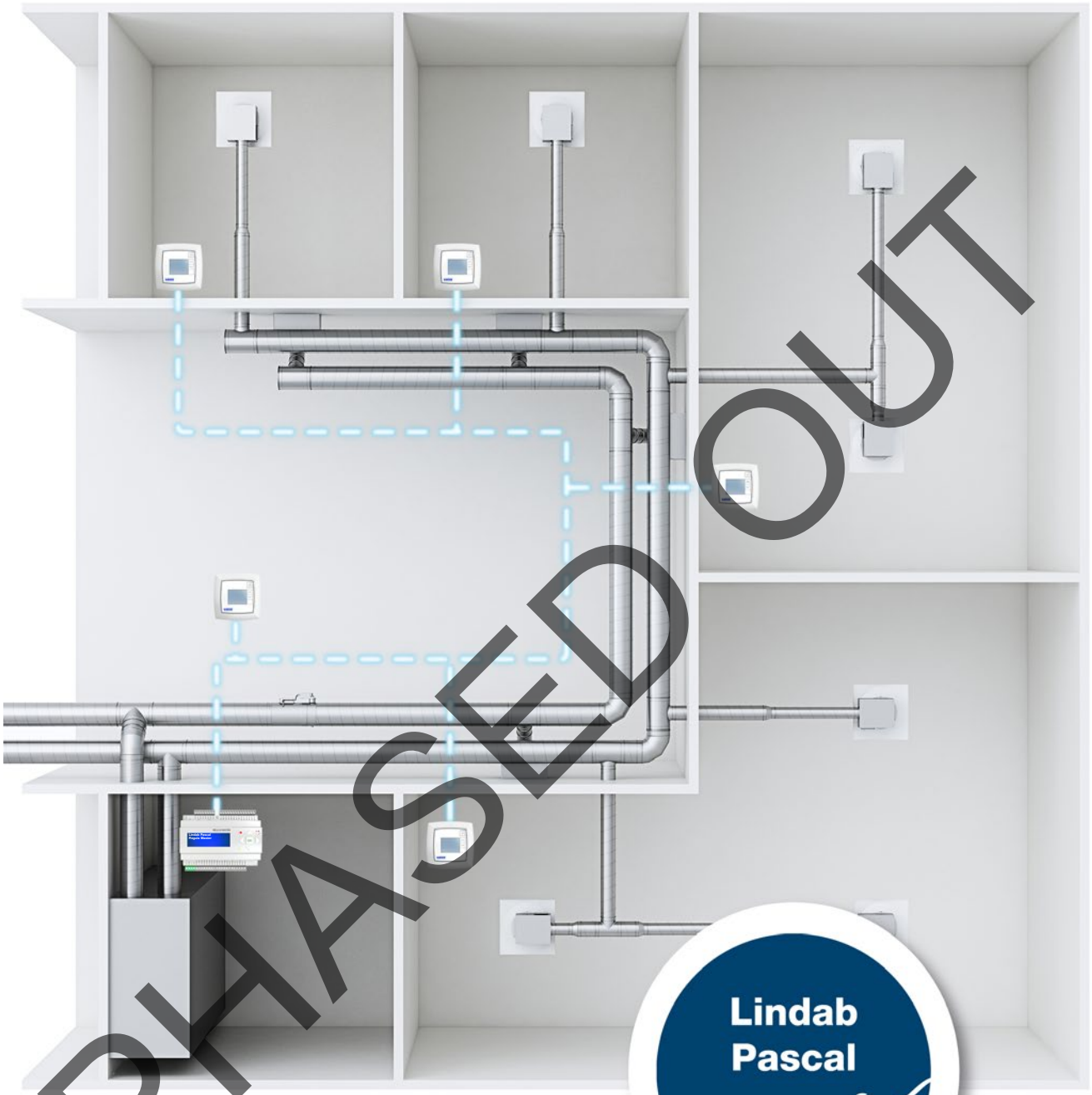
Lindab Pascal system



PHASED OUT

Technical documentation

Pascal system overview

Content

System introduction

Simplified VAV solution

Lindab Pascal is a solution that makes it more simple to fulfill the needs for a well functioning VAV system. The solution is basically based on volume flow regulation which makes it a variable pressure system. Unlike constant pressure systems the duct design is of less importance and the need for regulation equipment is less. With a variable pressure system it is possible to obtain correct airflows in all parts of the system in all operating conditions. The MBBV box is in the heart of Pascal which regulates each diffuser in the system to correct airflow. The unique linear cone damper technology of MBBV, which makes it possible to handle up to 200 Pa with low sound level, combined with an integrated actuator with precise flow measurement, eliminates the need for any other regulation equipment between the fan and the MBBV. The system is controlled by Regula units where all settings and parameters can easily be adjusted. All components used in the system are with standard settings from factory and can easily be adjusted and commissioned after installation. With a few number of standard components, no special requirements for duct design and a flexible system set up, Pascal makes designing, installation and commissioning so much easier.

Energy minimizing solution

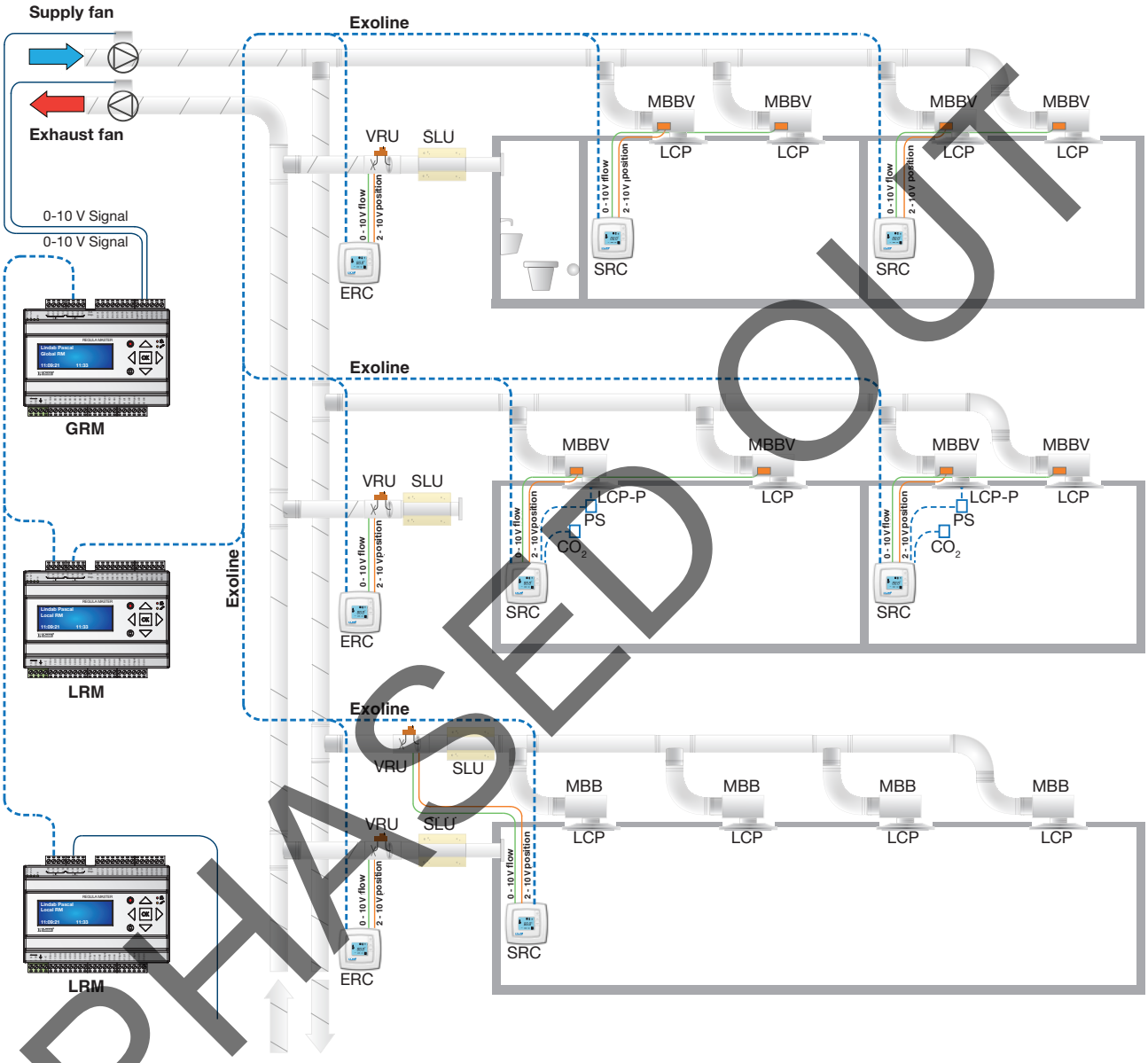
The demand for VAV systems in modern construction is increasing and with good reason. VAV systems in general save a lot of the energy used for transportation and cooling of air. With a Pascal solution it is possible to lower the energy consumption even more. Instead of a traditional pressure regulation of the fan, the Pascal solution has a fan optimizer function that controls the fan speed of both supply and exhaust fan. The system makes sure at least one damper in the system is 85% open, which ensures that enough air is available in all parts of the system, but simultaneously ensures that the fan does not provide more pressure than necessary. For optimal fan control Pascal reads all damper positions at room level.

Studies of modern office buildings shows that employees are only in their room in 70% of their daily working hours. Therefore Pascal has a Demand control function that via a presence sensor can detect absence in rooms and go to a low non-occupancy airflow level to save even more energy.

Regula Master

Pascal system description

System description




LKP/ LKP-P


LCP/ LCP-P


LCC/ LCC-P


Regula Combi (SRC, ERC)


Regula Master (SRM, LRM, GRM)


VRU-MF


MBB


MBBV

Pascal system description

System description

Type	Product	Function
LCP-P	Diffuser with integrated presence sensor	• Dynamic diffuser to handle 0-100% airflow without drafts • Indicates absence in room for lower airflows
LCP	Diffuser	• Dynamic diffuser to handle 0-100% airflow without drafts
SRC	Supply Regula Combi	• Room control with temperature regulation • Control of supply airflows in MBBV or VRU • Communicates airflows and damper position to LRM • Max. 26 per SRM/LRM
ERC	Exhaust Regula Combi	• Control of exhaust airflows in VRU • Communicates damper positions to LRM • Max. 8 per SRM/LRM
MBBV	Active plenum box with air flow regulation	• Airflows controlled by SRC • Regulates airflows regardless of pressure • Handles up to 200 pa with low sound level • Max. 10 per Regula Combi
MBB	Passive plenum box	• Manually balancing of airflow • Handles up to 200 pa with low sound level
VRU	Volume flow regulator	• Airflows controlled by SRC/ERC • Max. 10 per Regula Combi
SLU	Silencer	• Attenuates sound generated in VRU
LRM	Local Regula Master	• Collects airflows and damper positions from SRC • Controls ERC airflow based on SRC values • Communicates all damper positions to GRM • Performs operating control
GRM	Global Regula Master	• Collects damper positions from all LRM • Controls fan speed to minimize energy consumption
Exoline	BUS communication	• Communicates parameters between SRC/ERC and LRM/GRM
0-10 V flow	Flow signal	• Controls airflows from SRC / ERC to MBBV / VRU
2-10 V position	Damper position signal	• Indicates damper position from MBBV/VRU to SRC/ERC

Dynamic diffuser solution

- Flush mounted aesthetic diffuser
- Used in combination with motorized plenum box MBBV
- Dynamic work area 0-100% air flow
- Low airflows with high undertemperature without drafts
- Integrated presence sensor for Demand control

Demand control

- Integrated presence sensor in diffuser
- Standby airflow at non-occupancy in room
- Light control at non-occupancy is possible via relay function

Volume flow regulation

- Variable pressure system secures correct air flows at all time
- Flow measurement and regulation in MBBV and VRU
- Supply unit MBBV handles up to 200 Pa with low sound level
- No need for balancing dampers between fan and supply diffusers
- Easy wiring with Regula Connect on MBBV

Room regulation

- Temperature controller with flexible parameters
- CO2 regulation possible
- Presence control possible

Exhaust control

- Regula Master controls exhaust VRU to obtain balance
- No need for flow measurement in ducts for master / slave function
- Possible to add constant flow factor
- Possible to programme flow difference for under / overpressure
- ERC converts Exoline signal to 0-10V flow signal to exhaust damper

Communication

- Exoline BUS communication between Regula Combi and Regula Master units
- Exoline BUS communication to overall BMS system
- Possible to communicate with other systems to overall BMS system via OPC solution (BMS integrator)

Fan optimizer

- Regula Master register all damper positions in system
- Optimizes fan speed to minimize energy consumption
- Secures minimum one damper is 85% open

Operating control

- Regula Master register damper movements in system
- Regula Master alert is given if no damper movement

Designing a Pascal system

Designing step by step

Designing a Pascal system is simple and can basically be done in a few steps, as listed below here.

Details of each step follows on this page and a number of design principles can be found on the following pages.

1. Define room solution
   - Select numbers of Supply Regula Combi
   - Select if Demand control shall be used
   - Select supply regulation type
   - Select supply diffuser type, dimension and placement

2. Define exhaust strategy
   - Select exhaust principle
   - Select exhaust diffuser type, dimension and placement
   - Define exhaust control and place VRU dampers
   - Secure exhaust balance on floor level

3. Define system layout
   - Identify system size
   - Select numbers and placement of Single or Local Regula Master
   - Select numbers of Global Regula Master

Premises for the system
To achieve a well functioning VAV system with Pascal a few premises should be met:

- One volume flow regulator has to be between the fan and the diffusers in the system, not more or less
- Working pressure in the system must be below 200 Pa (calculated after AHU silencers)
- For systems with a working pressure exceeding 200 Pa, pressure limitation must be established on a zone level

Room solution

Supply Regula Combi
Pascal system is based on temperature regulation of the room using a standard Supply Regula Combi room controller in each room. Using more than one Supply Regula Combi can be chosen in larger rooms where multiple temperature zones is required.

Demand control
Presence control and/or CO2 control can be chosen optionally. Diffusers with integrated presence sensor is available (e.g. LCP-P) or external presence sensor can be used. For CO2 regulation an external CO2 sensor can be used. Demand control sensors will be connected to Supply Regula Combi, typically via the Regula Connect card placed on MBBV box.

Supply regulation
For single offices, small open offices and similar room types a solution with regulation directly in each plenum box type MBBV is being used. For large offices or other rooms with a large number of supply diffusers a solution with VRU regulation in the supply duct can be chosen. Note that using a VRU solution will require installation of a silencer after the VRU.

Supply diffuser
Choose the desired Pascal diffuser type, e.g. with integrated presence sensor and select the right dimension, according to technical data. Diffusers should be placed properly in the room to meet the given comfort demands in the room. Room calculations could be made in Lindab´s IT tool DIMcomfort.

Exhaust strategy

Exhaust principle
Exhaust in the rooms can be done by a central exhaust regulation, using overpressure valves or an exhaust diffuser placed in the room. For a room balanced solution exhaust dampers can be placed in the ducts into the rooms, controlled either by a parallel signal from Supply Regula Combi or controlled by Regula Master. A Regula Master unit can handle up to 8 exhaust units.

Exhaust diffuser
Choose the desired exhaust diffuser type according to the chosen exhaust principle and select the right dimension, according to technical data.

Exhaust control
Define which supply units that affects which exhaust units and place the necessary VRU dampers. Regula Master will register actual supply airflows in all selected rooms and control the corresponding exhaust units.

Exhaust balance
For a total balance of supply and exhaust on a floor level, areas with constant exhaust flow has to be taken into account. Typically the replacement air is taken from nearby rooms, therefore this can be corrected in the exhaust regulation of the given rooms, to secure a total balance.

System layout

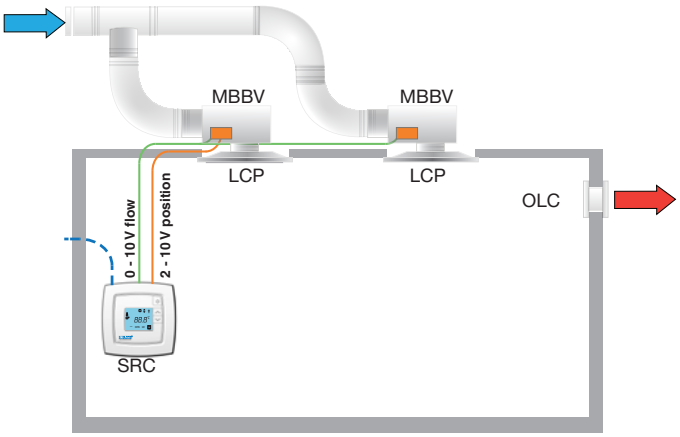
System size
For small systems (up to 26 rooms) a Single Regula Master can handle all the regulation of the system. For larger systems the upper control unit must be a Global Regula Master controlling up to 5 Local Regula Master (up to 5 x 26 rooms). For even bigger systems a number of Global Regula Master can be connected in cascade to control an unlimited number of rooms.

Local Regula Master
In systems with Local Regula Master the placement of the units should be close to the units it shall control. But also an appropriate wiring should be taken into account when choosing numbers and placement of Local Regula Master.
Local Regula Master shall therefore be physically placed on the floor level, typically placed in a secondary room.

Global Regula Master
Global Regula Master shall be placed close to the fan, since it has to control the fan speed.

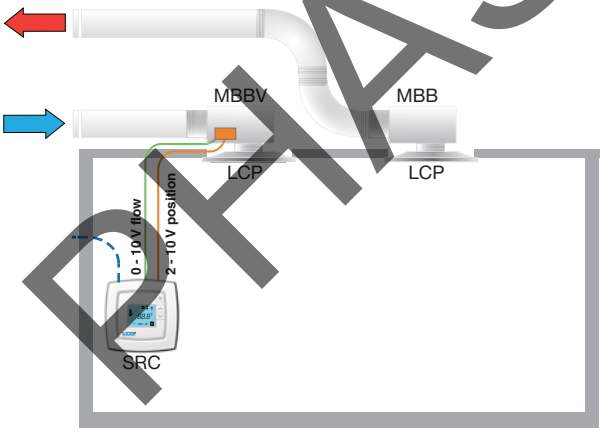
Pascal design manual

Supply: Temperature regulation with MBBV
Exhaust: Central regulation with overpressure valve



- SRC measures actual room temperature and gives 0-10V flow signal to MBBV
- MBBV regulates to correct air flow regardless of pressure
- Multiple MBBV controlled by same SRC can be wired with parallel signal
- MBBV indicate actual damper position to SRC by a 2-10V position signal
- SRC communicates actual flow and damper position to LRM
- Exhaust controlled centrally in corridor
- Exhaust from room via overpressure valve

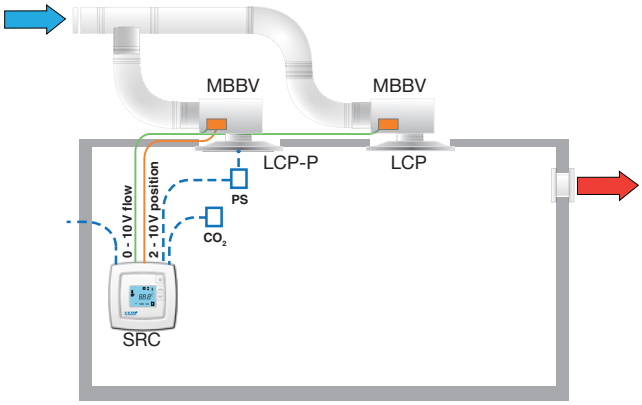
Supply: Temperature regulation with MBBV
Exhaust: Central regulation with exhaust diffuser



- SRC measures actual room temperature and gives 0-10V flow signal to MBBV
- MBBV regulates to correct air flow regardless of pressure
- Multiple MBBV controlled by same SRC can be wired with parallel signal
- MBBV indicate actual damper position to SRC by a 2-10V position signal
- SRC communicates actual flow and damper position to LRM
- Exhaust controlled centrally in corridor
- Exhaust from room via exhaust diffuser

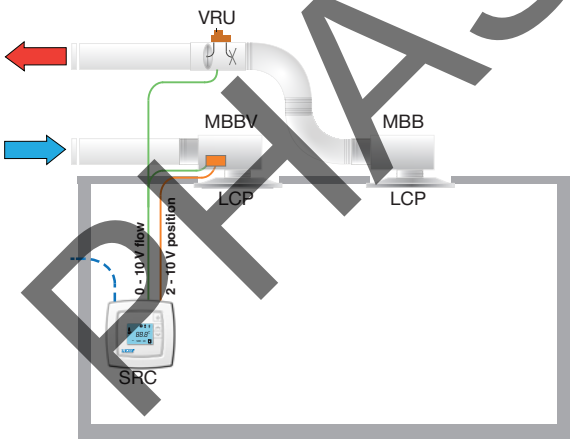
Pascal design manual

Supply: Demand control with MBBV
Exhaust: Central regulation with overpressure valve



- SRC measures actual room temperature
- External CO2 sensor measures CO2 level in room
- Integrated presence sensor register occupancy in room
- SRC gives 0-10V flow signal to MBBV according to room temperature and CO2 level
- At non-occupancy in room SRC regulates MBBV to “standby mode”
- MBBV indicate actual damper position to SRC by a 2-10V position signal
- SRC communicates actual flow and damper position to LRM
- Exhaust controlled centrally in corridor
- Exhaust from room via overpressure valve

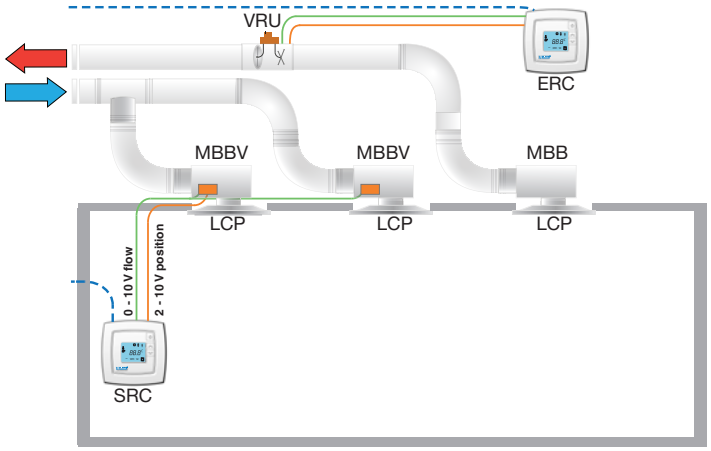
Supply: Temperature regulation with MBBV
Exhaust: Balanced with parallel signal



- SRC measures actual room temperature and gives 0-10V flow signal to MBBV
- MBBV regulates to correct air flow regardless of pressure
- MBBV indicate actual damper position to SRC by a 2-10V position signal
- SRC communicates actual flow and damper position to LRM
- SRC gives parallel 0-10V flow signal to exhaust VRU, to obtain room balance
- Parallel signal requires same size and numbers of MBBV and VRU
- No damper position from exhaust VRU is communicated to LRM
- No optimizer function on exhaust fan
- Exhaust fan must therefore be slave controlled by supply fan

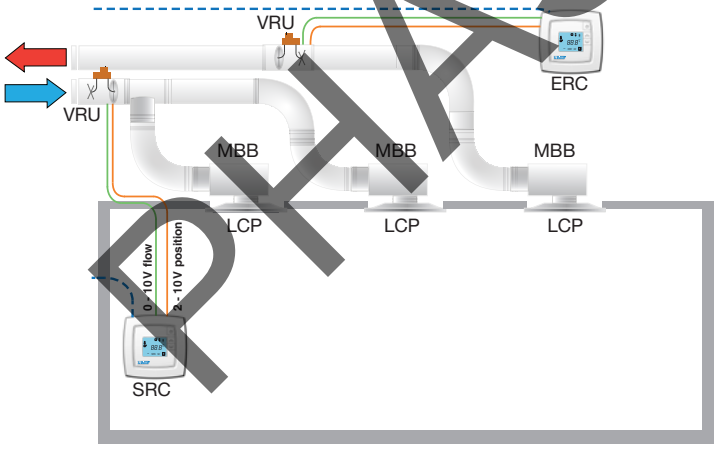
Pascal design manual

Supply: Temperature regulation with MBBV
Exhaust: Balanced with Regula Master control



- SRC measures actual room temperature and gives 0-10V flow signal to MBBV
- MBBV regulates to correct air flow regardless of pressure
- Multiple MBBV controlled by same SRC can be wired with parallel signal
- MBBV indicate actual damper position to SRC by a 2-10V position signal
- SRC communicates actual flow and damper position to LRM
- ERC receives actual flow from LRM and regulates VRU with a 0-10V flow signal, to obtain room balance
- VRU indicate actual damper position to ERC by a 2-10V position signal
- ERC communicates damper position to LRM
- Max. 8 ERC per LRM

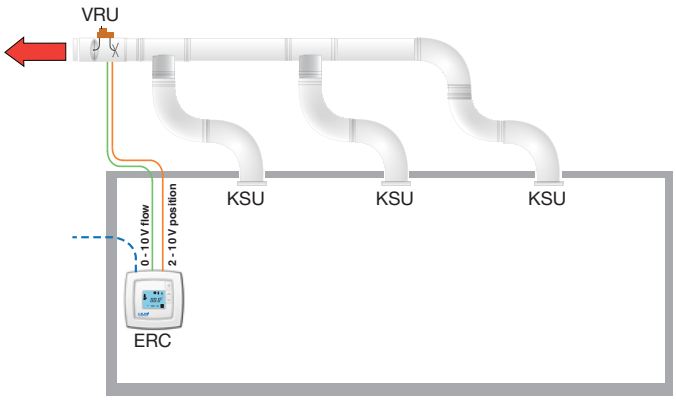
Supply: Temperature regulation with VRU
Exhaust: Balanced with Regula Master control



- SRC measures actual room temperature and gives 0-10V flow signal to supply VRU
- VRU regulates to correct air flow regardless of pressure
- VRU indicate actual damper position to SRC by a 2-10V position signal
- SRC communicates actual flow and damper position to LRM
- ERC receives actual flow from LRM and regulates exhaust VRU with a 0-10V flow signal, to obtain room balance
- VRU indicate actual damper position to ERC by a 2-10V position signal
- ERC communicates damper position to LRM
- Max. 8 ERC per LRM

Pascal design manual

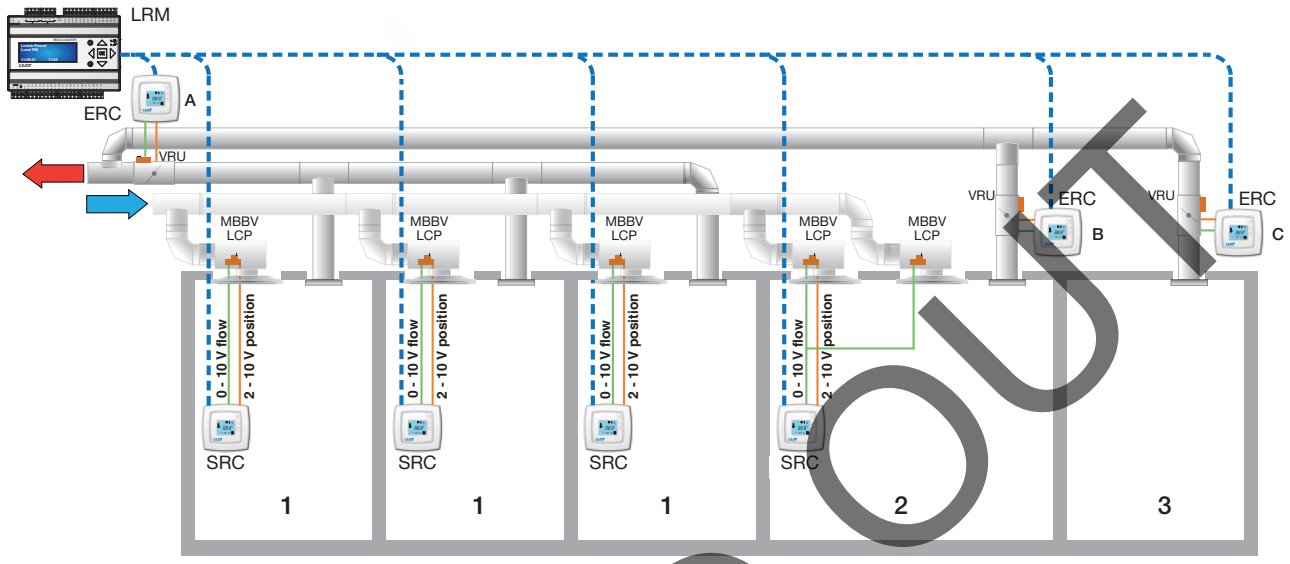
Supply: Overpressure from other rooms
Exhaust: Constant with communication



- The constant exhaust flow is assigned to ERC in LRM
- VRU regulates constant exhaust flow regardless of pressure
- VRU indicate actual damper position to ERC by a 2-10V position signal
- ERC communicates damper position to LRM
- The constant exhaust from this room must be compensated on ERC in other rooms
- Max. 8 ERC per LRM

Pascal design manual

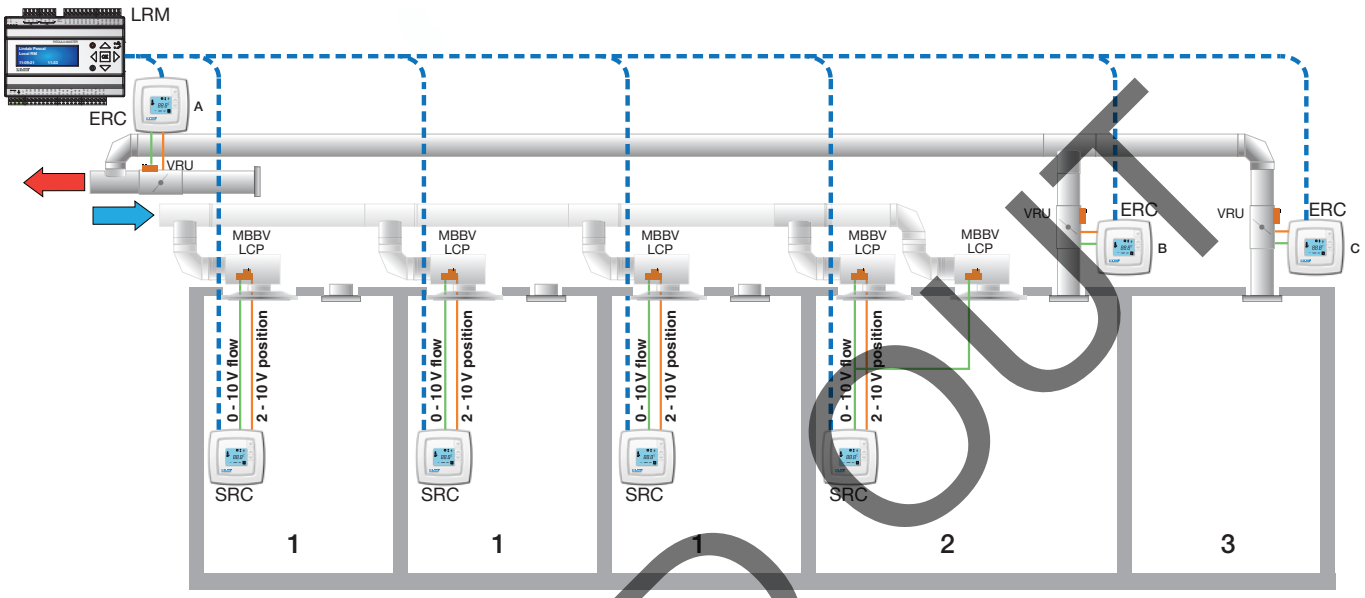
Exhaust strategy with central regulation and exhaust diffuser in rooms



- SRC regulates supply airflow in MBBV and communicates this airflow to LRM
- LRM regulates exhaust on VRU via ERC (A) to rooms (1) minus constant exhaust airflow in room (3)
- LRM regulates exhaust on VRU via ERC (B) to room (2) to secure room balance
- LRM regulates exhaust on VRU via ERC (C) to room (3) to secure constant air flow
- SRC and ERC communicates damper positions to LRM
- Damper positions for both supply and exhaust is used for fan optimizer function

Pascal design manual

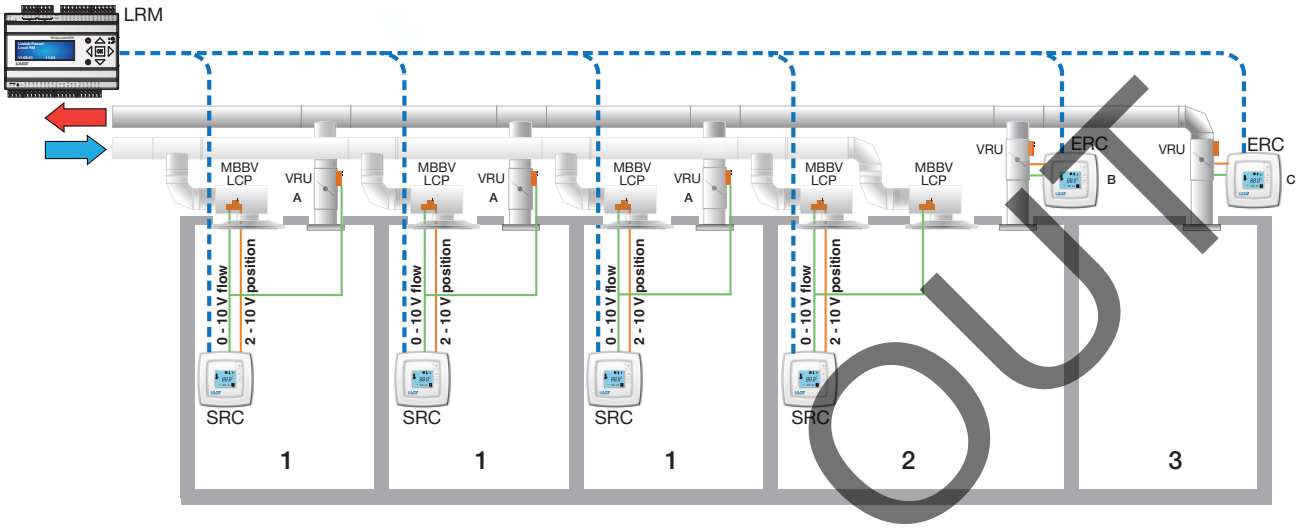
Exhaust strategy with central regulation and overpressure valves in rooms



- SRC regulates supply airflow in MBBV and communicates this airflow to LRM
- LRM regulates exhaust on VRU via ERC (A) to rooms (1) minus constant exhaust airflow in room (3)
- LRM regulates exhaust on VRU via ERC (B) to room (2) to secure room balance
- LRM regulates exhaust on VRU via ERC (C) to room (3) to secure constant airflow
- SRC and ERC communicates damper positions to LRM
- Damper positions for both supply and exhaust is used for fan optimizer function

Pascal design manual

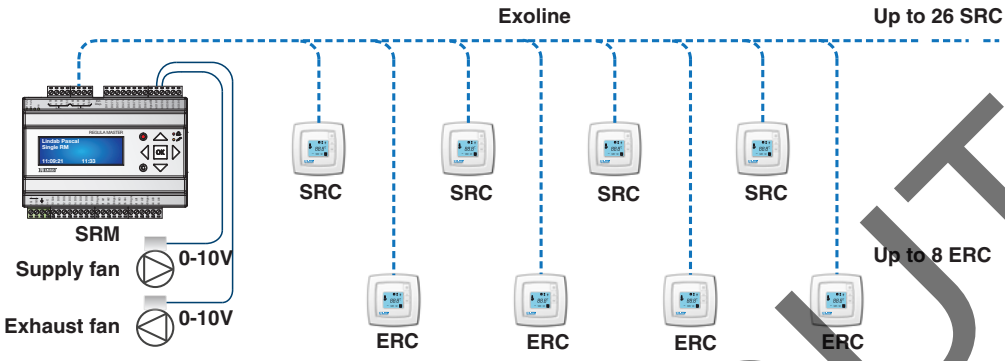
Exhaust strategy with room balance with parallel signal



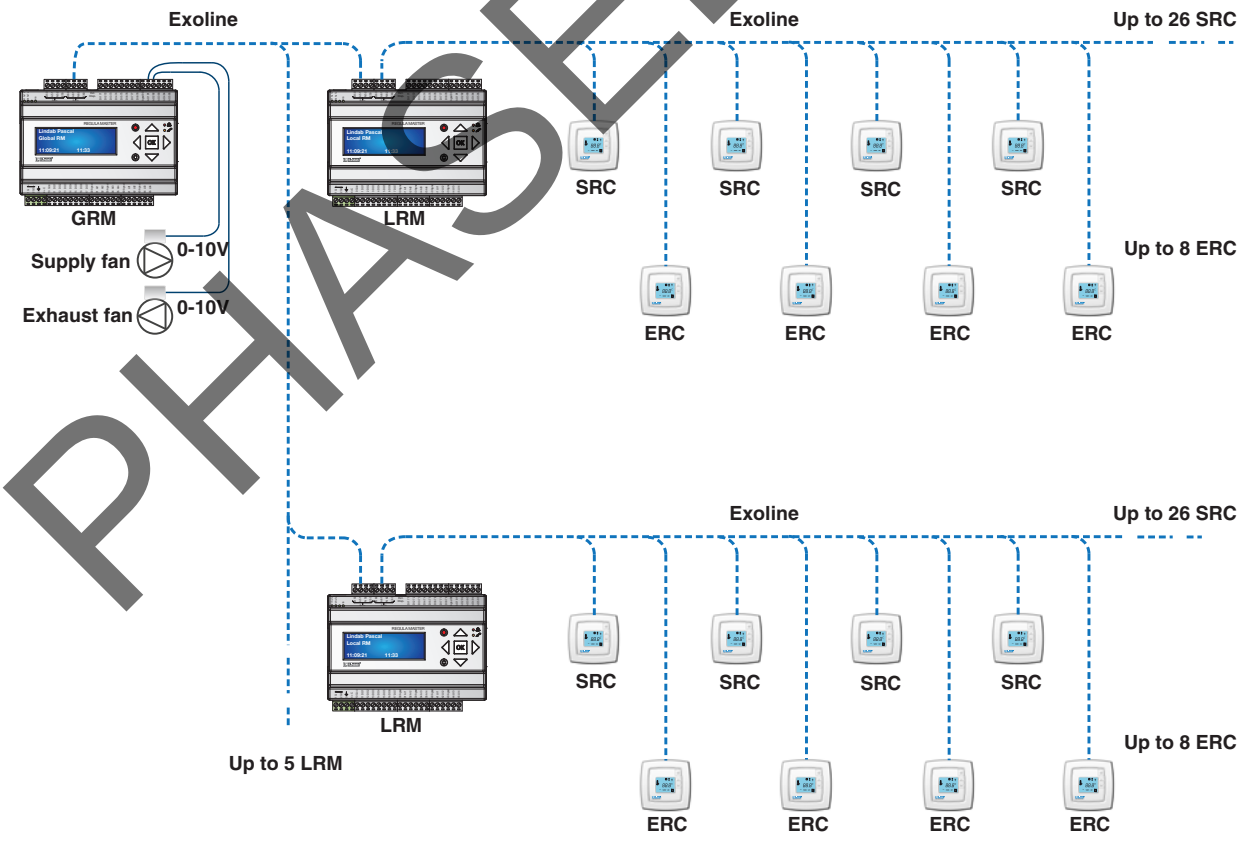
- SRC regulates supply airflow in MBBV and communicates this airflow to LRM
- SRC regulates VRU (A) with parallel signal to secure balance in rooms (1). Requires same size, numbers and airflow of MBBV and VRU
- LRM regulates exhaust on VRU via ERC (B) to room (2) minus constant exhaust airflow in room (3)
- LRM regulates exhaust on VRU via ERC (C) to room (3) to secure constant air flow
- SRC communicates supply damper positions to LRM
- Damper positions for supply is used for fan optimizer function
- Note that damper positions for exhaust is not communicated. Exhaust fan control can be done as a slave function of supply fan

Pascal design manual

System layout - small AHU

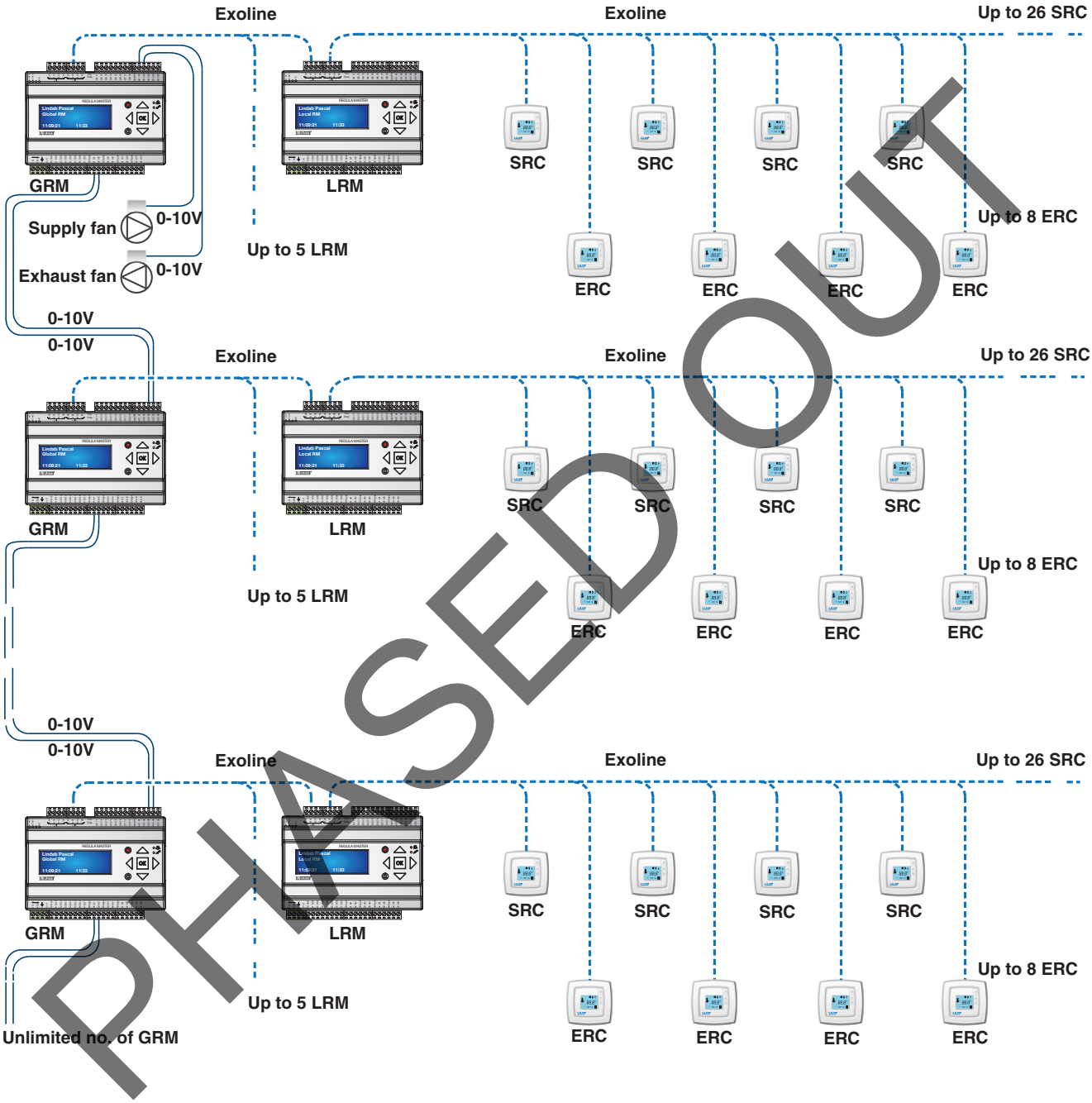


System layout - medium AHU



Pascal design manual

System layout - large AHU



PHASED OUT

Pascal diffuser

LCP / LCP-P

Description

LCP is a flush mounted square diffuser with a circular unperforated face plate for installation in ceiling systems. LCP is suitable for horizontal supply of cooled air and has a large dynamic range. This ability makes it is possible to regulate down to low airflows with high undertemperature without the risk of drafts. This makes it possible to do the VAV regulation before the diffuser itself and for supply this is done in a MBBV box with integrated volume flow regulation. For exhaust the diffuser is used with a standard MBB box and the VAV regulation is done in the duct system with a VRU volume flow regulator.

LCP-P is identical with LCP, but has a discrete presence sensor integrated in the face plate. The presence sensor can register activity in a room and in case if non-occupancy the airflow will be regulated to a stand-by minimum airflow to save energy.

- Simple and aesthetic appearance
- Large dynamic range 0-100% without the risk of drafts
- Integrated presence sensor for demand control
- Suitable for both supply and exhaust air
- Can be adapted to most ceiling systems

Order code

Product **LCP** **aaa** **b**

Type
LCP

Connection dim.
Ød 160-315

Ceiling system
1 - 14

Example: LCP-160-1

Quick selection, supply air

LCP + MBBV		Max. airflow L_{WA} 30 dB(A)		Max. airflow L_{WA} 35 dB(A)	
duct	LCP	l/s	m³/h	l/s	m³/h
125	160	56	202	66	238
125	200	61	220	73	263
160	200	79	284	99	356
160	250	95	342	113	407
200	250	105	378	122	439
200	315	118	425	145	522
250	315	131	472	168	605

Technical data

For full documentation including sound diagrams, K_{ok}-values and dimensions, see LCP in the Integra chapter.

Maintenance

The faceplate can be removed to enable cleaning of internal parts or to gain access to the plenum box. The visible parts of the diffuser can be wiped with a damp cloth.

Materials and finish

Upper part:	Galvanised steel
Face plate:	Aluminium
Face plate finish:	Powder coated
Standard colour:	RAL 9003, 9010, gloss 30

Other colours are available. Please contact Lindab's sales department for futher information.

Order code

Product **LCP** **aaa** **bb** **P**

Type
LCP

Connection dim.
Ød 160-315

Ceiling system
1 - 14

Sensor type
Presence sensor

Example: LCP-160-1-P

Pascal diffuser

LKP / LKP-P

Description

LKP is a flush mounted square diffuser with a square unperforated face plate for installation in ceiling systems. LKP is suitable for horizontal supply of cooled air and has a large dynamic range. This ability makes it is possible to regulate down to low airflows with high undertemperature without the risk of drafts. This makes it possible to do the VAV regulation before the diffuser itself and for supply this is done in a MBBV box with integrated volume flow regulation. For exhaust the diffuser is used with a standard MBB box and the VAV regulation is done in the duct system with a VRU volume flow regulator.

LKP-P is identical with LKP, but has a presence sensor integrated in the face plate. The presence sensor can register activity in a room and in case if non-occupancy the airflow will be regulated to a stand-by minimum airflow to save energy.

- Simple and aesthetic appearance
- Large dynamic range 0-100% without the risk of drafts
- Integrated presence sensor for demand control
- Suitable for both supply and exhaust air
- Can be adapted to most ceiling systems

Order code

Product	LKP	aaa	b
Type			
LKP			
Connection dim.			
Ød 160-315			
Ceiling system			
1 - 14			

Example: LKP-160-1

Quick selection, supply air

LKP + MBBV		Max. airflow L_{WA} 30 dB(A)		Max. airflow L_{WA} 35 dB(A)	
duct	LKP	l/s	m³/h	l/s	m³/h
125	160	56	202	66	238
125	200	61	220	73	263
160	200	79	284	99	356
160	250	95	342	113	407
200	250	105	378	122	439
200	315	118	425	145	522
250	315	131	472	168	605

Technical data

For full documentation including sound diagrams, K_{ok}-values and dimensions, see LKP in the Integra chapter.

Maintenance

The face plate can be removed to enable cleaning of internal parts or to gain access to the plenum box. The visible parts of the diffuser can be wiped with a damp cloth.

Materials and finish

Upper part:	Galvanised steel
Face plate:	Galvanised steel
Face plate finish:	Powder coated
Standard colour:	RAL 9003, 9010 Gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for futher information.

Order code

Product	LKP	aaa	bb	P
Type				
LKP				
Connection dim.				
Ød 160-315				
Ceiling system				
1 - 14				
Sensor type				
Presence sensor				

Example: LKP-160-1-P

Pascal diffuser

LCC / LCC-P

Description

LCC is a flush mounted circular diffuser with a circular unperforated face plate for installation in ceiling systems. LCC is suitable for horizontal supply of cooled air and has a large dynamic range. This ability makes it is possible to regulate down to low airflows with high undertemperature without the risk of drafts. This makes it possible to do the VAV regulation before the diffuser itself and for supply this is done in a MBBV box with integrated volume flow regulation. For exhaust the diffuser is used with a standard MBB box and the VAV regulation is done in the duct system with a VRU volume flow regulator.

LCC-P is identical with LCC, but has a presence sensor integrated in the face plate. The presence sensor can register activity in a room and in case if non-occupancy the airflow will be regulated to a stand-by minimum airflow to save energy.

- Simple and aesthetic appearance
- Large dynamic range 0-100% without the risk of drafts
- Integrated presence sensor for demand control
- Suitable for both supply and exhaust air

Maintenance

The faceplate can be removed to enable cleaning of internal parts or to gain access to the plenum box. the visible parts of the diffuser can be wiped with a damp cloth.

Order code

Product	LCC	aaa
Type		
LCC		
Connection dim.		
Ød 125-315		

Example: LCC-160

Quick selection, supply air

LCC + MBBV		Max. airflow L_{WA} 30 dB(A)		Max. airflow L_{WA} 35 dB(A)	
duct	LCC	l/s	m³/h	l/s	m³/h
125	160	56	202	66	238
125	200	61	220	73	263
160	200	79	284	99	356
160	250	95	342	113	407
200	250	105	378	122	439
200	315	118	425	145	522
250	315	131	472	168	605

Technical data

For full documentation including sound diagrams, K_{ok}-values and dimensions, see LCP in the Integra chapter.

Materials and finish

Upper part:	Galvanised steel
Face plate:	Aluminium
Face plate finish:	Powder coated
Standard colour:	RAL 9003, 9010, gloss 30

Other colours are available. Please contact Lindab's sales department for futher information.

Order code

Product	LCC	aaa	P
Type			
LCC			
Connection dim.			
Ød 160-315			
Sensor type			
Presence sensor			

Example: LCC-160-P

Pascal plenum box MBBV

Description

MBBV is a plenum box with integrated volume flow regulator used for VAV regulation of supply air diffusers. MBBV is equipped with a unique linear cone damper technology which makes it possible to regulate in the full operational area 0-100% up to 200 pa with low sound level.
The built-in VAV actuator is delivered pre-programmed with damper characteristic and in combination with a stable flow measurement over the damper, it makes the VAV regulation very accurate and reliable.
In Pascal system MBBV is controlled by a Regula Combi room controller where all room settings is to be done after installation. This means that no factory settings or specific room labeling is needed for MBBV.
MBBV must be used in combination with a suitable diffuser that can handle low airflows, in Pascal system this is LCP, LKP or LCC.
MBBV is as standard delivered with a special designed Regula Connect card, for easy and simple wiring.

- Plenum box with integrated volume flow regulator
- Accurate and reliable VAV regulation
- Large operational area 0-100%
- Up to 200 pa with low sound level
- No factory settings needed
- Settings to be done in Regula Combi after installation
- Used in combination with LCP/LKP/LCC diffuser
- Includes Regula Connect for easy wiring

Order code

Product	MBBV	aaa	bbb	S

Type
MBBV

Duct connection Ød$_1$
Ø125-250

Diffuser dimension Ød$_2$
Ø160-315

Function
S = Supply air

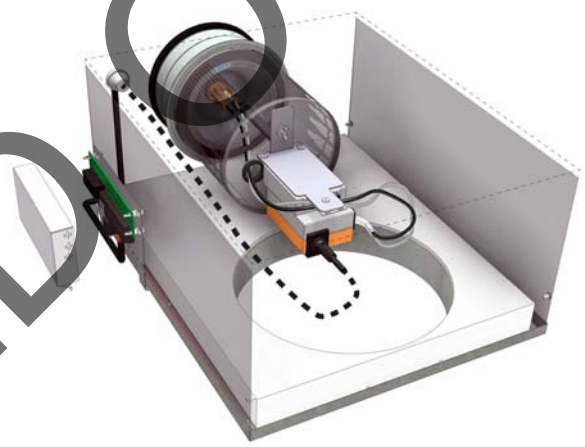
Example: MBBV- 160-200-S

Variants

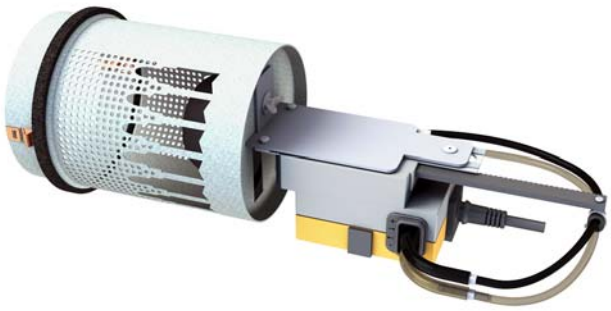
Available MBBV sizes
MBBV-125-160-S
MBBV-125-200-S
MBBV-160-200-S
MBBV-160-250-S
MBBV-200-250-S
MBBV-200-315-S
MBBV-250-315-S

Technical data

For full documentation including sound diagrams, K_{ok}-values and dimensions for pascal diffusers + MBBV plenum box, see LCP / LKP + MBB data in the Integra chapter. These values are valid for LCP / LKP / LCC +MBBV.



Motorized damper unit



Maintenance

The motorized damper-unit can be removed to enable cleaning of internal parts of the plenum box and gives access to the duct as well.

Materials and finish

Material: Galvanised steel
Standard Colour: Galvanized steel

Controller

Regula Master

Description

Regula Master is a small and compact preprogrammed controller with internal display.

The display is backlit and the menus are easy accessible and controlled by pushbuttons on the front together with two LED indicators for alarm and write indication.

The controller has 2 ports for EXOline communication via RS485 and has digital and analog I/O´s used for fan optimization.

The software in Regula Master is specially designed for the Pascal system, and contains three different set up configurations in the same standard unit: Single Regula Master (SRM), Local Regula Master (LRM) and Global Regula Master (GRM).

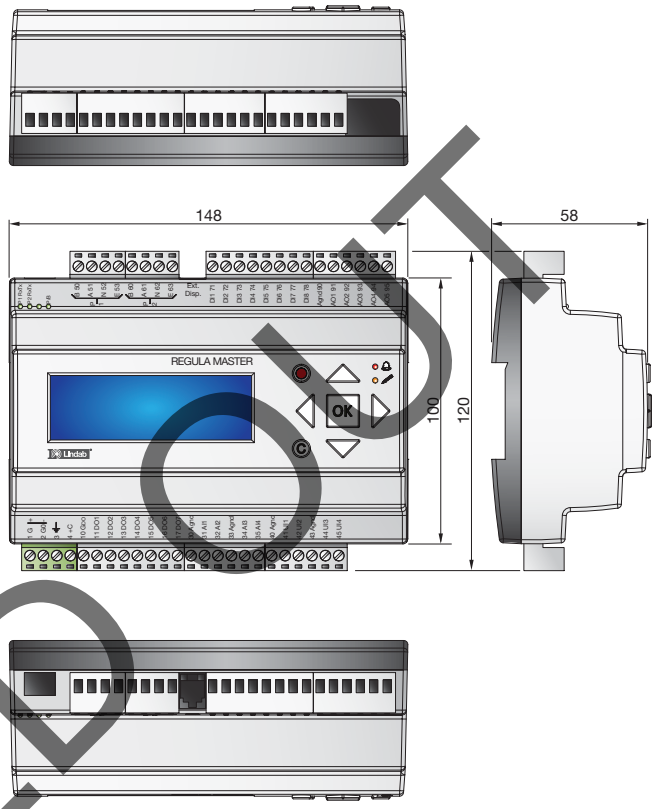
Maintenance

The visible parts of the device can bewiped with a damp cloth.

Order code

Product	Regula Master
Type	
Regula Master	

Dimensions



Functions

Regula Master is capable of handling three basic functions in the Pascal system: Exhaust control, fan optimization and operating control.

Exhaust control (SRM/LRM)

- Regula Master is able to sum up supply air flow from rooms via Regula Combi and control an exhaust volume flow regulator.
- A constant flow can be assigned to the exhaust volume flow regulator.
- A factor for more or less exhaust can be assigned to the volume flow regulator.

Fan optimization (SRM/GRM)

- Secures that at least one damper is open to a fixed value (default 85%).
- If the damper is more than 85% open, the fan is accelerated – if less it is slowed down.
- The function is working down to room level - in all rooms the damper position of a volume flow regulator is communicated to Regula Master via Regula Combi.

Operating control (SRM/LRM)

- Regula Master is monitoring damper behaviour in the system.
- Indicates alarm if a damper does not move over time.
- Indicates alarm if communication with Regula Combi is lost.

Controller Regula Combi Pascal

Description

Regula Combi is a room controller for integrated installation in products or directly on the wall. Regula Combi has a built-in temperature sensor and can use input from presence sensor, CO_2 sensor and an external temperature sensor. The display has indications for heating/cooling state, actual temperature and set point temperature when pressing increase/decrease buttons, and icons for the operating modes.

Regula Combi has 8 predefined programs which can be selected in the Service parameter menu in the display. Three of them are specially designed for Pascal VAV system.

Functions

The three Pascal programs in Regula Combi are called program 6 Pascal VAV supply (SRC), program 7 Pascal VAV exhaust (ERC) and program 8 Pascal VAV water (SRC).

Order code

Product	Regula Combi
Type	
Regula Combi	

Program 6 Pascal VAV supply (SRC)

The regulation of temperature takes place in sequences with heating and cooling by signals from the universal outputs UO1 (heating) and UO2 (cooling), and the volume flow regulator (MBBV or VRU-2) must be connected to the cooling output.

For easy commissioning all air flow settings for ventilation in the room are set in Regula Combi (and not in the volume flow regulator). The cooling part of the temperature sequence will then result in variable output signals, which depend on four different air flow settings:

Minimum air flow at presence/occupied (*AirflowMinOcc*)

Maximum air flow at presence/occupied (*AirflowMaxOcc*)

Standby air flow (*AirflowStandby*) when there is no presence.

A size dependable air flow (*AirflowNominal*). Normally *AirflowNominal* should not be changed manually.

Program 7 Pascal VAV exhaust (ERC)

The Pascal VAV exhaust program is quite simple, since there is no regulation of room temperature. This program simply collects the exhaust air flow value sent by Regula Master via EXOline and translates it to a corresponding 2-10V air flow control signal for the exhaust volume flow regulator at UO2.

In program 7 there is no temperature regulation.

The controller serves as a translator for the exhaust flow signal that is send from Regula Master (via EXOline). The exhaust flow signal is converted and transmitted to the cooling output depending on number of dampers (P138) and the chosen volume flow regulator size (P139). Every volume flow regulator size has predefined default values for *AirflowNominal* (P143). This value can be changed, but is reset to default value if the parameter for size is changed.

The exhaust damper position is registered (via EXOline) and used in Regula Master for fan optimization.

Program 8 Pascal VAV water

The Pascal VAV water program is identical with program 6 but with the cooling sequence split in two, with the first half (UO2) for VAV and the second half (UO3) for cooling actuator.

The program is designed to make it possible to combine Pascal VAV functionality with an active chilled beam, and making sure that there will be full (max.) air flow on the active chilled beam before the cooling water is active.

The cooling actuator for the chilled beam on UO3 must be for 0-10V.

Volume flow regulator - circular VRU

Description

VRU is a circular volume flow regulator for VAV regulation in duct systems and consists of a measuring unit and a damper. VRU is used for volume flow regulation in circular ducts controlled from e.g. a room controller or BMS. VRU is as standard supplied with MF actuator without communication, but can on request be delivered for Belimo MP, LON or ModBus communication. Further documentation on the actuator can be requested from Lindab.

VRU is equipped with LindabSafe for connection to the duct and is prepared for insulation up to 50 mm.
VRU can be installed in any position without adjustment required. To avoid contamination of the measuring cross, VRU should only be used for clean air.

- Requires minimal initial pressure (Less than 20 Pa at V_{nom})
- Simple adjustment of settings with ZTH or PC tool
- Damper tightness class 3
- Standard delivered with 2-10 V control signal
- Standard delivered with 2-10 V damper position feedback signal *
- Can be supplied with attenuation shield on request
- Can be supplied with actuator for several BUS systems
- Standard MF actuator is used in Pascal systems

Order code - VRU

Product	VRU	bbb	cccc

Type
VRU

Dimension
Ød 100 - 630

Motor type
MF, MP, LON, MOD, UNI, SPR, MF-D, MP-D, LON-D, MOD-D

Example: VRU - 250 - MF

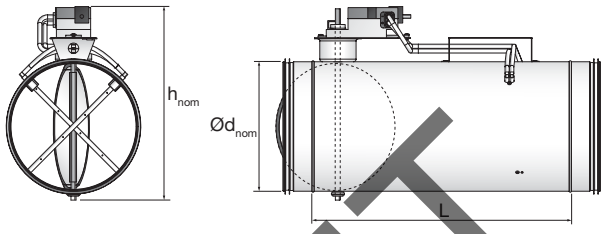
Factory settings

	Standard	On request
Min. airflow	0	Other min. flow
Max. airflow	V_{nom} (7m/s)	Other max. flow
Control signal	2-10 V	0-10 V
Feedback signal	Damper position *	Air flow

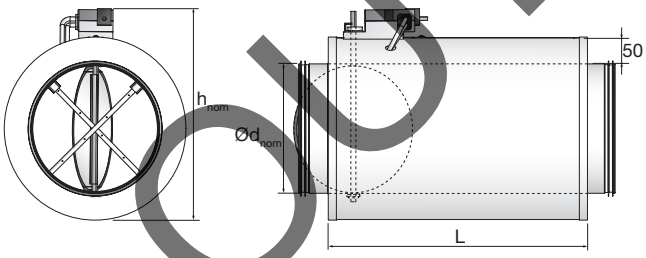
* Valid for MF and MP. UNI and SPR only available with air flow feedback signal.

Dimensions

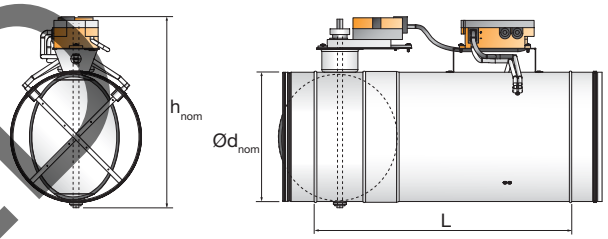
VRU-250 (MF, MP, LON, MOD)



VRU-250 (MF-D, MP-D, LON-D, MOD-D)



VRU-250 (UNI)



Ød$_{nom}$ mm	L mm	h_{nom} MF / MP / LON/ MOD / UNI	h_{nom} MF-D / MP-D / LON-D / MOD-D	h_{nom} SPR
100	400	225	262	241
125	400	250	287	266
160	400	285	322	301
200	400	325	358	341
250	500	375	407	391
315	500	440	471	455
400	510	526	557	560
500	610	626	657	660
630	660	756	787	790

Motor type table

Motor		
Type	**Ød 100 - 315**	**Ød 400 - 630**
MF (Standard)	LMV-D3-MF-F	NMV-D3-MF-F
MP	LMV-D3-MP-F	NMV-D3-MP-F
LON	LMV-D3-LON-F	NMV-D3-LON-F
MOD	LMV-D3-MOD-F	NMV-D3-MOD-F
UNI	VRD3+LM24A-V-F	VRD3+NM24A-V-F
SPR	VRD3+LF24-MFT	VRD3-NF24A-V-F
MF-D *	LMV-D3-MF-F	NMV-D3-MF-F
MP-D *	LMV-D3-MP-F	NMV-D3-MP-F
LON-D *	LMV-D3-LON-F	NMV-D3-LON-F
MOD-D *	LMV-D3-MOD-F	NMV-D3-MOD-F

* VRU with attenuation shield.

Volume flow regulator - circular VRU

Technical data

Settings

V_{nom} indicates the measuring range for the actuator. A standard VRU is calibrated to a V_{nom} of 7 m/s according to the table below.

In special cases the VRU can be set to a higher V_{nom} , e.g. 10 m/s.

For VRU, V_{max} and V_{min} indicate the limits for the actuators working range.

There is linearity between V_{min} to V_{max} and the input signal. V_{max} can be set in the range 20-100% of V_{nom} , V_{min} in the range of 0-100% of V_{nom} ; however, air velocities below 0,7 m/s corresponds to a measuring pressure of less than 1 Pa, which makes the flow regulation less accurate.

Volume flow measurement

The accuracy of volume flow measurement depends on the flow conditions in front of the measuring cross.

It is preferable to have a long straight duct section in front of the measuring point, according to the table below.

If these recommendations are not followed, it will cause an unstable flow measurement and therefore higher inaccuracy in the regulation of the required airflow.

Components	Recommended straight duct before unit
Bend	3 x d
Tee-piece	2 x d
Damper	6 x d

VRU_{nom} flow and measuring limit

Size Ød mm	Measuring limit (0,7 m/s) m^3/h	l/s	(Standard) V_{nom} (7m/s) m^3/h	l/s	V_{nom} (10m/s) m^3/h	l/s
100	20	6	198	55	283	79
125	31	9	309	86	442	123
160	51	14	506	141	723	201
200	79	22	791	220	1130	314
250	124	34	1236	343	1766	491
315	196	54	1963	545	2804	779
400	317	88	3165	879	4522	1256
500	495	138	4946	1374	7065	1963
630	785	218	7851	2181	11216	3116

Volume flow regulator - circular VRU

Technical data

Pressure drop diagram and sound data for dimensioning.
The solid curves indicate the total pressure drop Δp_t over the damper as a function of the volume flow q and the blade angle α.

The broken curves indicate the A-weighted sound effect level L_{WA}, in dB to the duct.

Example:

Dimension:	Ø100
Volume flow:	60 l/s
Pressure drop:	200 Pa

The following can be obtained from the diagram:

Blade angle α:	32°
Sound effect level:	63 dB(A)

Measuring method for sound:
Sound data has been measured by the Swedish National Testing and Research Institute (SP) with reference to ISO 5135 and EN/ISO 3741.

Blade angle:

0° =	open damper.
90°=	closed damper.

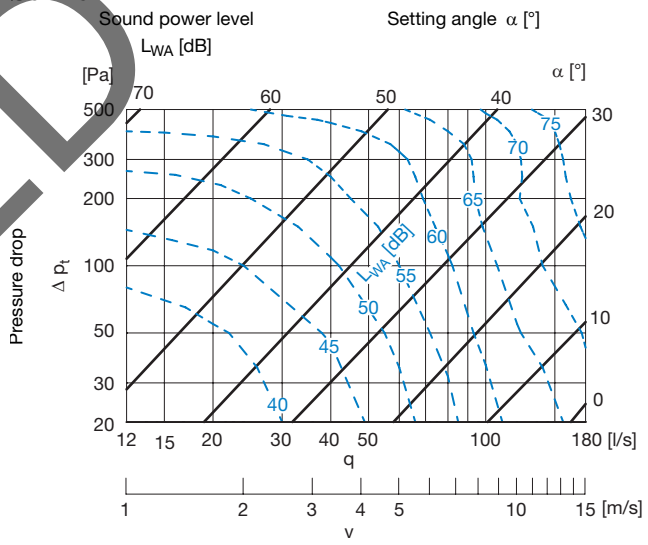
Dimensioning
When dimensioning the dampers inherent noise from the dampers and their regulating properties (damper characteristics) must be taken into consideration.

If excessively large dampers are used, the working area (angle of rotation) at given V_{min} and V_{max} may be so limited that regulation does not function satisfactorily.

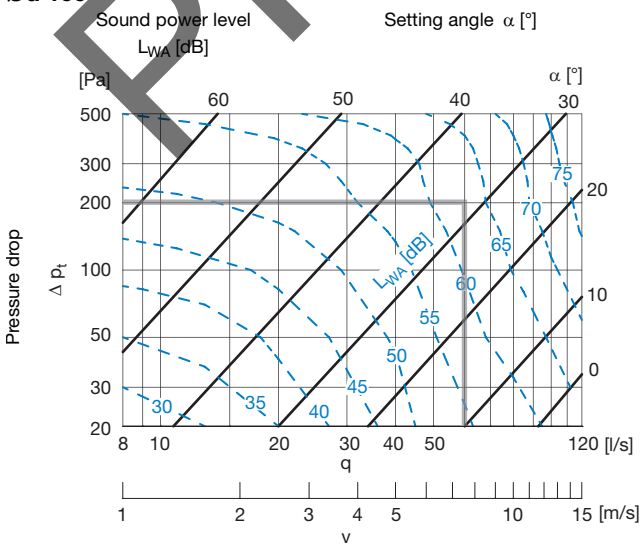
Efforts must be made to use damper dimensions that result in the largest possible working areas (angles of rotation).

Due to regulation accuracy, working areas with damper angles < 15° should be avoided.

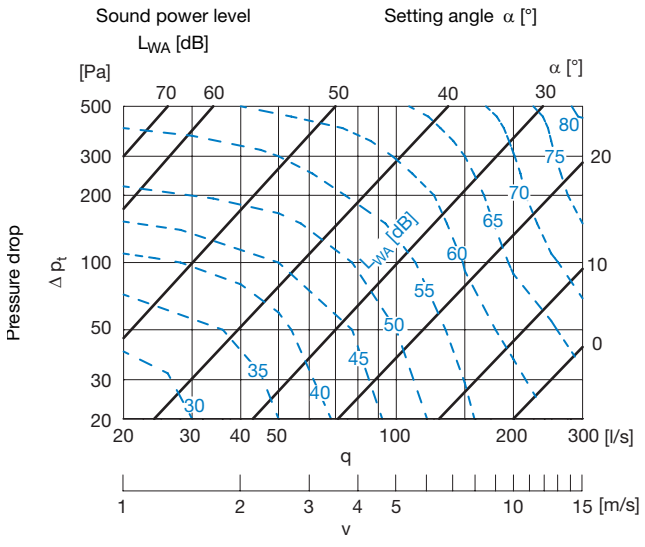
Ød 125



Ød 100



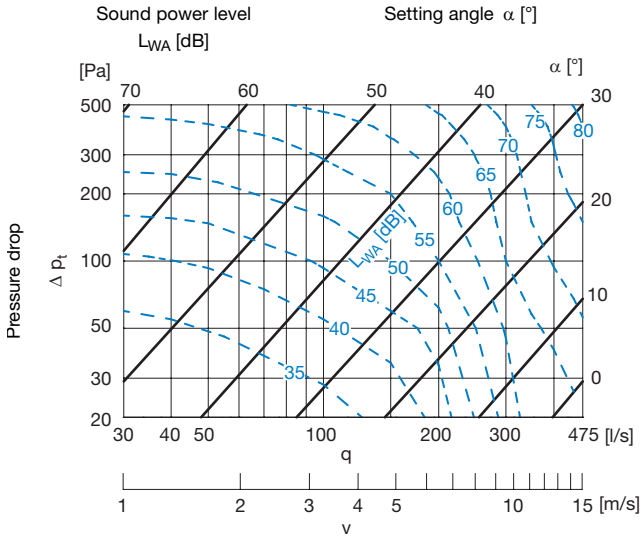
Ød 160



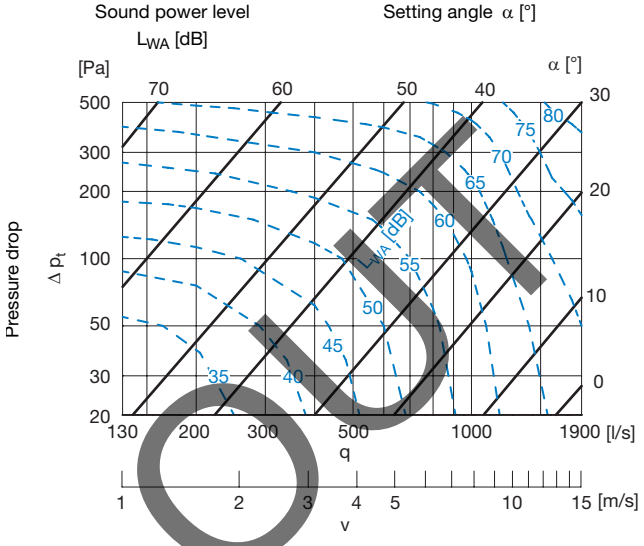
Volume flow regulator - circular VRU

Technical data

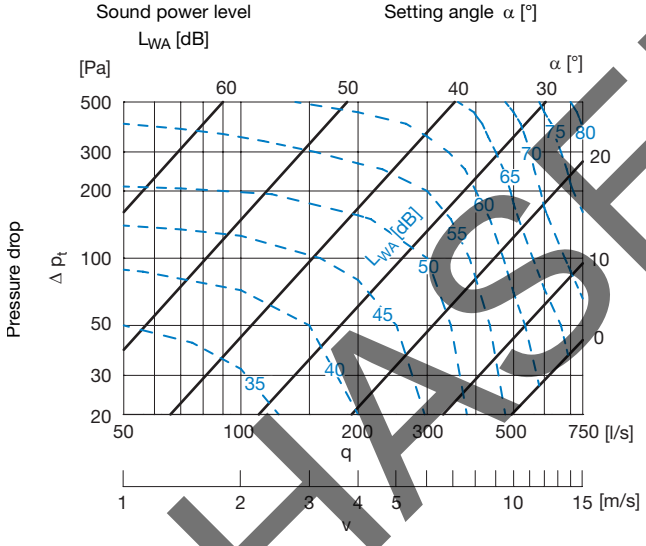
Ød 200



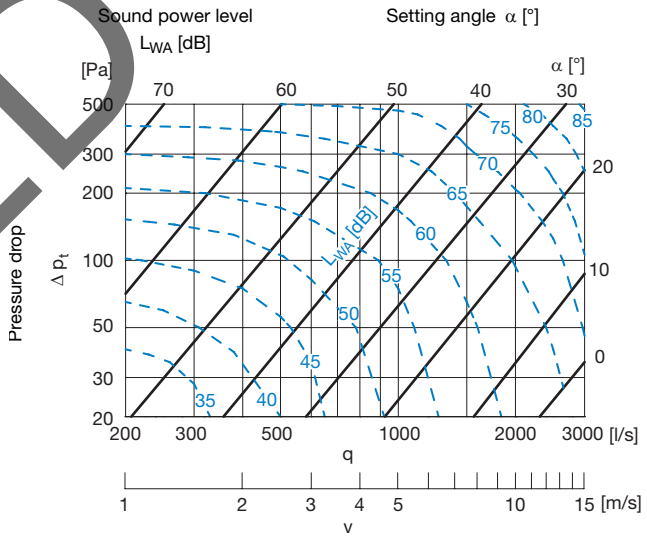
Ød 400



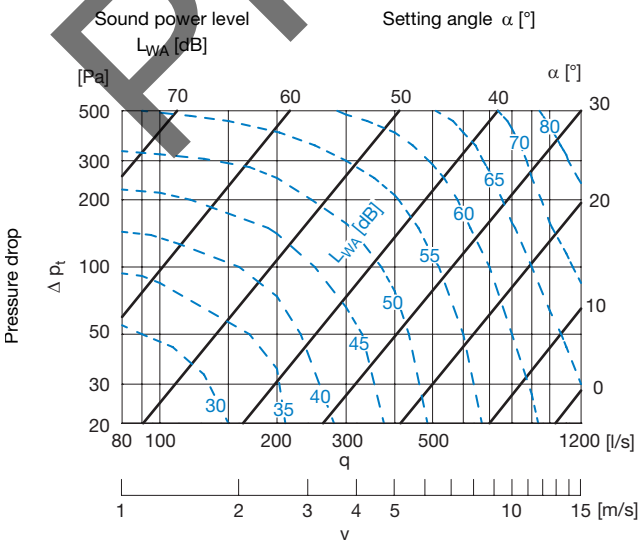
Ød 250



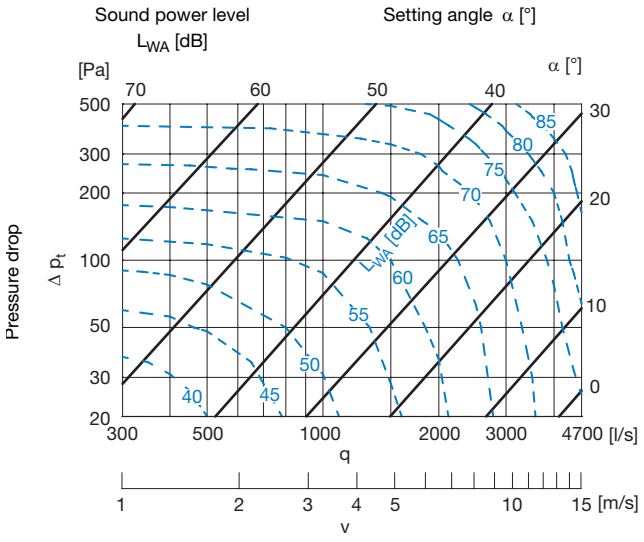
Ød 500



Ød 315



Ød 630



Volume flow regulator - circular VRU

Technical data

Sound data

Below sound effect levels for ducts (flow noise) with reference to ISO 5135 as a function of volume flow and pressure difference. The necessary minimum prepressure is 20 Pa for all sizes, equivalent to the pressure loss over VRU at nominal volume flow and with fully open damper.

dim Ød	Pressure drop [Pa]	Velocity app. 1 [m/s] Centre frequency [Hz]								Velocity app. 3 [m/s] Centre frequency [Hz]								Velocity app. 6 [m/s] Centre frequency [Hz]							
		63	125	250	500	1k	2k	4k	8k	63	125	250	500	1k	2k	4k	8k	63	125	250	500	1k	2k	4k	8k
		Flow 8 [l/s] / 29 [m³/h]								Flow 25 [l/s] / 90 [m³/h]								Flow 50 [l/s] / 180 [m³/h]							
100	500	60	60	59	52	50	44	44	44	67	64	64	57	54	48	48	48	72	69	69	62	59	52	52	52
	200	53	51	53	43	42	35	32	32	59	58	58	50	48	40	37	37	66	65	64	57	54	45	42	42
	100	51	46	44	38	35	28	21	20	58	55	53	46	41	34	26	24	65	64	62	54	48	40	31	29
	50	48	42	38	33	26	19	16	14	55	53	48	42	35	26	22	18	64	63	60	53	44	33	28	22
	20	43	35	30	23	17	9	7	6	50	49	42	37	28	17	15	14	62	61	57	51	41	27	25	15
		Flow 12 [l/s] / 43 [m³/h]								Flow 40 [l/s] / 144 [m³/h]								Flow 75 [l/s] / 270 [m³/h]							
125	500	66	63	61	55	52	46	47	44	71	68	65	59	56	50	50	47	76	73	70	63	60	53	53	50
	200	59	53	49	44	38	34	33	32	65	62	57	51	46	41	38	38	72	71	65	59	53	47	43	43
	100	58	49	43	40	31	28	22	22	64	59	53	47	39	34	29	27	71	70	63	55	47	40	35	32
	50	57	42	41	31	29	20	17	15	63	54	50	41	36	27	25	20	70	68	60	51	43	34	32	24
	20	56	32	39	29	27	11	15	11	62	48	48	34	34	20	22	15	68	65	56	47	39	29	28	17
		Flow 20 [l/s] / 72 [m³/h]								Flow 60 [l/s] / 216 [m³/h]								Flow 120 [l/s] / 432 [m³/h]							
160	500	62	63	61	56	52	51	50	49	68	67	64	59	55	53	52	51	73	71	68	62	59	55	54	53
	200	52	52	51	44	43	38	37	36	61	58	56	50	48	42	40	40	71	65	62	56	53	47	44	44
	100	47	43	39	37	32	27	27	25	59	54	50	45	40	35	33	31	70	64	60	53	48	42	39	38
	50	42	36	33	28	25	20	17	16	54	50	46	37	33	29	25	25	69	63	58	48	42	37	32	32
	20	37	30	30	26	19	16	11	10	49	46	43	35	27	24	19	18	68	61	55	44	36	32	27	23
		Flow 30 [l/s] / 108 [m³/h]								Flow 100 [l/s] / 360 [m³/h]								Flow 200 [l/s] / 720 [m³/h]							
200	500	65	60	56	52	49	47	44	42	70	64	61	55	52	52	55	55	75	69	65	59	55	55	59	59
	200	55	52	51	43	40	37	38	38	62	57	55	47	44	42	42	42	71	65	61	53	50	48	47	47
	100	46	43	41	34	32	29	29	29	57	52	48	41	39	36	34	34	69	64	58	50	47	44	42	42
	50	40	38	33	30	28	27	23	22	51	45	41	36	32	32	28	28	63	56	51	44	39	39	34	34
	20	34	31	26	25	25	23	18	16	44	37	33	29	27	25	21	19	56	47	43	36	29	27	24	22
		Flow 50 [l/s] / 180 [m³/h]								Flow 150 [l/s] / 540 [m³/h]								Flow 300 [l/s] / 1080 [m³/h]							
250	500	67	65	57	50	47	52	51	50	69	66	59	53	50	54	53	52	71	67	61	56	53	56	55	54
	200	55	54	49	43	42	38	42	42	59	57	52	46	44	41	44	44	63	60	55	49	46	44	46	46
	100	52	48	40	37	34	33	31	28	56	52	45	41	38	36	34	31	62	57	51	46	43	40	38	35
	50	44	41	35	32	29	24	22	20	52	48	40	38	34	30	28	24	61	56	47	45	40	38	33	28
	20	33	35	29	29	25	15	12	10	47	44	37	35	31	25	22	17	59	54	46	42	38	36	30	24
		Flow 80 [l/s] / 288 [m³/h]								Flow 250 [l/s] / 900 [m³/h]								Flow 500 [l/s] / 1800 [m³/h]							
315	500	63	60	53	49	47	46	45	44	68	65	59	53	50	50	53	50	74	71	65	58	55	55	58	55
	200	50	44	42	38	38	33	37	34	60	55	50	45	43	40	43	40	70	65	58	52	49	48	49	46
	100	42	39	33	31	30	25	30	23	54	52	45	41	38	36	36	31	66	64	56	50	47	46	44	39
	50	34	34	30	26	22	21	19	15	49	49	43	38	34	32	30	24	64	63	55	49	45	42	40	32
	20	26	30	27	21	16	15	13	11	44	46	41	35	30	27	25	18	62	61	54	48	43	37	34	24
		Flow 130 [l/s] / 468 [m³/h]								Flow 400 [l/s] / 1440 [m³/h]								Flow 800 [l/s] / 2880 [m³/h]							
400	500	76	71	66	59	55	58	57	56	79	73	67	62	57	60	59	58	82	75	68	65	59	62	61	60
	200	61	58	50	44	43	44	45	41	67	62	56	50	48	48	48	45	74	68	62	56	53	52	52	49
	100	50	45	40	34	36	35	35	29	61	56	49	44	42	39	39	34	72	67	58	53	49	47	46	40
	50	42	37	31	29	28	27	25	20	57	52	44	39	37	35	34	26	71	66	56	50	47	44	44	33
	20	40	34	27	25	24	23	21	11	55	50	40	35	34	32	30	20	70	65	54	47	44	40	38	28
		Flow 200 [l/s] / 720 [m³/h]								Flow 600 [l/s] / 2160 [m³/h]								Flow 1200 [l/s] / 4320 [m³/h]							
500	500	82	76	69	63	62	61	60	59	84	77	70	64	63	62	61	60	85	78	71	65	64	63	62	61
	200	66	60	55	48	45	44	46	43	71	65	59	53	50	50	50	47	77	70	64	58	56	55	54	51
	100	55	50	47	38	38	36	34	31	63	58	53	47	46	44	42	37	72	66	60	55	53	51	49	43
	50	46	40	36	33	32	29	29	25	59	52	47	44	42	38	38	31	71	63	57	54	51	46	46	37
	20	41	33	29	27	26	19	18	20	56	47	42	40	38	32	30	26	70	60	54	52	49	44	40	32
		Flow 300 [l/s] / 1080 [m³/h]								Flow 900 [l/s] / 3240 [m³/h]								Flow 1800 [l/s] / 6480 [m³/h]							
630	500	86	77	71	67	64	61	61	60	88	80	73	69	66	64	63	62	90	83	75	71	68	67	65	64
	200	76	70	63	60	56	53	52	48	78	72	65	62	59	55	55	49	80	74	67	64	60	57	57	50
	100	65	61	52	49	45	43	41	37	71	66	59	54	50	46	45	40	78	71	66	59	56	49	48	44
	50	54	49	45	39	34	36	30	26	66	58	53	48	43	40	39	30	77	68	62	57	51	45	47	36
	20	45	35	38	30	29	29	26	20	61	50	47	43	38	36	33	25	76	65	57	55	46	42	39	30