<	<	17	<	17	18	20	<	17	17	24
		1000	<	<	15	17	<	17	19	26	<	16	17	20	<	16	15	20	<	15	18	22	<	18	19	21	17	18	20	27
		500	<	<	19	22	<	20	25	33	<	17	22	26	<	23	27	30	15	20	26	31	17	27	31	32	24	30	32	37
		250	<	16	23	30	<	24	33	39	<	20	33	37	<	30	34	39	19	30	35	43	25	34	41	43	31	38	43	47
		125	<	22	28	37	<	28	40	39	<	29	42	48	<	35	42	48	30	41	44	51	36	41	45	48	35	42	51	54
		63	<	24	30	39	<	29	42	39	<	32	45	52	<	37	45	51	34	45	47	54	40	43	46	50	36	43	51	56
Δp_t =500 Pa	L_{WA}[dB(A)]		<	**16**	**26**	**32**	**21**	**30**	**35**	**40**	<	**24**	**36**	**41**	**16**	**26**	**34**	**41**	**24**	**31**	**34**	**43**	**24**	**33**	**40**	**44**	**38**	**41**	**45**	**48**
	L_W [dB/oct]	8000	<	<	<	<	<	<	17	19	<	<	<	27	<	<	<	20	<	<	<	19	<	<	19	30	17	22	24	27
		4000	<	<	<	<	<	<	16	18	<	<	<	25	<	<	<	19	<	<	<	18	<	<	18	29	15	20	20	23
		2000	<	<	<	15	<	<	18	22	<	<	18	31	<	<	21	22	<	15	16	22	<	<	22	32	20	27	31	34
		1000	<	<	16	18	15	17	19	26	<	16	27	34	<	<	27	26	15	18	22	32	15	23	26	36	22	34	35	37
		500	<	16	23	30	18	27	32	35	<	20	36	39	<	25	33	35	19	31	35	41	20	33	35	39	33	39	43	43
		250	<	20	30	38	23	33	41	45	<	27	38	43	18	29	35	46	27	32	27	48	28	35	45	45	43	43	48	51
		125	<	24	35	41	29	41	44	52	<	34	43	48	30	36	42	52	35	40	45	51	36	40	52	54	48	48	53	60
		63	<	25	37	42	31	44	45	54	<	36	45	50	34	38	44	54	38	43	51	52	39	42	54	57	50	50	55	63
Δp_t =1000 Pa	L_{WA}[dB(A)]		<	**27**	**32**	**40**	**21**	**31**	**39**	**42**	**19**	**33**	**41**	**47**	**20**	**35**	**41**	**44**	**28**	**36**	**44**	**46**	**34**	**40**	**46**	**50**	**43**	**46**	**51**	**53**
	L_W [dB/oct]	8000	<	<	<	17	<	<	16	19	<	<	19	30	<	<	25	23	<	<	23	28	<	22	24	32	21	22	34	38
		4000	<	<	<	15	<	<	15	18	<	<	18	29	<	<	26	21	<	<	21	29	<	20	23	29	20	21	32	36
		2000	<	<	<	22	<	16	18	22	<	<	22	32	<	16	24	26	16	18	26	25	21	25	27	37	24	25	37	41
		1000	<	17	21	26	<	18	27	32	<	21	26	36	<	25	30	34	18	27	34	35	22	32	36	42	28	36	44	47
		500	<	23	32	37	18	31	37	42	16	30	35	43	16	33	40	43	23	36	44	45	33	37	44	49	36	44	49	51
		250	<	30	33	44	25	32	44	46	23	35	43	48	24	37	43	46	33	38	46	51	36	43	50	53	49	50	54	53
		125	17	39	42	51	32	40	47	50	30	45	52	59	31	44	50	52	39	43	52	54	45	51	55	57	55	55	59	59
		63	<	42	45	53	34	43	48	51	32	48	54	63	33	46	50	54	41	45	54	55	48	54	57	58	57	57	61	61

Pressure-reducing box EBE / EBP

5.) Flow generated noise in round duct for supply air and return air

NW			100				125				160				200				250				315				400			
v_K		(m/s)	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
V_{ZU}		[l/s]	22	44	66	89	35	70	105	140	58	116	174	232	91	183	274	366	144	287	431	575	229	459	688	917	371	742	1114	1485
		(m^3/h)	80	160	239	319	125	252	379	505	209	418	627	836	329	658	987	1317	517	1034	1552	2070	826	1651	2476	3303	1337	2672	4009	5348
Δp_t =250 Pa	L_{WA}[dB(A)]		**44**	**52**	**58**	**60**	**47**	**57**	**60**	**62**	**49**	**57**	**62**	**64**	**51**	**59**	**65**	**67**	**53**	**61**	**65**	**67**	**59**	**63**	**68**	**68**	**58**	**65**	**70**	**71**
	L_W [dB/oct]	8000	23	34	48	47	41	38	46	44	30	42	45	59	33	43	44	62	30	44	55	58	47	40	54	44	48	51	59	60
		4000	30	40	50	49	40	43	52	53	37	48	52	56	38	47	49	60	37	49	57	56	53	45	60	58	53	55	63	65
		2000	37	46	50	51	38	47	54	50	42	51	52	56	44	52	56	59	46	53	59	61	53	50	60	58	52	56	61	63
		1000	39	46	51	52	37	47	47	54	41	48	52	53	46	51	57	59	48	54	57	58	52	50	63	60	46	58	61	65
		500	39	50	54	57	39	50	53	60	44	51	55	57	45	52	62	61	51	60	61	61	47	58	62	67	43	63	67	67
		250	43	51	58	61	41	55	59	65	50	58	67	66	50	61	67	65	53	60	65	66	47	70	64	70	43	66	71	71
		125	48	51	58	60	44	54	65	66	56	65	66	67	52	63	70	66	49	60	65	72	50	68	66	73	49	70	72	68
		63	54	59	67	68	61	64	65	67	60	65	67	69	59	69	70	74	58	54	67	78	54	62	68	72	58	72	76	76
Δp_t =500 Pa	L_{WA}[dB(A)]		**50**	**59**	**62**	**65**	**52**	**60**	**66**	**68**	**54**	**54**	**69**	**70**	**56**	**64**	**70**	**71**	**59**	**67**	**72**	**74**	**60**	**69**	**75**	**76**	**62**	**70**	**78**	**78**
	L_W [dB/oct]	8000	26	49	45	46	43	48	55	47	33	49	50	47	42	43	47	45	43	51	55	57	48	58	67	71	45	63	69	74
		4000	34	53	47	57	44	52	60	51	45	51	55	52	49	46	53	52	50	56	60	61	50	63	70	72	54	66	75	73
		2000	44	53	52	59	47	56	60	57	46	49	59	58	50	52	58	57	55	58	61	61	51	60	64	67	50	63	68	68
		1000	45	52	53	57	43	51	57	59	46	50	58	60	51	53	60	59	52	58	63	63	52	60	65	63	54	64	68	65
		500	46	48	60	61	39	50	58	67	53	58	65	67	48	60	67	68	53	64	70	71	57	65	69	68	60	60	68	68
		250	45	47	65	65	43	51	59	72	54	70	75	75	48	70	75	78	52	70	76	80	61	68	74	71	62	65	68	72
		125	41	50	61	68	45	56	62	71	55	68	71	72	51	71	74	71	51	70	74	77	61	69	75	70	66	63	74	71
		63	55	60	65	67	58	65	64	70	55	64	70	74	56	70	73	69	58	65	77	75	66	73	75	77	67	75	78	80
Δp_t =1000 Pa	L_{WA}[dB(A)]		**58**	**64**	**67**	**71**	**60**	**67**	**70**	**73**	**63**	**69**	**72**	**75**	**64**	**70**	**74**	**77**	**67**	**73**	**74**	**79**	**68**	**74**	**78**	**82**	**71**	**79**	**81**	**84**
	L_W [dB/oct]	8000	48	58	55	62	47	58	59	65	45	61	60	68	59	60	64	68	58	61	68	71	59	67	74	69	65	69	76	77
		4000	49	54	59	66	53	59	62	66	55	63	66	66	58	65	65	72	63	65	69	73	63	70	73	79	85	76	77	80
		2000	50	56	62	63	55	63	65	62	52	63	60	69	57	62	69	68	59	68	62	67	62	65	69	70	63	68	71	73
		1000	51	57	57	58	47	55	61	65	54	59	65	65	53	63	65	70	56	61	64	70	57	65	70	67	60	64	70	74
		500	54	57	61	60	53	60	67	68	60	63	68	69	57	65	69	72	55	70	70	74	61	68	72	73	63	68	73	78
		250	58	59	65	65	59	59	65	72	65	65	71	71	59	66	71	74	62	67	72	76	69	72	76	71	67	71	75	79
		125	57	65	68	63	64	66	67	75	67	70	72	76	64	70	76	78	63	69	75	80	69	76	78	76	70	75	79	82
		63	68	65	70	73	58	76	77	80	65	74	78	79	66	74	78	79	75	77	79	81	73	76	76	82	74	79	82	86

Pressure-reducing box EBE / EBP

6.) Flow generated noise of return air, without additional silencer

NW			100				125				160				200				250				315				400			
v_K		(m/s)	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
V_{ZU}		[l/s]	22	44	66	89	35	70	105	140	58	116	174	232	91	183	274	366	144	287	431	575	229	459	688	917	371	742	1114	1485
		(m^3/h)	80	160	239	319	125	252	379	505	209	418	627	836	329	658	987	1317	517	1034	1552	2070	826	1651	2476	3303	1337	2672	4009	5348
Δp_t =250 Pa	L_{WA}[dB(A)]		<	**19**	**21**	**25**	**17**	**25**	**30**	**32**	**21**	**27**	**32**	**37**	**23**	**32**	**33**	**39**	**27**	**34**	**39**	**46**	**33**	**38**	**41**	**49**	**33**	**39**	**45**	**53**
	L_W [dB/oct]	8000	<	<	<	<	<	<	<	<	<	<	<	23	<	<	23	28	<	<	26	36	<	21	31	40	<	26	34	45
		4000	<	<	<	<	<	<	<	<	<	<	<	16	<	<	15	21	<	<	17	28	<	16	20	28	<	17	26	48
		2000	<	<	<	<	<	<	<	15	<	<	<	21	<	15	21	26	<	<	24	34	20	20	28	37	20	24	32	46
		1000	<	<	<	<	<	19	23	22	<	15	20	28	<	21	26	31	20	27	28	39	23	28	33	42	26	29	36	45
		500	<	16	17	25	<	23	29	30	18	25	30	33	19	31	32	36	25	32	38	44	32	37	40	47	32	38	42	44
		250	<	23	23	27	22	27	31	34	25	31	36	39	37	36	34	41	29	36	43	46	35	40	43	49	34	43	46	47
		125	<	29	34	34	29	34	38	44	33	37	42	48	35	41	41	50	36	43	47	51	43	48	51	55	41	46	55	56
		63	<	31	38	36	31	36	40	47	36	39	44	51	38	43	43	53	38	45	48	53	46	51	51	57	43	47	58	59
Δp_t =500 Pa	L_{WA}[dB(A)]		<	**19**	**25**	**27**	**23**	**32**	**35**	**40**	**26**	**32**	**39**	**42**	**26**	**33**	**38**	**45**	**33**	**37**	**41**	**49**	**36**	**44**	**51**	**55**	**38**	**45**	**55**	**58**
	L_W [dB/oct]	8000	<	<	<	<	<	<	24	19	<	<	24	24	<	<	28	34	<	29	32	40	<	42	35	45	30	43	45	49
		4000	<	<	<	<	<	<	17	16	<	<	17	19	<	<	15	26	<	20	24	33	<	17	26	37	21	18	37	50
		2000	<	<	<	<	<	17	22	18	<	<	22	23	<	15	25	32	20	27	30	38	21	36	33	43	28	37	43	49
		1000	<	<	<	<	<	21	27	28	16	21	30	32	15	24	29	36	23	29	34	42	25	24	43	47	30	29	47	49
		500	<	16	25	19	19	31	32	41	22	32	36	40	25	33	38	42	32	36	38	47	35	38	51	53	37	38	53	54
		250	<	24	26	31	26	36	37	43	29	34	42	46	29	35	40	46	35	38	42	51	41	44	53	57	39	44	56	58
		125	<	30	35	41	35	41	46	47	28	40	49	50	36	40	45	55	42	44	51	56	44	48	57	60	45	48	60	61
		63	<	32	38	44	38	43	49	48	41	42	51	51	38	42	47	58	44	46	54	58	45	49	58	61	47	49	61	62
Δp_t =1000 Pa	L_{WA}[dB(A)]		<	**27**	**31**	**38**	**24**	**32**	**36**	**41**	**27**	**36**	**42**	**45**	**29**	**39**	**44**	**47**	**34**	**41**	**50**	**51**	**39**	**51**	**55**	**58**	**50**	**52**	**60**	**63**
	L_W [dB/oct]	8000	<	<	<	19	<	<	23	29	<	<	24	36	<	<	29	35	<	28	40	40	29	44	45	52	36	41	51	54
		4000	<	<	<	15	<	<	16	18	<	<	19	20	<	16	26	28	<	19	33	32	17	23	37	44	29	33	52	55
		2000	<	<	<	18	<	19	21	26	<	17	23	32	<	26	32	33	17	26	38	38	26	39	43	50	34	39	51	54
		1000	<	16	18	28	18	25	28	38	<	26	32	33	19	30	36	40	23	30	42	43	29	43	47	52	48	44	50	53
		500	<	27	31	37	22	31	33	37	25	36	40	43	25	39	42	45	33	40	47	50	38	49	53	55	44	51	59	60
		250	<	29	32	42	26	33	39	42	38	41	46	49	32	41	46	50	38	45	52	53	41	52	56	60	48	52	60	62
		125	27	35	40	45	33	40	47	48	39	42	51	53	41	46	53	55	43	49	56	58	49	56	60	62	52	59	62	63
		63	<	37	43	46	35	42	50	50	42	43	52	54	44	48	55	57	45	50	57	60	52	57	61	62	53	61	63	63

Pressure-reducing box EBE / EBP

7.) Flow generated noise of return air, with additional silencer (-ZS)

NW			100				125				160				200				250				315				400			
v_K		(m/s)	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
V_{ZU}		[l/s]	22	44	66	89	35	70	105	140	58	116	174	232	91	183	274	366	144	287	431	575	229	459	688	917	371	742	1114	1485
		(m^3/h)	80	160	239	319	125	252	379	505	209	418	627	836	329	658	987	1317	517	1034	1552	2070	826	1651	2476	3303	1337	2672	4009	5348
Δp_t =250 Pa	L_{WA}[dB(A)]		<	<	**16**	**21**	<	**19**	**25**	**29**	**19**	**21**	**30**	**36**	**19**	**28**	**32**	**35**	**24**	**30**	**36**	**40**	**29**	**35**	**36**	**45**	**30**	**35**	**40**	**48**
	L_W [dB/oct]	8000	<	<	<	<	<	<	<	<	<	<	<	22	<	<	<	24	<	<	<	31	<	<	26	36	<	22	29	44
		4000	<	<	<	<	<	<	<	<	<	<	<	15	<	<	<	17	<	<	<	23	<	<	15	24	<	13	21	35
		2000	<	<	<	<	<	<	<	<	<	<	<	20	<	<	<	22	<	<	21	29	16	17	23	33	17	20	27	42
		1000	<	<	<	<	<	<	18	19	<	<	18	27	<	17	25	27	17	23	25	34	19	25	28	38	23	25	31	41
		500	<	<	<	21	<	18	24	27	16	19	28	32	15	27	31	32	22	28	35	39	28	34	35	43	29	34	37	40
		250	<	19	18	23	18	22	26	31	23	25	34	38	23	32	33	37	26	32	40	41	31	37	38	45	31	39	41	43
		125	<	25	29	30	25	29	33	41	31	31	40	47	31	37	40	46	33	39	44	46	39	45	44	51	38	42	50	52
		63	<	27	33	32	27	31	35	44	34	33	42	50	34	39	42	49	35	41	45	48	42	48	46	53	40	43	53	55
Δp_t =500 Pa	L_{WA}[dB(A)]		<	**15**	**20**	**23**	**19**	**27**	**30**	**37**	**24**	**26**	**37**	**41**	**22**	**29**	**36**	**41**	**30**	**33**	**38**	**44**	**32**	**40**	**46**	**51**	**35**	**40**	**50**	**54**
	L_W [dB/oct]	8000	<	<	<	<	<	<	<	<	<	<	22	23	<	<	<	30	<	25	29	35	41	30	32	41	27	37	40	45
		4000	<	<	<	<	<	<	<	<	<	<	15	18	<	<	<	22	<	16	21	28	33	15	33	46	18	15	32	46
		2000	<	<	<	<	<	<	17	<	<	<	20	22	<	<	23	28	17	23	27	33	17	34	28	39	25	33	38	45
		1000	<	<	<	<	<	16	22	25	<	15	28	31	<	20	27	32	20	25	31	37	21	22	38	43	27	25	42	45
		500	<	<	20	15	15	26	27	38	20	26	34	39	21	29	36	38	29	32	35	42	31	36	46	49	34	34	48	50
		250	<	20	21	27	22	31	32	40	27	28	40	45	25	31	38	42	32	34	39	46	37	42	48	53	36	40	51	54
		125	<	26	30	37	31	36	41	44	36	34	47	49	32	36	43	51	39	40	48	51	40	46	52	56	42	44	55	57
		63	<	28	33	40	34	38	44	45	39	36	49	50	34	38	45	54	41	42	51	53	41	47	53	57	44	45	56	58
Δp_t =1000 Pa	L_{WA}[dB(A)]		<	**22**	**25**	**34**	**19**	**27**	**31**	**38**	**25**	**30**	**40**	**44**	**25**	**35**	**42**	**43**	**31**	**37**	**47**	**47**	**35**	**46**	**50**	**54**	**47**	**48**	**55**	**58**
	L_W [dB/oct]	8000	<	<	<	<	<	<	<	26	<	<	22	35	<	<	32	31	<	24	37	36	25	32	40	48	33	39	46	49
		4000	<	<	<	<	<	<	<	15	<	<	17	19	<	<	24	24	<	15	30	28	13	19	32	40	26	29	47	50
		2000	<	<	<	<	<	<	16	23	<	<	21	31	<	22	30	29	<	22	35	34	22	35	38	46	31	35	46	49
		1000	<	<	<	24	<	20	23	35	<	20	30	32	15	26	34	36	20	26	39	39	25	39	42	48	45	45	45	48
		500	<	23	26	33	18	26	28	34	23	30	38	42	21	35	40	41	30	36	44	46	34	45	48	51	41	47	54	55
		250	<	25	27	38	22	28	34	39	27	32	45	48	28	37	44	46	35	41	49	49	37	48	51	51	45	50	55	57
		125	23	31	35	41	29	35	42	45	37	36	49	52	37	42	51	51	40	45	54	54	48	52	55	56	49	55	57	58
		63	25	33	38	42	31	37	45	47	40	37	50	53	40	44	53	53	42	46	56	56	48	53	56	58	50	57	58	58

Pressure-reducing box EBE / EBP

8.) Radiated noise of return air, without acoustic cladding

NW				100				125				160				200				250				315				400			
v_K			(m/s)	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
V_{ZU}			[l/s]	22	44	66	89	35	70	105	140	58	116	174	232	91	183	274	366	144	287	431	575	229	459	688	917	371	742	1114	1485
			(m^3/h)	80	160	239	319	125	252	379	505	209	418	627	836	329	658	987	1317	517	1034	1552	2070	826	1651	2476	3303	1337	2672	4009	5348
Δp_t =250 Pa	L_{WA}[dB(A)]			**22**	**26**	**30**	**33**	**27**	**32**	**38**	**40**	**28**	**33**	**40**	**44**	**28**	**37**	**39**	**45**	**30**	**38**	**45**	**52**	**36**	**42**	**47**	**55**	**37**	**44**	**51**	**59**
	L_W [dB/oct]	f_m (Hz)	8000	<	16	18	19	19	22	28	24	16	18	29	30	18	21	29	34	19	18	32	42	25	26	37	46	21	31	40	51
			4000	<	16	19	16	15	17	17	20	19	17	19	23	17	16	21	27	16	17	23	34	16	18	26	34	28	22	32	54
			2000	<	16	18	18	18	24	25	23	17	18	19	28	18	20	27	32	18	18	30	40	23	24	34	43	23	29	38	52
			1000	<	15	18	19	16	25	31	30	17	21	28	35	17	26	32	37	23	31	34	45	26	32	39	48	29	34	42	51
			500	19	22	24	33	22	29	37	38	22	31	38	40	22	36	38	42	28	36	44	50	35	41	46	53	35	43	48	50
			250	26	29	30	35	29	33	39	42	29	37	44	46	30	41	40	47	32	40	49	52	38	44	49	55	37	48	52	53
			125	33	35	41	42	36	40	46	52	37	43	50	55	38	46	47	56	39	47	53	57	46	52	55	61	44	51	61	62
			63	35	37	45	44	38	42	48	55	40	45	52	58	41	48	49	59	41	49	54	59	49	55	57	63	46	52	64	65
Δp_t =500 Pa	L_{WA}[dB(A)]			**23**	**28**	**33**	**36**	**31**	**38**	**43**	**48**	**31**	**38**	**47**	**49**	**30**	**38**	**44**	**51**	**36**	**41**	**47**	**55**	**40**	**48**	**57**	**61**	**42**	**50**	**61**	**64**
	L_W [dB/oct]	f_m (Hz)	8000	<	16	20	20	21	25	32	27	20	19	32	31	21	21	34	40	25	33	38	46	26	46	41	51	33	48	51	55
			4000	<	17	21	20	21	18	25	24	15	18	25	26	17	18	21	32	17	24	30	39	17	21	32	43	24	23	43	56
			2000	<	16	20	20	21	23	30	26	19	19	30	30	20	20	31	38	23	31	36	44	24	40	39	49	31	42	49	55
			1000	<	20	19	20	20	27	35	36	20	27	38	39	18	29	35	42	26	33	40	48	28	28	49	53	33	34	53	55
			500	22	22	32	27	26	37	40	49	26	38	44	47	28	38	44	48	35	40	44	53	38	42	57	59	40	43	59	60
			250	25	30	33	39	33	42	45	51	33	40	50	53	32	40	46	52	38	42	48	57	44	48	59	63	42	49	62	64
			125	34	36	42	49	42	47	54	55	42	46	57	57	39	45	51	61	45	48	57	62	47	52	63	66	50	53	66	67
			63	37	38	45	52	45	49	57	56	45	48	59	58	41	47	53	64	47	50	60	64	48	53	64	67	53	54	67	68
Δp_t =1000 Pa	L_{WA}[dB(A)]			**26**	**33**	**38**	**46**	**32**	**38**	**44**	**49**	**32**	**42**	**50**	**52**	**33**	**44**	**50**	**53**	**37**	**45**	**56**	**57**	**42**	**55**	**61**	**64**	**53**	**57**	**66**	**69**
	L_W [dB/oct]	f_m (Hz)	8000	<	15	17	27	22	27	31	37	18	24	32	43	20	34	40	41	20	32	46	46	32	48	51	58	39	46	57	60
			4000	<	18	22	23	22	20	24	26	19	20	27	27	19	21	32	34	19	23	39	38	20	27	43	50	32	38	58	61
			2000	<	16	18	26	22	25	29	34	18	23	31	39	20	31	38	39	20	30	44	44	29	43	49	56	37	44	57	60
			1000	20	22	25	36	25	31	36	46	18	32	40	40	22	35	42	46	26	34	48	49	32	47	53	58	51	56	59	60
			500	25	33	38	45	29	37	41	45	29	42	48	50	28	44	48	51	36	44	53	56	41	53	56	61	47	56	65	66
			250	27	35	39	50	33	39	47	50	33	44	48	56	35	46	52	56	41	49	52	59	44	53	59	61	51	59	66	68
			125	35	41	47	53	40	46	55	56	43	48	55	60	44	51	59	61	46	53	62	64	52	60	66	66	55	64	68	69
			63	38	43	50	54	42	48	58	58	46	49	55	61	47	53	61	63	48	54	63	66	55	61	67	68	56	66	69	69

Pressure-reducing box EBE / EBP

9.) Radiated noise of return air, with acoustic cladding (-DS)

NW			100				125				160				200				250				315				400			
v_K		(m/s)	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
V_{ZU}		[l/s]	22	44	66	89	35	70	105	140	58	116	174	232	91	183	274	366	144	287	431	575	229	459	688	917	371	742	1114	1485
		(m^3/h)	80	160	239	319	125	252	379	505	209	418	627	836	329	658	987	1317	517	1034	1552	2070	826	1651	2476	3303	1337	2672	4009	5348
Δp_t =250 Pa	L_{WA}[dB(A)]		<	<	**20**	**28**	<	<	**24**	**31**	<	<	**22**	**32**	<	<	**29**	**31**	<	**19**	**31**	**37**	<	**25**	**33**	**39**	<	**21**	**32**	**41**
	L_W [dB/oct]	8000	<	<	<	<	<	<	<	21	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	31	<	<	<	31
		4000	<	<	<	<	<	<	<	17	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	19	<	<	<	26
		2000	<	<	<	<	<	<	22	20	<	<	<	20	<	<	<	<	<	<	<	30	<	<	20	28	<	<	<	30
		1000	<	<	<	<	<	21	23	22	<	16	17	21	<	18	19	25	<	15	25	33	<	22	27	35	<	<	<	28
		500	<	<	16	24	<	21	29	31	<	20	26	26	<	29	31	34	18	23	36	39	23	32	38	45	17	30	40	47
		250	<	18	21	32	<	24	32	38	<	24	36	40	<	32	32	42	20	37	41	46	26	33	42	48	22	33	40	43
		125	<	23	34	40	<	28	40	43	<	32	45	55	17	36	40	52	30	43	46	52	38	43	47	54	30	45	54	55
		63	<	25	38	43	<	29	43	45	<	35	48	60	<	37	43	55	33	45	48	54	42	46	49	56	43	49	59	59
Δp_t =500 Pa	L_{WA}[dB(A)]		<	<	**23**	**30**	**18**	**30**	**33**	**42**	<	**29**	**41**	**44**	**17**	**28**	**39**	**45**	**24**	**33**	**40**	**48**	**30**	**36**	**48**	**53**	**36**	**33**	**48**	**52**
	L_W [dB/oct]	8000	<	<	<	<	<	<	21	19	<	<	<	32	<	<	<	32	<	<	<	36	<	<	33	39	<	<	<	36
		4000	<	<	<	<	<	<	16	19	<	<	<	25	<	<	<	24	<	<	<	29	<	<	24	44	<	<	<	45
		2000	<	<	<	<	<	<	20	19	<	<	23	30	<	<	24	30	<	22	28	34	<	<	31	40	<	<	33	38
		1000	<	<	<	<	<	16	18	21	<	20	29	33	<	<	29	27	16	21	31	38	<	20	37	47	<	17	40	43
		500	<	<	21	21	16	30	29	37	<	29	38	40	<	30	38	36	253	34	40	45	25	37	47	48	25	28	45	45
		250	<	20	25	35	21	33	37	48	<	31	43	48	19	28	37	47	26	31	37	52	34	39	52	54	37	33	52	55
		125	<	22	35	42	29	39	44	52	<	36	54	51	30	37	50	58	34	37	49	55	42	41	56	60	50	46	55	61
		63	<	23	38	44	32	41	46	53	<	38	50	58	34	40	54	62	37	39	53	56	45	52	57	62	54	50	56	63
Δp_t =1000 Pa	L_{WA}[dB(A)]		<	**25**	**31**	**42**	**21**	**31**	**37**	**42**	**19**	**34**	**41**	**47**	**21**	**35**	**46**	**45**	**29**	**37**	**48**	**51**	**32**	**47**	**52**	**55**	**43**	**56**	**47**	**59**
	L_W [dB/oct]	8000	<	<	<	26	<	<	<	<	<	<	24	42	<	18	36	34	<	<	39	35	<	43	32	48	<	<	<	48
		4000	<	<	<	15	<	<	<	<	<	<	17	27	<	19	32	26	<	<	31	38	<	19	28	39	<	<	<	45
		2000	<	<	<	23	<	20	15	25	<	<	22	38	<	18	35	32	16	21	37	36	22	37	31	46	<	37	42	47
		1000	<	<	15	33	<	21	26	37	<	23	26	33	<	24	42	37	18	27	39	41	17	369	40	50	30	33	49	54
		500	<	22	33	41	16	32	35	39	<	35	35	43	15	34	41	45	26	38	47	51	29	42	50	50	34	45	55	57
		250	<	27	29	46	25	26	42	46	23	36	48	47	25	36	44	46	33	38	48	53	30	45	57	55	49	49	58	60
		125	21	38	38	49	33	36	45	48	33	42	50	55	34	44	52	51	37	40	52	54	44	54	62	61	54	57	58	59
		63	<	42	41	50	36	39	46	49	36	44	51	58	37	47	55	53	38	41	53	54	49	57	64	63	56	60	58	59

Pressure-reducing box EBE / EBP

Minimum static pressure difference

NW	v_K	V_{ZU}		$\Delta p_{st\ min}$ (Pa)	
	(m/s)	m^3/h	[l/s]	EBE-Z	EBE-A
100	3	80	22	20	20
	6	160	44	25	40
	9	239	66	45	80
	12	319	89	90	150
125	3	125	35	20	20
	6	252	70	25	40
	9	379	105	45	80
	12	505	140	90	150
160	3	209	58	20	25
	6	418	116	25	40
	9	627	174	45	90
	12	836	232	80	150
200	3	329	91	20	25
	6	658	183	20	30
	9	987	274	35	80
	12	1317	366	60	145
250	3	517	144	20	20
	6	1034	287	20	30
	9	1552	431	35	70
	12	2070	575	60	120
315	3	826	229	20	25
	6	1651	459	25	40
	9	2476	688	40	85
	12	3303	917	65	145
400	3	1337	371	20	20
	6	3672	742	20	30
	9	4009	1114	35	65
	12	5348	1485	60	110

Pressure-reducing box EBE / EBP

Heating register

EBE/EBP 100 H1 (1 duct row)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	170	47	634	10	6	0,093	1240	20	6	0,292
	2,5	284	79	812	8	13	0,145	1600	16	13	0,468
	3,5	397	110	956	7	22	0,195	1900	13	22	0,638
	5	567	158	1130	6	40	0,263	2260	11	40	0,873
10	1,5	170	47	456	18	5	0,051	1040	28	5	0,214
	2,5	284	79	582	16	12	0,079	1350	24	12	0,344
	3,5	397	110	682	15	22	0,106	1600	22	22	0,469
	5	567	158	801	14	39	0,142	1910	20	39	0,642
20	1,5	170	47	285	25	5	0,022	850	35	5	0,149
	2,5	284	79	360	24	12	0,033	1110	32	12	0,239
	3,5	397	110	420	23	21	0,044	1310	30	21	0,326
	5	567	158	489	23	37	0,058	1560	28	37	0,446

EBE/EBP 100 H2 (2 duct rows)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	170	47	1560	26	14	0,96	2750	45	14	2,47
	2,5	284	79	2120	21	32	1,66	3780	37	32	4,40
	3,5	397	110	2560	18	55	2,33	4580	32	55	6,25
	5	567	158	3080	15	99	3,25	5550	27	99	8,82
10	1,5	170	47	1180	30	13	0,57	2340	49	13	1,85
	2,5	284	79	1600	26	31	0,99	3220	43	31	3,29
	3,5	397	110	1920	24	53	1,38	3910	38	53	4,67
	5	567	158	2300	22	96	1,92	4730	34	96	6,61
20	1,5	170	47	807	34	13	0,29	1940	54	13	1,32
	2,5	284	79	1080	31	29	0,49	2670	48	29	2,35
	3,5	397	110	1300	30	51	0,68	3250	44	51	3,34
	5	567	158	1550	28	92	0,34	3930	41	92	4,73

T_W = Water inlet/outlet temperature
T_E = Air temperature
v_0 = Air average velocity
V = Volumetric flow
Q = Power
T_A = Air outlet temperature
Pa_L = Air-side pressure loss
Pa_W = Water-side pressure loss

Pressure-Reducing Box EBE / EBP

Heating register

EBE / EBP 125 H1 (1 duct row)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	236	66	968	11	6	0,25	1800	21	6	0,73
	2,5	394	109	1250	9	13	0,40	2340	17	13	1,17
	3,5	551	153	1480	7	22	0,54	2780	14	22	1,60
	5	788	213	1750	6	40	0,74	3310	12	40	2,20
10	1,5	236	66	713	19	5	0,15	1530	29	5	0,54
	2,5	394	109	918	17	12	0,23	1990	25	12	0,87
	3,5	551	153	1080	16	22	0,31	2360	22	22	1,19
	5	788	213	1280	15	39	0,42	2810	20	39	1,64
20	1,5	236	66	465	26	5	0,07	1260	36	5	0,38
	2,5	394	109	595	25	12	0,10	1640	32	12	0,61
	3,5	551	153	700	24	21	0,14	1950	31	21	0,84
	5	788	213	824	23	37	0,19	1330	29	37	1,16

EBE / EBP 125 H2 (2 duct rows)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	236	66	2280	27	14	2,38	3920	46	14	5,89
	2,5	394	109	3110	22	32	4,18	5390	38	32	10,50
	3,5	551	153	3760	19	55	5,88	6550	33	55	15,00
	5	788	213	4530	16	99	8,24	7940	28	99	21,20
10	1,5	236	66	1740	31	13	1,46	3340	51	13	4,42
	2,5	394	109	2370	27	31	2,55	4610	44	31	7,91
	3,5	551	153	2860	25	53	3,58	5600	39	53	11,30
	5	788	213	3440	23	96	5,00	6790	35	96	16,00
20	1,5	236	66	1220	35	13	0,76	2790	55	13	3,19
	2,5	394	109	1640	32	29	1,31	3840	49	29	5,70
	3,5	551	153	1980	31	51	1,83	4680	45	51	8,13
	5	788	213	2370	29	92	2,55	5680	41	92	11,50

Pressure-Reducing Box EBE / EBP

Heating register

EBE / EBP 160 H1 (1 duct row)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	350	97	1550	12	6	0,72	2780	22	6	1,94
	2,5	583	162	2020	10	13	1,16	3620	17	13	3,14
	3,5	816	227	2390	8	22	1,58	4310	15	22	4,31
	5	1166	324	2840	7	40	2,16	5140	12	40	5,92
10	1,5	350	97	1170	20	5	0,43	2370	29	5	1,45
	2,5	583	162	1510	17	12	0,69	3090	25	12	2,35
	3,5	816	227	1790	16	22	0,94	3680	23	22	3,24
	5	1166	324	2130	15	39	1,28	4390	21	39	4,46
20	1,5	350	97	786	27	5	0,21	1970	37	5	1,04
	2,5	583	162	1020	25	12	0,34	2570	33	12	1,68
	3,5	816	227	1200	24	21	0,46	3070	31	21	2,32
	5	1166	324	1430	24	37	0,62	3660	29	37	3,20

EBE / EBP 160 H2 (2 duct rows)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	350	97	3230	26	14	0,85	5660	45	14	2,23
	2,5	583	162	4390	21	32	1,49	7780	37	32	4,00
	3,5	816	227	5290	18	55	2,10	9450	32	55	5,70
	5	1166	324	6360	15	99	2,93	11400	27	99	8,09
10	1,5	350	97	2440	30	13	0,51	4820	50	13	1,66
	2,5	583	162	3300	26	31	0,89	6630	43	31	2,98
	3,5	816	227	3970	24	53	1,24	8050	38	53	4,25
	5	1166	324	4770	22	96	1,73	9750	34	96	6,04
20	1,5	350	97	1670	34	13	0,26	4010	54	13	1,19
	2,5	583	162	2250	31	29	0,44	5510	48	29	2,12
	3,5	816	227	2690	30	51	0,61	6690	44	51	3,03
	5	1166	324	3210	28	92	0,84	8110	41	96	4,31

Pressure-Reducing Box EBE / EBP

Heating register

EBE / EBP 200 H1 (1 duct row)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	508	141	2380	13	6	2,06	4140	23	6	5,24
	2,5	846	235	3100	10	13	3,32	4520	18	13	8,51
	3,5	1184	329	3690	9	22	4,55	6450	15	22	11,70
	5	1692	470	4390	7	40	6,24	7700	13	40	16,10
10	1,5	508	141	1810	20	5	1,25	3540	30	5	3,95
	2,5	846	235	2360	18	12	2,02	4640	26	12	6,43
	3,5	1184	329	2800	17	22	2,61	5540	23	22	8,86
	5	1692	470	3340	16	39	3,80	6620	21	39	12,20
20	1,5	508	141	1250	27	5	0,64	2960	37	5	2,85
	2,5	846	235	1620	25	12	1,03	3880	34	12	4,65
	3,5	1184	329	1930	25	21	1,41	4630	32	21	6,42
	5	1692	470	2300	24	37	1,93	5540	30	37	8,88

EBE / EBP 200 H2 (2 duct rows)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	508	141	4950	27	14	2,39	8450	46	14	5,94
	2,5	846	235	6760	22	32	4,2	11600	38	32	10,70
	3,5	1184	329	8170	19	55	5,94	14200	33	55	15,20
	5	1692	470	9850	16	99	8,35	17200	28	99	21,60
10	1,5	508	141	3790	31	13	1,46	7220	51	13	4,45
	2,5	846	235	5150	28	31	2,57	9950	44	31	8,00
	3,5	1184	329	6220	25	53	3,62	12100	39	53	11,40
	5	1692	470	7500	23	96	5,08	14700	35	96	16,30
20	1,5	508	141	2650	36	13	0,77	6030	55	13	3,2
	2,5	846	235	3590	33	29	1,33	8310	49	29	5,76
	3,5	1184	329	4320	31	51	1,86	10100	45	51	8,24
	5	1692	470	5180	29	92	2,59	12300	42	92	11,70

Pressure-Reducing Box EBE / EBP

Heating register

EBE / EBP 250 H1 (1 duct row)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	717	199	3200	12	6	0,73	5700	22	6	1,98
	2,5	1195	332	4150	10	13	1,18	7440	17	13	3,23
	3,5	1673	465	4930	8	22	1,61	8860	15	22	4,45
	5	2390	664	5850	7	40	2,2	10600	12	40	6,14
10	1,5	717	199	2400	20	5	0,43	4860	30	5	1,48
	2,5	1195	332	3120	18	12	0,70	6350	25	12	2,41
	3,5	1673	465	3700	16	22	0,95	7570	23	22	3,33
	5	2390	664	4390	15	39	1,30	9030	21	39	4,61
20	1,5	717	199	1620	27	5	0,21	4040	37	5,2	1,05
	2,5	1195	332	2100	25	12	0,34	5280	33	12	1,72
	3,5	1673	465	2490	24	21	0,46	6300	31	21	2,38
	5	2390	664	2950	24	37	0,63	7530	29	37	3,30

EBE / EBP 250 H2 (2 duct rows)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	717	199	6940	27	14	2,13	11900	46	14	5,44
	2,5	1195	332	9470	22	32	3,77	16400	38	32	9,84
	3,5	1673	465	11400	19	55	5,35	19900	33	55	14,10
	5	2390	664	13800	16	99	7,54	24100	28	99	20,10
10	1,5	717	199	5300	31	13	1,30	10200	51	13	4,06
	2,5	1195	332	7210	27	31	2,28	14000	44	31	7,35
	3,5	1673	465	8700	25	53	3,2	17000	39	53	10,60
	5	2390	664	10500	23	96	4,54	20600	35	96	15,10
20	1,5	717	199	3700	35	13	0,67	8470	55	13	2,91
	2,5	1195	332	5000	32	29	1,16	11700	49	29	5,26
	3,5	1673	465	6010	31	51	1,64	14200	45	51	7,56
	5	2390	664	7210	29	92	2,29	17200	41	96	10,80

Pressure-Reducing Box EBE / EBP

Heating register

EBE / EBP 315 H1 (1 duct row)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	1143	318	5440	13	6	2,74	9400	23	6	6,97
	2,5	1906	529	7090	10	13	4,43	12300	18	13	11,40
	3,5	2668	741	8440	9	22	6,09	14700	15	22	15,70
	5	3812	1059	10100	7	40	8,38	17500	13	40	21,70
10	1,5	1143	318	4150	20	5	1,67	8050	30	5	5,25
	2,5	1906	529	5410	18	12	2,33	10500	26	12	8,59
	3,5	2668	741	6440	17	22	3,71	12600	24	22	11,90
	5	3812	1059	7670	16	39	5,11	15000	21	39	16,50
20	1,5	1143	318	2870	28	5	0,85	6730	38	5	3,78
	2,5	1906	529	3740	26	12	1,38	8820	34	12	6,20
	3,5	2668	741	4460	25	21	1,90	10500	32	21	8,59
	5	3812	1059	5310	24	37	2,61	12600	30	37	11,90

EBE / EBP 315 H2 (2 duct rows)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	1143	318	11300	27	14	3,99	19200	46	14	10,20
	2,5	1906	529	15500	22	32	7,12	26400	38	32	18,50
	3,5	2668	741	18700	19	55	10,10	32200	33	55	26,60
	5	3812	1059	22600	16	99	14,40	39000	28	99	38
10	1,5	1143	318	8680	32	13	2,44	16400	52	13	7,58
	2,5	1906	529	11800	28	31	4,33	22600	44	31	13,80
	3,5	2668	741	14300	25	53	6,16	27500	40	53	19,90
	5	3812	1059	17200	23	96	8,72	33400	35	96	28,60
20	1,5	1143	318	6110	36	13	1,27	13700	56	13	5,43
	2,5	1906	529	8280	33	29	2,24	18900	49	29	9,89
	3,5	2668	741	9980	31	51	3,16	23000	46	51	14,30
	5	3812	1059	12000	29	92	4,45	28000	42	92	20,50

Pressure-Reducing Box EBE / EBP

Heating register

EBE / EBP 400 H1 (1 duct row)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	1802	501	8630	13	6	3,57	14900	23	6	9,18
	2,5	3004	834	11200	10	13	5,80	19400	18	13	15,10
	3,5	4205	1168	13400	9	22	8,00	23200	15	22	20,80
	5	6008	1669	15900	7	40	11,00	27700	13	40	28,90
10	1,5	1802	501	6580	21	5	2,17	12700	30	5	6,90
	2,5	3004	834	8580	18	12	3,53	16700	26	12	11,30
	3,5	4205	1168	10200	17	22	4,87	19900	24	22	15,70
	5	6008	1669	12200	16	39	6,72	23800	21	39	21,90
20	1,5	1802	501	4570	28	5	1,11	10600	38	5	4,96
	2,5	3004	834	5960	26	12	1,80	14000	34	12	8,17
	3,5	4205	1168	7090	25	21	2,49	16700	32	21	11,40
	5	6008	1669	8450	24	37	3,43	20000	30	37	15,80

EBE / EBP 400 H2 (2 duct rows)

T_E	v_0	V		T_W (°C) 60/40				90/70			
				Q	T_A	Pa_L	Pa_W	Q	T_A	Pa_L	Pa_W
(°C)	(m/s)	(m³/h)	[l/s]	(W)	(°C)	(Pa)	(kPa)	(W)	(°C)	(Pa)	(kPa)
0	1,5	1802	501	17900	28	14	3,83	30300	47	14	9,54
	2,5	3004	834	24500	23	32	6,81	41800	39	32	17,30
	3,5	4205	1168	29600	20	55	9,67	50800	34	55	24,80
	5	6008	1669	35800	17	99	13,70	61600	28	99	35,40
10	1,5	1802	501	13800	32	13	2,36	25900	51	13	7,14
	2,5	3004	834	18800	28	31	4,17	35800	44	31	12,90
	3,5	4205	1168	22700	26	53	5,91	43500	40	53	18,60
	5	6008	1669	27400	23	96	8,34	52800	35	96	26,60
20	1,5	1802	501	9710	36	13	1,24	21700	56	13	5,14
	2,5	3004	834	13200	33	29	2,18	29900	50	29	9,31
	3,5	4205	1168	15900	31	51	3,07	36400	46	51	13,40
	5	6008	1669	19100	29	92	4,30	44300	42	92	19,20

Pressure-Reducing Box EBE / EBP

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 controller Belimo product LMV-D3-MP Compact is 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 chart, 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 2-10 V DC). Accordingly, the 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 damper 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.

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 product, type VRU-D3-BAC, actuator type NF24A-VST). 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 command signal) has not been assigned, the value set from V_{min} is controlled as a constant volumetric flow.

Two-stage volumetric flow rate control

Stage 1: If terminal 3 (Y command signal) has not been assigned, the value set from V_{min} is controlled as a constant volumetric flow.

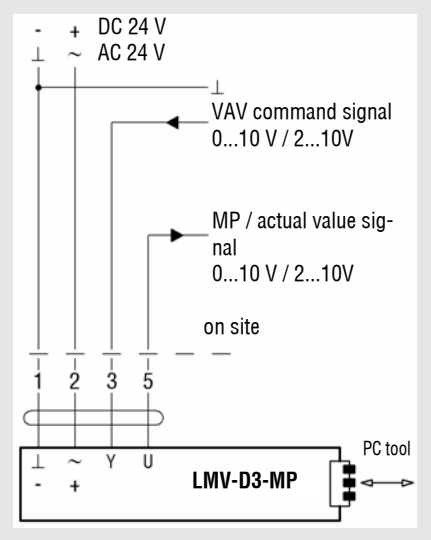
Stage 2: If AC 24 V is applied to terminal 3, the volumetric flow controller keeps the value set as V_{max} constant. With a switch or a contact in a connection line a "secondary volume flow control" is possible.

Pressure-Reducing Box EBE / EBP

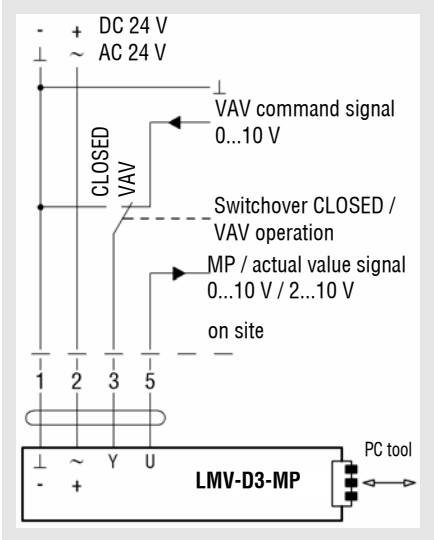
Circuit diagrams

Circuit diagram electric controller (standard)
Compact controller Belimo make LMV-D3-MP

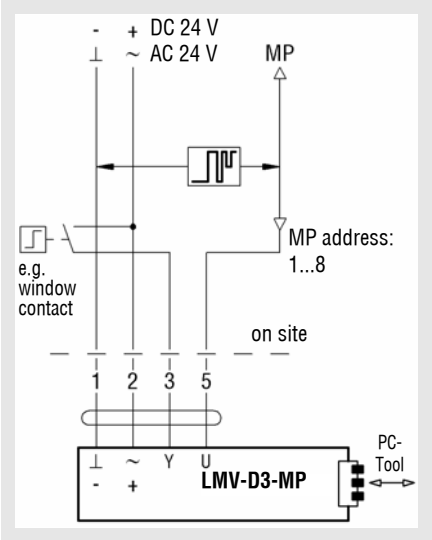
VAV with analogue command signal



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



MP bus activation with integrated switch

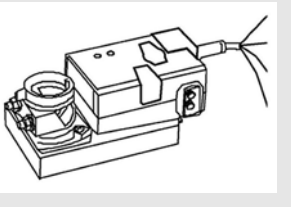


Lock mode (CLOSED)
In the 2...10 V mode, the following function can be carried out with a 0...10 V signal:

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}

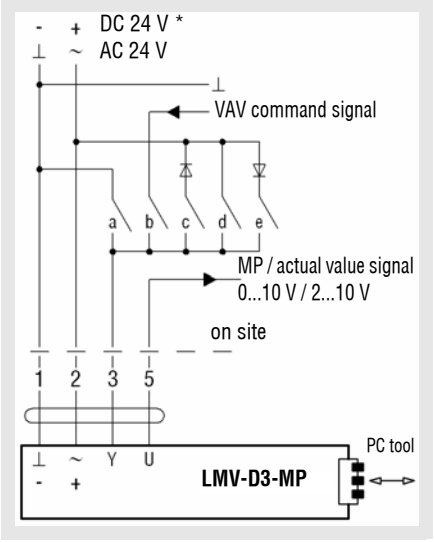
**Attention: Controller/DDC must be able to pull the command signal to 0 V.

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

CAV operation / positive contacts



Note: Please ensure mutual locking of the contacts!

CAV function for LMV-D3-MP

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

Pressure-Reducing Box EBE / EBP

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	- 24 V power supply o.k. - VAV-Compact ready for operation	LED 1 LED 2	
S1 service function	Synchronisation	Synchronisation started by: a) Operating / service unit b) Manual trigger device at the VAV-Compact c) Power ON behaviour	LED 1 LED 2	Start 1.) →
S2 service function	Adaptation	Adaptation started by: a) Operating / service unit b) Key on the VAV-Compact	LED 1 LED 2	Start 2.) →
V1 VAV service	VAV service active	a) Press both keys «Adaptation» & «Address» simultaneously b) VAV service will be activated: - until 24 V supply is switched off - until both keys are pressed again - after 2 hours have passed	LED 1 LED 2	
	Lack of air	Damper opens as actual volume is too low	LED 1 LED 2	
	Target volume reached	Control circuit balanced	LED 1 LED 2	
	Air excess	Damper closes as actual volume is too high	LED 1 LED 2	
B1 bus operation	Addressing via MP master (Acknowledgement at the VAV-Compact)	a) Addressing has been triggered at the MP master	LED 1 LED 2	
		b) Press addressing key LED will switch to the communication display as soon as the addressing process is complete.	LED 1 LED 2	◀ On event ▶ 3.)
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.	LED 1 LED 2	◀ Not address. ▶ 3.)
B3 bus operation communication	MP-PP display Communication	Communication display via MP master or operating / service unit	LED 1 LED 2	3.)

green LED (power) is lit

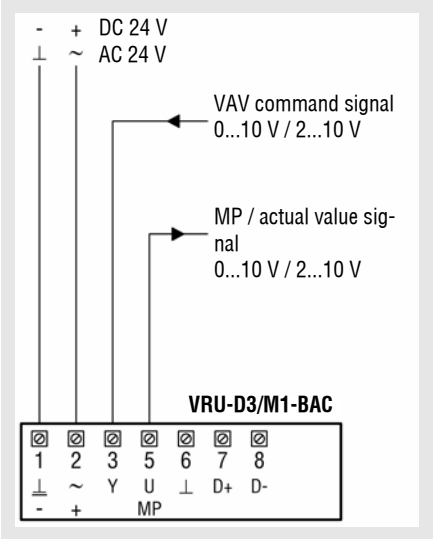
yellow LED (status) is lit

yellow LED (status) is flashing

1.) Synch time
2.) Adaptation time
3.) MP communication

Pressure-Reducing Box EBE / EBP

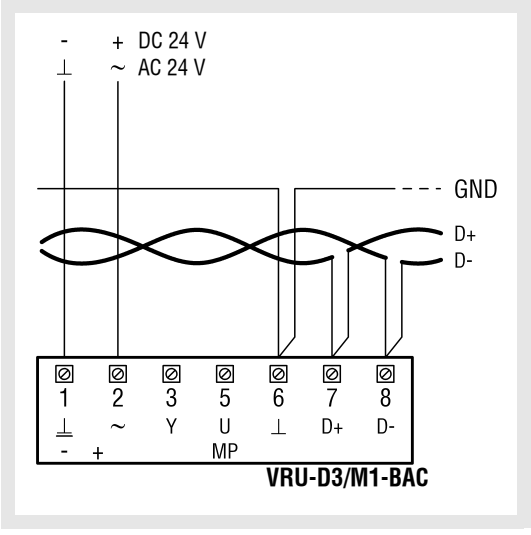
Circuit diagram of electric controller (alternative)
Universal controller Belimo make VRU-D3/M1-BAC
VAV with analogue command signal



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.

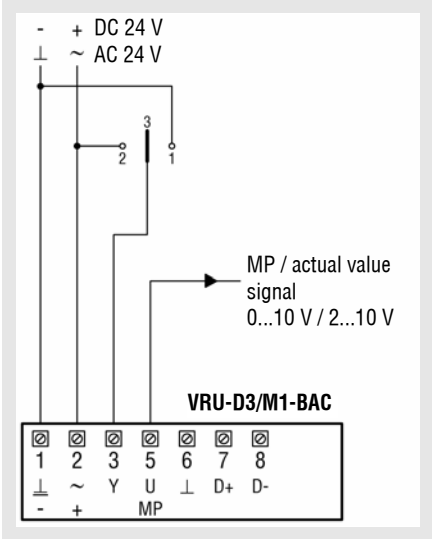
BACnet MS/TP / Modbus RTU operation



Priority rule - BACnet/Modbus control

1. z1
2. z2
3. Bus watchdog
4. a) Adaptation
   b) Synchronisation
5. Bus positive control
6. Bus setpoint value: Min...Max

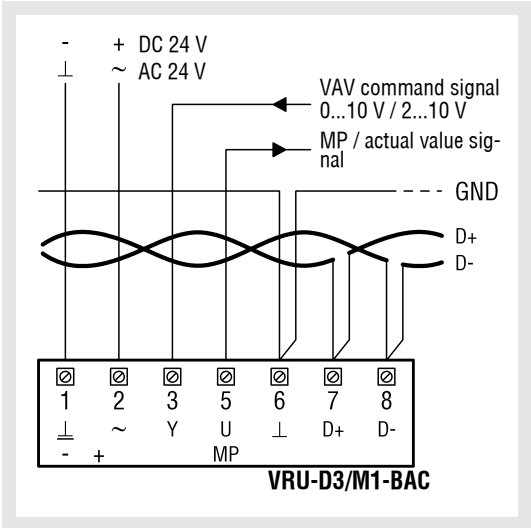
CAV operation



Priority rule - Analogue CAV step control

1. Damper CLOSED
2. V_{max}
3. V_{min}

BACnet MS/TP / Modbus RTU hybrid operation



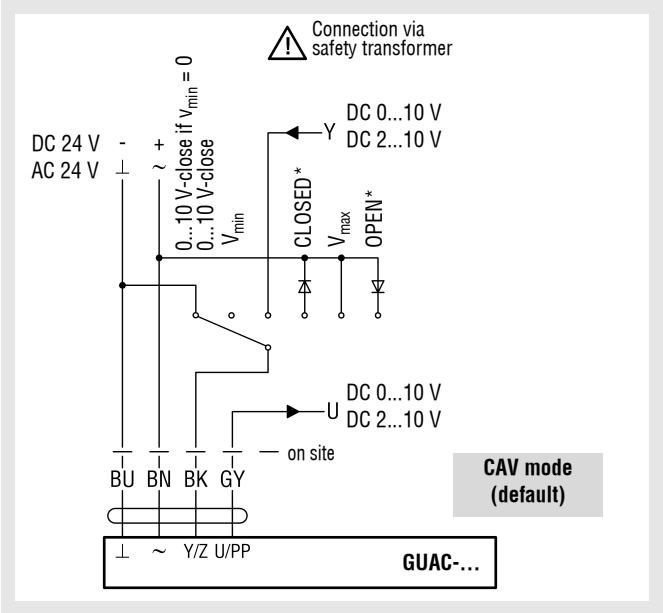
Priority rule - BACnet/Modbus hybrid operation

1. z1
2. z2
3. Bus watchdog
4. a) Adaptation
   b) Synchronisation
5. Bus positive control
6. Y stage: actuator CLOSED / MIN / MAX
7. Bus setpoint value: Min...Max

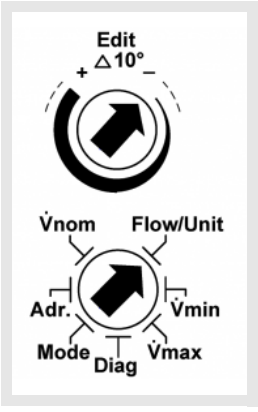
Pressure-Reducing Box EBE / EBP

Circuit diagram of electric controller (alternative)

Controller Gruner make:
GUAC-SM3/SCH Universal
Connection diagram



Setting

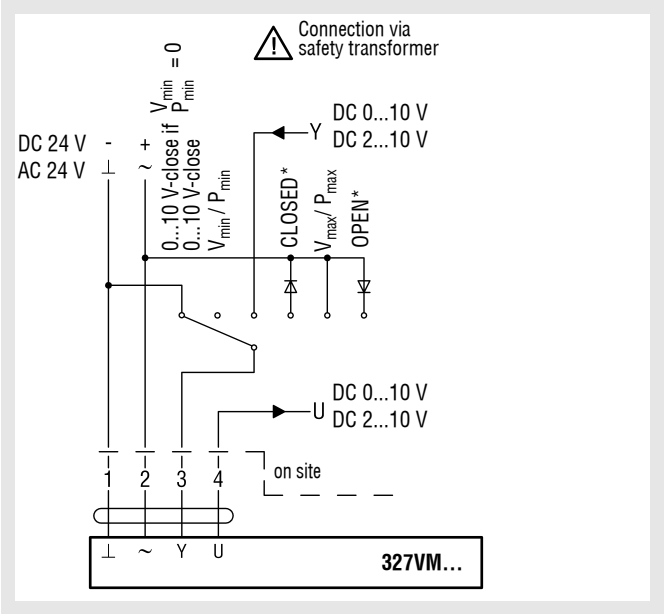


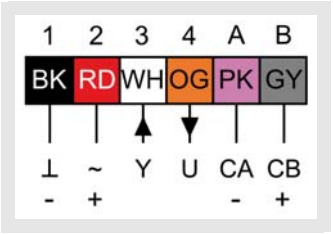
Edit:	The selector value allows values to be changed. The position of the arrow shows the set value. The changes are displayed as soon as the selector is moved ± 10 ° out of its position.
Flow / Unit:	To set the desired current volumetric flow unit in m³/h and l/s.
V_{min}:	To set the required min. volumetric flow (setpoint value Y = 0 V / 2 V)
V_{max}:	To set the required max. volumetric flow (setpoint value Y = 10 V)
Mode:	(To set the direction of rotation) 0-n...0-10 V normal (clockwise) 2-n...2-10 V normal 0-i ...0-10 V inverse (counterclockwise) 2-i ...2-10 V inverse
Diag:	Diagnostics menu: oP = opens the damper leaf cL = closes the damper leaf Hi = activates V_{max} Lo = activates V_{min} on = Diagnostic mode is on, motor is off off = Diagnostic mode is off, display Y setpoint
V_{nom}:	To display and set the nominal volumetric flow (by the box manufacturer only).
(for more information, please refer to data sheet **327VM-024-05-VM** from Gruner)	

Pressure-Reducing Box EBE / EBP

Circuit diagram of electric controller (alternative)

Controller Gruner make 327V? Compact
Connection diagram





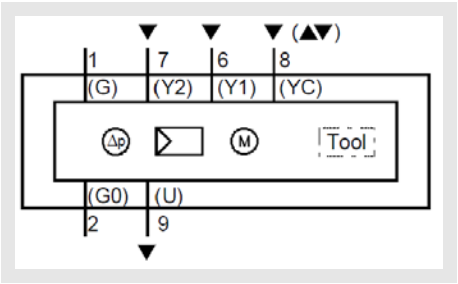
No.	Designation		Wire colour	Function
1	——	-	black	Power supply 24 V AC/DC
2	——	+	red	
3	◄—	Y	white	Input signal 0-10 V DC
4	—►	U	orange	Feedback signal 0-10 V DC
A	CA -		pink	Modbus RTU connection (RS485)
B	CB +		grey	

Act / Set:	Display of current value / setpoint value or positive control.
Min:	To set the required min. value (setpoint value Y = 0 / 2 V DC).
Max:	To set the required max. value (setpoint value Y = 10 V DC).
Diag:	Diagnostics menu: y/u - Display of setpoint value / feedback signal oP - opens the damper leaf cL - closes the damper leaf Hi - activates max. value Lo - activates min. value bE - activates intermediate value St - diagnostic mode is on, motor is off Adp - adaptation travel (only for Modbus version) 123 - software version
Mode:	0An (0-10 V DC I standard direction of rotation) 2An (2-10 V DC I standard direction of rotation)
Addr.:	Setting the Modbus address (1...247) and Modbus parameters (if the actuator is Modbus-capable).
Nom:	Display & setting of the nominal value, depending on the VAV box (setting is only possible with volumetric flow rate control).
Settings:	327 VAV controllers can be set directly on the display. All 327 VAV controllers can communicate with the setting device GUIV3-M or with the setting software Win-VAV2 via the service connection. When using the setting software WIN-VAV2, the GUIV3-S serves as an interface converter.
Accessories:	GUIV3-M – service plug + setting device GUIV3-M WIN-VAV2 bundle – service plug + interface converter GUIV3-S + setting software WIN-VAV2

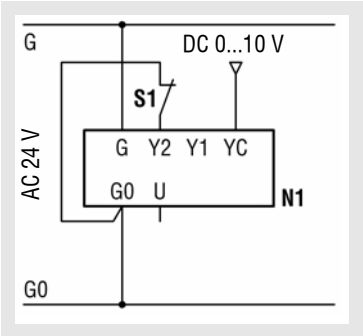
Pressure-Reducing Box EBE / EBP

Circuit diagram of electric controller (alternative)

Controller Siemens product: GDB181.1 E/3
Connection diagram



Constant control between
V_{max} and V_{min} and complete lock

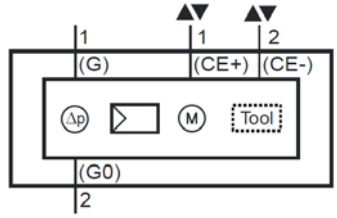


The wires of the connecting cable are colour-coded and labelled:

AB	AF	CO	Meaning
1	red	G	Phase AC 24 V
2	black	G0	System zero AC 24 V
6	violet	Y1	"Actuator direction of rotation" actuator signal (G0 switched), depends on the setting of AST10 or ACS931 (factory setting=clockwise rotation)
7	orange	Y2	"Actuator direction of rotation" actuator signal (G0 switched), depends on the setting of AST10 or ACS931 (factory setting=counter-clockwise rotation)
8	grey	YC	Volumetric flow command signal DC 0...10 V (setpoint) or communication signal, with connected setting device AST10 or interface converter AST11
9	pink	U	Volumetric flow measuring signal DC 0...10 V (actual value)

AB = Wire labelling
AF = Wire colour
CO = Terminal code (Landis & Staefa)

Controller Siemens product: GDB181.1 E/KN
Connection diagram for KNX



The wires of the connecting cable are colour-coded and labelled:

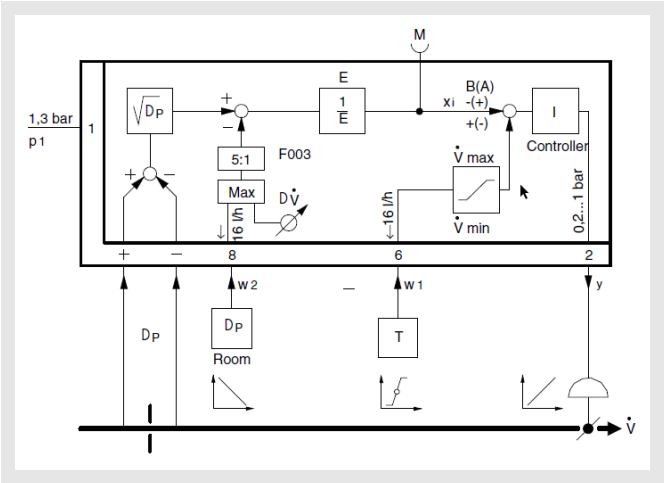
AB	AF	CO	Meaning
Cable 1: supply / black sheath			
1	red	G	Voltage phase AC 24 V
2	black	G0	Voltage neutral conductor AC 24 V
Cable 2: bus connection / green sheath			
1	red	CE+	Bus connection (KNX / PL-Kink)
2	black	CE-	Bus connection (KNX / PL-Kink)

AB = Wire labelling
AF = Wire colour
CO = Terminal code (Landis & Staefa)

Pressure-Reducing Box EBE / EBP

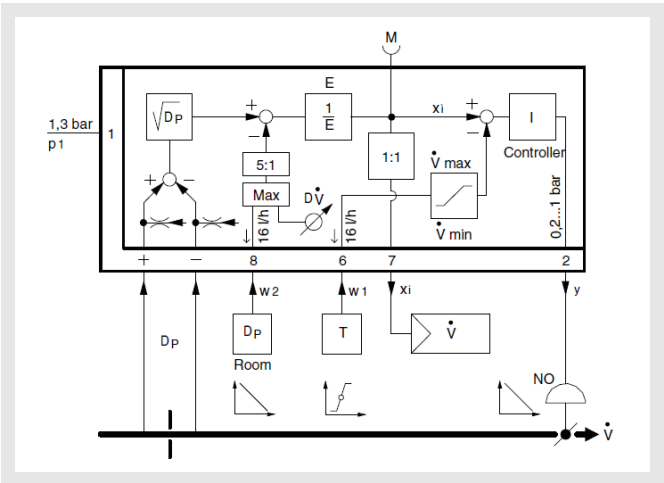
Circuit diagram of pneumatic controller (standard)

Compact controller Sauter make RLP100 F003



Circuit diagram of pneumatic controller (alternative)

Compact controller Sauter make RLP100 F914



w = Command variable
Δp = Pressure difference
v = Output pressure
y (2) = Output to the actuator

Pressure-Reducing Box EBE / EBP

Setting the operating potentiometers / calculation formulae

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.

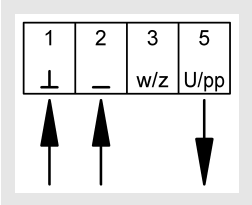
EW (%) = Set value
EK (m/s) = Calibration curve
U_5 (V DC) = U_5 signal
F (m^2) = Surface

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

Pressure-Reducing Box EBE / EBP

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

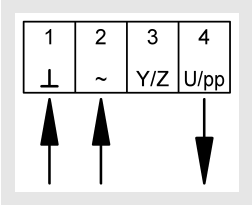
Terminal assignment
LMV-D3-MP



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)

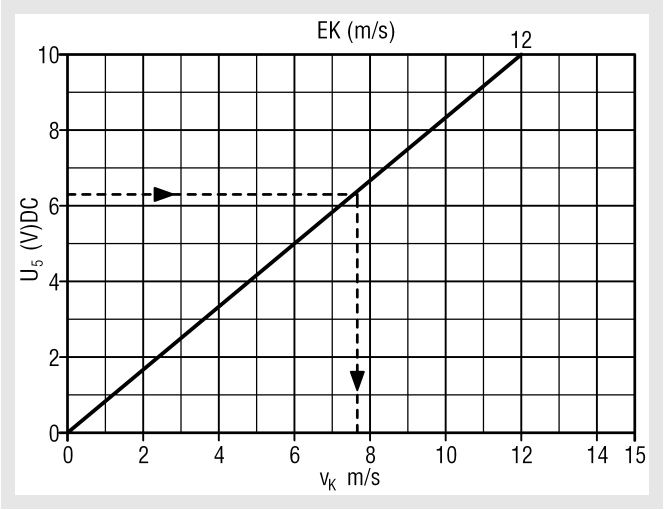
The actual value signal U_5 is a real feedback of the volumetric flow actual value for monitoring and controlling the air throughput volume.

327VM-... / GUAC-...



Supply voltage: 24 V AC/DC (terminals 1+2)
Measurement output 2 - 10 V DC (terminals 1+4)
Measurement output 0 - 10 V DC (terminals 1+4)

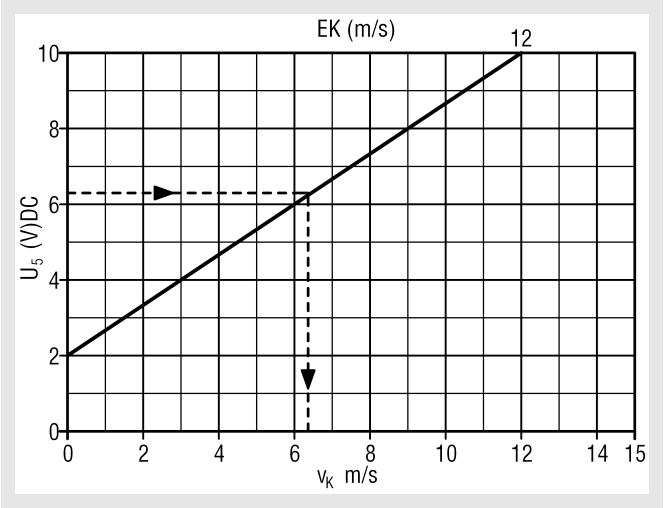
U_5 signal 0-10 V DC



Example

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

Pressure-Reducing Box EBE / EBP

Technical data of controllers and motors

Standard electric controller

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 volumetric flow
Measuring range 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...28.8 V
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...10 V
MP bus function Address in bus mode:	1 ... 8 (traditional operation: PP)
KNX/MODBUS RTU/ BACnet:	with BELIMO gateway UK24MOD/-BAC, 1 ... 8 BELIMO MP devices (VAV / flap drive/ valve)
DDC controller:	DDC controller / PLC from different manufacturers, with integrated MP interface
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)
Degree of protection:	IP 54 (hose-connected)
EMC:	CE according to 39/336/EEC
Measuring air and ambient temperatures:	0 °C to +50 °C, 5-95% relative humidity, non-condensing
Storage temperature:	-20 °C to +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

Alternative electric controller

VRU-D3-BAC (make Belimo)
Self-adapting digital volumetric flow/pressure controller, with integrated dynamic pressure sensor. Position-independent as a communication-capable universal solution with external actuators.

Measuring principle:	dynamic differential pressure measurement
Measuring range sensor:	2... ~500 Pa (bursting pressure +/- 10 kPA)
Sensor functional range:	0... ~500 Pa
Supply voltage:	AC 24 V, 50/60 Hz, DC 24 V
Functional range:	AC 19...29 V / DC 19...29 V
Power consumption:	1.5 W (without actuator)
Dimensioning:	2 VA (with VST actuator)
Control function:	VAV/CAV, STP (pressure), open loop Supply/return air or stand-alone operation; positive control; master/slave or parallel circuit
Setting range: V_{min}/V_{max} (volumetric flow)	V_{min} = 0...100% of V_{nom} V_{max} = 20...100 % of V_{nom} $V_{kon.}$ = 0...100% of V_{nom}
Setting range: P_{min} to P_{max} (pressure)	P_{min} = 0…100% of P_{nom} P_{max} = 20…100% of P_{nom} $P_{kon.}$ = 0…100% of P_{nom}
Bus function:	BACnet MS/TP, Modbus RTU, MP bus
Command variable Y/Z: (inherent resistance min. 100 kΩ)	DC 0-10 V DC 2-10 V variable
Setting range: (actual value signal U)	DC 0-10 V DC 2-10 V variable
Sensor integration:	passive or active sensors (0-10V) for example, humidity, temperature 2-point signal (switching power 16 mA @ 24 V), for example switch, motion detector
Protection class:	III Safety extra-low voltage (SELV)
Degree of protection:	IP42 (measuring hoses and actuator connected)
Ambient temperature:	0 °C to +50 °C (environment), 5-95% relative humidity, non-condensing
Storage temperature:	-20 °C to +80 °C, 5-95% relative humidity, non-condensing
Operation and service:	via the ZTH EU setting device, Belimo Assistant app (NFC, Bluetooth) or via feedback signal/service plug with Belimo PC-Tool
Connection:	Terminals 2.5 mm²
Dimensions:	170 x 98 x 58 mm
Weight:	approx. 340 g
Maintenance:	maintenance-free

Pressure-Reducing Box EBE / EBP

Alternative electric controller

VRU-M1-BAC (make Belimo)
Self-adapting digital volumetric flow/pressure controller, with integrated static pressure sensor. Position-independent as a communication-capable universal solution with external actuators.

Measuring principle:	static differential pressure measurement
Measuring range sensor:	0... ~600 Pa (bursting pressure +/- 10 kPA)
Sensor functional range:	0... ~600 Pa
Supply voltage:	AC 24 V, 50/60 Hz, DC 24 V
Functional range:	AC 19...29 V / DC 19...29 V
Power consumption:	1.5 W (without actuator)
Dimensioning:	2 VA (with VST actuator)
Control function :	VAV/CAV, STP (pressure), open loop Supply/return air or stand-alone operation; positive control; master/slave or parallel circuit
Setting range: V_{min}/V_{max} (volumetric flow)	V_{min} = 0...100% of V_{nom} V_{max} = 20...100 % of V_{nom} $V_{kon.}$ = 0...100% of V_{nom}
Setting range: P_{min} to P_{max} (pressure)	P_{min} = 0…100% of P_{nom} P_{max} = 20…100% of P_{nom} $P_{kon.}$ = 0…100% of P_{nom}
Bus function:	BACnet MS/TP, Modbus RTU, MP bus
Command variable Y/Z: (inherent resistance min. 100 kΩ)	DC 0-10 V DC 2-10 V variable
Setting range: (actual value signal U)	DC 0-10 V DC 2-10 V variable
Sensor integration:	passive or active sensors (0-10V) for example, humidity, temperature 2-point signal (switching power 16 mA @ 24 V), for example switch, motion detector
Protection class:	III Safety extra-low voltage (SELV)
Degree of protection:	IP42 (measuring hoses and actuator connected)
Ambient temperature:	0 °C to +50 °C (environment), 5-95% relative humidity, non-condensing
Storage temperature:	-20 °C to +80 °C, 5-95% relative humidity, non-condensing
Operation and service:	via the ZTH EU setting device, Belimo Assistant app (NFC, Bluetooth) or via feedback signal/service plug with Belimo PC-Tool
Connection:	Terminals 2.5 mm²
Dimensions:	170 x 98 x 58 mm
Weight:	approx. 340 g
Maintenance:	maintenance-free

GUAC-SM3/SCH (make Gruner)
Digital VAV controller, with static pressure sensor, position-independent als communication-capable universal solution.

Measuring principle:	static differential pressure measurement
Measuring range sensor:	0...~300 Pa (bursting pressure 1 bar)
Supply voltage:	AC 24 V, 50/60 Hz, DC 24 V
Functional range:	AC 19...29 V / DC 19...29 V
Power consumption:	0.5 W (without actuator)
Dimensioning:	1.5 VA (without actuator)
Control function:	VAV/CAV; Supply/return air or stand-alone operation; master/slave or parallel circuit
Setting range V_{min} to V_{max} :	V_{min} = 0...100% of V_{nom} V_{max} = 0...100% of V_{nom} $V_{konst.}$ = 0...100% of V_{nom}
Command variable Y/Z: (Inherent resistance at least 100 kΩ)	DC 0-10 V (0-20 mA at least 500 Ω input resistance) DC 2-10 V (4-20 mA at least 500 Ω input resistance)
Setting range (actual value signal U/ PP):	DC 0-10 V DC 2-10 V
DCC controller:	DCC controller or PLC
Sensor integration:	passive or active sensors (0-10V) for example, humidity, temperature 2-point signal (switching power 16 mA @ 24 V), for example switch, motion detector
Protection class:	III (Safety extra low voltage)
Degree of protection:	IP54 (measuring hoses connected)
Measuring air and ambient temp.:	0 °C to +70 °C (medium) 0 °C to +50 °C (environment), 5-95% relative humidity, non-condensing
Storage temperature:	-20 °C to +80 °C
Sound power level:	<35 dB(A)
Operation and service:	on the display, using a screwdriver directly at the device or via feedback signal/service plug using PC software
Connection:	cable 1000 mm, 4 x 0.75 mm² (halogen-free), terminals
Dimensions:	124 x 71.5 x 66.5 mm
Weight:	approx. 175 g
Maintenance:	maintenance-free

Pressure-Reducing Box EBE / EBP

Alternative electric controller

327VM-024-05-MB (-10, -15) (make Gruner)
Dynamic pressure sensor, digital VAV controller as a communication-capable VAV-Compact solution.

Measuring principle:	Pressure reading with volumetric flow
Measuring range sensor:	0... ~500 Pa (bursting pressure 1 bar)
Supply voltage:	AC 24 V, 50/60 Hz, DC 24 V
Functional range:	AC 19...29 V / DC 19...29 V
Power consumption:	2.5 W (5 Nm)
Dimensioning:	4.0 VA (5 Nm)
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} to V_{max} :	V_{min} = 0...100% of V_{nom} V_{max} = 0...100% of V_{nom} $V_{konst.}$ = 0...100% of V_{nom}
Command variable Y/Z: (Inherent resistance at least 100 kΩ)	DC 0-10 V (0-20 mA at least 500 Ω input resistance) DC 2-10 V (4-20 mA at least 500 Ω input resistance)
Setting range: (actual value signal U/PP)	DC 0-10 V DC 2-10 V
Bus function:	PP bus (open PP protocol) Modbus RTU, hybrid mode
DCC controller:	DCC controller or PLC
Sensor integration:	passive or active sensors (0-10V) for example, humidity, temperature 2-point signal (switching power 16 mA @ 24 V), for example switch, motion detector
Protection class:	III (Safety extra low voltage)
Degree of protection:	IP54 (measuring hoses connected)
Measuring air and ambient temp.:	0 °C to +70 °C (medium) 0 °C to +50 °C (environment) 5-95% relative humidity, non-condensing
Storage temperature:	-20 °C to +80 °C
Sound power level:	<35 dB(A)
Operation and service:	Plug-in via diagnostic plug to PC-Tool GUIV, manual setting device or feedback signal.
Communication:	Modbus RTU
Connection:	cable 1000 mm, 4 x 0.75 mm^2 (halogen-free), terminals
Dimensions:	115 x 65 x 61 mm
Weight:	approx. 550 g
Maintenance:	maintenance-free

327VM-024-05-DS4-MB (Gruner product)
Static pressure sensor, digital VAV and pressure controller as a communication-capable VAV-Compact solution.

Measuring principle:	static pressure measurement (position-independent)
Measuring range sensor:	0... ~300 Pa (bursting pressure 1 bar)
Supply voltage:	AC 24 V, 50/60 Hz, DC 24 V
Functional range:	AC 19…29 V / DC 19...29 V
Power consumption:	2.5 W (5 Nm)
Dimensioning:	4.0 VA (5 Nm)
Torque:	min. 5 Nm at the rated voltage
Control function:	VAV/CAV/Open-Loop; pressure control, supply/return air or stand-alone operation; master/slave parallel circuit; mixing box control
Setting range V_{min} to V_{max} :	V_{min} = 0...100% of V_{nom} V_{max} = 0...100% of V_{nom} $V_{konst.}$ = 0...100% of V_{nom}
Command variable Y/Z: (Inherent resistance at least 100 kΩ)	DC 0-10 V (0-20 mA at least 500 Ω input resistance) DC 2-10 V (4-20 mA at least 500 Ω input resistance)
Setting range: (actual value signal U/PP)	DC 0-10 V DC 2-10 V
Bus function:	Modbus RTU, hybrid mode
DCC controller:	DCC controller or PLC
Sensor integration:	passive or active sensors (0-10V) for example, humidity, temperature 2-point signal (switching power 16 mA @ 24 V), for example switch, motion detector
Protection class:	III (Safety extra low voltage)
Degree of protection:	IP54 (measuring hoses connected)
Measuring air and ambient temp.:	0 °C to +70 °C (medium) 0 °C to +50 °C (environment) 5-95% relative humidity, non-condensing
Storage temperature:	-20 °C to +80 °C
Sound power level:	<35 dB(A)
Operation and service:	Using the display by means of a screwdriver directly at the device or via the feedback signal.
Communication:	Modbus RTU
Connection:	cable 1000 mm, 4 x 0.75 mm^2 (halogen-free), terminals
Dimensions:	115 x 65 x 61 mm
Weight:	approx. 550 g
Maintenance:	maintenance-free

Pressure-Reducing Box EBE / EBP

Alternative electric controller

327V-024-05-DS6-MB (Gruner product)
Static pressure sensor, digital pressure controller as a communication-capable compact solution.

Measuring principle:	static pressure measurement (position-independent)
Measuring range sensor:	0... ~600 Pa (bursting pressure 1 bar)
Supply voltage:	AC 24 V, 50/60 Hz, DC 24 V
Functional range:	AC 19…29 V / DC 19...29 V
Power consumption:	2.5 W (5 Nm)
Dimensioning:	4.0 VA (5 Nm)
Torque:	min. 5 Nm at the rated voltage
Control function:	pressure control, open loop; supply/return air or stand-alone operation; master/slave parallel circuit;
Setting range P_{min} to P_{max} :	P_{min} = 0...100% of P_{nom} P_{max} = 0...100% of P_{nom} $P_{konst.}$ = 0...100% of P_{nom}
Command variable Y/Z: (Inherent resistance at least 100 kΩ)	DC 0-10 V (0-20 mA at least 500 Ω input resistance) DC 2-10 V (4-20 mA at least 500 Ω input resistance)
Setting range: (actual value signal U/PP)	DC 0-10 V DC 2-10 V
Bus function:	Modbus RTU, hybrid mode
DCC controller:	DCC controller or PLC
Sensor integration:	passive or active sensors (0-10V) for example, humidity, temperature 2-point signal (switching power 16 mA @ 24 V), for example switch, motion detector
Protection class:	III (Safety extra low voltage)
Degree of protection:	IP54 (measuring hoses connected)
Measuring air and ambient temp.:	0 °C to +70 °C (medium) 0 °C to +50 °C (environment) 5-95% relative humidity, non-condensing
Storage temperature:	-20 °C to +80 °C
Sound power level:	<35 dB(A)
Operation and service:	plug-in via diagnostic plug to PC-Tool GUIV, manual setting device or feedback signal
Communication:	Modbus RTU
Connection:	cable 1000 mm, 4 x 0.75 mm^2 (halogen-free), terminals
Dimensions:	115 x 65 x 61 mm
Weight:	approx. 550 g
Maintenance:	maintenance-free

Pressure-Reducing Box EBE / EBP

Alternative electric controller

GLB181.1 E/3 (make Siemens)
Digital VAV controller, with dynamic pressure sensor and integrated actuator, position-independent as a communication-capable VAV-Compact solution.

Measuring principle:	Pressure sensor for dynamic measurement of the effective pressure, automatic zero point calibration
Measuring range sensor:	0… ~500 Pa measuring range, 0… ~300 Pa operating range (bursting pressure 1 bar)
Supply voltage:	AC 24 V, 50/60 Hz, DC 24 V, ± 20 %
Functional range:	AC 19…29 V / DC 19…29 V
Torque:	min. 5 Nm at the rated voltage
Power consumption:	5.5 W (drive rotating) 0.5 W (stopping state)
Dimensioning:	7.5 VA (drive rotating) 1.0 VA (stopping state)
Control function:	VAV/CAV, open loop, Supply/return air or stand-alone operation; positive control; master/slave or parallel circuit
Setting range V_{min}/V_{max} :	V_{min} = -20…100% of V_{nom} V_{max} = 20…100% of V_{nom}
Setting range Command variable YC:	DC 0-10 V DC 2-10 V
Setting range Actual value signal U:	DC 0-10 V DC 2-10 V
Running time:	150 sec. for 90° angle of rotation
DCC controller:	DCC controller or PLC
Sensor integration:	passive or active sensors (0-10V)
Protection class:	III (Safety extra low voltage)
Degree of protection:	IP54 (measuring hoses connected)
Measuring air and ambient temperatures:	0 °C to +50 °C, 5-95% relative humidity, non-condensing
Storage temperature:	-25 °C to +70 °C
Operation and service:	via service socket with PC software ACS941 or AST 10 manual setting device
Connection:	cable 900 mm, 6 x 0.75 mm^2 (halogen-free)
Dimensions:	158 x 71 x 61 mm
Weight:	approx. 600 g
Maintenance:	maintenance-free

GDB181.1 E/KN (Siemens product)
Digital VAV controller, with dynamic pressure sensor and integrated actuator, position-independent as a communication-capable VAV-Compact solution with KNX.

Measuring principle:	Pressure sensor for dynamic measurement of the effective pressure, automatic zero point calibration
Measuring range sensor:	0…~500 Pa measuring range, 0…~300 Pa operating range (bursting pressure 1 bar)
Supply voltage:	AC 24 V, 50/60 Hz, DC 24 V, ± 20 %
Functional range:	AC 19…29 V / DC 19…29 V
Torque:	min. 5 Nm at the rated voltage
Power consumption:	2.5 W (drive rotating) 0.5 W (stopping state)
Dimensioning:	3.0 VA (drive rotating) 1.0 VA (stopping state)
Control function:	VAV/CAV, open loop, Supply/return air or stand-alone operation; positive control;
Setting range V_{min}/V_{max} :	V_{min} = -20…100% of V_{nom} V_{max} = 20…100% of V_{nom}
Setting range Command variable YC:	KNX bus
Setting range Actual value signal U:	KNX bus
Running time:	150 sec. for 90° angle of rotation
Protection class:	III (Safety extra low voltage)
Degree of protection:	IP54 (measuring hoses connected)
Measuring air and ambient temperatures:	0 °C to +50 °C (medium), 0 °C to +50 °C (environment), 5-95% relative humidity, non-condensing
Storage temperature:	-25 °C to +70 °C
Operation and service:	via service socket with PC software ACS941 or AST 10 manual setting device
Connection:	cable 900 mm, 2 x 2 x 0.75 mm^2 (halogen-free)
Dimensions:	158 x 71 x 61 mm
Weight:	approx. 600 g
Maintenance:	maintenance-free

Pressure-Reducing Box EBE / EBP

Standard pneumatic controller

RLP100 F003 (make Sauter)
Pneumatic integral volumetric flow controller in connection with a damper drive with control flap and a measuring sensor for use with fixed, switchover and variable control

Measuring principle:	High-precision, static differential pressure sensor
Measuring range sensor:	1...160 Pa
Feed pressure:	1.3 bar +/- 0.1 bar
Air consumption:	44 ln/h
Air flow pressure:	0.2...1.0 bar
Response sensitivity:	0.1 Pa
Allowed ambient temperature:	0 °C to +55 °C
Degree of protection:	IP 30
Control direction:	Depressurised CLOSED/OPEN (B/A)
Conforms to EN 13463-1 and EN 1127-1 (Ex II 2 G T6) and for use in potentially explosive atmospheres of Zone 1.	

For supply and return air (integral room air control system)

Alternative pneumatic controller

RLP100 F914 (make Sauter)
Pneumatic integral volumetric flow controller in connection with a damper drive with control flap and a measuring sensor for use with fixed, switchover and variable control Can be used if air

Measuring principle:	High-precision, static differential pressure sensor
Measuring range sensor:	1...160 Pa
Feed pressure:	1.3 bar +/- 0.1 bar
Air consumption:	44 ln/h
Air flow pressure:	0.2...1.0 bar
Response sensitivity:	0.1 Pa
Allowed ambient temperature:	0 °C to +55 °C
Degree of protection:	IP 30
Control direction:	Depressurised OPEN (A)
Conforms to EN 13463-1 and EN 1127-1 (Ex II 2 G T6) and for use in potentially explosive atmospheres of Zone 1.	

contains aggressive media.
For return air with aggressive gases (integral room air control system)

Damper actuators ...24A-VST (make BELIMO) for VRU-...-BAC

LM24A-VST
Actuator, communicative, with position feedback

Supply voltage:	AC 24 V, 50/60 Hz, DC 24 V, ready to plug in
Functional range:	AC 19.2-28.8 V / DC 21.6-28.8 V
Power consumption:	1 W (during operation)
Dimensioning:	2 VA
Torque:	5 Nm (at the rated voltage)
Running time for 90° (or 95°):	120 sec.
Activation:	communicative PP
Protection class:	III Safety extra-low voltage (SELV)
Degree of protection:	IP 54
Ambient temperature:	-30 °C to +50 °C, 5-95% relative humidity, non-condensing
Storage temperature:	-40 °C to +80 °C
Sound power level:	max. 35 dB(A)
Manual adjustment:	Gears are disengaged by pushbutton, self-restoring
Connection:	cable 500 mm with VST plug
Dimensions:	116 x 66 x 61 mm
Weight:	approx. 560 g
Maintenance:	maintenance-free

LMQ24A-VST
High-speed actuator, communicative,
with position feedback

Supply voltage:	AC 24 V, 50/60 Hz, DC 24 V, ready to plug in
Functional range	AC 19.2-28.8 V / DC 21.6-28.8 V
Power consumption:	13 W (during operation)
Dimensioning:	23 VA
Torque:	4 Nm (at the rated voltage)
Running time for 90°:	2.5 sec.
Activation:	communicative PP
Protection class:	III Safety extra-low voltage (SELV)
Degree of protection:	IP 54
Ambient temperature:	-30 °C to +50 °C, 5-95% relative humidity, non-condensing
Storage temperature:	-40 °C to +80 °C
Sound power level:	max. 54 dB(A)
Manual adjustment:	Gears are disengaged by pushbutton, self-restoring
Connection:	cable 500 mm with VST plug
Dimensions:	124 x 80 x 75 mm
Weight:	approx. 560 g
Maintenance:	maintenance-free

Pressure-Reducing Box EBE / EBP

Functional control

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 control during startup and service
If required, easily accessible setting potentiometers and connections allow set values and the correct operation of the pressure-reducing boxes to be reliably and quickly checked on-site.

Pressure-Reducing Box EBE / EBP

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.

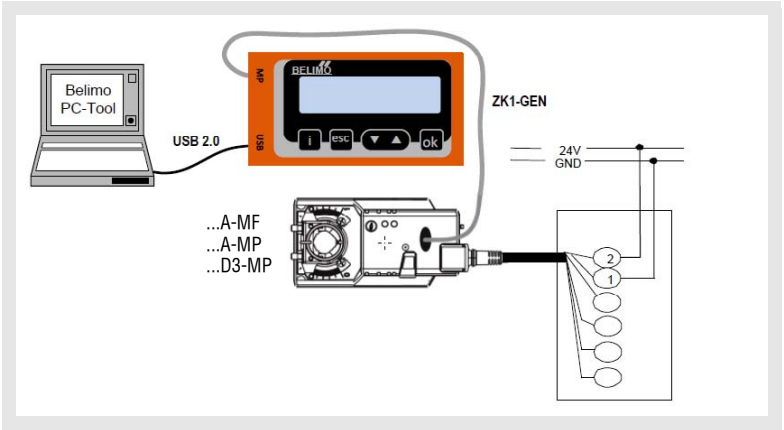
Driver

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

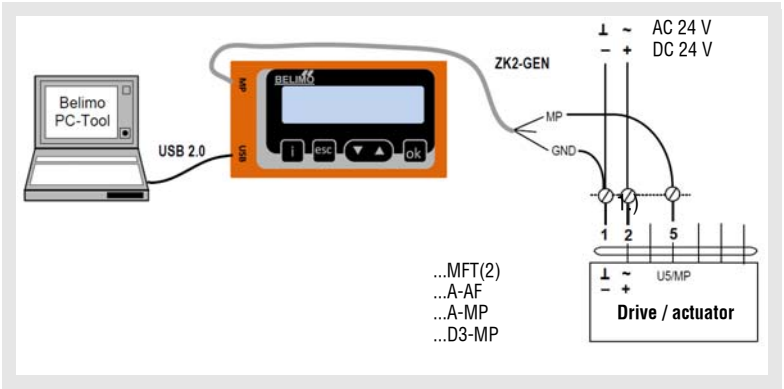
For connection to USB ports of PCs and BELIMO 24 V drives only (to safety extra low voltage SELV or US class 2 feeds).

Connection diagram 1



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

Connection diagram 2



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

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

Pressure-Reducing Box EBE / EBP

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

Brief 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).

Operating element:
LCD display:
- Backlight
- Display with 2 x 16 digits

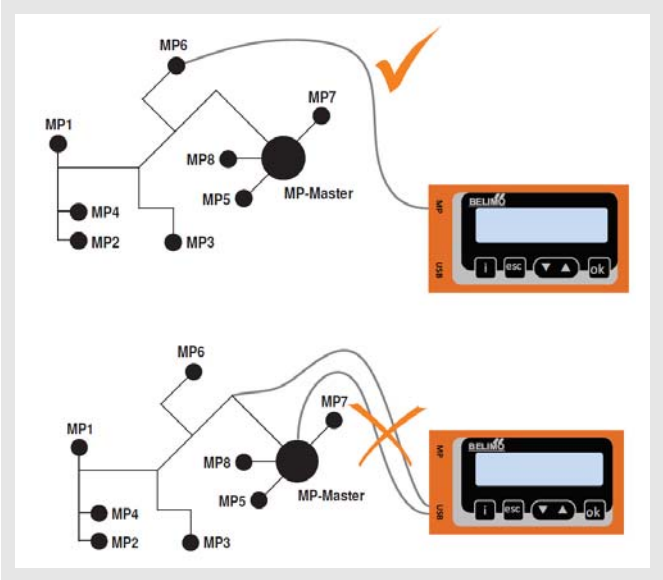
Key function:

▲▼	Forwards / backwards, change value / status
ok	Confirm input / switch to the submenu
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: LMV-D3-MP.
With the VRP-M and LMV-D3M, 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.

Pressure-Reducing Box EBE / EBP

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 with printed NFC label

Non-NFC-capable devices:

- All devices without NFC label

Start-up using the setting device GUIV-S

Application
The setting device GUIV-S is used by the start-up or service personnel in order to carry out simple settings to the equipment or to check the actual values.
The controller type 327VM does not have any operating elements such as switches or setpoint potentiometers. To program the operating modes and the operating parameters V_{min} and V_{max}, the setting device GUIV-S is required, which can also be used to switch from 2-10 V DC to 0-10 V DC.

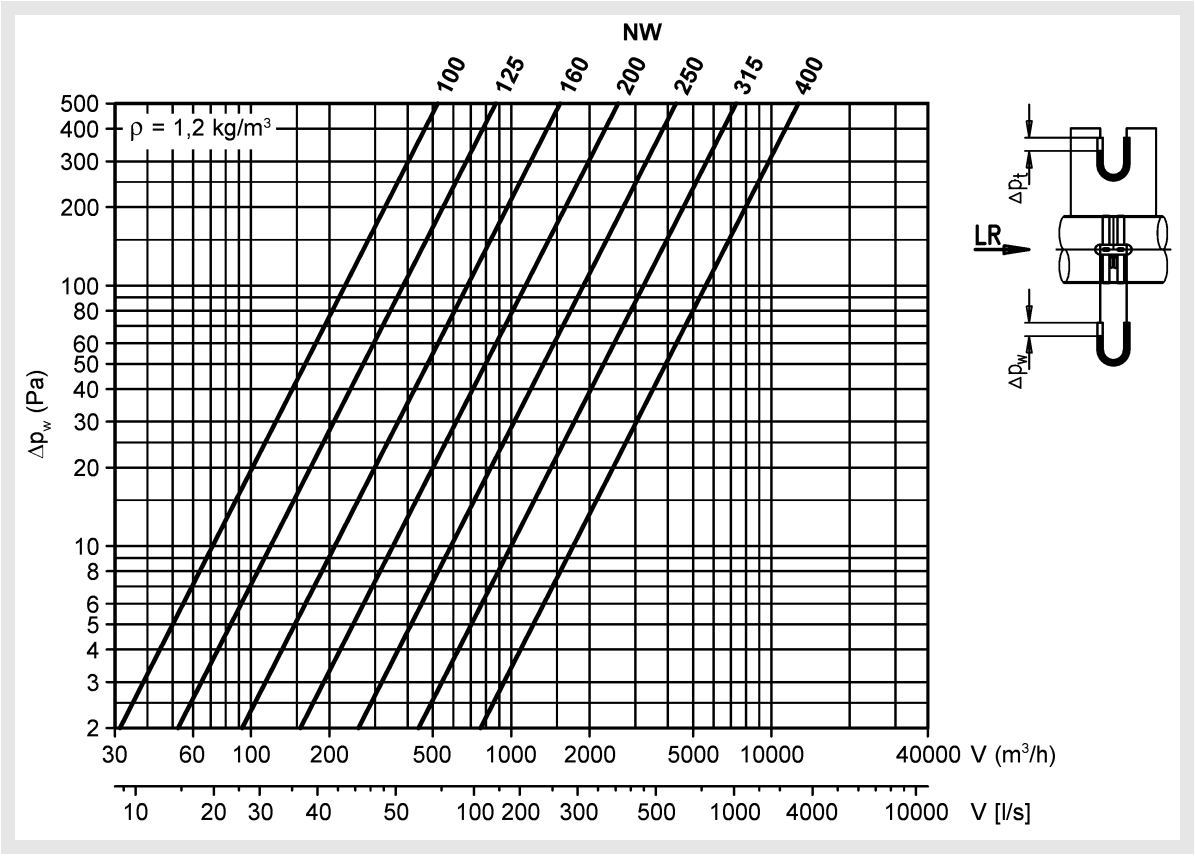
Connection
The GUIV-S can be connected electrically to 327VM via the U/PP connection by direct on-site or remote control, for example in a switch cabinet.

Structure and operation
The relevant parameters can be set and queried in the individual menu items, while the operating parameters programmed in-factory can be queried under menu item 10.

Note:
As long as the U/PP connector is connected to the GUIV-S, the actual value signal U does not correspond to the actual value.

Pressure-Reducing Box EBE / EBP

Differential pressure diagram
for EBE/EBP



Pressure-Reducing Box EBE / EBP

Controller selection

The selection of each actuator (torque) depends on the housing dimensions. The actuator is already selected and mounted at the factory.

Electric controller - standard				
Controller	**Actuator**	**DM**	**AN**	**AG**
- **Belimo** :				
- LMV-D3-MP	Compact	5 Nm	-	-A003

Electric controller - alternative				
Controller	**Actuator**	**DM**	**AN**	**AG**
- **Belimo** :				
- LMV-D3-MOD-F	Compact	5 Nm	-	-A140
- LMV-D3-KNX-F	Compact	5 Nm	-	-A141
- VRU-D3-BAC	LM24A-VST	5 Nm	-	-A142
	LMQ24A-VST	4 Nm	SL	-A145
- VRU-M1-BAC	LM24A-VST	5 Nm	-	-A150
	LMQ24A-VST	4 Nm	SL	-A153
- VRU-M1R-BAC	LMQ24A-VST	4 Nm	SL	-A158
- **Siemens** :				
- GDB181.1E/3	Compact	5 Nm	-	-A076
- GDB181.1E/KN	Compact	5 Nm	-	-A078
- **Gruner** :				
- GUAC-SM3/SCH	341C-024-05-V	5 Nm	FR	-A068
	328CS-024-05B-V/ST06	5 Nm	SL	-A070
- GUAC-PM3/SCH	341C-024-05-V	5 Nm	FR	-A072
	328CS-024-05B-V/ST06	5 Nm	SL	-A074
- GUAC-DM3/SCH	341C-024-05-V	5 Nm	FR	-A131
- 327VM-24-05-MB	Compact	5 Nm	-	-A160
- 327VM-24-05-DS4-MB	Compact	5 Nm	-	-A163
- 327VM-24-05-DS6	Compact	5 Nm	-	-A166

Pneumatic controller - standard				
Controller	**servo cylinder**	**DM**	**AN**	**AG**
- **Sauter** :				
- RLP100 F003	2x AK31P1 F001	70 N	LA	-A106

Pneumatic controller - alternative				
Controller	**servo cylinder**	**DM**	**AN**	**AG**
- **Sauter** :				
- RLP100 F914	2x AK31P1 F001	70 N	LA	-A108

Accessories:
S1A/S2A, limit switch make Belimo, to fit all new compact controllers and actuators of make Belimo.
ZTH EU, PC-Tool and ZTH EU for Belimo LMV-D3-MP for Siemens GLB 181.1 E/3 for Gruner 327VM.
Other modules are available upon request.

DM = Torque
AN = Actuator type
SL (High-speed damper drive)
FR (Spring return)
LA (Linear drive)
- (standard)
AG = Attachment assembly

Pressure-Reducing Box EBE / EBP

Maintenance and service

Assembly and maintenance instructions

1. When the device is delivered, check whether the controllers are complete and have been delivered without damage. Complaints have to be communicated immediately and directly to the transporter and SCHAKO.
2. The pressure-reducing boxes must not be carried on the regulation components, the measuring cross or the damper blade, but only on the housing.
3. The controllers must be carefully stored on-site. They must be protected from dust, dirt and from direct weather effects.
4. The controllers must be assembled in a way to allow inspection.
5. Assembly must be carried out by expert personnel, observing recognised technical rules and regulations.
6. **For polluted air, the pressure-reducing boxes must be used with an integrated controller with a static membrane pressure sensor. In this case, it is absolutely necessary to observe the mounting position. The pressure-reducing boxes are not suitable for air containing sticky and oily particles.**

Cleaning of the dynamic differential pressure sensor

The dynamic differential pressure sensor integrated into the **LMV-D3-MP** and **VRU-D3-BAC** 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.

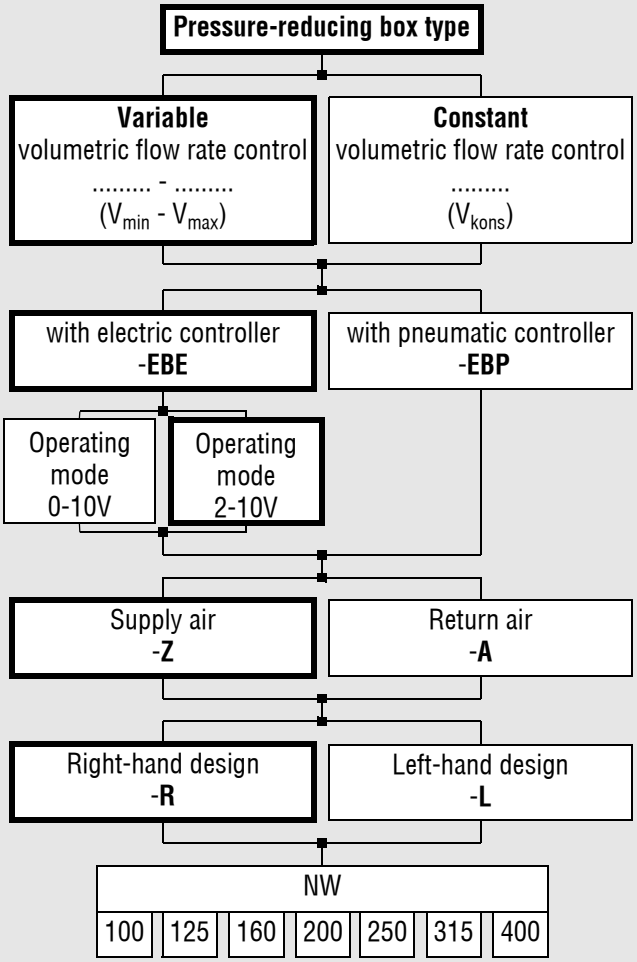
1. Pull off the pressure hoses from the sensor connection spigot of the LMV-D3-MP or of the VRU-D3-BAC.
   Attention! Make a note of the (+) and (-) assignments.
2. Using a suitable hand pump, blow air into the (-) spigot of the sensor (this will blow any dirt deposited inside the sensor out of the (+)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

Pressure-Reducing Box EBE / EBP

Legend

V_{ZU}	(m^3/h)	=	Supply air volume
V_{ZU}	[l/s]	=	Supply air volume
V	(m^3/h)	=	Air volume
V	[l/s]	=	Air volume
<		=	L_W value smaller than 15
Δp_t	(Pa)	=	Pressure loss
$\Delta p_{st\ min}$	(Pa)	=	Minimum static pressure difference
Δp_W	(Pa)	=	Differential pressure
Pa_L	(Pa)	=	Air-side pressure loss
Pa_W	(kPa)	=	Water-side pressure loss
v_K	(m/s)	=	Duct velocity
v_0	(m/s)	=	Air velocity in damper
RE	(m/s)	=	Controller calibration value
f_m	(Hz)	=	Octave centre frequency
D_e	[dB/Okt]	=	Insertion loss
L_W	[dB/Okt]	=	Sound power level/octave
L_{WA}	[dB(A)]	=	A-weighted sound power level
T_W	(°C)	=	Water inlet/outlet temperature
T_E	(°C)	=	Air inlet temperature
T_A	(°C)	=	Air outlet temperature
Q	(kW)	=	Power
U_5	(V) DC	=	Measurement output (electric voltage)
ρ	(kg/m^3)	=	Density
NW	(mm)	=	Nominal width
EW	(%)	=	Set value
EK	(m/s)	=	Calibration curve
F	(m^2)	=	Surface

Order details



Accesso-

Acoustic cladding **-DS**	Connection frame **-AR**
Additional silencer **-ZS**	Rubber lip seal **-GD**

Heating register	
1 row of pipes **-H1**	2 rows of pipes **-H2**

Order example:
EBE-V_{min}-V_{max}-Z-R-200-LMV-DS

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

Pressure-Reducing Box EBE / EBP

Specification texts

Pressure-reducing box for use in supply air systems, for spiral duct connection to DIN EN 1506 with integrated volumetric flow controller for use in constant or variable volumetric flow, room or duct pressure control. With positive control V_{min}, V_{max} or "CLOSED". Allowed pressure difference range: 50-1000 Pa, allowed ambient temperatures 0-55 C. Suitable for use with duct velocities of 2-12 m/s. It is possible to subsequently adjust the manufacturer set operation volumetric flow at any time. The actual throughput of the volumetric flow can be measured via the U5 signal. The output signal can be used for master/slave or parallel operation of several controllers or for actual value display 2-10 V DC (0-10 V DC), which corresponds to 0-100 % of the set V_{max} in DDC/ZLT systems. Standard production of the galvanised sheet steel housing with mineral wool lining, with guiding grille made of galvanised perforated sheet steel, with damper blade made of galvanised sheet steel and silicone-free damper blade seal made of PUR for airtight design according to DIN EN 1751 (class 2 NW100 only, class 3 NW125 - 400 only), housing leakage class B according to DIN EN 1751, with measuring cross blades made of extruded aluminium profile, blade mount made of plastic material (PA6). A special measuring cross allows position-independent mounting. With electric controller, control voltage 24 V AC, 50/60 Hz, temperature compensation of 10-40 C, wired and adjusted in factory.
Product: SCHAKO **type EBE-Z**

- For use in return air systems.
  Product: SCHAKO **type EBE-A**

- With spring return actuator (at an extra charge).
  - currentless "CLOSED"
  - currentless "OPEN"

- With pneumatic controller, feed pressure 1.2 ± 0.1 bar, for use with duct velocities 3-12 m/s.
  - Depressurised "CLOSED" or
  - depressurised "OPEN"

  Requirement: measuring air 0 C to +50 C, 5-95% relative humidity, non-condensing. For use in supply air systems.
  Product: SCHAKO **type EBP-Z**
  - For use in return air systems.
    Product: SCHAKO **type EBP-A**

Model:

- right (-R)
- Left (-L)

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), for connecting EBE/EBP to additional silencer.

- Additional silencer (-ZS) made of galvanised sheet steel with mineral wool lining and perforated cover:

- Heating register (-H1/-H2): with connection via an external thread, operating pressure 8 bar, test pressure 16 bar, consisting of galvanised sheet steel frame, copper pipes, steel collector, aluminium blades.
  - 1 row of pipes
  - 2 rows of pipes

- Rubber lip seal (-GD), made of special rubber.