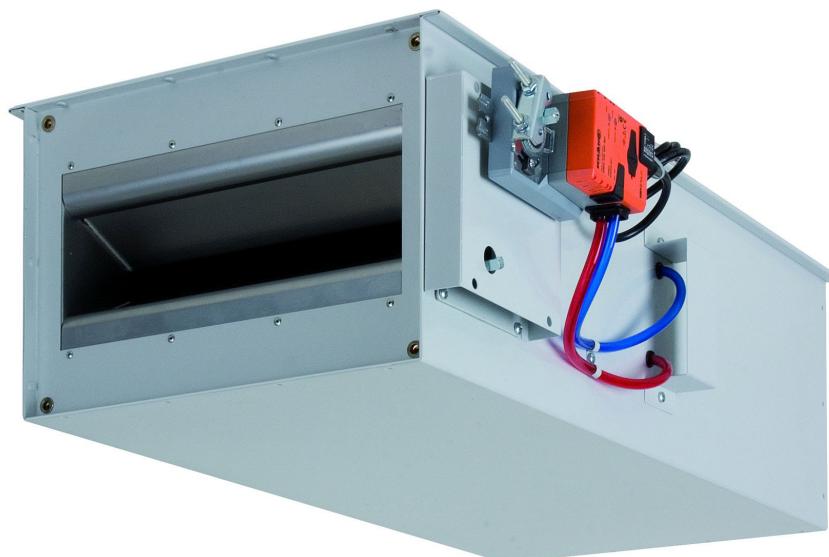




Sound-damped Volumetric flow controller Piano / Piano-S



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Sound-damped volumetric flow controller model Piano / Piano-S

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Sound-damped volumetric flow controller model Piano / Piano-S

Description

The shorter design compared with conventional pressure reducing boxes simplifies mounting in constricted places and allows space to be saved due to the low overall height. Due to the smaller dimensions, installation has been radically simplified.

The sound-damped volumetric flow controller type Piano with rectangular connection can be connected to rectangular ducts to DIN 24190 or to spiral ducts to DIN 24145 via a transition piece. This allows the sound-damped volumetric flow controller type Piano to be used for different applications in reconstruction.

The integrated aerodynamically optimised closing profile can be completely opened to achieve a free flow cross-section of 100%. This free cross-section, which is as high as possible, reduces pressure losses and minimises flow generated noise. Due to its optimum aerodynamic flow characteristics, it does not require inflow and outflow distances! This allows the sound-damped volumetric flow controller model Piano also to be used in places where space is very constricted. Due to the minimal pressure loss, the running operating costs of the air-conditioning system are also reduced. The sound-damped volumetric flow controller type Piano / Piano-S can already be used at a static pressure difference of as little as 20 Pa, i.e., the duct network and the fan can be designed for small air velocities, which makes the Piano / Piano-S suitable for use in low-pressure systems.

The radiated noise can be reduced further by mounting a newly developed flat-bed acoustic cladding at an extra charge. The flat-bed acoustic cladding achieves the same reduction of the radiated noise as the previously used mineral wool acoustic claddings, but at a minimum installation height.

For reducing the flow generated noise, the type Piano-S, which has a longer silencer unit, can be used in place of the type Piano. This makes it possible to do without an additional silencer, thus reducing the mounting time and simplifying handling.

The sound-damped volumetric flow controller type Piano consists of a galvanised sheet steel housing and an integrated silencer portion 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 value can be measured via the output signal. Setpoints are initially set ex works. During this in-factory setting, the functions of all sound-damped volumetric flow controllers 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.

The volumetric flow controller is largely insensitive to the in-

flow, owing to the built-in measuring cross.

12 measuring points are distributed on this measuring cross according to the median line method. Compared with measuring rods having only 4 measuring points or measuring orifices, this gives optimum measurement results.

A cover protects the peripheral gear wheels from outside dirt and reduces the personal risks of injury during assembly or maintenance.

When using the controllers in systems with heavy dust contamination, suitable filters must be connected upstream. For polluted air, the sound-damped volumetric flow controllers 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 sound-damped volumetric flow controllers are not suitable for air containing sticky and oily particles.

The standard compact controller make Belimo, type NMV-D3-MP, opens the control damper clockwise.

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 20 to 1000 Pa
- for air velocities in the silencer gap from 2.0 - 12 m/s
- for temperature compensations of 10 - 40°C
- for ambient temperatures of 0 - 55°C
- Connection voltage for Piano (electronic): 24 V AC, -0 % +10 %, 50 / 60 Hz
- Control signal 0(2) - 10 V DC
- For reducing the flow generated noise, type Piano-S has a longer silencer unit.
- Additional flat-bed acoustic cladding to reduce radiated noise available at an extra charge. The acoustic cladding is integrated into the unit, thus not changing or increasing the unit dimensions.

Information regarding Piano-A / Piano-S-A:

If a fire damper or a baffle silencer is mounted in front of the return air model, a minimum distance of 300 mm must be maintained.

Sound-damped volumetric flow controller model Piano / Piano-S

Construction

Housing

- Standard (-): made of galvanised sheet steel, lined with mineral wool (abrasion-resistant up to an air velocity of 20 m/s in the duct).

Damper leaves

- Standard (-): made of extruded aluminium profile, tightness element made of plastic (polyurethane).

Measuring cross

- Standard (-): made of extruded aluminium profile

Gear wheel segments

- Steel, peripheral, arranged on one side, covered.

with damper leaf open

NW	FQ (m ²)
1	0,010
2	0,016
3	0,025
4	0,040
5	0,064
6	0,048
7	0,076
8	0,120

FQ (m²) = Free cross-section

model

Piano	- Standard
Piano-S	- Extended version
...-E	- with electronic controller
...-P	- with pneumatic controller
...-...-Z	- Supply air
...-...-A	- Return air
...-...-A-DD	- Return air, for aggressive media
...-...-...-R	- right-hand design
...-...-...-L	- left-hand design

Accessories

Flat-bed acoustic cladding (-FDS)

- Galvanised sheet steel, with sound-absorbing lining.

Rubber lip seal (-GD)

- Special rubber (-ÜS only)

Heating register (-H2/-H4)

- With 2 or 4 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

Transition piece

- (-ÜS) for round ducts, high-pressure side, made of galvanised sheet steel
- (-ÜSE) for rectangular ducts, high-pressure side, made of galvanised sheet steel

DD coating (-DD)

- for aggressive return air, coated with PUR paint on all sides

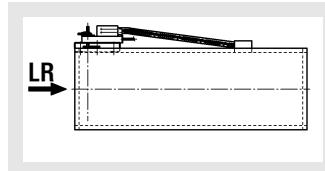
Attention:

The Piano units must be mounted via suitable, commercially available mounting rails and approved dowels only. Their dimensioning must be performed on-site. Free cross-section (-FQ)

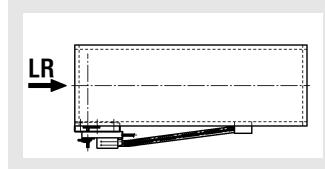
Models and dimensions

Models

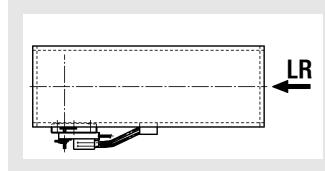
Supply air left-hand model top view



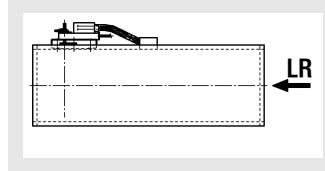
Supply air right-hand model top view



Return air left-hand model top view



Return air right-hand model top view

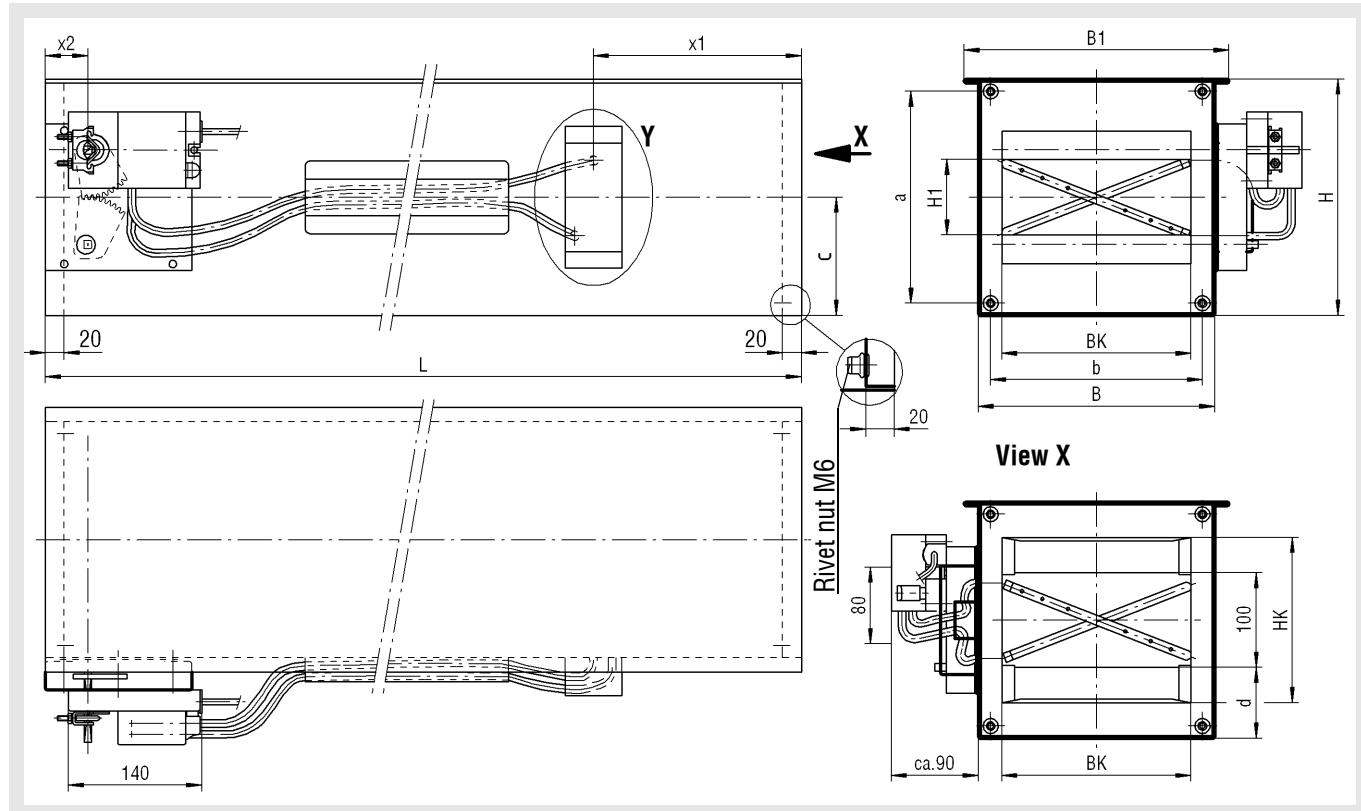


LR = Air flow direction

Sound-damped volumetric flow controller model Piano / Piano-S

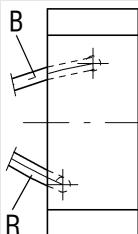
Dimensions

Piano / Piano-S

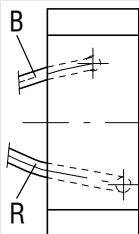


Detail Y

Supply air



Return air



Duct:
B = blue
R = red

Piano:

NW 1-8 = length one-piece

Piano-S:

NW 1-7 = length one-piece

NW 8 = length two-piece

Available sizes

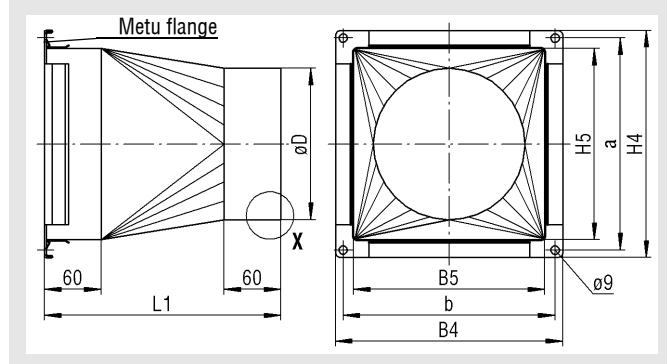
NW	L		B	B1	BK	H	H1	HK	a	b	c	d	Supply air		Return air	
	Piano	Piano-S											x1	x2	Piano	Piano-S
1	800	1250	175	205	125	250	80	175	224	149	125,0	75,0	250	45	390	840
2	800	1250	250	280	200	250	80	175	224	224	125,0	75,0	250	45	390	850
3	800	1250	365	395	315	250	80	175	224	339	125,0	75,0	250	45	400	850
4	800	1250	550	580	500	250	80	175	224	524	125,0	75,0	250	45	400	850
5	800	1250	850	880	800	250	80	175	224	824	125,0	75,0	250	45	400	850
6	1250	2000	475	515	400	375	120	300	348	448	187,5	137,5	360	45	625	1375
7	1250	2000	705	745	630	375	120	300	348	678	187,5	137,5	360	45	625	1375
8	1250	2000	1075	1115	1000	375	120	300	348	1048	187,5	137,5	360	45	625	1375

Note: Boxes are suspended above the on-site U-profiles!

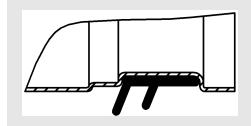
Sound-damped volumetric flow controller model Piano / Piano-S

Dimensions of accessories

Transition piece (-ÜS) (rectangular/round)
high-pressure side, for supply air or return air



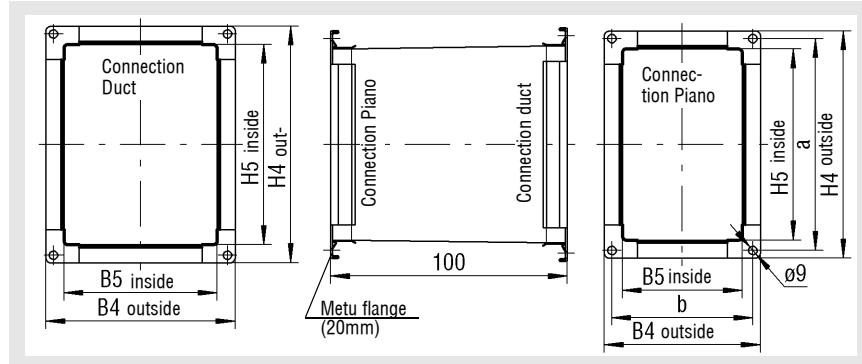
Rubber lip seal (-GD, with -ÜS only)
Detail X



Available sizes transition piece (-ÜS)

NW	a	b	B4	H4	B5	H5	L1	ØD
1	224	149	165	240	125	200	250	123
2	224	224	240	240	200	200	250	158
3	224	339	355	240	315	200	250	198
4	224	524	540	240	500	200	350	248
5	224	824	840	240	800	200	350	313
6	348	448	464	364	424	324	350	248
7	348	678	694	364	655	324	350	313
8	348	1048	1064	364	1024	324	400	398

Transition piece (-ÜSE) (rectangular/rectangular)
for supply or return air



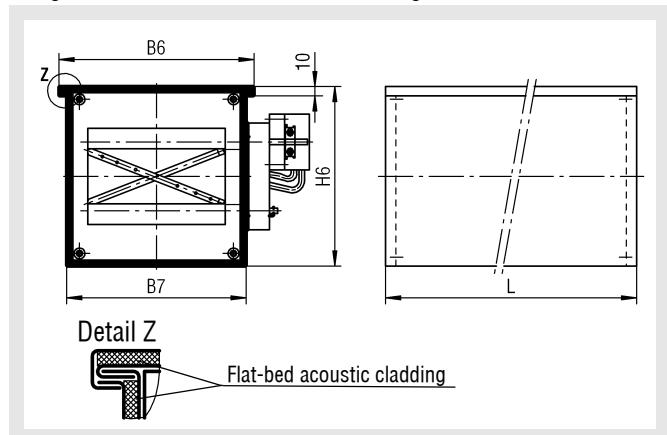
Available sizes transition piece (-ÜSE)

NW	Connection Piano						Connection duct			
	a	b	B4	H4	B5	H5	B4	H4	B5	H5
1	224	149	165	240	125	200	200	250	160	210
2	no transition piece required									
3	224	339	355	240	315	200	400	250	360	210
4	224	524	540	240	500	200	550		510	
5	224	824	840	240	800	200	850		810	
6	348	448	464	364	424	324	500	400	460	360
7	348	678	694	364	654	324	700		660	
8	348	1048	1064	364	1024	324	1000		960	

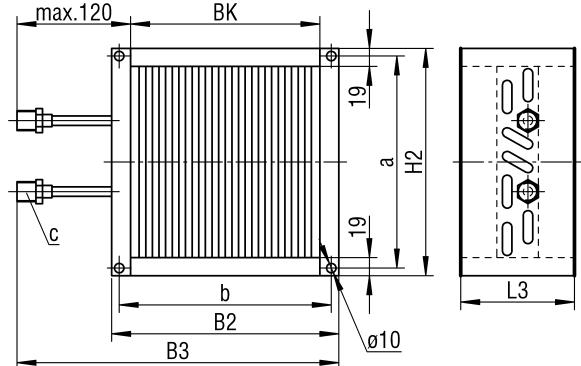
Sound-damped volumetric flow controller model Piano / Piano-S

Flat-bed acoustic cladding (-FDS)

Integrated into Piano / Piano-S housing



Heating register (-H2/-H4)



Available sizes heating register (-H2/-H4)

NW	L	B6	B7	H6
	Piano	Piano-S		
1	800	1250	208	181
2	800	1250	283	256
3	800	1250	398	371
4	800	1250	583	556
5	800	1250	883	856
6	1250	2000	518	481
7	1250	2000	748	711
8	1250	2000	1118	1081

NW	B2	H2	a	b	BK	HK	B3	c	L3	-H2	-H4
1	165	240	224	149	125	175	265	3/8"	120	180	
2	240	240	224	224	200	175	340	3/8"			
3	355	240	224	339	315	175	455	3/8"			
4	540	240	224	524	500	175	640	3/8"			
5	840	240	224	824	800	175	940	3/8"			
6	460	360	348	448	400	300	550	1/2"			
7	690	360	348	678	630	300	780	1/2"			
8	1060	360	348	1048	1000	300	1150	1/2"			

Sound-damped volumetric flow controller model Piano / Piano-S

Technical data

Volumetric flow range

NW	V _{ZU} /V _{AB}	electric controller		pneumatic controller	
		V _{min} from 1 m/s	V _{max} to 12 m/s	V _{min} from 3 m/s	V _{max} to 12 m/s
1	m ³ /h	36	432	108	432
	l/s	10	120	30	120
2	m ³ /h	58	690	173	690
	l/s	16	192	48	192
3	m ³ /h	91	1086	272	1086
	l/s	25	300	76	300
4	m ³ /h	144	1728	432	1728
	l/s	40	480	120	480
5	m ³ /h	231	2766	691	2766
	l/s	64	768	192	768
6	m ³ /h	174	2082	518	2082
	l/s	48	576	144	576
7	m ³ /h	272	3264	816	3264
	l/s	76	906	227	906
8	m ³ /h	432	5184	1296	5184
	l/s	120	1440	360	1440

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

- this table merely specifies the complete measuring range of the controller (volumetric flow range), calibration curve 12 m/s
- If the customer absolutely wants a calibration curve, it must be specified!
- 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 specifying a value), then the volumetric flow controller will be delivered as a constant volumetric flow controller. The volume specified in the order is set to the V_{min} value, and the V_{max} value is set to 100%.
- The air volumes can be changed using setting devices specific for the controller make, depending on the calibration curve set ex works.
- The controller of the make Belimo, type VRP, equipped with aneroid diaphragm VFP 300 and the controller VRD3-SO are also delivered with calibration curves of 12 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 specific system elevation of the specified installation site.
- If no system elevation is given in the order, the controllers will be calibrated to the elevation of the delivery address.

Static minimum pressure difference

NW	v _k (m/s)	V (m ³ /h)	V [l/s]	Δp _{t min} (Pa)
1	3	108	30	15
	6	216	60	15
	9	324	90	20
	12	432	120	35
2	3	173	48	12
	6	346	96	15
	9	518	144	18
	12	691	192	30
3	3	272	76	12
	6	544	151	15
	9	816	227	18
	12	1088	363	27
4	3	432	120	12
	6	864	240	15
	9	1296	360	18
	12	1728	480	27
5	3	691	192	12
	6	1382	384	15
	9	2074	576	18
	12	2765	768	27
6	3	518	144	12
	6	1037	288	15
	9	1555	432	18
	12	2073	576	27
7	3	816	227	15
	6	1633	454	15
	9	2449	680	20
	12	3265	907	35
8	3	1296	360	15
	6	2592	720	15
	9	3888	1080	25
	12	5184	1440	40

Insertion loss

to DIN EN ISO 7235

NW	D _e (dB/Oct)							
	f (Hz)							
	63	125	250	500	1000	2000	4000	8000
Piano	1 - 3	3	6	20	32	38	40	31
	4 - 6	2	5	17	25	29	35	31
	7 - 8	2	4	18	26	34	37	24
Piano-S	1 - 3	3	8	27	37	47	51	44
	4 - 6	3	6	23	34	46	51	46
	7 - 8	2	5	25	31	41	46	29

Sound-damped volumetric flow controller model Piano / Piano-S

Flow generated noise

Piano-Z

NW	v _k	V _{ZU}	$\Delta p_t = 250 \text{ Pa}$										$\Delta p_t = 500 \text{ Pa}$										$\Delta p_t = 1000 \text{ Pa}$									
			L _w [dB]										L _w [dB]										L _w [dB]									
			f _m (Hz)					L _{WA} [dB(A)]					f _m (Hz)					L _{WA} [dB(A)]					f _m (Hz)					L _{WA} [dB(A)]				
1	3	108	30	39	40	32	22	<	<	<	<	<	28	43	44	36	26	<	<	<	<	32	47	48	40	30	<	<	<	<	36	
	6	216	60	43	45	42	32	22	16	15	<	36	47	49	46	36	26	20	19	<	40	51	53	50	40	30	24	23	<	44		
	9	324	90	43	45	42	35	23	17	15	<	37	47	49	46	39	27	21	19	<	41	51	53	50	43	31	25	23	<	45		
	12	432	120	49	52	45	35	30	28	24	23	41	53	56	49	39	34	32	28	27	45	57	60	53	43	38	36	32	31	49		
2	3	173	48	35	42	34	25	<	<	<	<	<	30	39	46	38	29	<	<	<	<	34	43	50	42	33	<	<	<	<	38	
	6	346	96	45	48	44	30	18	17	19	<	38	49	52	48	34	22	21	23	<	42	53	56	52	38	26	25	27	<	46		
	9	518	144	46	50	46	32	25	23	22	22	40	50	54	50	36	29	27	26	26	44	54	58	54	40	33	31	30	30	48		
	12	691	192	49	52	46	36	31	30	26	24	42	53	56	50	40	35	34	30	28	46	57	60	54	44	39	38	34	32	50		
3	3	272	76	41	42	37	25	26	19	<	<	33	45	46	41	29	30	23	<	<	37	49	50	45	33	34	27	<	<	41		
	6	544	151	46	50	46	32	26	24	22	22	40	50	54	50	36	30	28	26	26	44	54	58	54	40	34	32	30	30	48		
	9	816	227	49	52	47	37	33	31	27	25	43	53	56	51	41	37	35	31	29	47	57	60	55	45	41	39	35	33	51		
	12	1088	363	49	53	48	38	34	32	28	25	44	53	57	52	42	38	36	32	29	48	57	61	56	46	42	40	36	33	52		
4	3	432	120	42	44	41	32	22	16	15	<	35	46	48	45	36	26	20	19	<	39	50	52	49	40	30	24	23	<	43		
	6	864	240	49	52	46	36	31	30	26	24	42	53	56	50	40	35	34	30	28	46	57	60	54	44	39	38	34	32	50		
	9	1296	360	54	57	52	40	36	29	25	22	47	58	61	56	44	40	33	29	26	51	62	65	60	48	44	37	33	30	55		
	12	1728	480	55	59	54	42	38	31	27	25	49	59	63	58	46	42	35	31	29	53	63	67	62	50	46	39	35	33	57		
5	3	691	192	45	49	44	30	18	17	19	19	38	49	53	48	34	22	21	23	23	42	53	57	52	38	26	25	27	27	46		
	6	1382	384	49	52	47	37	33	31	27	25	43	53	56	51	41	37	35	31	29	47	57	60	55	45	41	39	35	33	51		
	9	2074	576	56	59	56	44	39	32	29	26	50	60	63	60	48	43	36	33	30	54	64	67	64	52	47	40	37	34	58		
	12	2765	768	58	61	57	47	45	37	34	30	52	62	65	61	51	49	41	38	34	56	66	69	65	55	53	45	42	38	60		
6	3	518	144	43	45	42	32	22	16	15	<	36	47	49	46	36	26	20	19	<	40	51	53	50	40	30	24	23	<	44		
	6	1037	288	49	52	46	36	31	30	26	24	42	53	56	50	40	35	34	30	28	46	57	60	54	44	39	38	34	32	50		
	9	1555	432	54	57	53	43	38	30	27	24	48	58	61	57	47	42	34	31	28	52	62	65	61	51	46	38	35	32	56		
	12	2073	576	56	59	56	44	39	32	29	26	50	60	63	60	48	43	36	33	30	54	64	67	64	52	47	40	37	34	58		
7	3	816	227	45	49	46	32	18	17	19	19	39	49	53	50	36	22	21	23	23	43	53	57	54	40	26	25	27	27	47		
	6	1633	454	49	53	48	38	34	32	28	25	44	53	57	52	42	38	36	32	29	48	57	61	56	46	42	40	36	33	52		
	9	2449	680	57	60	56	46	40	32	30	27	51	61	64	60	50	44	36	34	31	55	65	68	64	54	48	40	38	35	59		
	12	3265	907	58	62	57	48	45	38	34	31	53	62	66	61	52	49	42	38	35	57	66	70	65	56	53	46	42	39	61		
8	3	1296	360	49	52	45	35	30	28	24	23	41	53	56	49	39	34	32	28	27	45	57	60	53	43	38	36	32	31	49		
	6	2592	720	49	53	49	40	36	32	30	27	45	53	57	53	44	40	36	34	31	49	57	61	57	48	44	40	38	35	53		
	9	3888	1080	58	61	56	48	42	36	32	30	52	62	65	60	52	46	40	36	34	56	66	69	64	56	50	44	40	38	60		
	12	5184	1440	58	63	58	49	45	40	34	31	54	62	67	62	53	49	44	38	35	58	66	71	66	57	53	48	42	39	62		

Sound-damped volumetric flow controller model Piano / Piano-S

Flow generated noise

Piano-A

NW	v _K	V _{AB}	Δp _t = 250 Pa								Δp _t = 500 Pa								Δp _t = 1000 Pa																		
			L _w [dB]								L _w [dB]								L _w [dB]																		
			f _m (Hz)		63		125		250		500		1000		2000		4000		8000		f _m (Hz)		63		125		250		500		1000		2000		4000		8000
1	3	108	30	37	38	31	21	<	<	<	<	<	26	41	42	35	25	<	<	<	<	30	45	45	39	29	25	20	<	<	34						
	6	216	60	41	44	40	30	22	<	<	<	<	34	45	48	44	34	26	<	<	<	<	38	49	52	48	38	30	25	23	17	42					
	9	324	90	42	45	42	34	23	17	15	<	37	46	49	46	38	27	21	19	<	41	50	53	50	42	31	25	23	20	45							
	12	432	120	45	49	45	31	18	18	19	19	39	49	53	49	35	22	22	23	23	43	53	57	53	39	26	26	27	27	47							
2	3	173	48	37	39	32	23	<	<	<	<	<	27	40	42	36	27	20	16	<	<	31	44	44	40	31	24	20	18	<	35						
	6	346	96	42	44	41	31	22	16	15	<	35	46	48	45	35	26	20	19	<	39	50	52	49	39	30	24	23	20	43							
	9	518	144	45	48	44	30	18	17	19	<	38	49	52	48	34	22	21	23	<	42	53	56	52	38	26	25	27	25	46							
	12	691	192	46	50	46	32	26	24	22	22	40	50	54	50	36	30	28	26	26	44	54	58	54	40	34	32	30	30	48							
3	3	272	76	36	40	31	25	<	<	<	<	<	28	39	43	35	28	25	20	<	<	32	43	45	39	32	29	24	22	18	36						
	6	544	151	43	45	42	30	21	16	15	<	36	47	49	46	34	25	20	19	<	40	51	53	50	38	29	24	23	20	44							
	9	816	227	45	49	46	32	18	17	19	19	39	49	53	50	36	22	21	23	23	43	53	57	54	40	26	25	27	27	47							
	12	1088	363	49	52	45	35	30	28	24	23	41	53	56	49	39	34	32	28	27	45	57	60	53	43	38	36	32	31	49							
4	3	432	120	35	43	36	25	22	<	<	<	<	31	39	46	40	29	26	20	16	<	35	43	50	44	33	30	24	20	17	39						
	6	864	240	46	49	43	33	19	18	20	<	38	50	53	47	37	23	22	24	16	42	54	57	51	41	27	26	28	20	46							
	9	1296	360	46	49	46	33	27	25	23	23	40	50	53	50	37	31	29	27	27	44	54	57	54	41	35	33	31	31	48							
	12	1728	480	49	54	49	37	32	27	25	25	44	53	58	53	41	36	31	29	29	48	57	62	57	45	40	35	33	33	52							
5	3	691	192	41	43	38	25	26	19	<	<	33	45	47	42	29	30	23	20	16	37	49	51	46	33	34	27	24	20	41							
	6	1382	384	46	50	46	32	18	18	20	20	40	50	54	50	36	22	22	24	24	44	54	58	54	40	26	26	28	28	48							
	9	2074	576	50	54	49	38	35	34	30	28	45	54	58	53	42	39	38	34	32	49	58	62	57	46	43	42	38	36	53							
	12	2765	768	54	57	53	43	38	30	27	24	48	58	61	57	47	42	34	31	28	52	62	65	61	51	46	38	35	32	56							
6	3	518	144	41	42	37	25	24	19	19	<	32	45	46	41	29	28	23	23	20	36	49	50	45	33	32	27	27	24	40							
	6	1037	288	45	49	46	32	18	17	19	19	39	49	53	50	36	22	21	23	23	43	53	57	54	40	26	25	27	27	47							
	9	1555	432	49	52	46	36	31	30	26	24	42	53	56	50	40	35	34	30	28	46	57	60	54	44	39	38	34	32	50							
	12	2073	576	53	56	52	39	36	29	25	22	46	57	60	56	43	40	33	29	26	50	61	64	60	47	44	37	33	30	54							
7	3	816	227	43	45	42	32	22	16	15	15	36	47	49	46	36	26	20	19	19	40	51	53	50	40	30	24	23	23	44							
	6	1633	454	49	54	49	38	37	32	30	25	45	53	58	53	42	41	36	34	29	49	57	62	57	46	45	40	38	33	53							
	9	2449	680	53	56	53	42	38	30	27	24	47	57	60	57	46	42	34	31	28	51	61	64	61	50	46	38	35	32	55							
	12	3265	907	57	60	56	46	40	32	30	27	51	61	64	60	50	44	36	34	31	55	65	68	64	54	48	40	38	35	59							
8	3	1296	360	45	48	45	34	18	17	19	19	39	49	52	49	38	22	21	23	23	43	53	56	53	42	26	25	27	27	47							
	6	2592	720	49	54	50	41	37	33	31	29	46	53	58	54	45	41	37	35	33	50	57	62	58	49	45	41	39	37	54							
	9	3888	1080	56	59	56	44	39	32	29	26	50	60	63	60	48	43	36	33	30	54	64	67	64	52	47	40	37	34	58							
	12	5184	1440	57	60	57	48	42	32	30	27	52	61	64	61	52	46	36	34	31	56	65	68	65	56	50	40	38	35	60							

Sound-damped volumetric flow controller model Piano / Piano-S

Flow generated noise

Piano-S-Z

NW	V _K	V _{ZU}	$\Delta p_t = 250 \text{ Pa}$										$\Delta p_t = 500 \text{ Pa}$										$\Delta p_t = 1000 \text{ Pa}$									
			L _w [dB]					f _m (Hz)					L _{WA} [dB(A)]					L _w [dB]					f _m (Hz)					L _{WA} [dB(A)]				
			(m/s)	(m ³ /h)	[l/s]	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	L _{WA} [dB(A)]		
1	3	108	30	26	29	25	19	18	<	<	<	<	<	27	30	22	22	20	17	<	<	26	32	34	28	28	24	21	19	<	30	
	6	216	60	35	43	36	25	22	<	<	<	<	<	31	39	43	40	29	26	24	22	20	35	43	47	44	33	30	28	26	24	39
	9	324	90	40	43	38	30	22	16	<	<	<	<	33	44	47	42	34	26	20	19	17	37	48	51	46	38	30	24	23	21	41
	12	432	120	42	44	42	31	22	17	15	<	<	<	36	46	48	46	35	26	21	19	17	40	50	52	50	39	30	25	23	21	44
2	3	173	48	36	37	30	21	<	<	<	<	<	<	25	38	39	33	25	23	<	<	<	29	40	40	35	29	27	25	21	15	33
	6	346	96	39	42	37	23	24	20	<	<	<	<	32	43	46	41	27	28	24	<	<	36	47	50	45	31	32	28	17	16	40
	9	518	144	42	44	42	32	22	17	17	<	<	<	36	46	48	46	36	26	21	21	<	40	50	52	50	40	30	25	25	15	44
	12	691	192	45	49	46	32	18	17	19	19	<	<	39	49	53	50	36	22	21	23	23	43	53	57	54	40	26	25	27	27	47
3	3	272	76	37	39	31	22	20	<	<	<	<	<	27	38	41	33	26	24	22	<	<	31	42	45	37	30	28	26	24	20	35
	6	544	151	42	44	38	27	26	20	<	<	<	<	34	46	48	42	31	30	24	22	21	38	50	52	46	35	34	28	26	25	42
	9	816	227	46	49	43	33	19	18	20	<	<	<	38	50	53	47	37	23	22	24	20	42	54	57	51	41	27	26	28	24	46
	12	1088	363	49	52	45	35	30	28	24	23	<	<	41	53	56	49	39	34	32	28	27	45	57	60	53	43	38	36	32	31	49
4	3	432	120	38	40	33	25	22	21	16	<	<	<	29	42	44	37	29	26	25	20	<	33	46	48	41	33	30	29	24	22	37
	6	864	240	41	44	40	30	24	16	15	15	<	<	35	45	48	44	34	28	20	19	19	39	49	52	48	38	32	24	23	23	43
	9	1296	360	49	52	45	35	30	28	24	23	<	<	41	53	56	49	39	34	32	28	27	45	57	60	53	43	38	36	32	31	49
	12	1728	480	49	52	47	37	33	31	27	25	<	<	43	53	56	51	41	37	35	31	29	47	57	60	55	45	41	39	35	33	51
5	3	691	192	39	41	34	22	22	18	16	<	<	<	30	43	45	38	26	26	22	20	<	34	47	49	42	30	30	26	24	21	38
	6	1382	384	43	45	42	35	23	17	15	15	<	<	37	47	49	46	39	27	21	19	19	41	51	53	50	43	31	25	23	23	45
	9	2074	576	49	52	47	37	33	31	27	25	<	<	43	53	56	51	41	37	35	31	29	47	57	60	55	45	41	39	35	33	51
	12	2765	768	51	53	50	39	35	28	24	20	<	<	44	55	57	54	43	39	32	28	24	48	59	61	58	47	43	36	32	28	52
6	3	518	144	36	42	31	25	18	16	16	<	<	<	29	40	46	35	29	22	20	20	<	33	44	47	40	33	27	23	22	20	37
	6	1037	288	42	45	42	31	22	16	15	15	<	<	36	46	49	46	35	26	20	19	19	40	50	53	50	39	30	24	23	23	44
	9	1555	432	49	52	46	36	31	30	26	24	<	<	42	53	56	50	40	35	34	30	28	46	57	60	54	44	39	38	34	32	50
	12	2073	576	49	52	48	38	34	32	28	25	<	<	43	53	56	52	42	38	36	32	29	47	57	60	56	46	42	40	36	33	51
7	3	816	227	37	39	38	30	20	15	15	<	<	<	32	41	43	42	34	24	19	19	17	36	45	47	46	38	28	23	23	21	40
	6	1633	454	45	49	46	32	18	17	19	19	<	<	39	49	53	50	36	22	21	23	23	43	53	57	54	40	26	25	27	27	47
	9	2449	680	49	54	49	37	32	27	25	25	<	<	44	53	58	53	41	36	31	29	29	48	57	62	57	45	40	35	33	33	52
	12	3265	907	50	54	51	38	33	28	26	26	<	<	45	54	58	55	42	37	32	30	30	49	58	62	59	46	41	36	34	34	53
8	3	1296	360	40	43	39	30	20	16	15	15	<	<	34	44	47	43	34	24	20	19	19	38	48	51	47	38	28	24	23	23	42
	6	2592	720	46	50	46	32	25	23	22	22	<	<	40	50	54	50	36	29	27	26	26	44	54	58	54	40	33	31	30	30	48
	9	3888	1080	49	53	50	40	35	32	28	25	<	<	45	53	57	54	44	39	36	32	29	49	57	61	58	48	43	40	36	33	53
	12	5184	1440	54	57	53	43	38	30	27	24	<	<	48	58	61	57	47	42	34	31	28	52	62	65	61	51	46	38	35	32	56

Sound-damped volumetric flow controller model Piano / Piano-S

Flow generated noise

Piano-S-A

NW	v _K	V _{AB}	Δp _t = 250 Pa								Δp _t = 500 Pa								Δp _t = 1000 Pa																		
			L _w [dB]								L _w [dB]								L _w [dB]																		
			f _m (Hz)		63		125		250		500		1000		2000		4000		8000		f _m (Hz)		63		125		250		500		1000		2000		4000		8000
1	3	108	30	21	23	20	17	18	<	<	<	<	<	<	23	24	20	21	19	18	<	<	24	27	28	24	25	23	22	20	<	28					
	6	216	60	32	38	34	23	16	15	<	<	28	36	42	38	27	20	19	17	<	<	32	40	45	42	31	24	23	21	20	36						
	9	324	90	41	42	37	25	24	19	19	<	32	45	46	41	29	28	23	23	<	<	36	49	50	45	33	32	27	27	24	40						
	12	432	120	41	43	37	26	27	19	18	<	33	45	47	41	30	31	23	22	<	<	37	49	51	45	34	35	27	26	23	41						
2	3	173	48	25	27	24	18	17	<	<	<	<	22	23	21	21	20	19	17	<	<	25	26	27	25	25	24	23	21	18	29						
	6	346	96	34	41	35	25	22	15	<	<	30	42	44	38	28	24	19	19	17	<	<	34	46	48	42	32	28	23	21	38						
	9	518	144	41	42	36	25	26	18	15	<	32	45	46	40	29	30	22	19	16	<	<	36	49	50	44	33	34	26	23	20	40					
	12	691	192	42	43	40	31	21	16	15	15	34	46	47	44	35	25	20	19	19	<	<	38	50	51	48	39	29	24	23	23	42					
3	3	272	76	27	30	25	21	17	15	<	<	23	30	32	27	25	20	19	17	15	<	<	27	34	36	31	29	24	23	21	19	31					
	6	544	151	36	37	35	24	23	17	15	<	30	40	41	39	28	27	21	19	15	<	<	34	44	45	43	32	31	25	23	19	38					
	9	816	227	40	41	39	29	24	16	15	15	33	44	45	43	33	28	20	19	3	<	<	37	48	49	47	37	32	24	23	7	41					
	12	1088	363	43	45	42	30	21	16	15	15	36	47	49	46	34	25	20	19	19	<	<	40	51	53	50	38	29	24	23	44						
4	3	432	120	31	33	29	21	17	15	<	<	25	35	37	33	25	21	19	17	17	<	<	29	39	41	37	29	25	23	21	21	33					
	6	864	240	39	41	39	29	24	16	15	15	33	43	45	43	33	28	20	19	19	<	<	37	47	49	47	37	32	24	23	23	41					
	9	1296	360	41	44	40	30	24	16	15	15	35	45	48	44	34	28	20	19	19	<	<	39	49	52	48	38	32	24	23	23	43					
	12	1728	480	46	49	43	33	19	18	20	17	38	50	53	47	37	23	22	24	21	<	<	42	54	57	51	41	27	26	28	25	46					
5	3	691	192	33	37	32	22	16	15	<	<	27	37	41	36	26	20	19	16	15	<	<	31	41	45	40	30	24	23	20	19	35					
	6	1382	384	43	45	42	30	21	16	15	<	36	47	49	46	34	25	20	19	17	<	<	40	51	53	50	38	29	24	23	21	44					
	9	2074	576	46	50	46	32	26	24	22	22	40	50	54	50	36	30	28	26	26	<	<	44	54	58	54	40	34	32	30	30	48					
	12	2765	768	49	51	47	37	33	31	27	25	42	53	55	51	41	37	35	31	29	<	<	46	57	59	55	45	41	39	35	33	50					
6	3	518	144	31	33	30	22	17	15	<	<	26	35	37	34	26	21	19	18	16	<	<	30	39	41	38	30	25	23	22	20	34					
	6	1037	288	41	42	39	25	26	19	15	<	33	45	46	43	29	30	23	19	18	<	<	37	49	50	47	33	34	27	23	22	41					
	9	1555	432	43	45	42	30	21	16	15	15	36	47	49	46	34	25	20	19	19	<	<	40	51	53	50	38	29	24	23	23	44					
	12	2073	576	45	49	47	32	20	17	19	19	40	49	53	51	36	24	21	23	23	<	<	44	53	57	55	40	28	25	27	27	48					
7	3	816	227	40	42	36	25	25	20	19	15	32	44	46	40	29	29	24	23	19	<	<	36	48	50	44	33	33	28	27	23	40					
	6	1633	454	46	49	46	33	27	25	23	23	40	50	53	50	37	31	29	27	27	<	<	44	54	57	54	41	35	33	31	31	48					
	9	2449	680	48	51	45	36	31	30	26	24	41	52	55	49	40	35	34	30	28	<	<	45	56	59	53	44	39	38	34	32	49					
	12	3265	907	49	54	49	38	37	32	30	25	45	53	58	53	42	41	36	34	29	<	<	49	57	62	57	46	45	40	38	33	53					
8	3	1296	360	40	42	39	29	22	16	15	15	33	44	46	43	33	26	20	19	19	<	<	37	48	50	47	37	30	24	23	23	41					
	6	2592	720	46	50	46	32	18	18	20	20	40	50	54	50	36	22	22	24	24	<	<	44	54	58	54	40	26	26	28	28	48					
	9	3888	1080	48	52	47	38	37	32	30	25	44	52	56	51	42	41	36	34	29	<	<	48	56	60	55	46	45	40	38	33	52					
	12	5184	1440	53	55	51	40	36	29	25	22	46	57	59	55	44	40	33	29	26	<	<	50	61	63	59	48	44	37	33	30	54					

Sound-damped volumetric flow controller model Piano / Piano-S

Radiated noise

Piano-Z / Piano-S-Z

NW	V _K (m/s)	V _{ZU} (m ³ /h) [l/s]	Δp _t = 250 Pa								Δp _t = 500 Pa								Δp _t = 1000 Pa											
			L _w [dB]				f _m (Hz)				L _{WA} [dB(A)]				L _w [dB]				f _m (Hz)				L _{WA} [dB(A)]							
			63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	L _{WA} [dB(A)]			
1	3	108	30	39	39	30	15	<	<	<	26	43	43	34	19	17	15	<	<	30	47	47	38	23	21	19	17	15	34	
	6	216	60	42	44	34	28	17	<	<	31	46	47	38	32	21	20	18	<	35	50	51	42	36	25	24	22	20	39	
	9	324	90	45	45	38	27	17	15	<	33	49	49	42	31	21	19	19	18	37	53	53	46	35	25	23	23	21	41	
	12	432	120	49	49	39	30	19	16	15	<	36	53	53	43	34	23	20	19	17	40	57	57	47	38	27	24	23	23	44
2	3	173	48	38	41	30	18	16	<	<	27	42	43	34	22	20	18	16	<	31	46	47	38	26	24	22	20	17	35	
	6	346	96	43	45	37	28	18	15	<	33	47	49	41	32	22	19	16	15	37	51	53	45	36	26	23	20	19	41	
	9	518	144	42	44	38	27	26	20	18	<	34	46	48	42	31	30	24	22	20	38	50	52	46	35	34	28	26	24	42
	12	691	192	46	47	42	33	22	19	25	24	37	50	51	46	37	26	23	29	28	41	54	55	50	41	30	27	33	32	45
3	3	272	76	36	40	31	25	<	<	<	28	37	38	34	28	26	24	22	<	32	39	41	37	32	30	28	26	24	36	
	6	544	151	42	44	41	31	22	16	15	<	35	46	48	45	35	26	20	19	17	39	50	52	49	39	30	24	23	21	43
	9	816	227	47	50	43	28	16	15	15	<	37	51	54	47	32	20	19	19	18	41	55	58	51	36	24	23	23	22	45
	12	1088	363	48	39	43	33	20	21	27	30	38	52	43	47	37	24	25	31	34	42	56	47	51	41	28	29	35	38	46
4	3	432	120	43	45	35	28	17	15	<	32	47	49	39	32	21	19	19	16	36	51	53	43	36	25	23	23	20	40	
	6	864	240	46	49	43	33	19	18	20	<	38	50	53	47	37	23	22	24	22	42	54	57	51	41	27	26	28	26	46
	9	1296	360	46	50	46	32	18	18	20	20	40	50	54	50	36	22	22	24	24	44	54	58	54	40	26	26	28	28	48
	12	1728	480	49	52	47	37	33	31	27	25	43	53	56	51	41	37	35	31	29	47	57	60	55	45	41	39	35	33	51
5	3	691	192	40	43	38	30	22	16	15	<	33	44	47	42	34	26	20	19	17	37	48	51	46	38	30	24	23	21	41
	6	1382	384	46	50	46	32	26	24	22	22	40	50	54	50	36	30	28	26	26	44	54	58	54	40	34	32	30	30	48
	9	2074	576	48	52	48	42	37	32	30	28	45	52	56	52	46	41	36	34	32	49	56	60	56	50	45	40	38	36	53
	12	2765	768	54	57	53	43	38	30	27	24	48	58	61	57	47	42	34	31	28	52	62	65	61	51	46	38	35	32	56
6	3	518	144	39	42	39	23	24	22	20	<	33	43	46	43	27	28	26	24	22	37	47	50	47	31	32	30	28	26	41
	6	1037	288	45	49	46	32	18	17	19	19	39	49	53	50	36	22	21	23	23	43	53	57	54	40	26	25	27	27	47
	9	1555	432	49	52	48	42	37	32	30	28	41	53	56	49	39	34	32	28	27	45	57	60	53	43	38	36	32	51	
	12	2073	576	49	54	49	37	32	27	25	25	44	53	58	53	41	36	31	29	29	48	57	62	57	45	40	35	33	52	
7	3	816	227	42	45	42	31	22	16	15	15	34	46	49	46	35	26	20	19	19	38	50	53	50	39	30	24	23	23	42
	6	1633	454	50	54	51	38	33	28	26	26	41	54	58	55	42	37	32	30	30	45	58	62	59	46	41	36	34	34	49
	9	2449	680	53	56	53	42	38	30	27	24	46	57	60	57	46	42	34	31	28	50	61	64	61	50	46	38	35	32	54
	12	3265	907	56	60	57	44	39	32	29	26	49	60	64	61	48	43	36	33	30	53	64	68	65	52	47	40	37	34	57
8	3	1296	360	41	44	40	30	24	16	15	15	35	45	48	44	34	28	20	19	19	39	49	52	48	38	32	24	23	23	43
	6	2592	720	49	52	46	36	31	30	26	24	41	53	56	50	40	35	34	30	28	46	57	60	54	44	39	38	34	32	50
	9	3888	1080	49	53	51	45	37	32	28	25	47	53	57	55	49	41	36	32	29	51	57	61	59	53	45	40	36	33	55
	12	5184	1440	56	59	56	44	39	32	29	26	50	60	63	60	48	43	36	33	30	54	64	67	64	52	47	40	37	34	58

Sound-damped volumetric flow controller model Piano / Piano-S

Radiated noise

Piano-A / Piano-S-A

NW	V _K (m/s)	V _{AB} (m ³ /h)	[l/s]	Δp _t = 250 Pa								Δp _t = 500 Pa								Δp _t = 1000 Pa										
				L _w [dB] f _m (Hz)								L _w [dB] f _m (Hz)								L _w [dB] f _m (Hz)										
				63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	L _{WA} [dB(A)]		
1	3	108	30	27	29	27	21	21	<	<	<	24	27	29	27	25	22	21	<	<	28	31	33	31	29	26	25	23	20	32
	6	216	60	36	40	31	25	21	19	<	<	29	40	44	35	29	25	23	21	<	33	44	48	39	33	29	27	25	23	37
	9	324	90	41	41	34	25	26	18	15	<	31	45	45	38	29	30	22	19	<	35	49	49	42	33	34	26	23	21	39
	12	432	120	42	44	38	27	26	20	15	15	34	46	48	42	31	30	24	19	19	38	50	52	46	35	34	28	23	23	42
2	3	173	48	32	33	29	20	18	17	<	<	25	36	37	33	24	22	21	<	<	29	40	41	37	28	26	25	23	21	33
	6	346	96	36	37	35	26	23	20	15	<	31	40	41	39	30	27	24	19	<	35	44	45	43	34	31	28	23	22	39
	9	518	144	41	42	36	25	26	18	15	<	32	45	46	40	29	30	22	19	17	36	49	50	44	33	34	26	23	22	40
	12	691	192	41	44	40	30	24	16	15	15	35	45	48	44	34	28	20	19	19	39	49	52	48	38	32	24	23	23	43
3	3	272	76	36	35	30	20	19	17	<	<	26	40	39	34	24	23	21	16	<	30	44	43	38	28	27	25	20	18	34
	6	544	151	40	43	38	30	22	16	15	<	33	44	47	42	34	26	20	19	17	37	48	51	46	38	30	24	23	21	41
	9	816	227	42	44	39	30	26	20	18	17	35	46	48	43	34	30	24	22	21	39	50	52	47	38	34	28	26	25	43
	12	1088	363	43	45	42	30	21	16	15	15	36	47	49	46	34	25	20	19	19	40	51	53	50	38	29	24	23	23	44
4	3	432	120	36	37	35	24	23	17	15	<	30	40	41	39	28	27	21	19	16	34	44	45	43	32	31	25	23	20	38
	6	864	240	43	45	42	30	21	16	17	15	36	47	49	46	34	25	20	21	19	40	51	53	50	38	29	24	25	23	44
	9	1296	360	46	49	43	33	19	18	20	18	38	50	53	47	37	23	22	24	22	42	54	57	51	41	27	26	28	26	46
	12	1728	480	46	50	48	32	20	18	17	16	41	50	54	52	36	24	22	21	20	45	54	58	56	40	28	26	25	24	49
5	3	691	192	36	37	35	26	25	18	15	<	31	40	41	39	30	29	22	19	16	35	44	45	43	34	33	26	23	20	39
	6	1382	384	46	49	43	33	19	18	20	17	38	50	53	47	37	23	22	24	21	42	54	57	51	41	27	26	28	25	46
	9	2074	576	49	52	47	37	33	31	27	25	43	53	56	51	41	37	35	31	29	47	57	60	55	45	41	39	35	33	51
	12	2765	768	53	56	53	42	38	30	27	24	46	57	60	57	46	42	34	31	28	50	61	64	61	50	46	38	35	32	54
6	3	518	144	38	40	35	27	22	21	16	15	31	42	44	39	31	26	25	20	19	35	46	48	43	35	30	29	24	23	39
	6	1037	288	43	45	42	35	23	17	15	15	37	47	49	46	39	27	21	19	19	41	51	53	50	43	31	25	23	23	45
	9	1555	432	45	49	46	32	18	17	19	19	39	49	53	50	36	22	21	23	23	43	53	57	54	40	26	25	27	27	47
	12	2073	576	49	52	46	36	31	30	26	24	42	53	56	50	40	35	34	30	28	46	57	60	54	44	39	38	34	32	50
7	3	816	227	41	42	37	25	24	19	19	16	32	45	46	41	29	28	23	23	20	36	49	50	45	33	32	27	27	24	40
	6	1633	454	45	49	46	32	18	17	19	19	39	49	53	50	36	22	21	23	23	43	53	57	54	40	26	25	27	27	47
	9	2449	680	49	52	48	37	37	32	30	25	44	53	56	52	41	41	36	34	29	48	57	60	56	45	45	40	38	33	52
	12	3265	907	53	56	53	42	38	30	27	24	47	57	60	57	46	42	34	31	28	51	61	64	61	50	46	38	35	32	55
8	3	1296	360	39	41	39	29	24	16	15	15	33	43	45	43	33	28	20	19	19	37	47	49	47	37	32	24	23	23	41
	6	2592	720	46	50	46	32	26	24	22	22	40	50	54	50	36	30	28	26	26	44	54	58	54	40	34	32	30	30	48
	9	3888	1080	49	54	49	38	37	32	30	25	45	53	58	53	42	41	36	34	29	49	57	62	57	46	45	40	38	33	53
	12	5184	1440	54	57	53	43	38	30	27	24	48	58	61	57	47	42	34	31	28	52	62	65	61	51	46	38	35	32	56

Sound-damped volumetric flow controller model Piano / Piano-S

Radiated noise

Piano-Z-FDS / Piano-S-Z-FDS

NW	v _k (m/s)	V _{ZU} (m ³ /h)	I/s	Δp _t = 250 Pa								Δp _t = 500 Pa								Δp _t = 1000 Pa											
				L _w [dB]				L _w [dB(A)]				L _w [dB]				L _w [dB(A)]				L _w [dB]				L _w [dB(A)]							
				63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	L _{WA} [dB(A)]			
1	3	108	30	26	28	26	20	<	<	<	<	<	29	30	27	24	20	<	<	<	25	36	38	31	25	23	19	17	15	29	
	6	216	60	36	36	31	21	20	<	<	<	<	26	36	38	33	25	24	22	<	<	30	40	41	39	31	22	16	15	15	34
	9	324	90	32	33	30	25	23	20	<	<	<	28	35	36	32	29	27	24	22	15	32	43	45	42	30	21	16	15	15	36
	12	432	120	40	42	36	27	20	16	15	<	31	44	46	40	31	24	20	19	17	35	45	49	46	32	18	17	19	19	39	
2	3	173	48	20	22	20	17	17	15	<	<	<	34	35	31	21	20	16	<	<	26	32	34	33	25	24	19	19	17	30	
	6	346	96	32	33	30	25	23	19	15	<	28	39	42	35	28	25	20	18	15	32	43	45	42	30	21	16	16	15	36	
	9	518	144	36	38	31	25	23	19	17	<	29	41	42	37	25	25	20	19	17	33	43	45	42	34	25	16	16	16	37	
	12	691	192	40	41	38	25	23	19	17	15	32	43	45	42	32	22	16	15	15	36	46	50	46	32	18	18	20	20	40	
3	3	272	76	25	26	23	21	16	15	15	<	23	35	36	29	23	20	18	15	15	27	38	39	36	25	24	19	19	15	31	
	6	544	151	36	37	35	24	23	17	15	15	30	41	43	38	27	27	19	18	15	34	44	47	44	32	18	17	19	19	38	
	9	816	227	38	40	37	29	24	16	15	15	32	43	45	42	32	22	16	15	15	36	46	49	46	33	27	25	23	23	40	
	12	1088	363	39	41	39	29	24	16	15	15	33	45	43	33	28	20	19	20	16	37	49	52	45	35	30	28	24	23	41	
4	3	432	120	29	30	27	23	21	20	16	<	27	38	39	36	25	24	19	19	15	31	42	44	41	31	22	16	15	15	35	
	6	864	240	39	43	36	28	25	21	16	15	33	47	40	32	29	25	20	20	16	37	49	52	45	35	30	28	24	23	41	
	9	1296	360	42	44	41	31	22	16	15	15	35	45	49	46	32	18	17	19	19	38	49	53	50	36	22	21	23	23	43	
	12	1728	480	44	47	44	32	18	17	19	19	38	49	52	46	36	31	30	26	24	42	49	54	50	41	37	33	31	29	46	
5	3	691	192	34	35	30	24	21	20	17	<	28	41	42	37	25	24	19	19	17	32	43	45	42	32	22	16	15	15	36	
	6	1382	384	42	44	41	31	22	16	15	15	35	45	49	46	32	18	17	19	19	39	49	52	47	38	33	30	26	24	43	
	9	2074	576	46	49	46	33	27	25	23	23	40	49	54	49	37	32	27	25	25	44	53	56	53	43	40	30	27	24	48	
	12	2765	768	49	52	47	38	33	30	26	24	43	53	56	53	42	38	30	27	24	47	57	60	56	46	40	32	30	27	51	
6	3	518	144	34	34	30	24	21	20	17	16	28	40	42	37	25	24	19	19	18	32	43	44	42	31	21	16	16	15	36	
	6	1037	288	40	41	39	31	22	16	15	15	34	43	44	45	34	18	17	19	19	38	49	52	46	36	31	30	26	24	42	
	9	1555	432	43	45	42	30	21	16	15	15	36	46	50	46	32	18	18	20	20	40	49	54	49	37	32	27	25	25	44	
	12	2073	576	45	49	46	32	18	17	19	19	39	53	50	36	22	21	23	23	20	43	53	56	53	42	38	30	27	24	47	
7	3	816	227	33	34	33	23	23	19	18	17	29	41	42	38	25	26	19	18	15	33	43	45	42	34	25	16	16	16	37	
	6	1633	454	43	45	42	30	21	16	16	15	36	49	46	34	25	20	20	19	17	40	49	54	49	37	32	27	25	25	44	
	9	2449	680	49	52	45	35	30	28	24	23	41	49	54	49	38	37	32	30	25	45	53	58	53	42	41	36	34	25	49	
	12	3265	907	49	54	49	37	32	27	25	25	44	53	56	53	43	40	30	27	24	48	57	60	57	48	42	32	30	27	52	
8	3	1296	360	32	34	33	25	24	19	19	17	30	38	42	38	29	27	20	16	15	34	43	44	45	34	18	17	19	19	38	
	6	2592	720	43	45	42	34	25	16	16	16	37	49	52	45	35	30	28	24	23	41	53	56	49	39	34	32	28	27	45	
	9	3888	1080	49	52	46	36	31	30	26	24	42	49	54	50	41	37	33	31	29	46	56	59	56	44	39	32	29	26	50	
	12	5184	1440	49	54	49	38	37	32	30	25	45	58	53	42	41	36	34	29	25	49	58	62	57	48	45	38	34	31	53	

Sound-damped volumetric flow controller model Piano / Piano-S

Radiated noise

Piano-A-FDS / Piano-S-A-FDS

NW	V _K (m/s)	V _{AB} (m ³ /h)	[l/s]	Δp _t = 250 Pa								Δp _t = 500 Pa								Δp _t = 1000 Pa													
				L _w [dB] f _m (Hz)								L _w [dB] f _m (Hz)								L _w [dB] f _m (Hz)													
				63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	L _{WA} [dB(A)]					
1	3	108	30	22	24	22	20	<	<	<	<	<	<	<	<	25	26	23	21	16	15	15	<	23	37	39	30	20	18	16	15	<	27
	6	216	60	27	29	27	21	21	<	<	<	<	24	34	34	30	24	21	20	17	16	28	38	38	37	23	24	22	20	16	32		
	9	324	90	36	36	31	21	20	<	<	<	<	26	36	37	35	24	23	17	15	15	30	40	41	39	31	22	16	15	15	34		
	12	432	120	36	38	31	25	23	19	17	<	29	39	41	39	29	24	16	15	15	33	46	47	43	28	16	16	15	15	37			
2	3	173	48	24	26	24	20	<	<	<	<	<	24	25	23	20	19	17	16	<	24	32	33	30	25	23	19	15	<	28			
	6	346	96	34	35	31	21	20	16	<	<	26	36	37	35	24	23	17	15	15	30	40	41	39	31	22	16	15	15	34			
	9	518	144	35	36	29	23	20	18	15	15	27	36	37	35	26	23	20	15	15	31	42	44	39	30	26	20	18	17	35			
	12	691	192	36	37	35	24	23	17	15	15	30	40	41	39	31	22	16	15	15	34	46	49	43	33	19	18	20	18	38			
3	3	272	76	20	21	21	20	18	<	<	<	<	30	31	28	20	18	17	16	<	25	33	34	33	23	23	19	18	17	29			
	6	544	151	32	33	30	25	23	19	15	<	28	38	38	37	23	24	22	20	16	32	43	45	42	30	21	16	15	15	36			
	9	816	227	36	37	35	24	23	17	15	15	30	42	44	38	27	26	20	18	17	34	48	39	43	33	20	21	27	30	38			
	12	1088	363	38	39	36	25	24	19	19	15	31	42	44	41	31	22	16	15	15	35	45	49	46	32	18	17	19	19	39			
4	3	432	120	26	27	24	23	20	17	15	<	25	36	38	31	25	23	19	17	<	29	40	43	38	31	22	16	15	15	33			
	6	864	240	38	39	36	25	24	19	19	15	31	42	44	41	31	22	16	15	15	35	45	49	46	32	18	17	19	19	39			
	9	1296	360	41	42	38	25	26	19	18	15	33	45	46	42	29	30	23	20	16	37	49	52	45	35	30	29	25	23	41			
	12	1728	480	43	45	42	32	22	16	15	15	36	46	50	46	32	18	18	20	20	40	49	54	49	37	32	27	25	25	44			
5	3	691	192	34	33	30	20	19	17	15	<	26	36	37	35	24	23	17	15	15	30	40	41	39	31	22	16	15	15	34			
	6	1382	384	40	43	38	30	22	16	15	15	33	43	45	42	35	21	16	15	15	37	49	51	46	35	31	29	25	23	41			
	9	2074	576	48	39	43	33	20	21	27	30	38	49	52	46	36	31	30	26	24	42	49	54	50	41	37	33	31	29	46			
	12	2765	768	49	52	45	35	30	28	24	23	41	49	54	49	38	37	32	30	25	45	53	56	54	45	40	35	27	24	49			
6	3	518	144	33	34	29	21	20	16	15	<	26	36	37	35	24	23	17	15	15	30	40	41	39	31	22	16	15	15	34			
	6	1037	288	38	40	37	29	24	16	15	15	32	49	49	39	30	19	16	16	15	36	46	50	46	32	26	24	22	22	40			
	9	1555	432	40	41	39	31	22	16	15	15	34	46	49	43	33	19	18	20	18	38	49	52	46	36	31	30	26	24	42			
	12	2073	576	47	48	43	28	16	16	16	15	37	50	54	51	38	33	28	26	26	41	41	54	58	55	42	37	32	30	30	45		
7	3	816	227	29	30	27	23	21	20	16	16	27	38	39	36	25	24	19	19	15	31	41	44	40	30	24	16	15	15	35			
	6	1633	454	40	41	39	31	22	16	15	15	34	48	39	43	34	21	21	27	30	38	52	43	47	38	25	25	31	34	42			
	9	2449	680	45	49	46	32	18	17	19	19	39	49	52	47	37	33	32	28	25	43	53	56	53	42	38	30	27	24	47			
	12	3265	907	49	52	47	38	33	30	26	24	43	49	53	51	45	37	32	28	25	47	53	57	55	49	41	36	32	29	51			
8	3	1296	360	34	34	30	24	21	20	17	16	28	38	40	37	29	24	16	15	15	32	42	44	41	33	28	20	19	17	36			
	6	2592	720	42	44	39	30	26	20	18	17	35	45	49	46	32	18	17	19	19	39	49	53	50	36	22	21	23	23	43			
	9	3888	1080	46	50	46	32	26	24	22	22	40	49	54	49	37	32	27	25	25	44	54	57	53	43	38	30	27	24	48			
	12	5184	1440	49	52	47	37	33	31	27	25	43	53	56	53	42	38	30	27	24	47	47	57	60	57	46	42	34	31	51			

Sound-damped volumetric flow controller model Piano / Piano-S

Heating register (-H2)

with 2 duct rows

NW	Air volume	Pa _L	T _E = 15° C			WK	AG
			T _W = 70-50° C	Q	Pa _W		
	V _{min} / V _{max} (m ³ /h)	[l/s]	(kW)	(kPa)	[l/h]	(St.)	("")
1	125	35	7,5	0,75	0,27	33	1 1/2
	250	69	27,0	1,25	0,73	55	
	375	104	58,0	1,62	1,19	71	
	500	139	99,0	1,92	1,66	84	
2	200	56	7,5	1,43	1,10	63	1 1/2
	400	111	27,0	2,26	2,60	99	
	600	167	58,0	2,91	4,25	127	
	800	222	99,0	3,45	5,90	151	
3	313	87	7,5	2,39	3,50	104	1 1/2
	625	174	27,0	3,78	8,30	166	
	938	261	58,0	4,85	13,30	212	
	1250	347	99,0	5,79	18,65	253	
4	500	139	7,6	3,70	1,50	162	2 3/4
	1000	278	27,0	5,86	2,60	257	
	1500	417	58,0	7,51	5,70	329	
	2000	556	99,0	8,95	7,90	392	
5	800	222	7,6	6,23	5,20	273	2 3/4
	1600	444	27,0	9,83	12,20	430	
	2400	667	58,0	12,70	19,60	556	
	3200	889	99,0	15,10	27,00	662	
6	600	167	9,0	4,40	0,70	192	2 1
	1200	333	31,5	6,95	1,60	305	
	1800	500	66,5	8,95	2,60	392	
	2400	667	113,0	10,63	3,55	465	
7	950	264	9,0	7,40	2,20	324	2 1
	1900	528	31,5	11,74	5,20	514	
	2850	792	67,0	15,27	8,60	668	
	3800	1056	114,0	17,95	11,60	786	
8	1500	417	9,0	12,17	7,20	533	2 1
	3000	833	32,0	19,40	17,00	848	
	4500	1250	67,0	25,10	27,50	1098	
	6000	1667	114,0	30,00	38,00	1307	

Heating register (-H4)

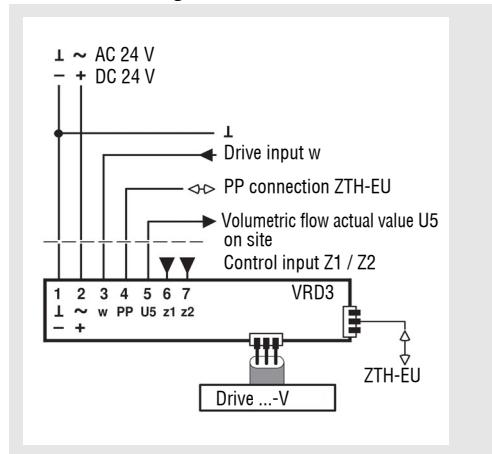
with 4 duct rows

NW	Air volume	Pa _L	T _E = 15° C			WK	AG
			T _W = 45-35° C	Q	Pa _W		
	V _{min} / V _{max} (m ³ /h)	[l/s]	(kW)	(kPa)	[l/h]	(St.)	("")
1	125	35	15	0,79	2,10	68	1 1/2
	250	69	52	1,34	5,84	116	
	375	104	110	1,71	9,40	149	
	500	139	188	2,10	13,90	182	
2	200	56	15	1,33	6,80	116	1 1/2
	400	111	52	2,27	18,70	197	
	600	167	111	2,90	29,70	251	
	800	222	188	3,50	43,00	307	
3	313	87	15	2,05	2,70	178	2 3/4
	625	174	52	3,46	7,20	301	
	938	261	110	4,42	11,50	384	
	1250	347	186	5,40	16,80	469	
4	500	139	15	3,30	2,60	285	3 1
	1000	278	52	5,55	7,00	483	
	1500	417	111	7,40	12,00	645	
	2000	556	189	9,00	17,00	786	
5	800	222	15	5,35	4,10	464	4 1
	1600	444	52	9,10	11,00	788	
	2400	667	111	12,10	19,00	1051	
	3200	889	189	14,70	27,00	1279	
6	600	167	17	4,10	4,00	354	2 1
	1200	333	60	7,00	11,00	603	
	1800	500	126	8,85	17,00	769	
	2400	667	214	10,85	25,00	943	
7	950	264	17	6,50	3,60	562	3 1
	1900	528	60	11,00	9,60	957	
	2850	792	127	14,00	15,20	1221	
	3800	1056	216	17,20	22,30	1498	
8	1500	417	17	10,40	5,60	899	4 1
	3000	833	60	17,70	15,00	1537	
	4500	1250	126	23,70	26,00	2057	
	6000	1667	214	28,80	37,00	2504	

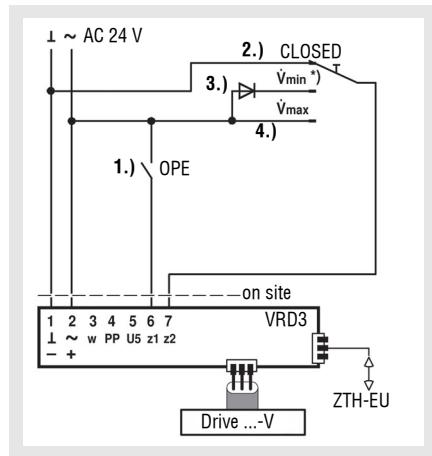
Sound-damped volumetric flow controller model Piano / Piano-S

Circuit diagram

Connection diagram VRD3-SO



Positive control VRD3-SO

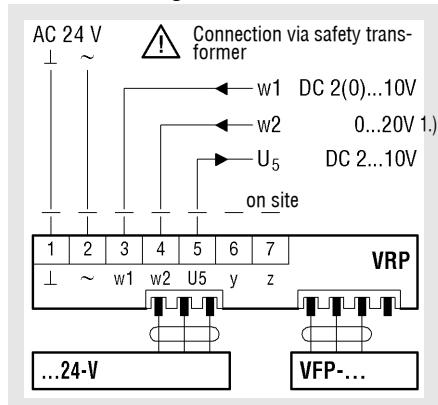


Overview control signals / functions

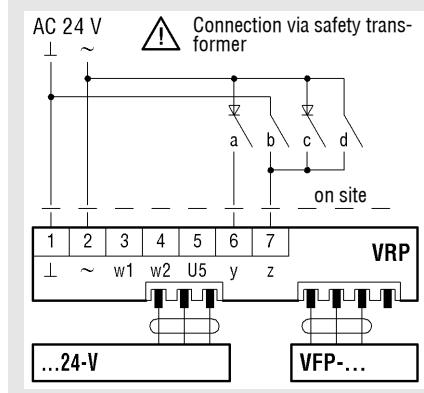
Signal terminal / Function	Priority	GND	pos HW	neg HW	24 V AC	open
Forced contact Z1 - Terminal 6	1	-	OPEN 1.)	-	OPEN 1.)	-
Forced contact Z2 - Terminal 7	2	CLOSED 2.)	V _{min} 3.)	-	V _{max} 4.)	-
Tool (PP-Cmd) -> ZTH-EU	3	CAV stages (Auto, OPEN, CLOSED, V _{min} , V _{max} , Stop)				
Command signal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

*) requires AC 24 V power supply

Connection diagram VRP



Positive control VRP

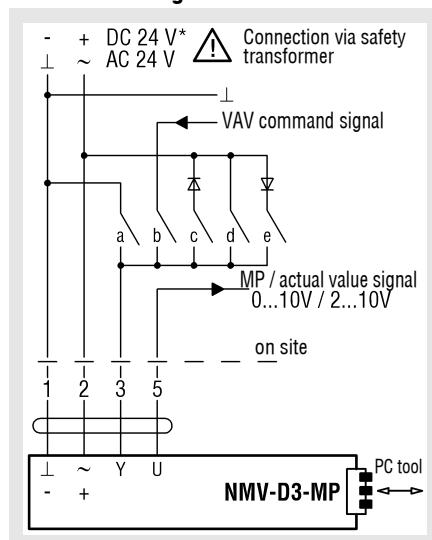


Function	a	b	c	d
CLOSED	/	/	/	/
V_{min}	/	/	/	/
V_{max}	/	/	/	/
OPEN	/	/	/	/

Sound-damped volumetric flow controller model Piano / Piano-S

Circuit diagram controller NMV-D3-MP

Connection diagram NMV-D3-MP



* not available for DC 24 V supply

CAV function for NMV-D3-MP

Mode setting	---	0...10 V	0...10 V	0...10 V	0...10 V
Signal	2...10 V	2...10 V	2...10 V	2...10 V	2...10 V
Function					
Damper CLOSED	a) CLOSED		c) CLOSED *		
V _{min} ...V _{max} CAV - V _{min}	b) VAV				
Damper OPEN CAV - V _{max}					e) OPEN*
			d) V _{max}		

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

* not available for DC 24 V supply

Cable connection

No.	Designation	Wire colour	Function
1	-	black	- { Supply AC/DC 24 V
2	+	red	~ +
3	Y	white	Input for - Sensor connection - Positive control
5	U	orange	MP bus connection

Notes:

- Supply voltage via safety transformer!
- The connections 1 and 2 (AC/DC 24V) and 5 (MP signal) must be connected to readily accessible terminals (room controller, floor distributor, switch cabinet, etc.), in order to allow them to be accessed by the PC-Tool for diagnostic and service work.



Sound-damped volumetric flow controller model Piano / Piano-S

LED table of functions for NMV-D3-MP

Application	Function	Description / action	LED pattern	Adaptation Address	⊕ LED 1 power ⊕ LED 2 status
N1 operation	Status display	- 24V 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		
S2 service function	Adaptation	Adaptation started by: a) Operating / service unit b) Key on the VAV-Compact	LED 1 LED 2		
V1 VAV service	VAV service active	a) Press both keys «Adaptation» & «Address» simultaneously b) VAV service will be activated: - until 24V supply is switched off - until both keys are pressed again - after 2 hours have passed	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 ▶ MP communication	
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. ▶ MP communication	
B3 bus operation communication	MP-PP display Communication	Communication display via MP master or operating / service unit	LED 1 LED 2	MP communication	

[■] green LED (power) is lit

[■■] yellow LED (status) is lit

[■■■] yellow LED (status) is flashing

Sound-damped volumetric flow controller model Piano / Piano-S

Technical data of the controllers

NMV-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 of the sensor :	2...450 Pa
Supply voltage :	AC 24 V 50/60 Hz; DC 24 V
Functional range :	AC 19.2...28.8 V; DC 21.6...28.8V
Power consumption :	3 W
Dimensioning :	5 VA
Torque :	min. 10 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	$V_{\min} = 0\ldots100\%$ of set V_{henn} volumetric flow
V_{\min}/V_{\max} :	$V_{\max} = 20\ldots100\%$ of set V_{henn} volumetric flow
Command variable w/Y :	DC 2-10 V (4...20 mA with 500 Ω input resistance) (Input resistance min. 100 k Ω)
	DC 0-10 V (0...20 mA with 500 Ω input resistance) adjustable DC 0...10 V
Setting range actual value signal U_5 :	DC 2...10 V DC 0...10V
MP bus function	
Address in bus mode :	MP 1 ... 8 (traditional operation: PP)
LONWORKS® / EIB-Konnex / MODBUS RTU / BACnet:	with BELIMO interface UK24LON / UK24EIB, 1 ... 8 BELIMO MP devices (VAV / flap drive/ valve)
DDC controller :	DDC controller / PLC from different manufacturers, with integrated MP interface
Fan Optimiser :	with BELIMO Optimiser COU24-A-MP
Sensor connection :	Passive (Pt1000, Ni1000, etc.) and active sensors (0...10 V), for example temperature, humidity, 2-point signal (switching power 16 mA @ 24 V), for example switch, presence detector
Protection class :	III (safety extra low voltage)
Degree of protection :	IP 54 (hose-connected)
EMC:	CE according to 39/336/EEC
Measuring air and ambient temperatures :	0° C ...+50° C, 5...95% rH, non-condensing
Storage temperature :	-20° C ...+80° C
Sound power level:	max. 35 dB (A)
Operation and service :	plug-in via service socket / PC-Tool (from V3.1) / ZEV hand-held operating unit
Communication :	PP/MP bus, max. DC 15V, 1200 baud
Connection :	Cable, 4 x 0.75mm ² , terminals
Weight:	approx. 700 g

VRD3-SO

with integrated dynamic differential pressure sensor

Measuring principle :	Pressure reading with volumetric flow
Measuring range of the sensor :	2...300 Pa
Supply voltage :	AC 24 V 50/60 Hz; DC 24 V
Power consumption :	2 W
Dimensioning :	3.5 VA (without damper drive)
Command variable w:	-
Command variable w1:	DC 0-10 V (input resistance 100 k Ω)
Command variable w2:	-
Operating range:	DC 2-10 V (0-10 V switch over via ZEV)
Volumetric flow:	DC 0-10 V (for operating mode 0-10)
Actual value signal U5:	DC 2-10 V (for operating mode 2-10)
Torque :	-
Sound power level:	-

VRP

For static differential pressure control with separately available sensors VFP-100, 300 or 600

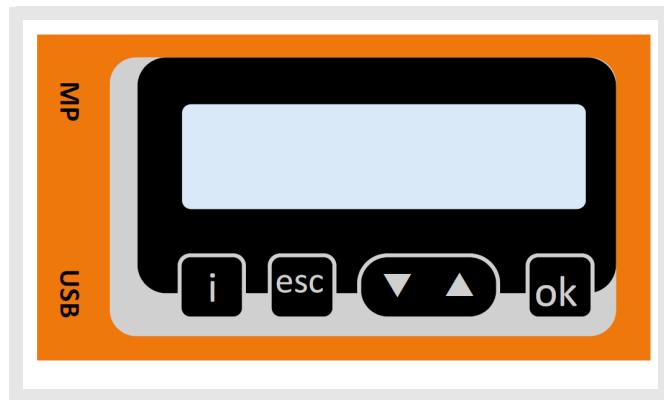
Measuring principle :	Pressure measurement with metal membrane
Measuring range of the sensor :	0...100 Pa, 0...300 Pa or 0...600 Pa
Supply voltage :	AC 24 V 50/60 Hz;
Power consumption :	1.3 W (incl. sensor VFP-..., without actuator)
Dimensioning :	2.6 VA (incl. sensor VFP-..., without actuator)
Command variable w:	-
Command variable w1:	DC 2-10 V (input resistance 100 k Ω)
Command variable w2:	0-20 V phase crossover (input resistance 8 k Ω)
Operating range:	DC 2-10 V
Volumetric flow:	DC 2-10 V
Actual value signal U5:	-
Torque :	-
Sound power level:	-

Sound-damped volumetric flow controller model Piano / Piano-S

Startup using PC-Tool

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

ZTH EU as MP level converter



Description

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

Power supply

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

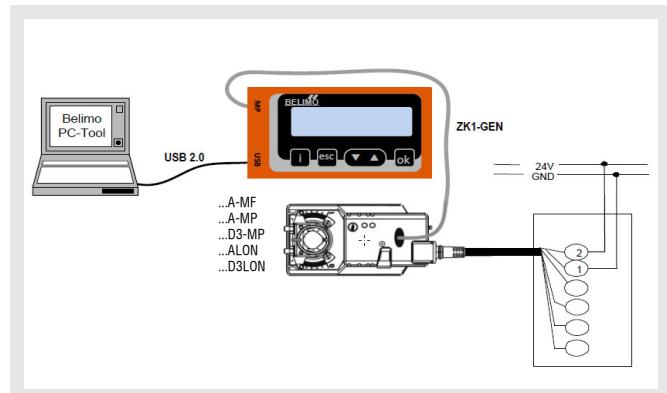
Driver

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

Note

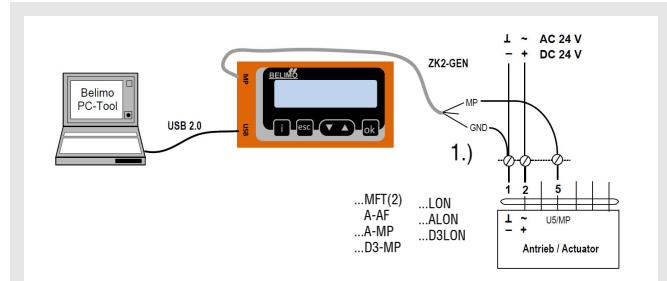
For connection to USB ports of PCs and BELIMO 24 V drives only (to safety extra low voltage SELV or US class 2 feeds).

Connection diagram 1



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

Connection diagram 2



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

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

Sound-damped volumetric flow controller model Piano / Piano-S

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



2 x 16-digit LCD with background lighting

MP Forwards / Backwards

USB Change value / status

i OK Confirm input

esc ESC Cancel input/ Leave submenu/ Discard changes

i shows additional information if available

Connection:

Locally via service socket



Dimensions::

85x65x23 (WxHxD)

Connection and supply

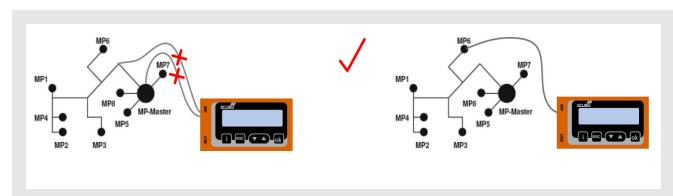
Stand-alone operation:

Connection including supply takes place via the service socket at the VAV controller or via the terminals.

Bus operation:

The ZTH EU can be used in the following units while the bus is running if it is connected via the local service socket: VAV-Compact L/N/SMV-D3-MP, NMVAX-D3-MP, L/NMV-D3LON.

With the VRP-M, L/NMV-D3-M and NMVAX-D3-MP, the MP bus must be disconnected when the service socket is used.



Restriction:

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

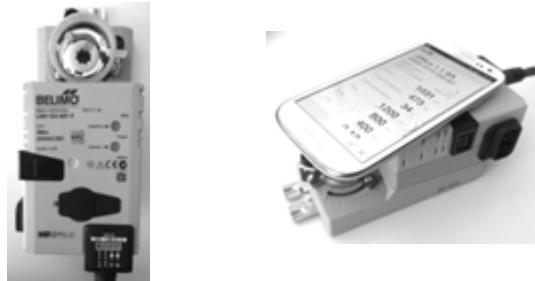
The ZTH EU comes with a quick start guide de/en to be affixed to the back of the unit.

Sound-damped volumetric flow controller model Piano / Piano-S

Smartphone - Belimo Assistant App

The NFC antenna area of the VAV Compact is located between the Belimo or OEM logo and the NFC label.

Align NFC-capable android smartphone with loaded Assistant app on the VAV-Compact such that the two antennae are above one another.



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

NFC-capable devices:

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

Non-NFC-capable devices:

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

Maintenance and service

Assembly and maintenance instructions

1. When the device is delivered, check whether the sound-damped volumetric flow controllers are complete and delivered without damage. Complaints have to be communicated immediately and directly to the transporter and SCHAKO.
2. The sound-damped volumetric flow controller types Piano or Piano-S must not be carried on the regulation components, measuring cross or the damper leaf, but only on the housing.
3. The units must be carefully stored on site. They must be protected from dust, dirt and from direct weather effects.
4. The devices 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 sound-damped volumetric flow controllers 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 sound-damped volumetric flow controllers 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 NMV-D3-MP and VRD3-SO requires little maintenance. However, if, depending on the degree of pollution of the air, unexpected volumetric flow deviations occur, then the following procedure is recommended.

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

Sound-damped volumetric flow controller model Piano / Piano-S

Zero adjustment of the static pressure sensors VFP-...

The pressure probe is based on a static pressure meter. Great care must be taken to ensure correct transport and correct assembly. The volumetric flow controllers have been adjusted in-factory by the OEM manufacturer according to their mounting position. If the controllers are installed in another position the sensors can be adjusted as follows:

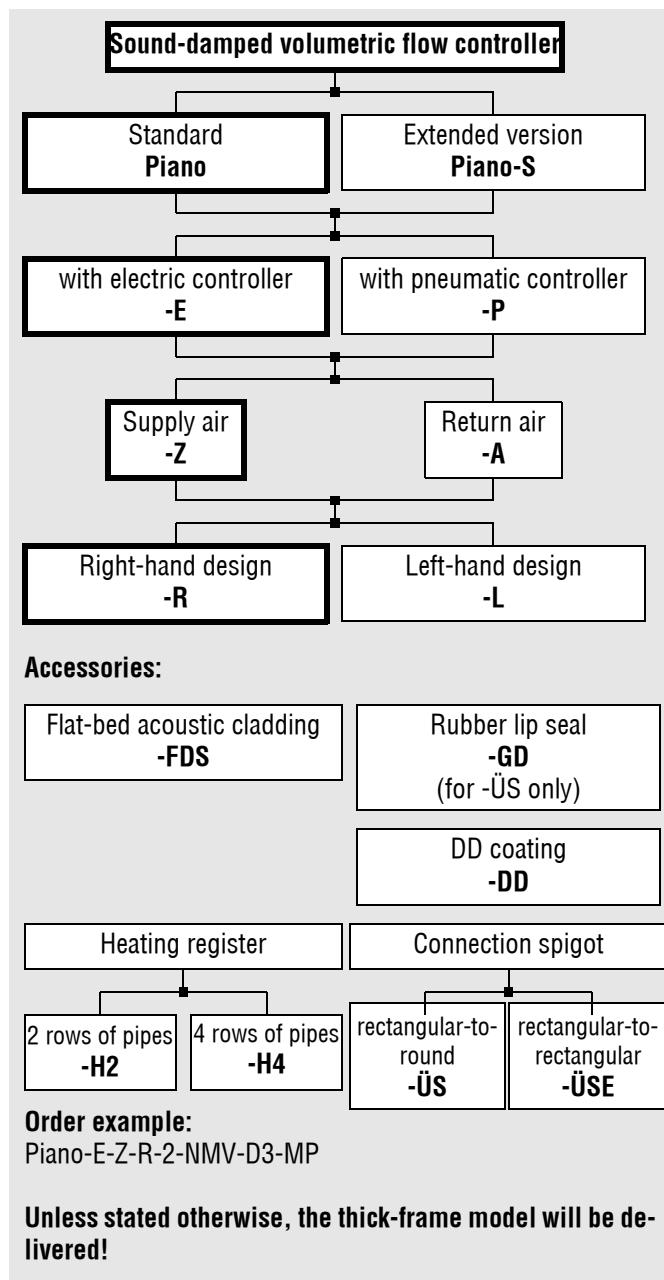
1. Sensor VFP-... must be installed.
2. Connect VFP-... to VRP and supply VRP with 24 V AC mains voltage.
3. Remove lid from VFP....
4. Move damper to the "OPEN" position.
5. Pull damper drive plug from the VRP.
6. Remove the pressure hoses from the connection pipes.
Attention! Make a note of the (+)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

Legend

V_{ZU}	(m³/h)	= Supply air volume
V_{ZU}	[l/s]	= Supply air volume
V_{AB}	(m³/h)	= Return air volume
V_{AB}	[l/s]	= Return air volume
V_W	[l/s]	= Water flow volume
V_{min}	(m³/h)/[l/s]	= Minimum volumetric flow
V_{max}	(m³/h)/[l/s]	= Maximum volumetric flow
V_{nenn}	(m³/h)/[l/s]	= Nominal volumetric flow
<		= L_W values smaller than 15
f_m	(Hz)	= Octave centre frequency
f	(Hz)	= Frequency
D_e	[dB/Oct]	= Insertion loss
L_{WA}	[dB(A)]	= A-weighted sound power level
L_W	[dB]	= Sound power level
Δp_t	(Pa)	= Pressure loss
$\Delta p_{t\ min}$	(Pa)	= Minimum static pressure difference
P_{aL}	(Pa)	= Air-side pressure loss
P_{aW}	(kPa)	= Water-side pressure loss
T_W	(°C)	= Water inlet/outlet temperature
T_E	(°C)	= Air inlet temperature
v_K	(m/s)	= Duct velocity
v_{min}	(m/s)	= Minimum end velocity of jet
v_{max}	(m/s)	= Maximum end velocity of jet
Q	(kW)	= Power
NW	(-)	= Nominal size
WK	(St.)	= Water circuits
AG	(")	= Connecting thread

Sound-damped volumetric flow controller model Piano / Piano-S

Order details



Sound-damped volumetric flow controller model Piano / Piano-S

Specification text

Sound-damped volumetric flow controller for use in supply and return air systems, for duct connection to DIN 24190, with integrated volumetric flow controller for use in constant or variable volumetric flow, room or duct pressure regulation. With positive control V_{\min} , V_{\max} or "CLOSED".

Allowed ambient temperatures: 0 - 55°C. It is possible to subsequently adjust the manufacturer-set operating volumetric flow at any time. The actual throughput of the volumetric flow can be measured via the U_5 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 joint, opposed adjustable, flow-favouring louvres made of distortion-resistant aluminium profile and sealing rubber free of silicone for airtight design to DIN EN 1751, Class 3, with measuring cross blades made of extruded aluminium profile, blade mount made of plastic (PA6). A special measuring cross allows position-independent mounting.

- For use in supply air systems, with electric controller, control voltage 24 V AC, 50 / 60 Hz, temperature compensation of 10-40°C, wired and adjusted in-factory.

Make: SCHAKO **type Piano-E-Z** or **type Piano-S-E-Z** with a longer silencer unit.

- For use in return air systems, with electric controller, control voltage 24 V AC, 50 / 60 Hz, temperature compensation of 10-40°C, wired and adjusted in-factory.

Make: SCHAKO **type Piano-E-A** or **type Piano-S-E-A** with a longer silencer unit.

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

- For use in supply air systems, with pneumatic controller, feed pressure 1.3 bar +/- 0.1 bar, control pressure 0.1 - 1.0 bar

- Depressurised "CLOSED"
- Depressurised "OPEN"

Make: SCHAKO **type Piano-P-Z** or **type Piano-S-P-Z** with a longer silencer unit.

- For use in return air systems, with pneumatic controller

Make: SCHAKO **type Piano-P-A** or **type Piano-S-P-A** with a longer silencer unit.

- Connection: standard design with rectangular duct connection on both sides
 - Right-hand model (-R)
 - Left-hand model (-L)

Accessories (at an extra charge):

- Flat-bed acoustic cladding (-FDS), for reducing the radiated noise, made of sound-absorbing material arranged inside the housing, thus same outer dimensions.
- Heating register (-H2-H4): 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.
 - with 2 duct rows (-H2)
 - with 4 duct rows (-H4)
- Rubber lip seal (GD) made of special rubber (for Piano or Piano-S with transition piece (ÜS) to round ducts only)
 - with DD coating (-DD) for aggressive return air
- Transition piece, high-pressure side, made of galvanised sheet steel
 - for connection to round ducts (-ÜS)
 - for connection to rectangular ducts (-ÜSE)