
# Lindab **Pascal**

## Design manual for air systems

Lindab®

# Pascal system overview

## Table of content

# Designing a Pascal system

## Designing step by step

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

Details of each step follow 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 (SRC).
    - Select if Demand control shall be used.
    - Select supply regulation type.
    - Select supply diffuser type, dimension and placement.

2. Define extract strategy
    - Select extract principle.
    - Select extract diffuser type, dimension and placement.
    - Define extract control and place VRU/FTCU dampers.
    - Secure extract 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 must be between the fan and the diffusers in the system.
- 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.
- Design the duct system as if it was a CAV system.

## Room solution

**Supply Regula Combi**
The Pascal Air system regulates the room temperature by using a standard Supply Regula Combi (SRC) room controller in each room. More supply Regula Combis are feasible for multiple temperature zones, for example inlandscape offices.

**Demand control**
Presence control and/or $CO_2$ are optional. Both are available for external control by connecting demand control sensors to the Supply Regula Combi (SRC), typically via the Regula Connect Pascal card placed on the ACB, the DBV, or the FTCU/VRU

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

**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 www.lindQST.com.

# Designing a Pascal system

## Extract strategy

**Extract principle**
Extract in the rooms can be done by a central extract regulation, using overpressure valves or an extract diffuser placed in the room. For a room balanced solution extract dampers can be placed in the ducts into the rooms controlled and balanced by Regula Master. A Regula Master unit can handle up to 16 extract units.

**Extract diffuser**
Choose the desired extract diffuser type according to the chosen extract principle and select the right dimension, according to technical data.

**Extract control**
Define which supply units that affects which extract units and place the necessary FTCU/VRU dampers. Regula Master will register actual supply airflows in all selected rooms and control the corresponding extract units.

**Extract balance**
For a total balance of supply and extract on a floor level, areas with constant extract flow has to be taken into account. Typically the replacement air is taken from nearby rooms, therefore this can be corrected in the extract 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 main unit must be a Global Regula Master controlling up to 8 Local Regula Master (up to 8 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/Single Regula Master**
Global/Single Regula Master shall be placed close to the fan, since it has to control the fan speed.
It is recommended to have GRM/SRM connected to a router/network (IP) together with LRM. Secure internet access so the system can be accessed from a office PC.

## Symbol and cable overview


FTMU
Airflow & temperature measuring (Ultralink)


EUC (FTCU)
Airflow regulator & temperature measuring (Ultralink)


VRU
Airflow regulator


Silencer
Sound attenuator


MBV with celling diffser
Plenumbox, Airflow regulator


DBV
Straight through plenumbox, Airflow regulator


ACB
Active Chilled Beam


OLR
Pressure control valve


Room controler


Supply fan
Extract fan


Extract airflow


Supply airflow


Presence sensor


Humidity sensor


$CO_2$ sensor


Temperature sensor (extern)

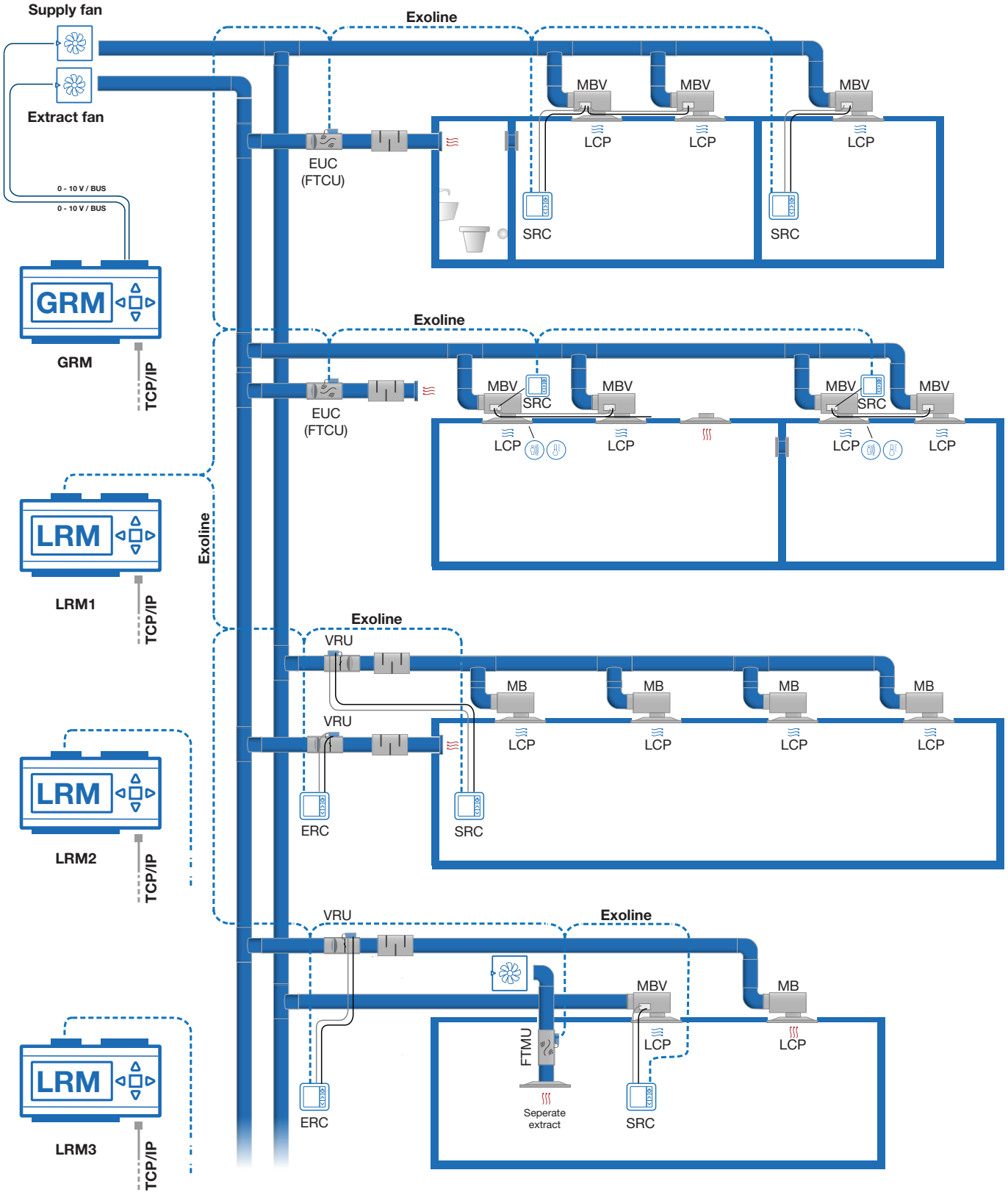

2-10 V flow signal.


RJ45 data cable.


Exoline RS485/Exoline TCP, Bus communication.

# Pascal system description

## System description



# Pascal component description

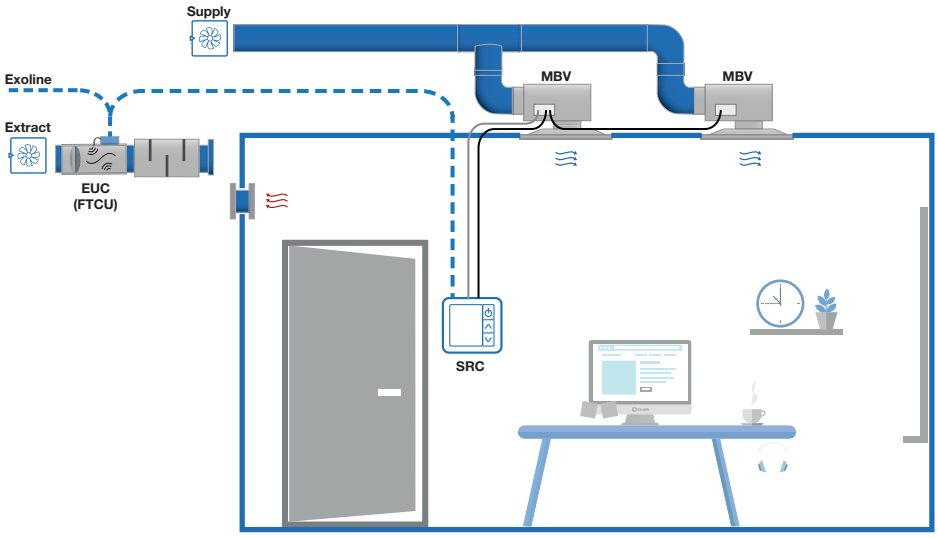
## Component overview

| | Product | Description | Function |
|---|---|---|---|
| **Diffusers** | LCP/LCC (-P), (-T), (-PT) LKP (-P) | Diffuser with integrated presence (-P) and / or temperature sensor (-T). | • Dynamic diffuser to handle 0-100% airflow without drafts.<br>• Presence sensor (-P) Indicates absence in room for lower airflows.<br>• Temperature sensor (-T) Measures temperature in room. |
| | LCP, LKP, LCC | Diffuser | • Dynamic diffuser to handle 0-100% airflow without drafts. |
| | LCFV-P | Visible diffuser with integrated airflow regula-tor and presence sensor. | • Airflows controlled by SRC.<br>• Regulates airflows regardless of pressure.<br>• Handles up to 200 pa with low sound level.<br>• Presence sensor (-P) Indicates absence in room for lower airflows |
| | LCFV | Visible diffuser with integrated airflow regu-lator. | • Airflows controlled by SRC.<br>• Regulates airflows regardless of pressure.<br>• Handles up to 200 pa with low sound level. |
| **Active and passive plenum boxes** | MBBV/MBV | Active plenum box with air flow regulation. | • Airflow rate controlled by SRC.<br>• Regulates airflow regardless of pressure.<br>• Handles up to 200 Pa with low sound level.<br>• Max. 10 pcs. per Regula Combi. |
| | MB | Passive plenum box with several damper options. | • Manually balancing of airflow rate.<br>• Handles up to 200 Pa with low sound level.<br>• Several damper options. |
| | DBV | Active plenum box | • Volume flow reugulator which is placed before a Chill beam.<br>• Handles up to 200 Pa with low sound level. |
| **Flow measure eqiupment:** | VRU/VRA | Volume flow regulator. | • Airflow controlled by SRC / ERC.<br>• Max. 10 pcs. per Regula Combi. |
| | FTCU | Ultra link | • Airflow controlled by SRC.<br>• Max. 10 pcs pr SRC.<br>• Used as EUC in extract, 1 FTCU = 1 EUC. |
| | FTMU | Flow & Temperature Measuring (Ultralink). | • Measure flow very accurat with ultra sound |
| **Regula and communication equipment** | GRM/SRM | Global Regula Master / Single Regula Master | • Collects damper positions from all LRM.<br>• Controls fan speed to minimize energy consumption. |
| | LRM | Local Regula Master | • Collects airflows and damper positions from SRC.<br>• Controls ERC airflow based on SRC values.<br>• Communicates all damper positions to GRM.<br>• Performs operating control. |
| | SRC | Supply Regula Combi | • Room control with temperature regulation.<br>• Control of supply airflows in MBBV or VRU.<br>• Communicates airflows and damper position to SRM/LRM.<br>• Max. 26 pcs. per SRM/LRM. |
| | ERC | Extract Regula Combi | • Control of extract airflow in VRU.<br>• Communicates damper positions to LRM/SRM.<br>• Max. ERC/EUC 16 pcs. per SRM/LRM. |
| | EUC | Extract Ultralink Controller | • A FTCU connected directly to SRM/LRM.<br>• Max. ERC/EUC 16 pcs. per SRM/LRM. |
| | Exoline RS485/Exoline TCP | BUS communication | • Communicates parameters between SRC/ERC and LRM/SRM/GRM. |
| | 2-10 V flow | Flow signal | • Controls airflows from SRC / ERC to MBB / DBV / VRU / FTCU. |
| | 2-10 V position | Damper position signal | • Indicates damper position from regulator unit to controller |
| | TCP, Modbus, BACnet, EXOline | Bus communication | • Communication to BMS. |
| **Sound attenuators** | SLU | Silencer | • Attenuates sound generated in VRU. |
| **Sensors and accessories** | $CO_2$ | $CO_2$ sensor | • Indicates $CO_2$ level in the room. |
| | RH | Humidity sensor | • Indicates RH level in the room. |
| | PIR | Presence sensor | • Indicates occupancy in the room. |
| | TEMP | Temperature sensor | • Indicates temperature in the room. |
| | APR | Actuator for water valves | • 0-10 V or 24 V on/off. |

# Pascal design manual

## 1.

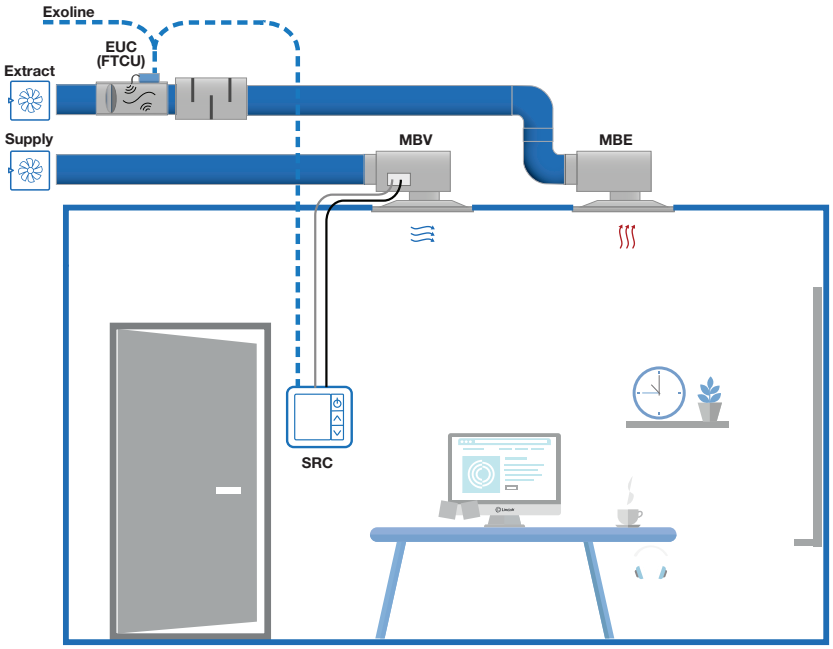
**Supply: Demand controlled with temperature regulator and MBV**
**Extract: Central regulation with overpressure valve**




- SRC measures actual room temperature and gives 2-10 V flow signal to MBV.
- MBV regulates to correct air flow regardless of pressure.
- Multiple MBV controlled by same SRC can be wired with parallel signal (max 10 per SRC).
- MBV indicates actual damper position to SRC by a 2-10 V position signal.
- SRC communicates airflow and damper position to LRM/SRM.
- Extract controlled centrally in corridor with an extract controller.
- Extract from room via overpressure valve can also be done above the suspended ceiling.

## 2.

**Supply: Demand controlled with temperature regulation and MBV**
**Extract: Central regulation with extract diffuser**

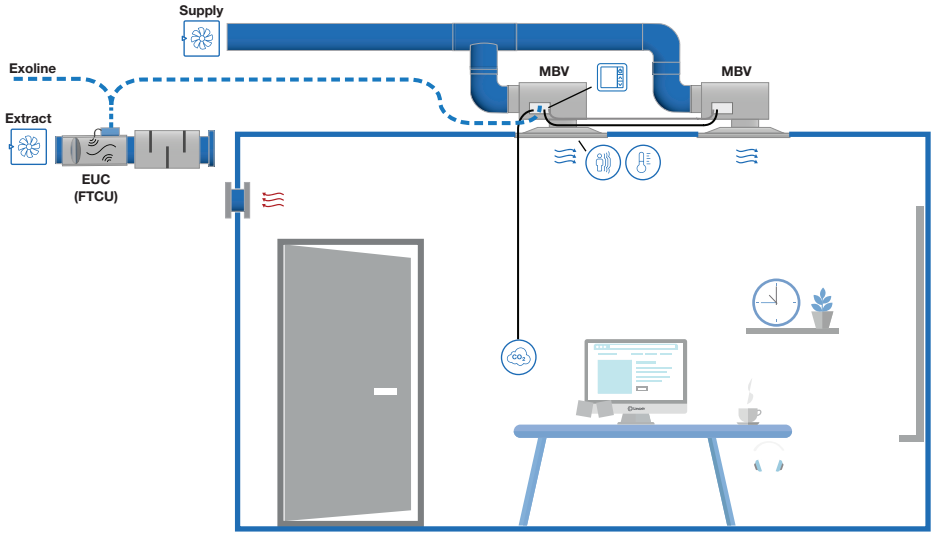



- SRC measures actual room temperature and gives 2-10 V flow signal to MBV.
- MBV regulates to correct air flow regardless of pressure.
- Multiple MBV controlled by same SRC can be wired with parallel signal (max 10 per SRC).
- MBV indicate actual damper position to SRC by a 2-10 V position signal.
- SRC communicates airflow and damper position to LRM/SRM.
- Extract controller gets regulation communication signal from SRM/LRM.
- Extract can also be above the suspend ceilling.

# Pascal design manual

### 3.

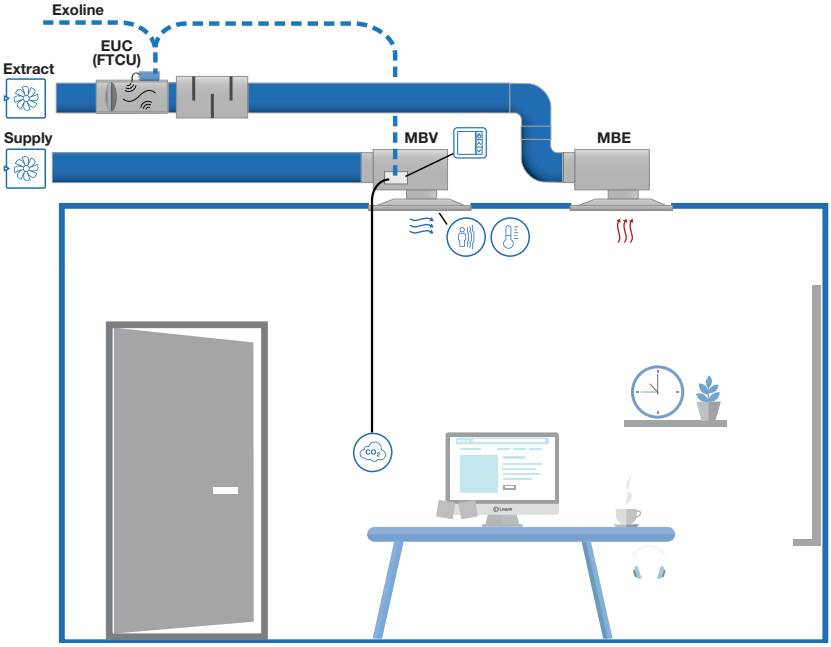
**Supply: Demand controlled with indoor climate sensor regulation and MBV**
**Extract: Central regulation with overpressure valve**




- Integrated temperature sensor (in diffuser) measures actual room temperature.
- External $CO_2$ sensor measures $CO_2$ level in room (optional).
- Integrated presence sensor defects occupancy in room.
- SRC gives 2-10 V flow signal to MBV according to room temperature and $CO_2$ level (highest demand).
- If no presence in the room SRC regulates MBV to “standby mode”.
- MBV indicate actual damper position to SRC by a 2-10 V position signal.
- SRC communicates airflow and damper position to SRM/LRM.
- Extract from room via overpressure valve can also be done above the suspended ceiling.

### 4.

**Supply: Demand controlled with indoor climate sensor regulation and MBV**
**Extract: Central regulation with extract diffuser**

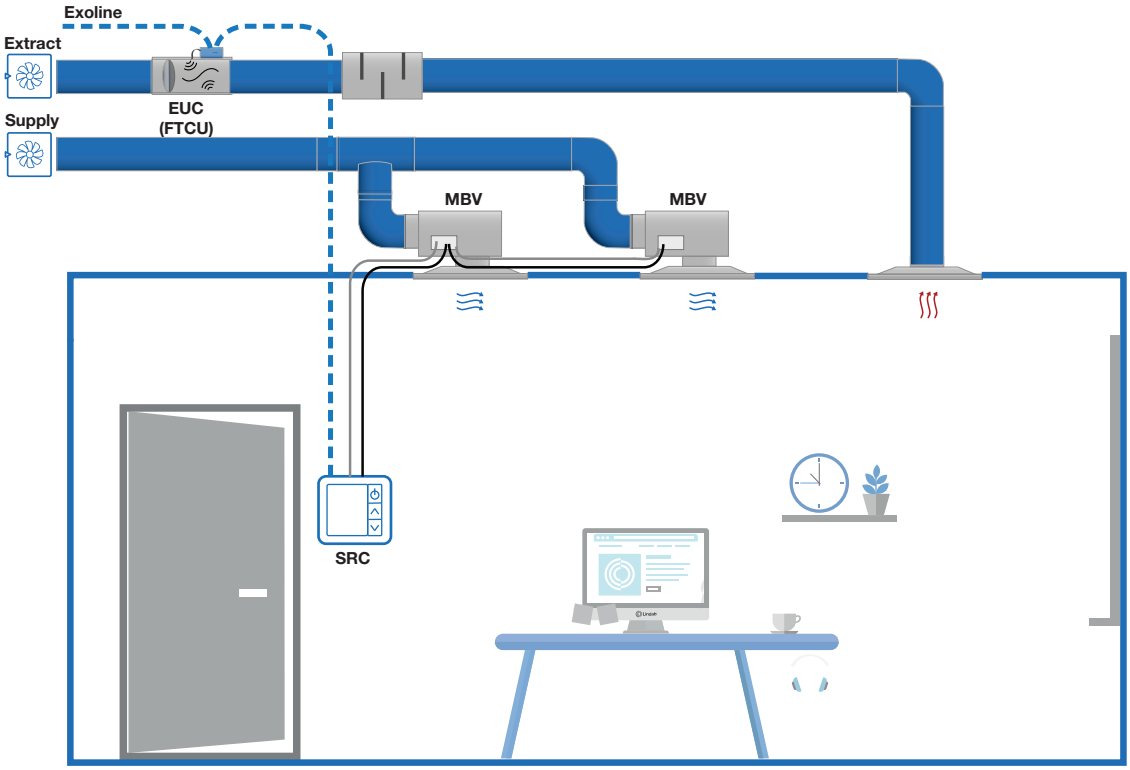



- Integrated temperature sensor (in diffuser) measures actual room temperature and gives 2-10 V flow signal to MBV.
- MBV regulates to correct air flow regardless of pressure.
- Multiple MBV controlled by same SRC can be wired with parallel signal (max 10 per SRC).
- MBV indicate actual damper position to SRC by a 2-10 V position signal.
- SRC communicates airflow and damper position to LRM/SRM.
- Extract controller gets regulation communication signal from SRM/LRM.
- Extract can also be above the suspend ceilling.

# Pascal design manual

## 5.

**Supply: Demand controlled with temperature regulator and MBV**
**Extract: Balanced airflow with EUC**

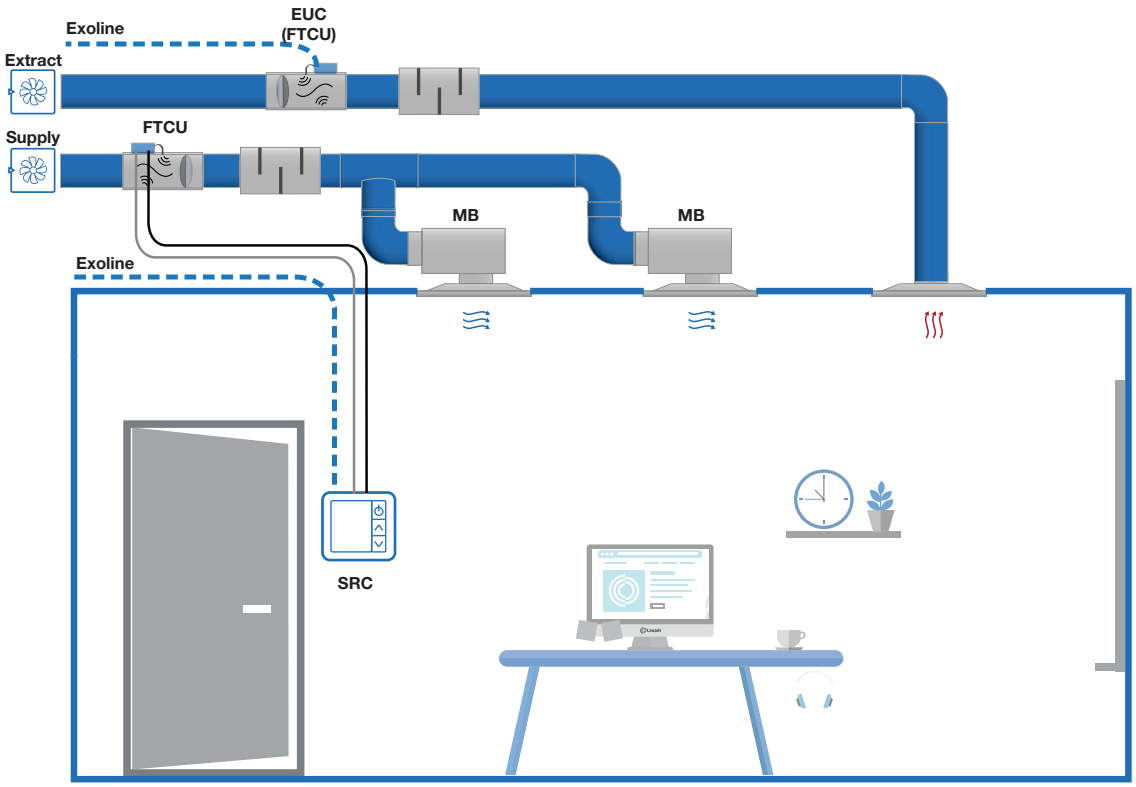



- SRC measures actual room temperature and gives 2-10 V flow signal to MBV.
- MBV regulates to correct air flow regardless of pressure.
- Multiple MBV controlled by same SRC can be wired with parallel signal (max 10 per SRC).
- MBV indicate actual damper position to SRC by a 2-10 V position signal.
- SRC communicates airflow and damper position to SRM/LRM.
- EUC (FTCU) receives airflow setpoint from SRM/LRM and regulates with a 2-10 V flow signal, to obtain room balance.
- EUC communicates damper position and actual flow to LRM/SRM.
- If VRU is used instead of FTCU an ERC is required. There will only be damper position feedback.
- Max. 16 ERC/EUC per SRM/LRM.

# Pascal design manual

## 6.

**Supply: Demand controlled with temperature regulator and FTCU**
**Extract: Balanced airflow with EUC**

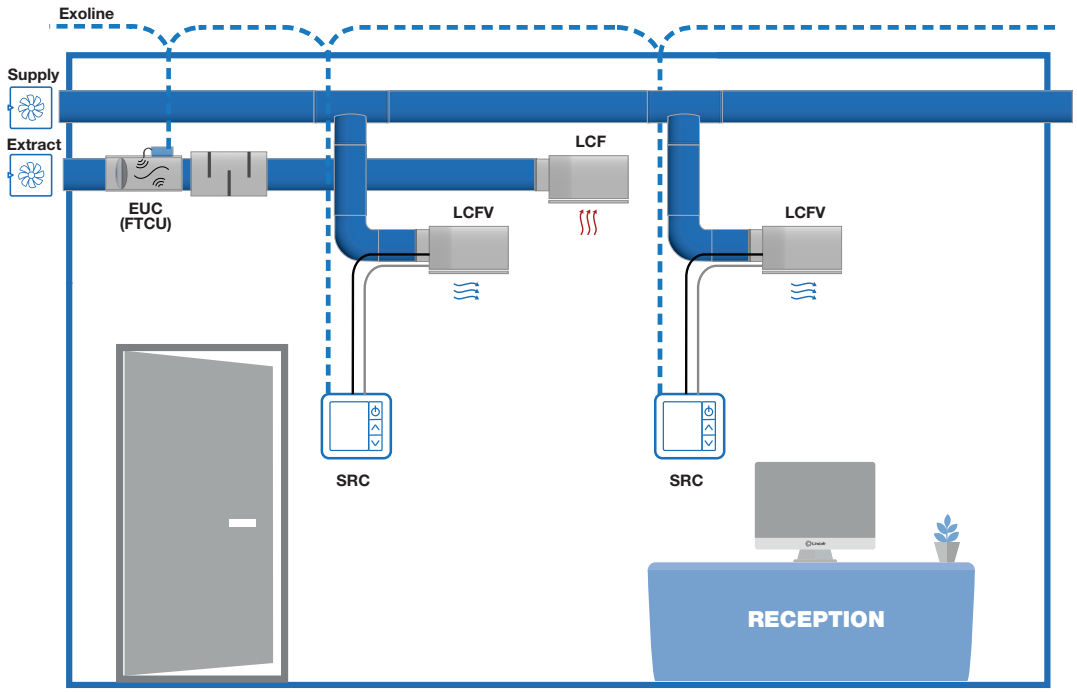



- SRC measures actual room temperature and gives 2-10 V flow signal to supply FTCU/VRU.
- FTCU/VRU regulates to correct air flow regardless of pressure.
- FTCU/VRU indicate actual damper position to SRC by a 2-10 V position signal.
- SRC communicates airflow and damper position to LRM/SRM.
- EUC (FTCU) receives airflow setpoint from SRM/LRM and regulates with a 2-10 V flow signal, to obtain room balance.
- EUC communicates damper position and actual flow to LRM/SRM.
- If VRU is used instead of FTCU an ERC is required. There will only be damper position feedback.
- Max. 16 ERC/EUC per SRM/LRM.

# Pascal design manual

## 7.

**Supply: Demand controlled with temperature regulator and LCFV**
**Extract: Balanced airflow with EUC and LCF**




- SRC measures actual room temperature and gives 2-10 V flow signal to LCFV.
- LCFV regulates to correct airflow regardless of pressure.
- LCFV indicate actual damper position to SRC by a 2-10 V feedback position signal.
- SRC communicates airflow and damper position to SRM/LRM.
- EUC (FTCU) receives airflow setpoint from SRM/LRM and regulates with a 2-10 V flow signal, to obtain room balance.
- EUC communicates damper position and actual flow to LRM/SRM.

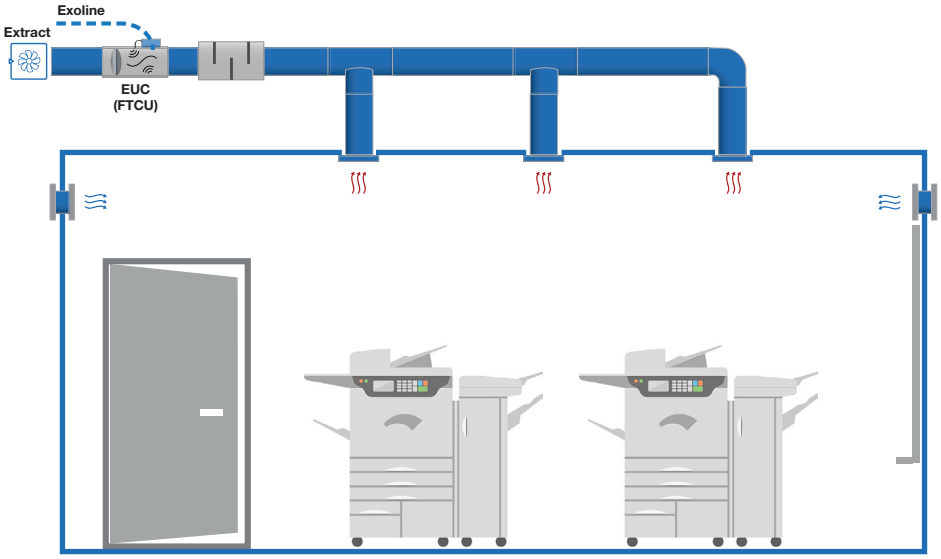
**Options:**

- Multiple LCFV controlled by same SRC can be wired with parallel signal (max 10 per SRC).
- LCFV can be with integrated presence sensor (-P).
- If VRU is used instead of FTCU an ERC is required. There will only be damper position feedback.
- Max. 16 ERC/EUC per SRM/LRM.

# Pascal design manual

## 8.

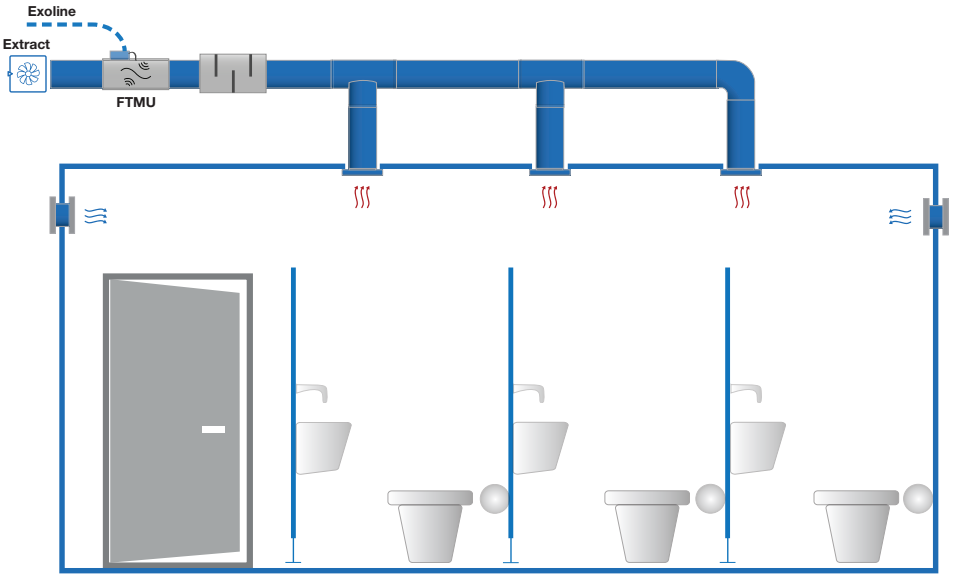
**Supply: Overpressure from other rooms**
**Extract: Constant airflow with EUC**




- The constant extract flow is assigned to ERC/EUC in SRM/LRM.
- EUC (FTCU) regulates constant extract flow regardless of pressure.
- The actual flow is measured by EUC (FTCU).
- EUC measures the airflow and damper position is communicated via Exoline to SRM/LRM.
- The constant extract from this room must be compensated on the extract in other rooms.
- If VRU is used instead of FTCU an ERC is required. There will only be damper position feedback.
- Max. 16 ERC/EUC per SRM/LRM.

## 9.

**Supply: Overpressure from other rooms**
**Extract: Separate extract fan. Airflow measuring with FTMU to obtain balance in section**

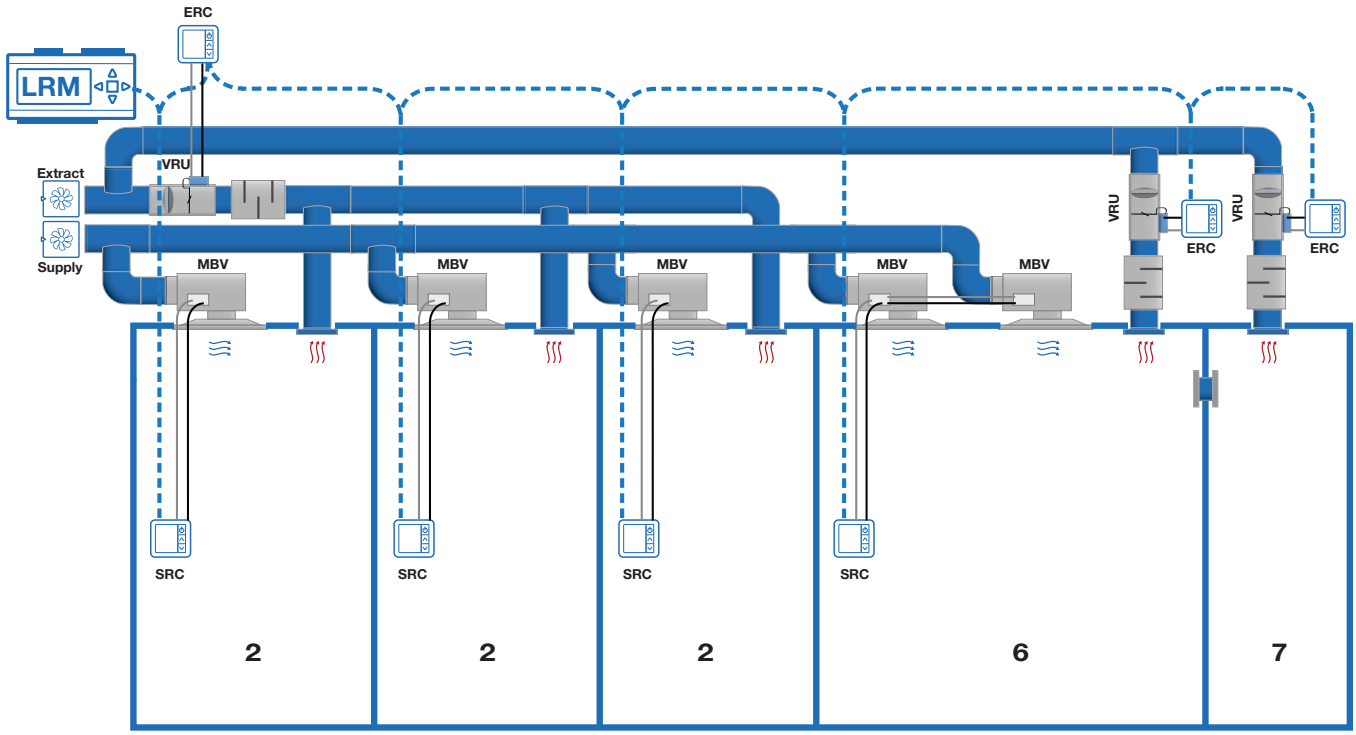



- Airflow from seperate extract fan is meassured with FTMU
- The actual airflow is communicated directly to SRM/LRM
- The airflow can be ballance with adjacent rooms in SRM/LRM
- Max. 8 FTMU per SRM/LRM

# Pascal design manual

## Combined Pascal building solution example with different room types. Can be combined to fit the exact building layout.

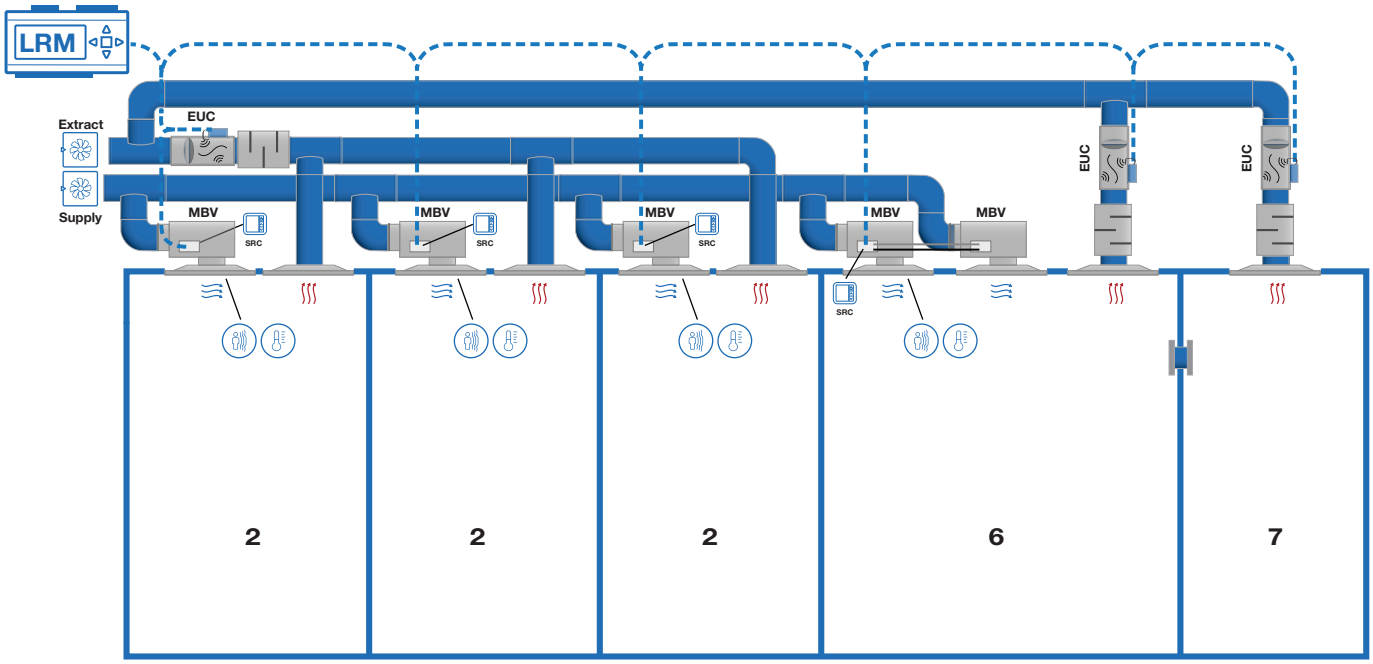
**Supply: Demand controlled with temperature regulator and MBV.**
**Extract: Balanced airflow with ERC and VRU.**




- SRC regulates supply airflow in MBV and communicates this airflow to SRM/LRM.
- SRM/LRM regulates extract ERC to rooms (2).
- SRM/LRM regulates extract ERC to rooms (6) to secure room balance minus constant extract (7).
- SRM/LRM secures constant extract flow with regulation ERC to rooms (7).
- SRC and EUC/ERC communicates damper positions to SRM/LRM.
- Damper positions for both supply and extract are used for fan optimizer function.

# Pascal design manual

**Supply: Demand controlled with SRC on MBV and external sensors**
**Extract: Balanced airflow with EUC**

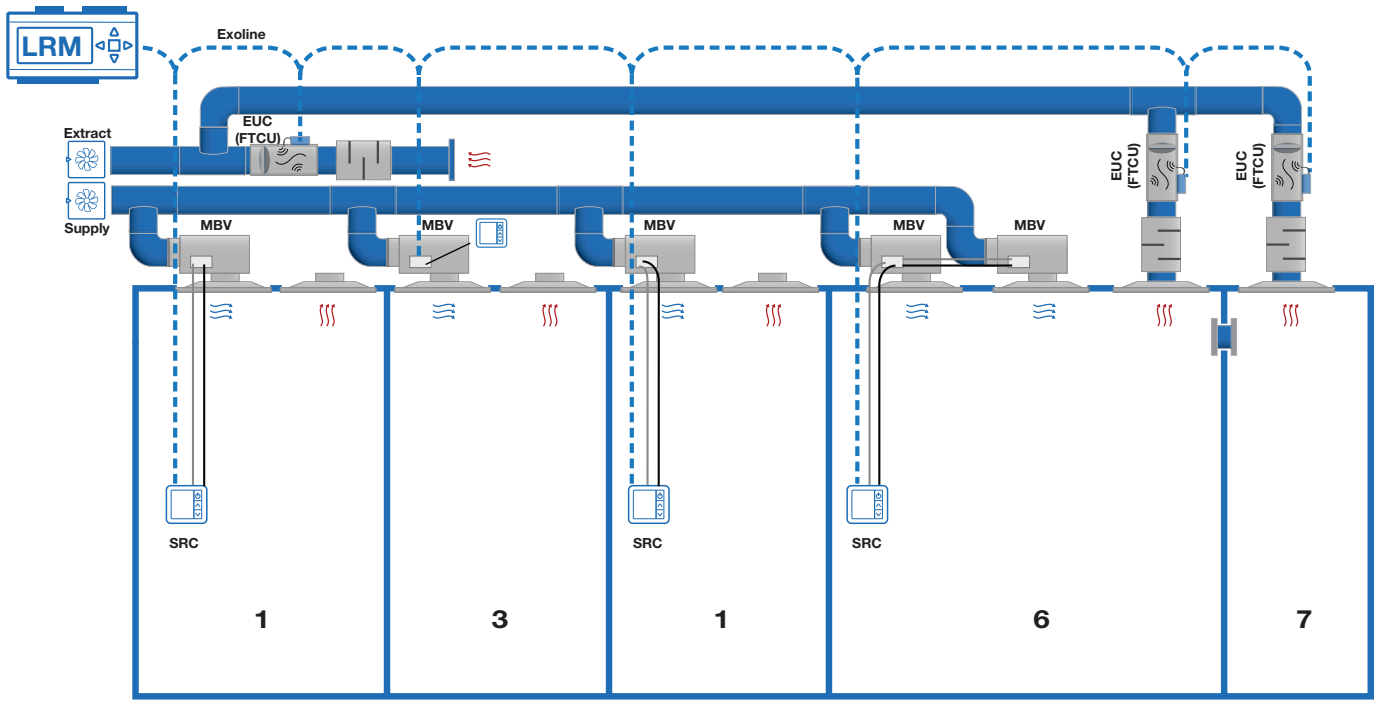



- SRC regulates supply airflow in MBV and communicates this airflow to SRM/LRM.
- SRM/LRM regulates extract EUC to rooms (2).
- SRM/LRM regulates extract EUC to rooms (6) to secure room balance minus constant extract (7).
- SRM/LRM secures constant extract flow with regulation EUC to rooms (7).
- SRC and EUC/ERC communicates damper positions to SRM/LRM.
- Damper positions for both supply and extract is used for fan optimizer function.

# Pascal design manual

## Combined Pascal building solution example with different room types. Can be combined to fit the exact building layout.

**Supply: Demand controlled with mixed solutions, temperature regulation and MBV**
**Extract: Mixed solutions balanced with EUC**

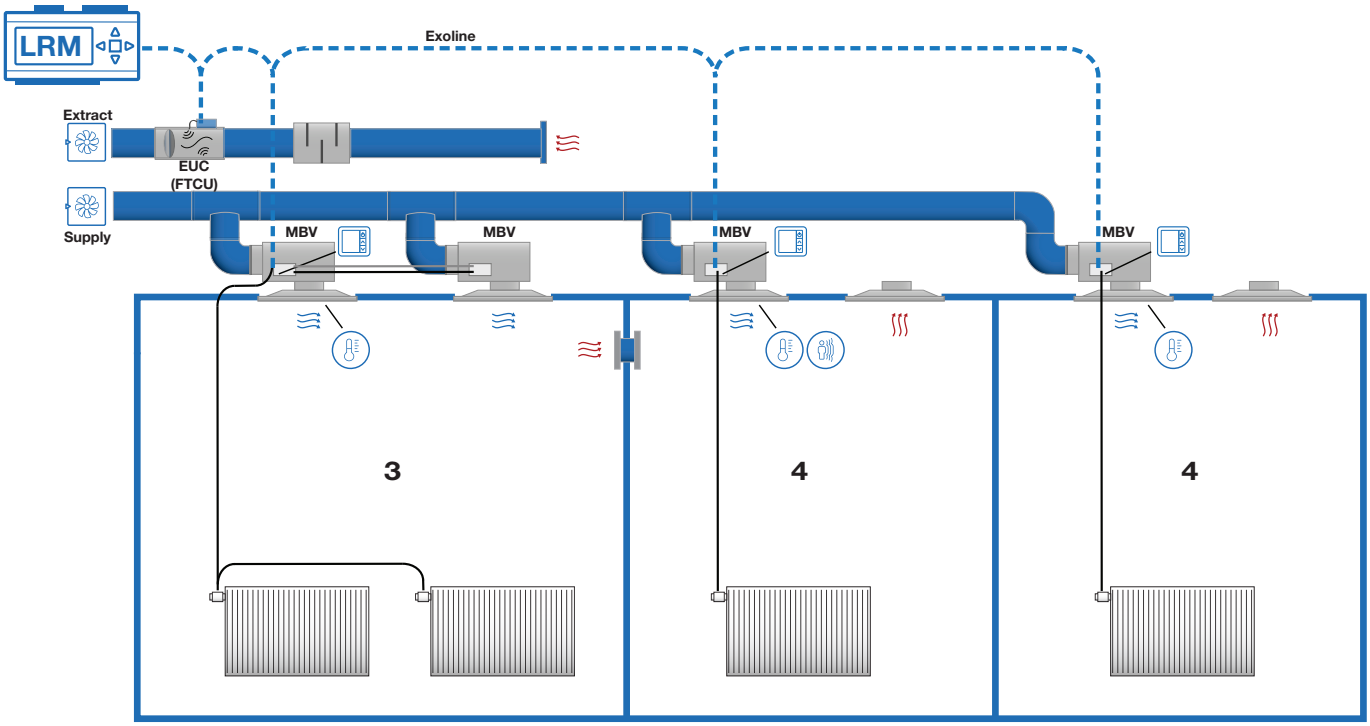



- SRC regulates supply airflow in MBV and communicates this airflow to SRM/LRM.
- SRM/LRM regulates extract ERC/EUC to rooms (1) and (3).
- SRM/LRM regulates extract ERC/EUC to rooms (6) to secure room balance minus constant extract (7).
- SRM/LRM secures constant extract flow with regulation ERC/EUC to rooms (7).
- SRC and EUC (FTCU) communicates damper positions to SRM/LRM.
- Damper positions for both supply and extract is used for fan optimizer function.
- If VRU is used instead of FTCU an ERC is required. There will only be damper position feedback.

# Pascal design manual

## Solutions with valve control for room heating

**Supply: Demand controlled with SRC on MBV, external sensors and heating**
**Extract: Balanced airflow with EUC**

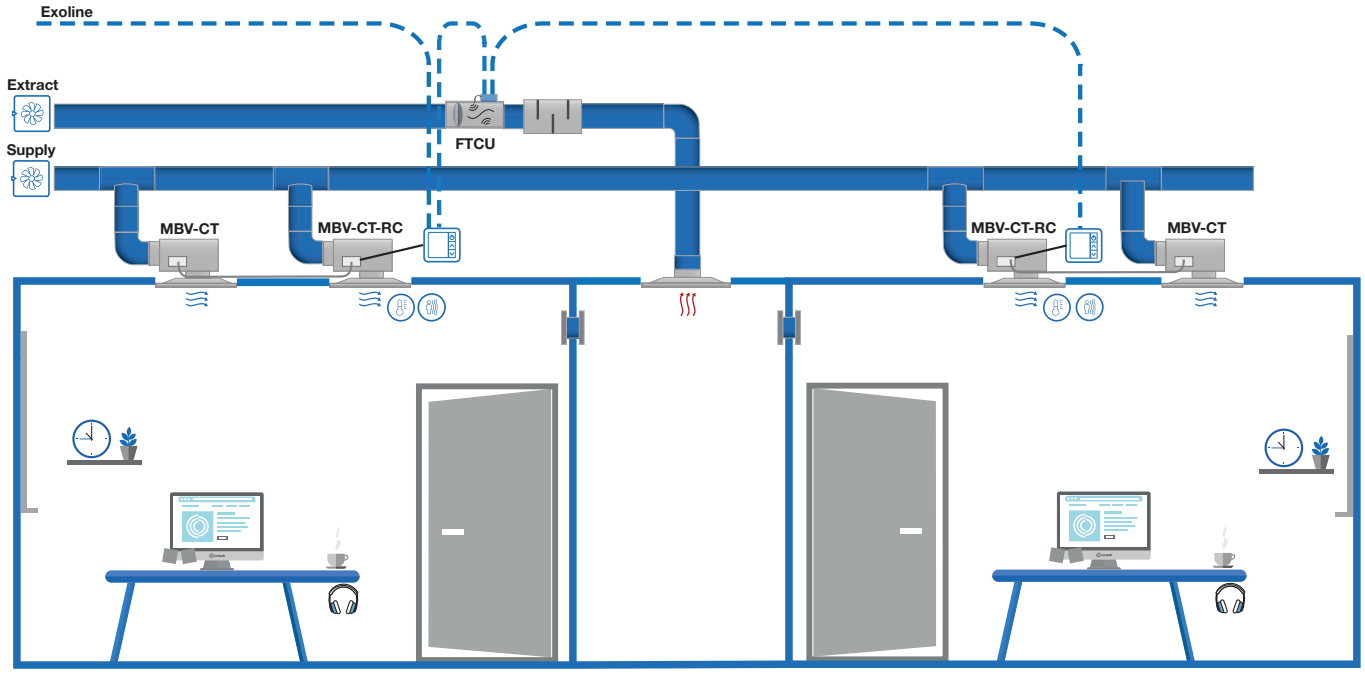



- SRC supply airflow in MBV and communicates this airflow to LRM.
- SRC is mounted on MBV with Regula Control card for easy wiring.
- Temperature and/or Presence sensors integrated in diffusers.
- Room heating is controlled from SRC with 0-10 V or 24 V control signal.
- LRM communicates directly to EUC with airflow.
- Supply and Extract are connected and balanced in SRM/LRM via Exoline.
- Room heating is controlled from SRC with 0-10 V or 24 V control signal.
- Damper positions for both supply and extract is used for fan optimizer function.

# Pascal design manual

## Single offices with different heat load

**Supply: Demand controlled with SRC on MBV. SRC controls several MBVs.**
**Extract: Central from hallway, balanced airflow with EUC and several SRCs.**

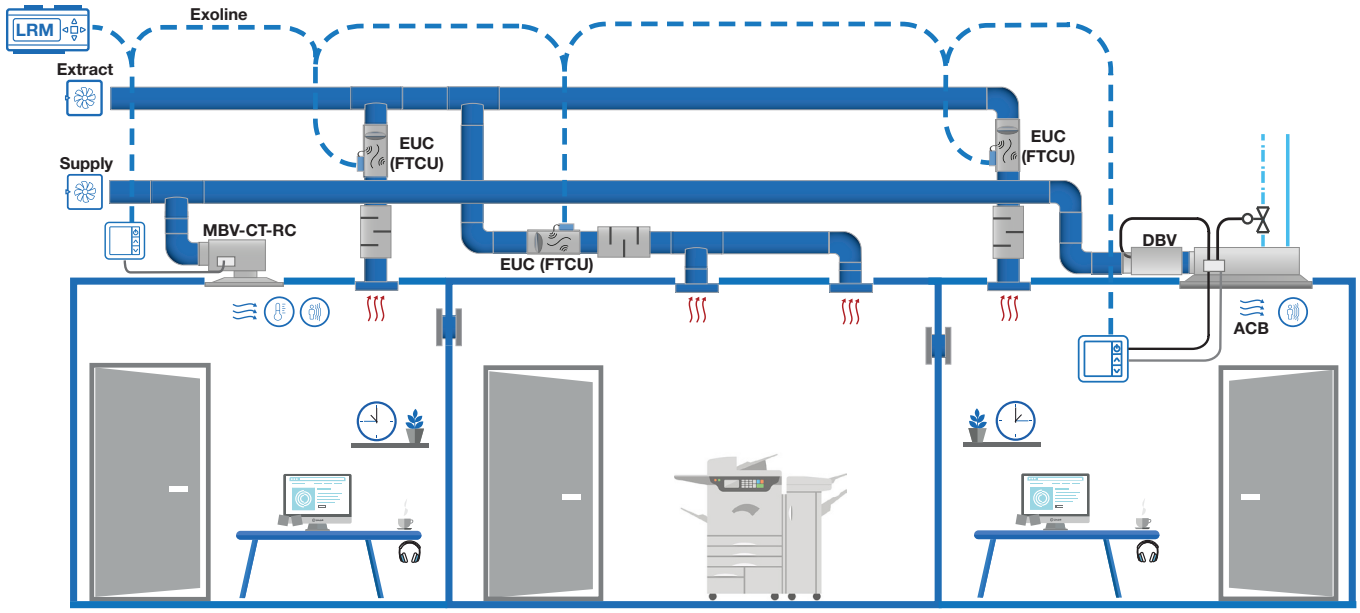



- Room controllers mounted on MBV with integrated sensor in ceiling diffuser. Controlling airflow to large temperature zone with parallel connected MBVs.
- Central extract from hallway with overflow to each office. Airflow regulated with FTCU.

# Pascal design manual

## Air and water solution

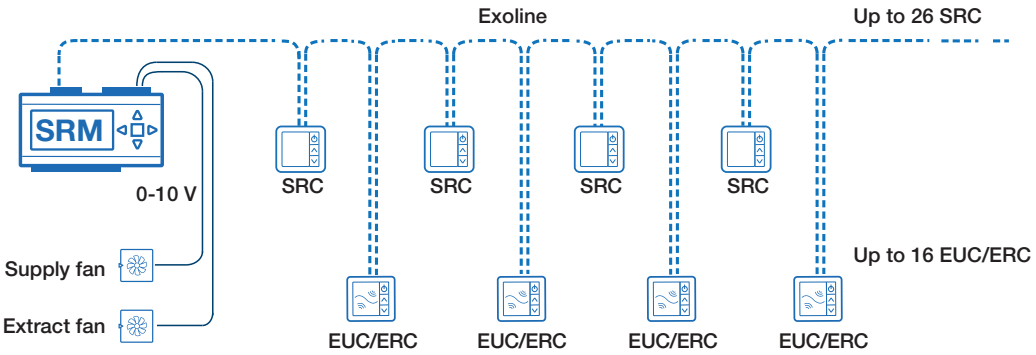
**Supply: Single offices with different heat load**
**Extract: Ballanced between offices and printer station.**



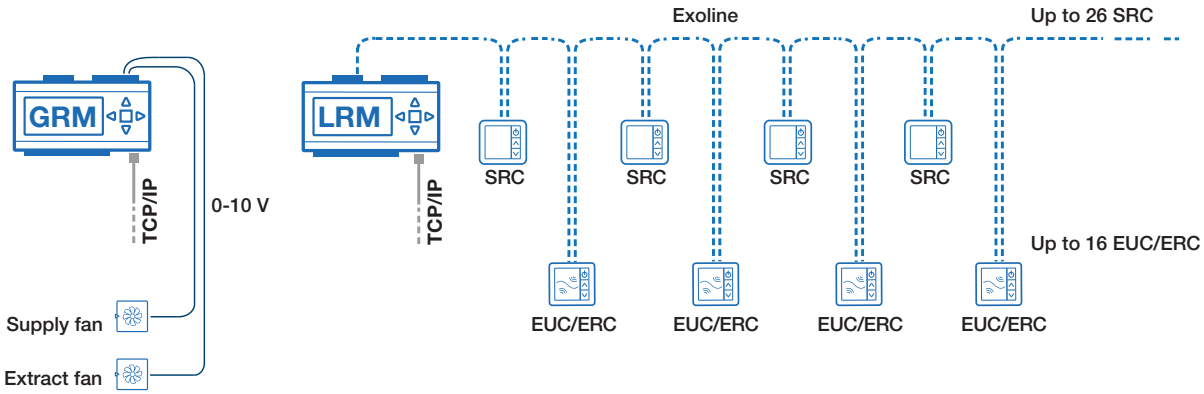

- Single offices with different heat load.
- ACB solution with room controller for temperaure regulation. Presence sensor integrated in ACB.
- MBV solution with presence and temperature sensor intregreted in ceiling diffuser.
- Constant extract with FTCU in ”printer room?” balanced with overflow from offices. Variable extract in the offices to compensate the total supply airflow to balance section.

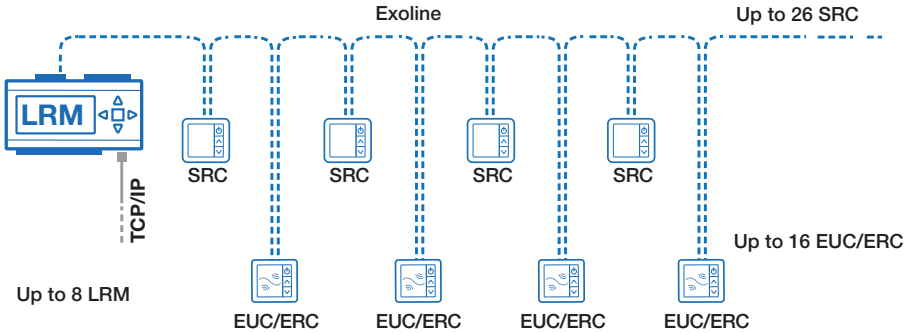
# Pascal design manual

## System layout - small AHU
## Single Regula Master (SRM)




## System layout - medium AHU
## Global Regula Master and 2-8 Local Regula Masters



Most of us spend the majority of our time indoors. Indoor climate is crucial to how we feel, how productive we are and if we stay healthy.

We at Lindab have therefore made it our most important objective to contribute to an indoor climate that improves people's lives. We do this by developing energy-efficient ventilation solutions and durable building products. We also aim to contribute to a better climate for our planet by working in a way that is sustainable for both people and the environment.

Lindab | For a better climate