VAV/CAV system solution for energy-optimised fan regulation for room ventilation

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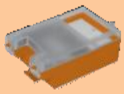
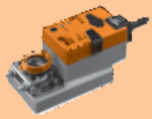
Overview of system

Function	VAV-Compact: LON types	VAV-Compact: MP types	VAV-Universal: VRP-M system solutions	VAV-Universal: Universal range	VAV-Universal: Universal range
Sensors		MP BUS	 VFP..	 VRD3	 VFP..
Controllers			MP BUS  VRP-M		 VRP VRP-STP
Actuators	 LMV-D2LON NMV-D2LON	 LMV-D2-MP NMV-D2-MP SMV-D2-MP  LHV-D2-MP	 LMQ24A-SRV-ST * NMQ24A-SRV-ST * NM24A-V-ST	 LM24A-V NM24A-V SM24A-V	 LF24A-V AF24A-V with safety function
Bus integration		MP BUS  In fieldbus systems via MP gateway For LONWORKS®: UK24LON gateway For Konnex: UK24EIB gateway			
Fan optimisation via MP-Bus		MP BUS  Fan Optimiser COU24-A-MP			
Adjustment tool	 ZTH-VAV				
Parameterisation and service software	PC-Tool for: VAV-Compact VRP-M				
Room controller		 CR24..			
Positioner		 SG..			

* Not permitted in conjunction with optimiser

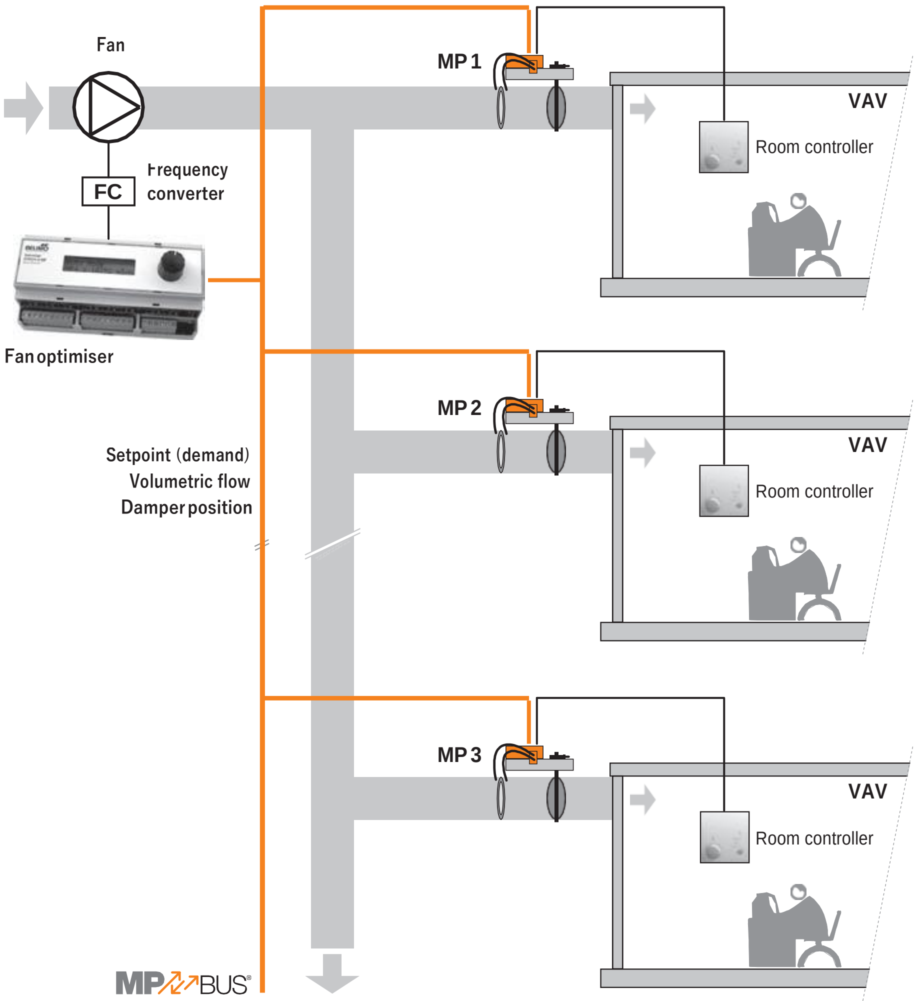
Note: Separate documentation for the VAV-Compact LON version, VRP-M system solution, VAV-Universal, CR24 single-room controller, tools and interfaces can be found on the internet at **www.belimo.eu**

Operating principle

The volumetric flow and its transport are determining factors for the **energy consumption of the fans.**

With **conventional, pressure-controlled systems**, the supply pressure is selected to provide enough air to the most unfavourably placed VAV unit during full load operation. The remaining oversupplied units have to eliminate the excess energy, i.e. the overpressure, by closing the dampers. These units are often operated in the most unfavourable range – for control characteristics, noise and pressure loss.
The **greatest energy loss** occurs at **partial load**, which often accounts for the largest share of the operating time of a VAV system.

Fan optimisation: The nominal volume (space requirement), actual volume and damper position are recorded via the MP-Bus, analysed by the optimiser and specified as a setpoint for the frequency converter.
Result: The system is operated in the optimum range – for control characteristics, noise and energy consumption.
The **greatest potential energy saving** occurs at partial load, which accounts for a considerable share of the time of a VAV system.



Fields of application

Variable and constant air volume systems for room ventilation applications with fans controlled by a frequency converter.

Principle of operation

The system is operated by the fan optimiser with optimum damper positions based on current demand signals. The objective is to keep the pressure loss across the VAV units as low as possible and thus permanently reduce operating costs by decreasing the fanoutput.
The damper position of each VAV unit is recorded and transferred to the fan optimiser via the MP-Bus. These values are used there as a control variable for regulating the fan controlled by the frequency converter. As a result of this technology – which is based on the Belimo MP-Bus – an **energy saving of up to fifty percent** can be achieved compared to conventional systems in which fans are controlled by air duct pressure.

Proportionality laws

The proportionality laws form the basis of the volumetric flow transport.

- The volumetric flow is proportional to the speed $\frac{\dot V_1}{\dot V_2} = \frac{n_1}{n_2}$
- Pressure increases change to the second power with the volumetric flow ratio $\frac{p_1}{p_2} = \left(\frac{\dot V_1}{\dot V_2}\right)^2 = \left(\frac{n_1}{n_2}\right)^2$
- The power consumption changes to the third power with the volumetric flow ratio $\frac{P_1}{P_2} = \left(\frac{\dot V_1}{\dot V_2}\right)^3 = \left(\frac{n_1}{n_2}\right)^3$

Damper diagrams

- Pressure-controlled system

Damper opening
[%]
100
40
0

Operating status
Optimum range
Unfavourable range
(for energy efficiency and control characteristics)

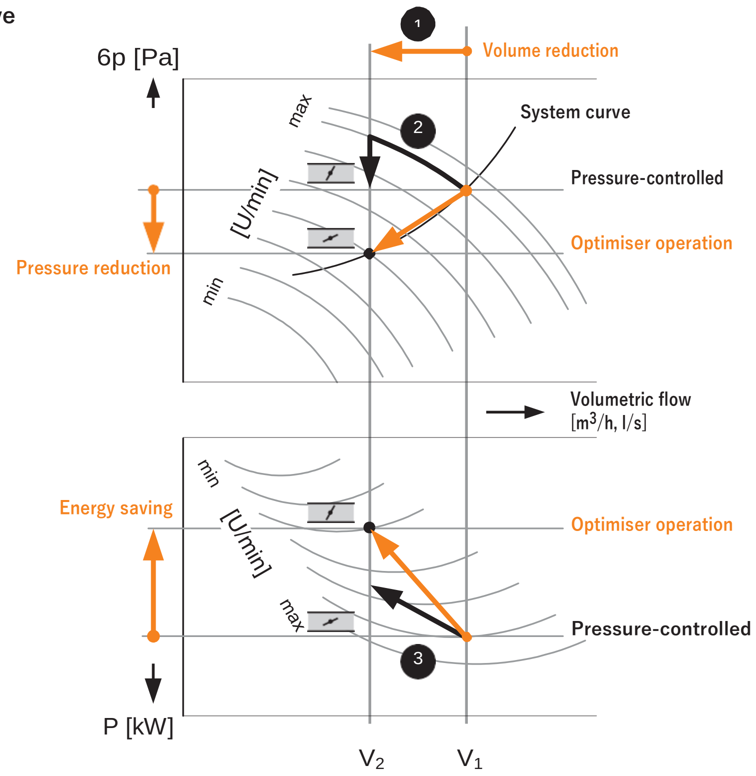
- Fan-optimised system

Damper opening
[%]
100
40
0

Operating status
Optimum range
Unfavourable range
(for energy efficiency and control characteristics)

Operating principle (continued)

Duct pressure diagram with system curve



	Pressure-controlled	**Optimiser operation**
Volume reduction 1	VAV units: Dampers close until set volume reached	VAV units: Dampers close until volume setpoint is reached
Response of air duct pressure 2	– Air duct pressure rises – Pressure control corrected to set constant pressure, i.e. pressure at full load – VAV dampers close in order to compensate (eliminate) the excess air duct pressure – Increased flow noise	The optimiser determines the new situation from the change in the damper diagram and reduces the fan speed until the dampers of the downstream VAV units are operated in the optimum range
Energy saving 3	The fan is operated at a lower speed owing to the reduced volumetric flow. The downstream VAV units are not taken into account and are operated in an unfavourable range as a result of the excess pressure. The result: – Unnecessary pressure loss in the air duct system – Unnecessarily high power consumption	– Fan operated with lower speed – volumetric flow ratio – Significantly lower air duct pressure than with the air duct type due to the smaller pressure drop in the air duct network (optimum damper position)

Customer benefits

- Energy saving – up to fifty percent lower fan energy consumption due to the reduced dropin pressure across the downstream VAV units.
- Lower costs – supply and exhaust air pressure controls are eliminated.
- Quicker installation – standard cable for the 3-pole MP-Bus.
- Easier commissioning – owing to the elimination of pressure controls.
- Greater system convenience thanks to the lower flow noise – the flow noise through the units and in the air duct system is reduced by the lower supply pressure.
- Increased operational reliability – pressure losses due to filter contamination are automatically compensated. Complaints such as «the system does not supply enough air» are a thing of the past.
- Optimum cost-benefit ratio – the investment pays even with small and medium-sized buildings.
- Flexible system designs – for example as:
  - CAV system: volume changeover OFF / $\square_{min}$ / $\square_{max}$ via motion detector, etc.
  - VAV system: demand-controlled via CR24-B1 room temperature controller
  - VAV system: demand-controlled via room or DDC system controller or UK24LON/EIB
  - Mixed VAV / CAV system
- Can be used for new systems, retrofitting for system optimisations and renovation of existing systems – all VAV-Compacts (LMV-D2M / NMV-D2M from 2001 and later) support the optimiser function!
- Simple engineering and efficient commissioning – thanks to pre-configuration, LC display and self-adaptive control function.

Fan optimisation

- Is an effective measure to fulfil EU Directive 2002/91/EC on the overall efficiency of buildings and derived implementation measures, e.g. DE: DIN V 18599.
- Is an effective measure for permanently reducing operating costs.

Short payoff period

- The massive potential energy savings meanthat the initial costs of the fan optimisation solution are quickly recovered

Interfaces

Control

The energy requirements of the single-room or DDC controller are transferred to the COU24-A-MP fan optimiser via analogue signals or the MP-Bus.

VAV controllers

As a result of the MP-Bus technology, the VAV controllers provide access to all relevant data such as the current actual volumetric flow, damper position, etc. Setting and control functions are possible at any time with the Belimo PC-Tool.

Frequency converter

The frequency converter is controlled via a 0 … 10 V analogue output. In the case of mixed systems with VAV and mechanical CAV units, a minimum fan speed can be set.

System size

The system size is unlimited; more fan optimisers can be operated in a sequential circuit via the optimiser's cascade output.
Number of VAV / CAV units per fan optimiser: 1 to 8

Operation and display

All relevant information (overall / individual actual volumes, damper positions, frequency converter setpoint, etc.) are shown on the LC display. There is a user-guided setting and display menu for easy operation with an encoder button.

VAV controllers

The VAV controllers can be addressed and checked via the fan optimiser. In addition to the actual volumetric flow and damper position information, the operating volumetric flow settings $\square_{min}$ and $\square_{max}$ can be displayed and adjusted if necessary.
The PC-Tool can be used for service work, for example.
It is plugged into the central RJ12 connection.

VAV / CAV system solution for energy-optimised fan regulation for room ventilation.

Interfaces

- Room controller input DDC: 0 ··· 10 / 2 ··· 10 V / MP-Bus
- VAV controller input / output: MP-Bus
- Frequency converter output: 0 ··· 10 V
- LC display for settings and diagnostics

Technical data

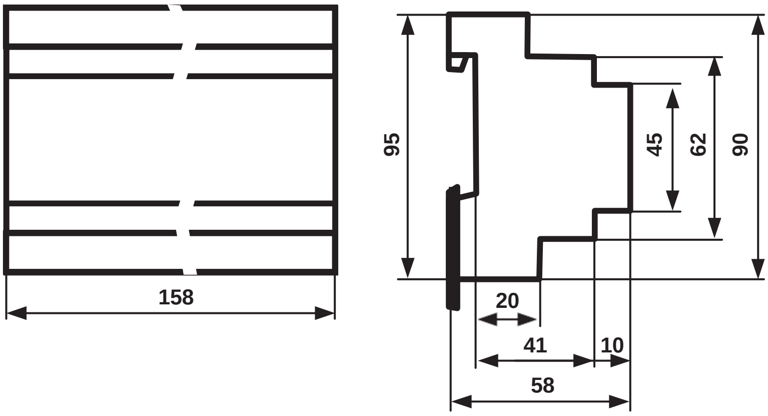
Electrical data	Nominal voltage	AC 24 V, 50/60 Hz / DC 24 V
	Power supply range	AC ±20% / DC +20% / –10%
	Power consumption	15 VA / 7.5 W (without connected VAV controller)
	Switch-on current (actuators)	max. 8.3 A at 5 ms
Connection	Inputs and outputs 1 … 32	Screw terminals, 2.5 mm²
	MP-Bus / supply 33 … 38	Screw terminals, 2.5 mm²
	MP-Bus operating devices	RJ12
	Wire sizing	See «Connections – topology and wire sizing»
Inputs / outputs	Inputs IN A - CASC	Cascade input, 0 … 10 V, internal resistance 200 k
	IN B - IN	Override control input, 0 ... 10 V, internal resistance 100 k
	Outputs OUT A - FC	Frequency converter control output (protection class III), 0 … 10 V, max. 10 mA
	OUT B - OUT	Reserve
	Controller analogue IN 1 ... 8	Analogue setpoint input for VAV controllers 1 … 8, 0 … 10 / 2 … 10 V (switchable), internal resistance 200 k
	OUT 1 ... 8	Analogue actual volumetric flow output for VAV controllers 1 … 8, 0 … 10 V / 2 … 10 V (switchable), max. 10 mA
	Controller MP MP	DDC MP interface, MP-Bus connection, 24 V AC/DC supply
	RJ12	MP-Bus service socket (PC-Tool)
	Actuators MP	VAV controllers 1 … 8, MP-Bus, 24 V AC/DC, max. 5A
Operation	Optimiser Data input	Menu-guided encoder operation Acknowledge button
	Data display	LC display, 2 x 16 characters with LED back-lighting
	VAV controllers Settings and display	Via MP-Bus Tool connection with Belimo PC-Tool
Housing	Colour	Grey RAL 7035
	Installation	Control cabinet installation, snaps onto standard rail DIN EN 50 022
	Flame Test	UL94 V0
Safety	Protection class	III Safety extra-low voltage
	Degree of protection	IP10 (IP20 with plugs connected)
	EMC	CE according to 2004/108/EC
	Mode of operation	Type 1 (EN 60730-1)
	Rated impulse voltage	0.8 kV (EN 60730-1)
	Control pollution degree	2 (to EN 60730-1)
	Software class	A (EN 60730-1)
	Ambient temperature range	0 … 50°C
	Storage conditions	–20 … +80°C non-condensating (EN 60730-1)
	Ambient humidity range	+5 … 95% r.H., non-condensating (EN 60730-1)
	Maintenance	Maintenance-free
Dimensions / weight	Dimensions	See «Dimensions» on page 8
	Weight	Approx. 300 g

Safety notes

The COU24-A-MP fan optimiser system solution:
- Is not allowed to be used outside the specified field of application.
- Only works with Belimo MP actuators
- May only be installed and commissioned by suitably trained personnel.
- May only be opened at the manufacturer's site. The devices do not contain any parts that can be replaced or repaired by the user.
- Contains electrical and electronic components and is not allowed to be disposed of as household refuse. All local and currently valid regulations and requirements must be observed.

Dimensions [mm]

Dimensional diagrams



Planning

WARNING

Relevant national and local regulations and safety specifications must be taken into account and observed when planning and carrying out work.

Improper installation and handling of the fan motor or frequency converter may result in damage to the system, serious injury or even death.
All electrical installations and maintenance work on these system parts must be carried out by qualified specialists. Work must never be undertaken on a frequency converter that is activated.
The instructions provided by the frequency manufacturer must therefore be observed.

Protective equipment and connectio

Protective equipment for people and systems

A Belimo fan optimiser system is used to regulate the performance of a frequency converter-controlled supply air or exhaust air fan depending on the damper position of the downstream VAV units.
In order to protect people and the system, the control (release, ON/OFF) and equipment must be protected externally in line with the specifications of local legislation and the frequency converter manufacturer.
System and personal protection such as fire control system, protective equipment for the frequency converter and fan, installation and duct network etc. do not form part of the fan optimisation equipment!

Cabling

The cables for the optimiser and VAV controllers should be laid at a distance from the motor connection cable to prevent feedback (high frequency noise) between the cables. As large a distance as possible should be left between the cables, especially if they are laid parallel to one another.

Wiring 0 ··· 10 V control signal for frequency converter

When cabling and connecting the optimiser's 0 … 10 V control signal (FC terminals) for frequency converter control, please follow the manufacturer's description. When assigning the frequency converter's terminals, refer to the manufacturer's documents. The optimiser's 0 … 10 V control signal should be laid separately from the motor cable.

Commissioning the frequency converter

The frequency converter equipment may only be commissioned once correctly installed and set. This work should be undertaken by qualified specialists following the instructions of the frequency converter manufacturer.

Fire and fire protection damper control

Note
The local safety specifications must be observed during planning and implementation!

Note
Closing the fire protection dampers when the fan is running, i.e., without a deactivation command being sent to the fan at the same time, or starting the fan when the fire protection dampers are closed, may result in system damage!

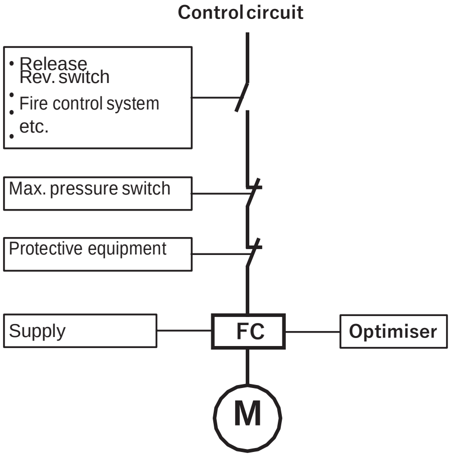
Consideration must be given to the impact of the fire and fire protection damper control, including its function test, on the system (installation and function) during planning and implementation.

Proposal:

System release via fire control and system needs (clock etc.)
1. Fire protection dampers OPEN command
2. Feedback: Fire dampers open → Fan ON

System OFF via fire control system or fire protection dampers test function
1. Fire protection dampers closed and fan OFF

Pressure limitation



Note
Locally binding safety regulations and the specifications of the frequency converter manufacturer must be taken into account when planning and designing the application!

Pressure control

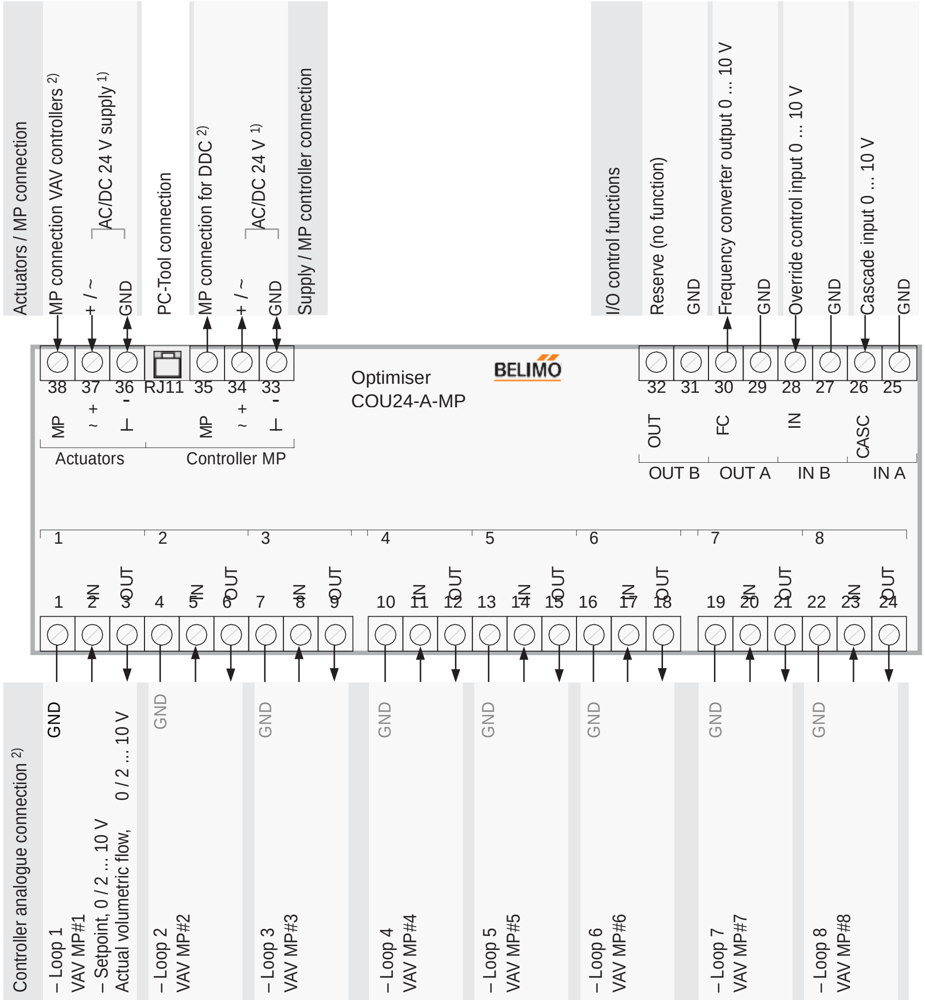
Air duct pressure control does not have to be used in a fan optimiser system.

Maximum pressure limitation

The optimiser is a control device for covering the volumetric flow required. If a system concept requires safety functions, e.g. max. pressure limitation, these must be provided from outside.

Maximum pressure limitation can be provided using a simple pressure switch, ON-OFF function, in the fan control circuit.

Terminal assignment



Explanation

1) Supply via 24 V safety transformer.
Account must be taken of the total power rating data of the connected VAV controllers when sizing the transformer and the connection line.
A double supply to the COU24-A-MP is not permitted. Terminals 33 and 36 and terminals 34 and 37 are connected internally!

2) MP or analogue (Ain / AiMP) operation must be defined in the Configuration menu.

Note

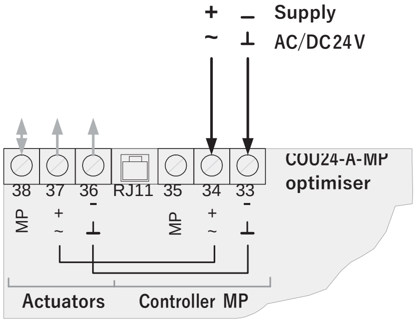
This is a description of the connections. The terminal assignment may vary, or some terminals may not be assigned at all, depending on the application. See «Connection diagram and typical application» for detailed connection information.
The devices may only be connected and commissioned by suitably trained personnel.

Supply, VAV controllers, inputs and outputs

Supply

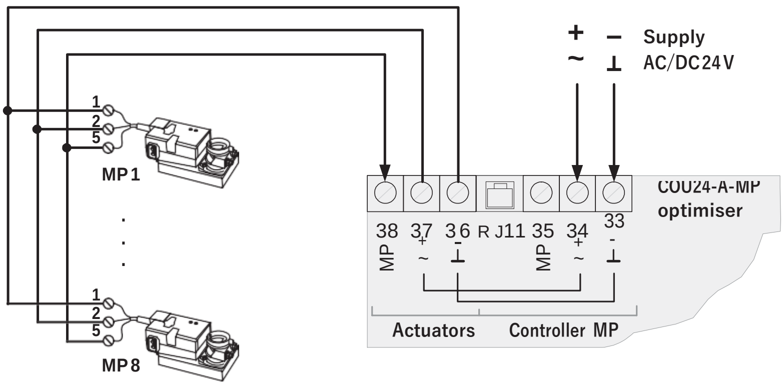
Caution
- Connection 24 V supply only via safety isolating tranfsormer.

Max. load connection 36 and 37: 5 A

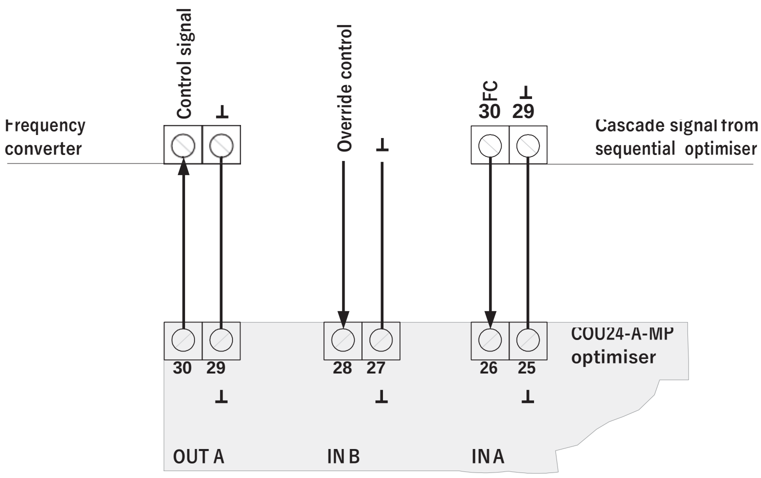


VAV controllers – MP-Bus

Topology and cable lengths
see page 16 … 19



Inputs / outputs



Function

Out A 0 ... 10 V output for control, frequency converter or cascade signal

IN A 0 ... 10 V cascade input from optimiser in sequential circuit. When cabling and connecting the optimiser's 0 ... 10 V control signal (FC terminals) for frequency converter control, please follow the manufacturer's description.

IN B 0 ... 10 V override control input

Note
For frequency converter connection, see page 9

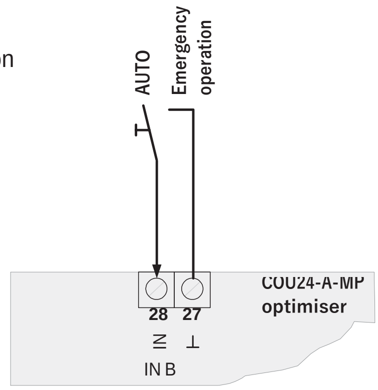
Supply, VAV controllers, inputs and outputs *(continued)*

Note
The override control input is deactivated during the power ON initialisation.

Override control			
Signal at IN B input (terminal 28)	Function	Override control, effecting	
		Frequency converter (terminal 30)	VAV controller (MP-Bus) 1)
10 V	Off	Output signal: 0 V	Dampers CLOSED
Input open	Auto	Control mode: 0 … 10 V	VAV operation
0 V	Emergency operation	Output signal: 10 V	Dampers OPEN

1) Acting on all connected VAV controllers

Example With step switch: auto / emergency operation (e.g. to support smoke extraction)

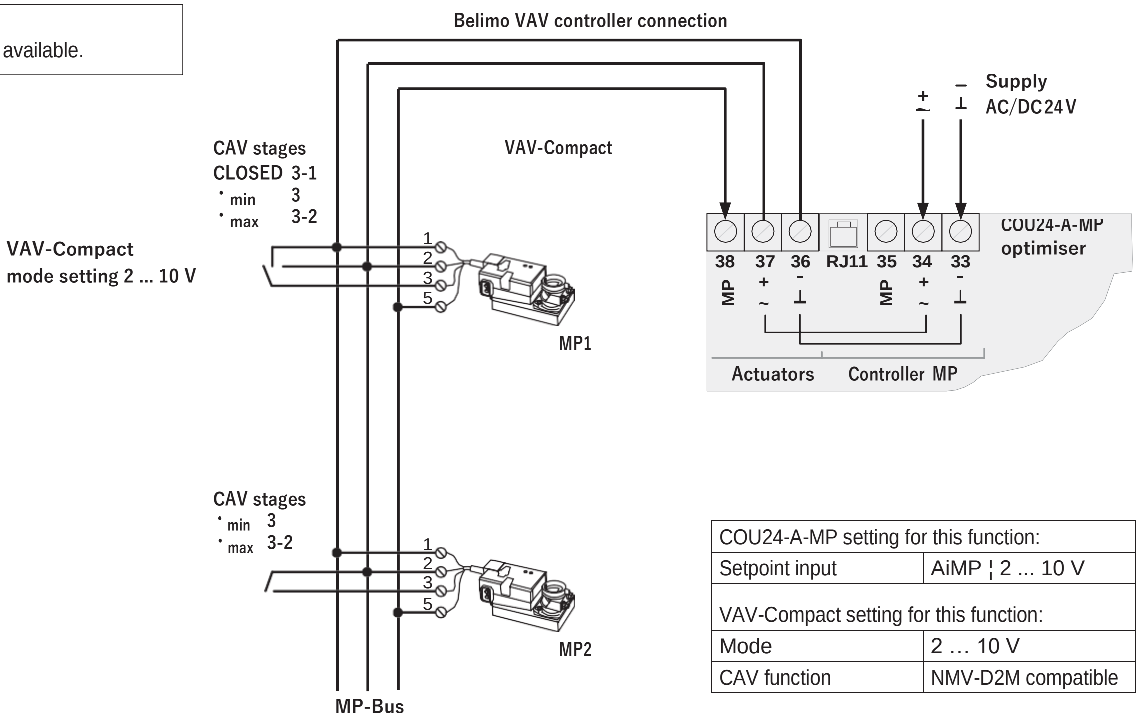


CAV: signal integration via VAV-Compact

Connection of conntacts for CAV applications

Signals are transmitted using the «External sensor integration» MP-Bus function of the VAV-Compact.

Note
□mid and OPEN levels are not available.



COU24-A-MP setting for this function:	
Setpoint input	AiMP ¦ 2 ... 10 V

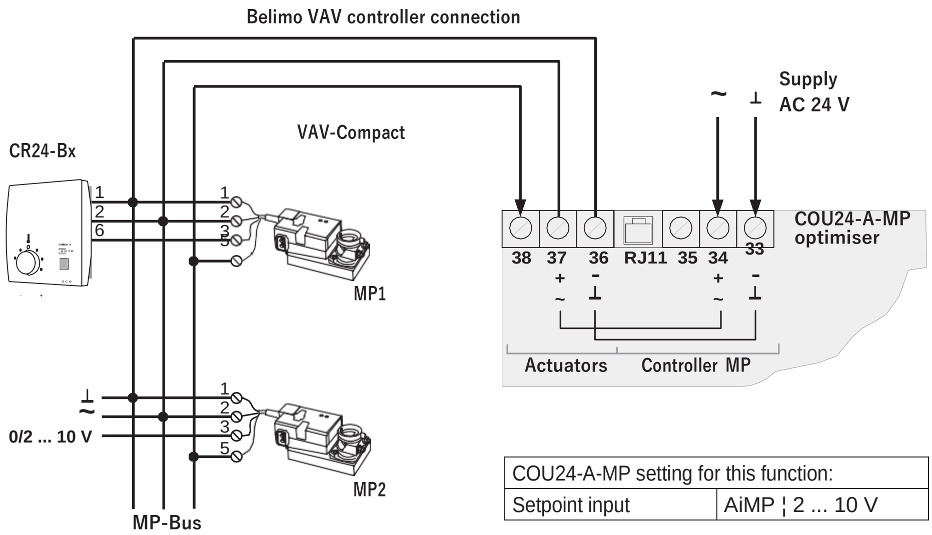
VAV-Compact setting for this function:	
Mode	2 … 10 V
CAV function	NMV-D2M compatible

VAV: Room temperature controller (e.g. CR24) connection via MP bus and/or VAV-Compact

Connection of a CR24 room controller for VAV applications

Signals are transmitted using the «External sensor integration» MP-Bus function of the VAV-Compact.

Note
Applications with CR24 require a 24 V AC supply.

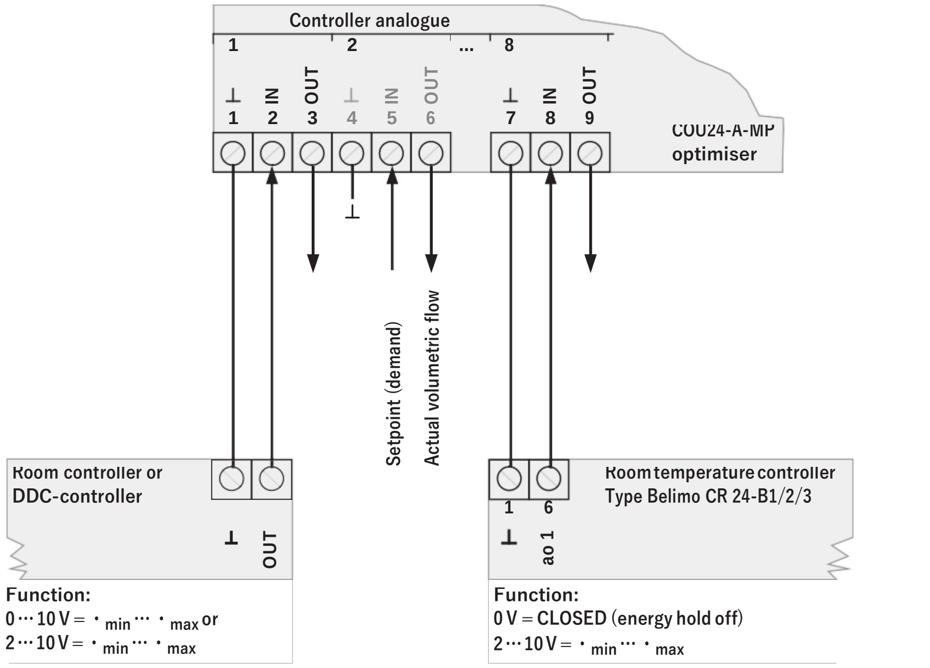


COU24-A-MP setting for this function:	
Setpoint input	AiMP ¦ 2 ... 10 V

VAV: Controller integration on COU24-A-MP – analogue controller signals

«Controller analogue» connection for a room temperature controller or DDC controller with a 0 … 10 V / 2 … 10 V signal

Note
The following functions are defined in the [Configuration] menu:
– DDC or analogue operation
– 0 … 10 V / 2 … 10 V



COU24-A-MP setting for this function:	
Setpoint input	Ain ¦ 0 … 10 V / 2 … 10 V

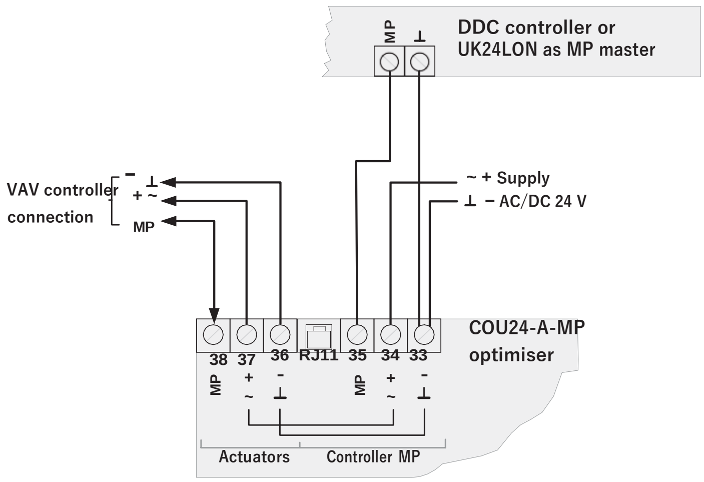
COU24-A-MP setting for CR24:	
Setpoint input	Ain ¦ 2 … 10 V

Function

1 … 8	Controller analogue for Control loop 1 → VAV MP#1 … Control loop 8 → VAV MP#8
⊥	Ground connection
IN	0 … 10 V / 2 … 10 V input of room controller / DDC Function: Setpoint for VAV controller
OUT	0 … 10 V / 2 … 10 V output Function: Actual volumetric flow of VAV controller Range: 0 … 100% $\dot{V}_{nom}$ (controller setting) Application: Reference signal for slave controller in M/S operation

VAV: Controller integration on COU24-A-MP – DDC as MP master

«Controller MP» connection for DDC / PLC controller, with integrated MP-Bus interface or UK24LON/EIB



Note
The actual volumetric flow can also be tapped in this application at the «Controller analogue» terminals as a 0 … 10 V signal (see «Controller analogue connection»).
OUT 0 ... 10 V / 2 ... 10 V output
Function:
Actual volumetric flow of VAV controller
Range:
0 ... 100% $\dot{V}_{nom}$ (controller setting)
Application:
Reference signal for slave controller in M/S operation

COU24-A-MP setting for this function:	
Setpoint input:	MP

Sizing of 24 V supply, wiring, topology, cable lengths

Supply, controller MP connection

A safety transformer must be used for the 24 V supply. Account must be taken of the performance data of the connected VAV controllers when sizing the transformer and the connection line.
The power ratings [VA] of the connected VAV controllers must be added first together and then to the 15 VA of the COU24-A-MP.

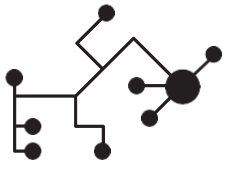
MP-Bus – VAV controller connection

The MP connection, a network for 1 … 8 Belimo VAV controllers, is a 3-pole connection for MP communication and the 24 V supply.
Neither special cables nor terminating resistors are required for the wiring.
The cable lengths (see calculation below) are limited by:

- The sum of the power ratinga of the connected VAV controllers
- The type of supply (AC 24 V via the bus or DC 24 V
- The cable cross-section

MP-Bus – topology

The cables of up to eight VAV controllers can be laid in a freely definable bus topology. The following topologies are permitted: star-shaped, ring-shaped, tree-shaped or mixed forms.

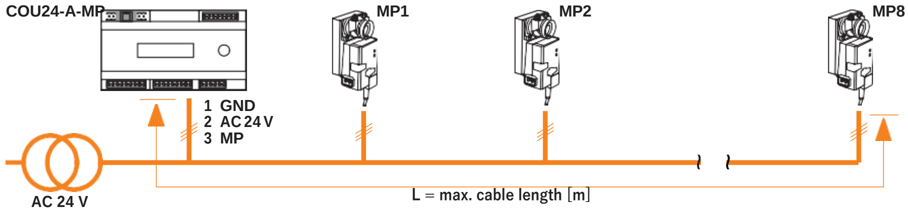


MP-Bus – cable lengths

The cable lengths (see calculation below) are limited by:

- The sum of the power rating of the connected VAV controllers, e.g. LMV-D2-MP 5 VA / 3 W
- The type of supply (AC 24 V or DC 24 V)
- The cable cross-section

MP-Bus cable length for AC 24 V supply via the bus cable



Calculation of the maximum cable lengths (AC 24 V)

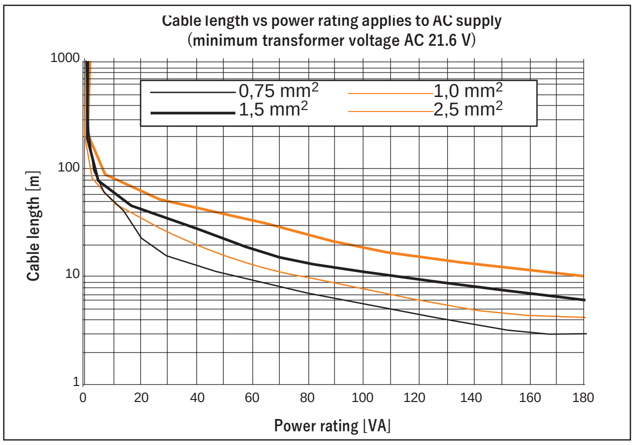
The power ratings (VA) of the connected NMVD2Ms or other MFT2 actuators must be added together. The corresponding cable lengths can then be read from the graph.

Example:

MP-Bus with 4x LMV-D2-MP
Total power rating: 4 x 5 VA = 20 VA
Values read from the graph:

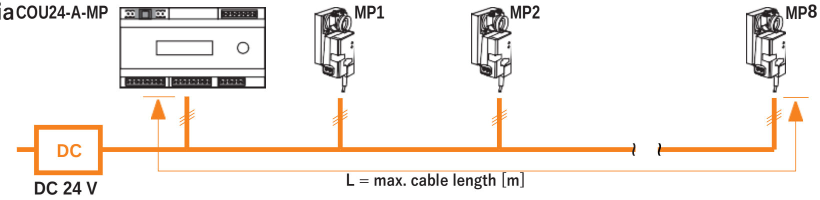
- Cable with wire Ø 0.75 mm²: max. cable length: 28 m
- Cable with wire Ø 1.0 mm²: max. cable length: 40 m
- Cable with wire Ø 1.5 mm²: max. cable length: 54 m
- Cable with wire Ø 2.5 mm²: max. cable length: 90 m

Total power rating of VAV controllers [VA]



Sizing of 24 V supply, wiring, topology, cable lengths *(continued)*

MP-Bus cable length for DC 24 V supply via the bus cable



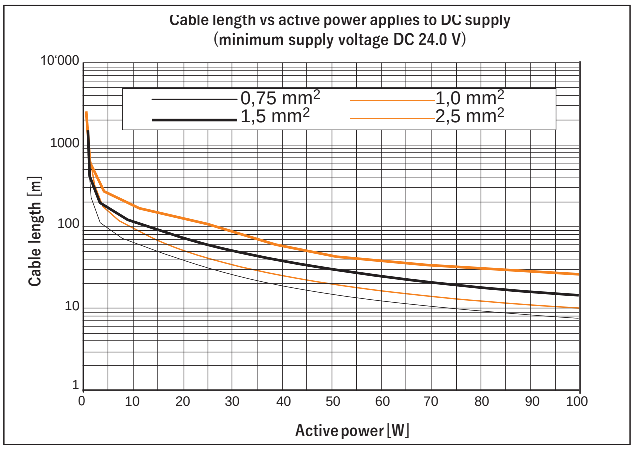
Calculation of the maximum cable lengths (DC 24 V)

The power consumptions [W] of the connected VAV controllers must be added together. The corresponding cable lengths can then be read from the graph.

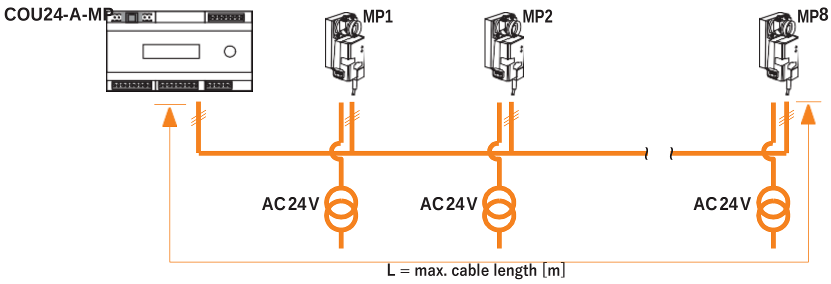
Example: MP-Bus with 4x LMV-D2-MP
Total power rating: 4 x 3 W = 12 W
Values read from the graph:

- Cable with wire Ø 0.75 mm²: max. cable length: 60 m
- Cable with wire Ø 1.0 mm²: max. cable length: 80 m
- Cable with wire Ø 1.5 mm²: max. cable length: 115 m
- Cable with wire Ø 2.5 mm²: max. cable length: 200 m

Total power rating of VAV controllers [W]



MP-Bus cable length for local AC 24 V supply



If the VAV controllers are supplied locally with AC 24 V via a separate transformer, the cable lengths can be significantly increased. The cable lengths indicated in the table apply regardless of the performance data of the connected actuators.

Maximum MP-Bus cable length for local AC 24 V supply

Wire Ø mm²	L = max. cable length [m]
0.75	800
1	
1.5	

Sizing of 24 V supply, wiring, topology, cable lengths *(continued)*

Input / output wiring

Override control input IN [0 ··· 10 V]

Max. cable length in an interference-free environment: 0.75 mm^2, max. 150 m
If necessary, the override control signals of several COU24-A-MPs can be controlled in parallel, e.g. with a common switch.

Cascade input CASC [0 ··· 10 V]

Max. cable length in an interference-free environment: 0.75 mm^2, max. 150 m

Frequency converter output FC [0 ··· 10 V]

Max. cable length in an interference-free environment: 0.75 mm^2, max. 100 m
Connection and cabling in accordance with details of frequency converter manufacturer, see page 9

Analogue controller wiring

Input IN [0 ··· 10 / 2 ··· 10 V]

Account must be taken of the total power rating and the installation guidelines for the connected room temperature controller when sizing the wiring!
Max. cable length in an interference-free environment: 0.75 mm^2, max. 150 m
If necessary, the IN inputs of several COU24-A-MPs can be controlled in parallel with a common control signal.
Application: Parallel control of the supply and exhaust air VAV units with a common room temperature controller.

Output OUT [0 ··· 10 / 2 ··· 10 V]

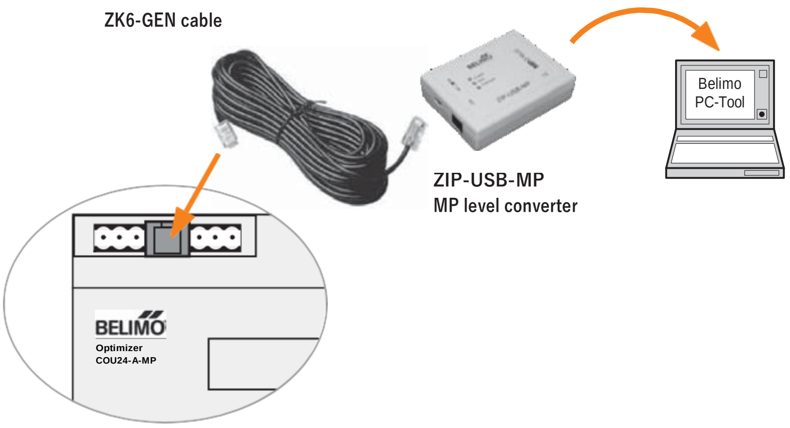
Max. cable length in an interference-free environment: 0.75 mm^2, max. 150 m

Tool connection

ZTH-VAV (ZEV) setting device
The ZTH-VAV/ZEV is not allowed to be connected to the RJ12 plug on the optimiser because it is only PP-capable (not MP).

As a result of the MP-Bus technology, the connected VAV controllers can be diagnosed and set quickly and easily with the Belimo PC-Tool.
A ZK6-GEN cable can be plugged onto the RJ12 and connected to a MP-Bus level converter for the Belimo PC-Tool.

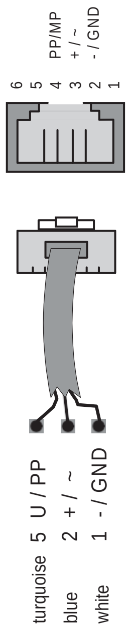
Connection with ZIP-USB-MP

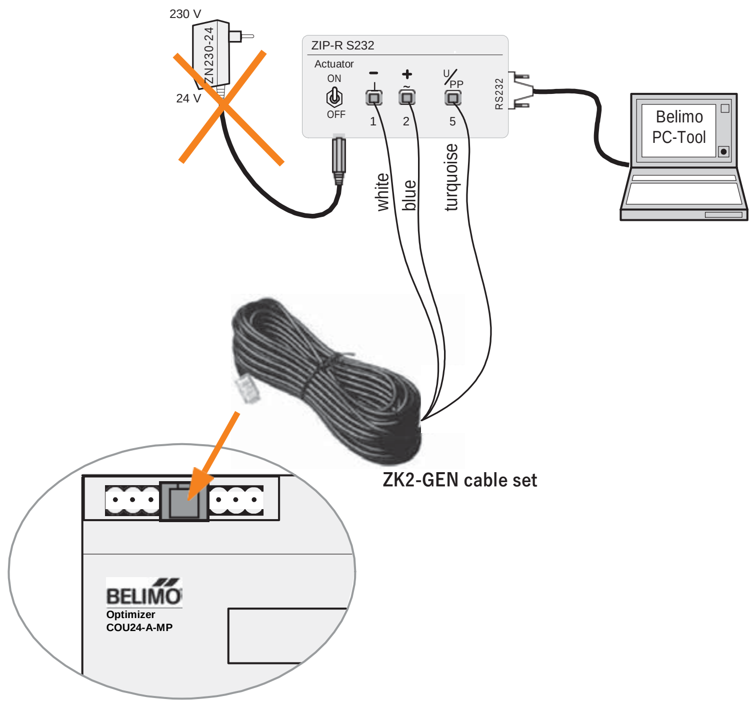


Connection to ZIP-RS232

The terminal assignment shown below must be used if a ZIP-RS232 level converter is connected. **Please note**: The ZIP-RS232 must not be supplied with 24 V in conjunction with the COU24-A-MP optimiser!

The COU24-A-MP optimiser is not allowed to be supplied via the RJ12 connection!





Principles behind application, limitations – examples

Application directory

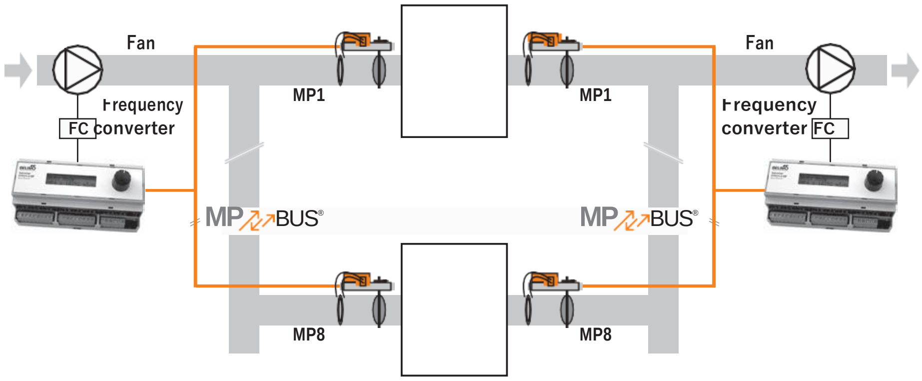
The applications shown below are examples of optimiser applications. The function, size and topology may vary depending on the options and system characteristics described in this document.

The following application examples with VAV-Compact can also be implemented using VRP-M and the standard actuator NM24A-V-ST.

Optimiser for supply and exhaust air systems

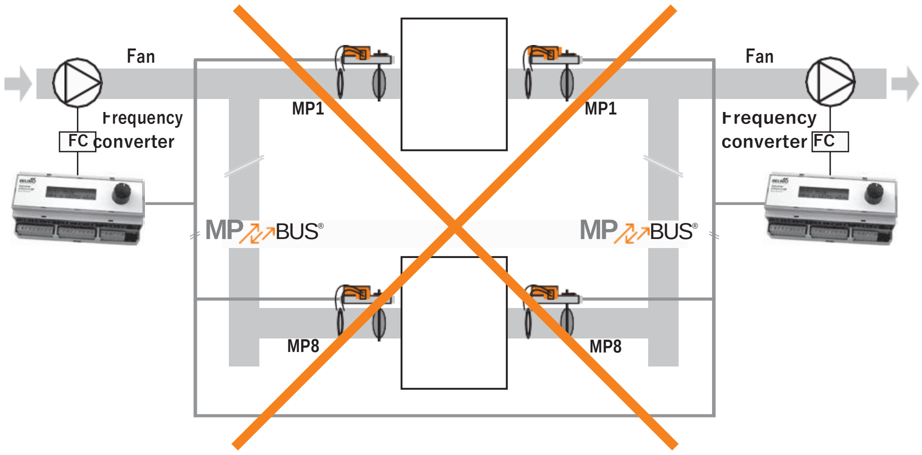
Independent operation

The supply and exhaust air system must be operated by two separately functioning optimisers.



Optimiser system with supply and exhaust air units on the same MP bus

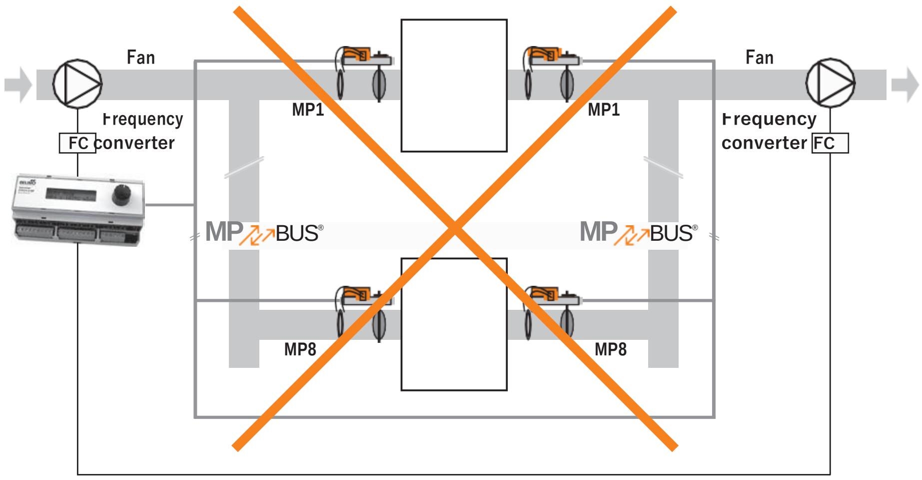
The MP bus must be separately managed for the supply and exhaust air system. The two lines **cannot** be connected.



Note
Merging the VAV controllers for the supply and exhaust air lines into one common MP line is not permitted!

Optimiser system with one optimiser for the supply and exhaust air fan

Controlling the supply and exhaust air fan using a common optimiser signal is **not permitted**.



Note
Parallel control of the supply and exhaust air fan with an optimiser is not permitted!

Interconnecting VAV controllers

Parallel or master slave connection

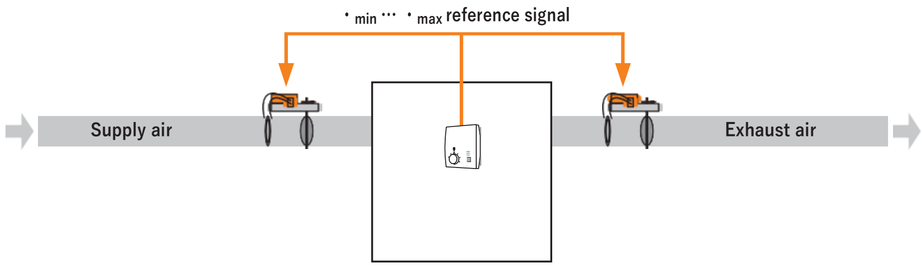
The setpoint signals for the SUPPLY and EXHAUST AIR VAV controller can be implemented in a VAV system as parallel or master-slave connections – also known as a sequential circuit.

Note
Parallel connections have proven to be easier to handle (ordering, parameter setting and wiring) than a master-slave connection.
To simplify the system concept of an optimiser system, we would therefore recommend connecting the reference signal of e.g. a room temperature sensor to the supply and exhaust air VAV controller in parallel.

Parallel connection

In the parallel connection, the reference signal $\dot{V}_{min}$ .... $\dot{V}_{max}$, for example from a room temperature controller 0 ... 10 V output signal, is connected in parallel to the supply and exhaust air controller.

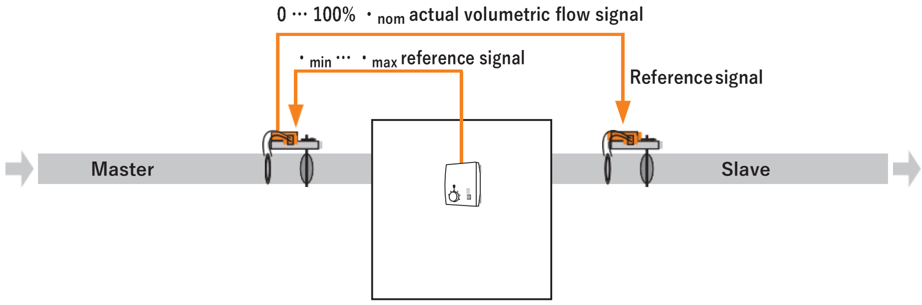
VAV controller setting	
Supply air unit	
$\dot{V}_{min}$	e.g. 250 m³/h
$\dot{V}_{max}$	e.g. 500 m³/h
Exhaust air unit	
$\dot{V}_{min}$	e.g. 250 m³/h
$\dot{V}_{max}$	e.g. 500 m³/h



Master-slave (M/S) connection

With a master-slave connection, the reference signal $\dot{V}_{min}$ .... $\dot{V}_{max}$, for example from a room temperature controller 0 ... 10 V output signal, is connected to the master controller. The resultant actual volumetric flow signal of the master controller is the reference signal of the slave controller.

Master unit	
$\dot{V}_{min}$	e.g. 250 m³/h
$\dot{V}_{max}$	e.g. 500 m³/h
Slave unit	
$\dot{V}_{min}$	0 m³/h
$\dot{V}_{max}$	$\dot{V}_{nom}$ of master unit!



Setpoint connection for an optimiser system

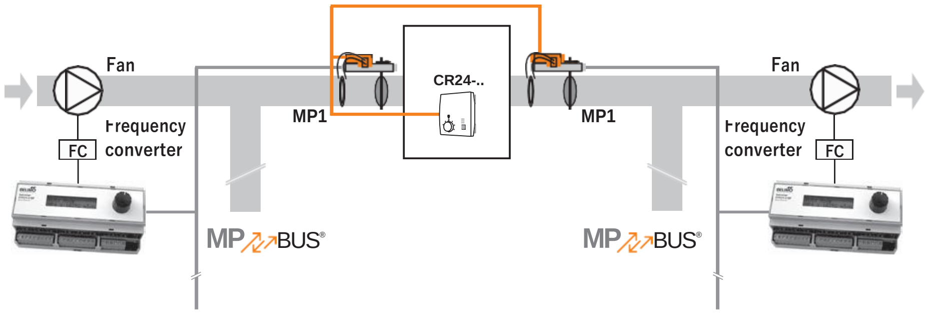
Principle

In principle, the setpoint connection for an optimiser system functions as previously described.
Depending on the application, the reference signal is
– connected directly to the VAV controller or
– connected directly to the optimiser and transferred to the VAV controller.
To simplify the system concept of an optimiser system, we would therefore recommend connecting e.g. the reference signal of a room temperature sensor to the supply and exhaust air VAV controller in parallel.
Master-slave connections are always possible but more complex.
The actual volumetric flow signal is available at the OUT terminal (terminals for analogue controller) as a 0 … 10 / 2 … 10 V analogue signal.

Setpoint connection to VAV controller – parallel connection of supply and exhaust air unit

When connecting the supply and exhaust air VAV unit in parallel, the reference signal is wired in parallel to the setpoint input of the two VAV control circuits.

Parallel connection: AiMP system solution with CR24-B..

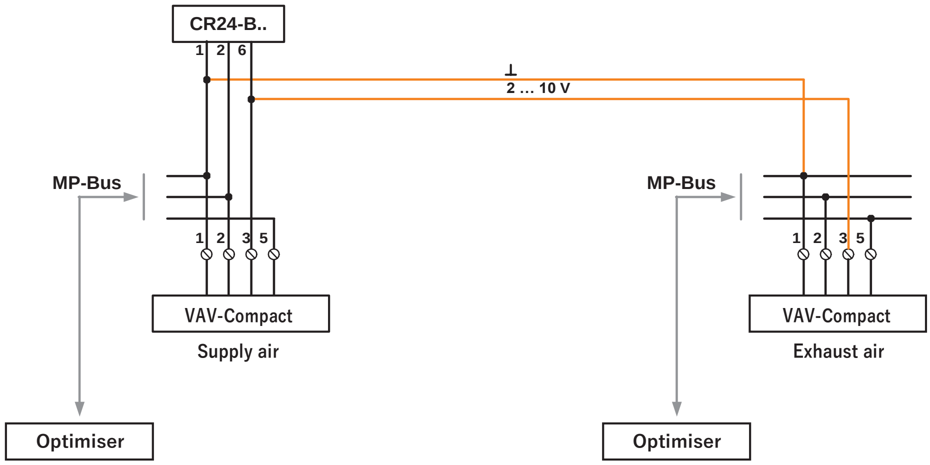


Setting for both optimisers	
COU24-A-MP	
Setpoint input	AiMP 2 … 10 V

VAV controller setting	
Supply and exhaust air unit	
min	according to room layout
max	

Note
The actual volumetric flow signal (OUT terminal – analogue controller) is available at the optimiser as an analogue signal, irrespective of the optimiser operating setting (setpoint input), incl. Controller MP operation.

Connection



Setpoint connection for an optimiser system *(continued)*

Setpoint connection to VAV controllers – master-slave connection of supply and exhaust air unit

When the supply and exhaust air VAV unit has a master-slave connection (M/S), the reference signal is wired to the master's setpoint input only (supply air or exhaust air unit). The resultant actual volumetric flow signal of the master controller is the reference signal for the slave controller.

> **Note**
> To simplify the system concept of an optimiser system, we would recommend connecting the reference signal of e.g. a room temperature sensor to the supply and exhaust air VAV controller in parallel.

Actual volumetric flow signal OUT

The actual volumetric flow signals of every connected VAV controller are available at the OUT terminals of the «Analogue controller» optimiser connections. This signal corresponds to the U5 signal e.g. of a Belimo VAV-Compact controller:
0 … 10 and/or 2 … 10 V correspond to 0 … 100% nominal volumetric flow.

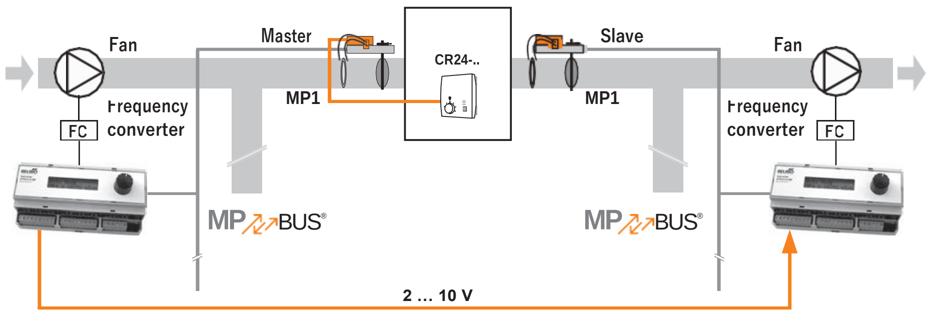
> **Note**
> The actual volumetric flow signal of the VAV control is available at the optimiser (OUT terminal – analogue controller).

Examples with 0 … 10 V mode:

– □$_{nom}$: 500 m^3/h
– Terminal 3 (MP1): 3.4 V
– the resultant volumetric flow is (500 / 10) * 3.4 = 170 m^3/hw

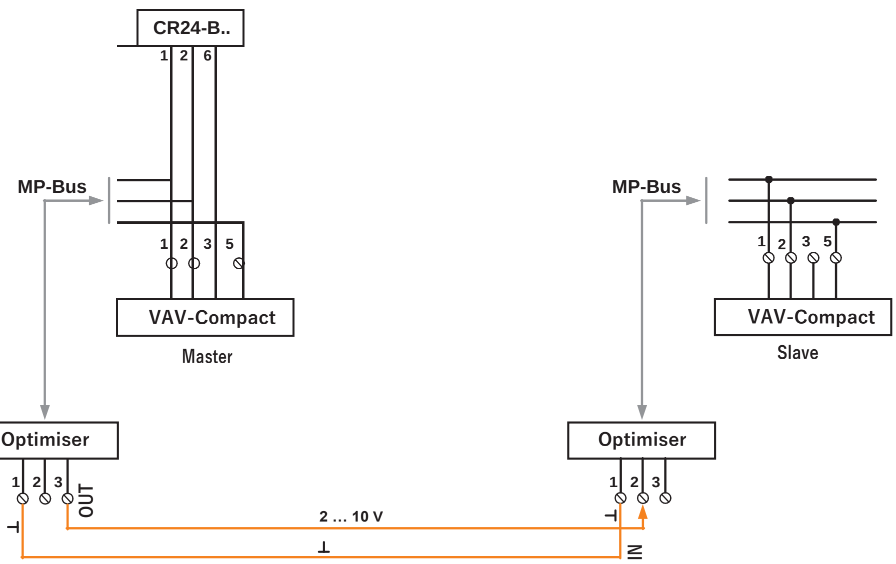
Master-slave circuit: AiMP system solution with CR24-B..

Setting for «master» optimiser	
COU24-A-MP	
Setpoint input	AiMP 2 … 10 V
Master unit	
Mode	2 … 10 V
□min	according to room layout
□max	



Setting for «slave» optimiser	
COU24-A-MP	
Setpoint input	Ain 2 … 10 V
Slave unit	
Mode	2 … 10 V
□min	0 m^3/s and/or l/s!
□max	□nom value of master unit!

Connection

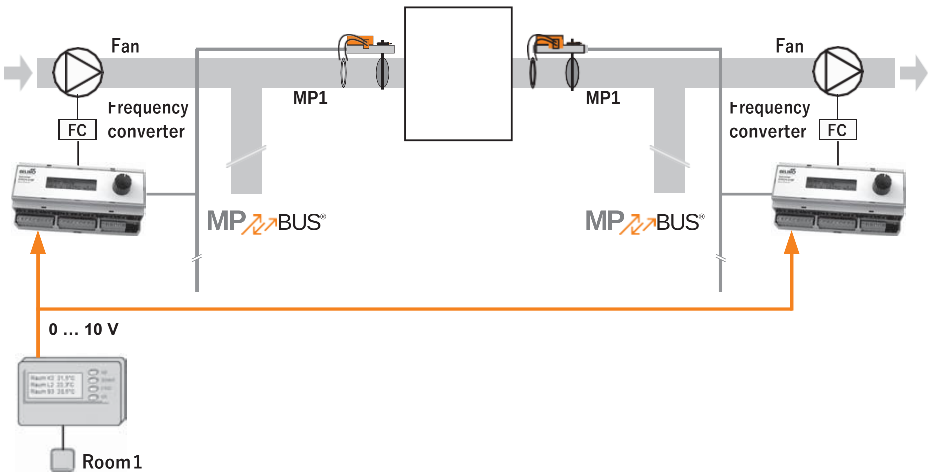


Setpoint connection for an optimiser system *(continued)*

Setpoint connection to optimiser – parallel connection of supply and exhaust air unit

When connecting the supply and exhaust air VAV unit in parallel, the reference signal is wired in parallel to the two setpoint inputs of the supply and exhaust air optimiser. The setpoint is converted into an MP command by the optimiser and sent to the corresponding VAV controller.

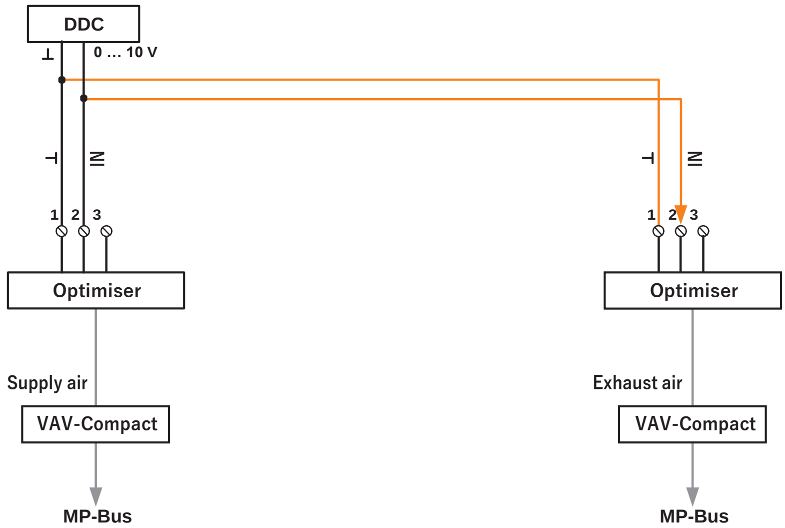
Parallel connection: Ain – 0 ··· 10 V connection via optimiser input



Setting for both optimisers	
COU24-A-MP	
Setpoint input	Ain 0 … 10 V

VAV controller setting	
Supply and exhaust air unit	
Mode	0 … 10 V
□min	according to room layout
□max	

Connection



Setpoint connection for an optimiser system *(continued)*

Setpoint connection to optimiser – master-slave connection of supply and exhaust air unit

When the supply and exhaust air VAV unit has a master-slave connection (M/S), the reference signal is connected only to the optimiser's setpoint input to which the master is connected (supply air or exhaust air unit). The resultant actual volumetric flow signal of the master controller, tapped at the OUT terminal of the «master optimiser», is the reference signal for the slave controller.

Note
To simplify the system concept of an optimiser system, we would recommend connecting the reference signal in parallel.

Note
The actual volumetric flow signal of the VAV control is available at the optimiser (OUT terminal – analogue controller).

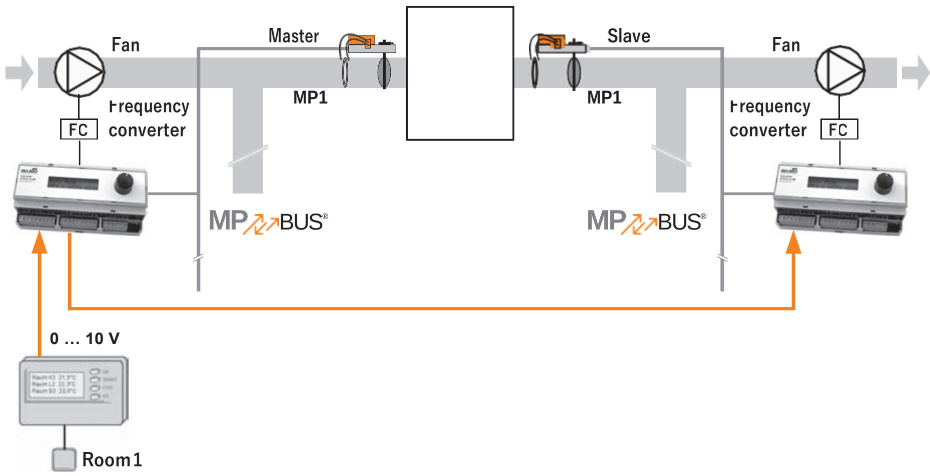
Actual volumetric flow signal OUT

The actual volumetric flow signals of every connected VAV controller are available at the OUT terminals of the «Analogue controller» optimiser connections. This signal corresponds to the U5 signal e.g. of a Belimo VAV-Compact controller:
0 … 10 and/or 2 … 10 V correspond to 0 … 100% nominal volumetric flow.

Examples with 0 … 10 V mode:

– $\square_{nom}$: 700 m^3/h
– Terminal 3 (MP1): 5.0 V
– the resultant volumetric flow is (700 / 10) * 5.0 = 350 m^3/h

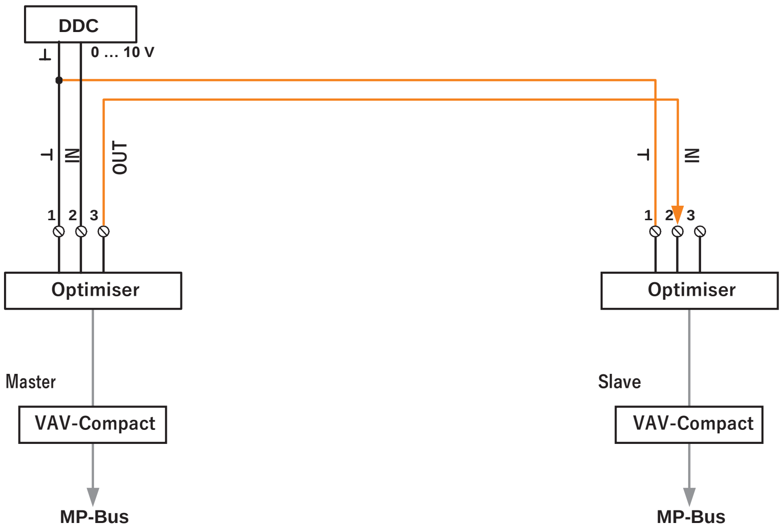
Master-slave circuit: Ain – 0 … 10 V connection via optimiser input



Setting for «master» optimiser	
COU24-A-MP	
Setpoint input	Ain 0 … 10 V
VAV-Compact	
Mode	0 … 10 V
$\square_{min}$	according to room layout
$\square_{max}$	

Setting for «slave» optimiser	
COU24-A-MP	
Setpoint input	Ain 0 … 10 V
VAV-Compact	
Mode	0 … 10 V
$\square_{min}$	0 m^3/s and/or l/s!
$\square_{max}$	$\square_{nom}$ value of master unit!

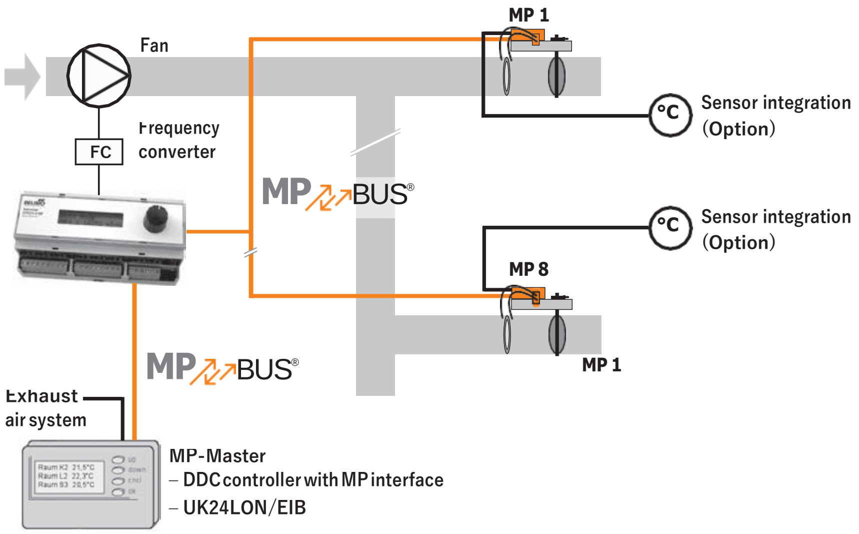
Connection



Setpoint connection for an optimiser system (continued)

Setpoint connection of an MP master (DDC with MP interface or UK24LON/EIB)

With an MP master system, the setpoints for the VAV controllers and the link between the supply and exhaust air systems is generated by the corresponding MP master (DDC or UK24LON/EIB).



Setting	
COU24-A-MP	
Setpoint input	MP
VAV-Compact	
Mode	2 … 10 V / 0 … 10 V
$\dot{V}_{min}$	according to room layout
$\dot{V}_{max}$	

MP master – sensor integration
The «sensor integration» function available with an MP bus system is also available to an optimiser with a connected MP master.

The optimiser has two MP interfaces:
- Controller MP
- Actuator MP

The MP master communicates with the MP slave (VAV controllers) via the optimiser. All data points of the VAV controller integrated in the MP master are available.
The optimiser makes a copy of the relevant data of the connected VAV controllers. If data that are not managed in the copy are requested, the optimiser forwards the corresponding commands to the addressed VAV controller.

In this operating mode, the frequency converter is controlled by the optimiser. If additional control or safety functions are planned, these must be given appropriate consideration (see planning, protective equipment on page 9+10).

Interconnection or mixed mode of different control systems

The setting for the setpoint input (configuration ¦ 3 setpoint input) applies to all eight connected control circuits of an optimiser.
Mixed mode using e.g. a DDC controller with a 0 … 10 V output and a room controller with a 2 … 10 V output on a shared optimiser is not therefore possible.

Workaround:

using two optimisers and connecting with the cascade function.
– Optimiser 1 for DDC 0 … 10 V
– Optimiser 2 for room controller 2 … 10 V

See optimiser cascade function on page 37

Limitation – clean room systems with fans controlled by optimiser?

Notes

The start-up behaviour of an optimiser system may impact on the operating behaviour of a clean room!
The start-up behaviour of the optimiser cannot be changed.
(Power-up behaviour: Damper actuator: adaptation, frequency converter output: 1.0 V).

The range of applications of the optimiser is defined as variable and constant air volume systems in the comfort room ventilation area. These applications focus on comfort and operating costs (energy saving).

Operating costs are certainly also an issue in clean room systems, however the priorities are clearly directed towards maintaining the necessary room conditions (positive pressure in the room).
Using the optimiser in a clean room system is definitely outside the application area defined and approved by Belimo for the fan optimiser, namely the comfort room ventilation area. This means application is clearly subject to the responsibility of the person(s) in charge of project planning and project implementation.

Limitation – optimiser for quick-running VAV applications

Notes

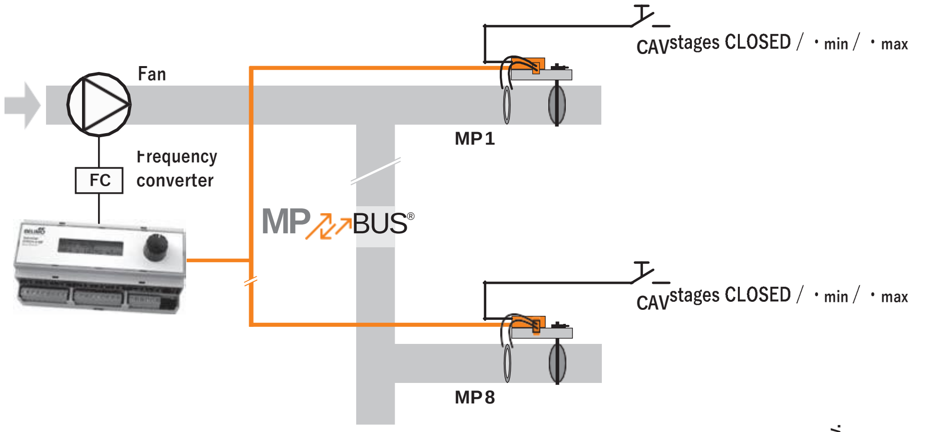
The VRP-M must **not** be operated in combination with the fast-running actuators:
– NMQB24-SRV-ST
– LMQ24A-SRV-ST
– NMQB24-SRV-ST
on fan optimiser COU24-A-MP!

The applications described in this document can also always be realised using the VRP-M system solution, but only when VRP-M is combined with a standard actuator NM24A-V-ST.
Using fast-running VAV solutions in optimiser systems is not permitted!

System	Function, Control	Connection	Type
CAV	Local step control, CLOSED / $\dot{V}_{min}$ / $\dot{V}_{max}$	to VAV-Compact	AiMP

Connection to VAV-Compact Type: AiMP

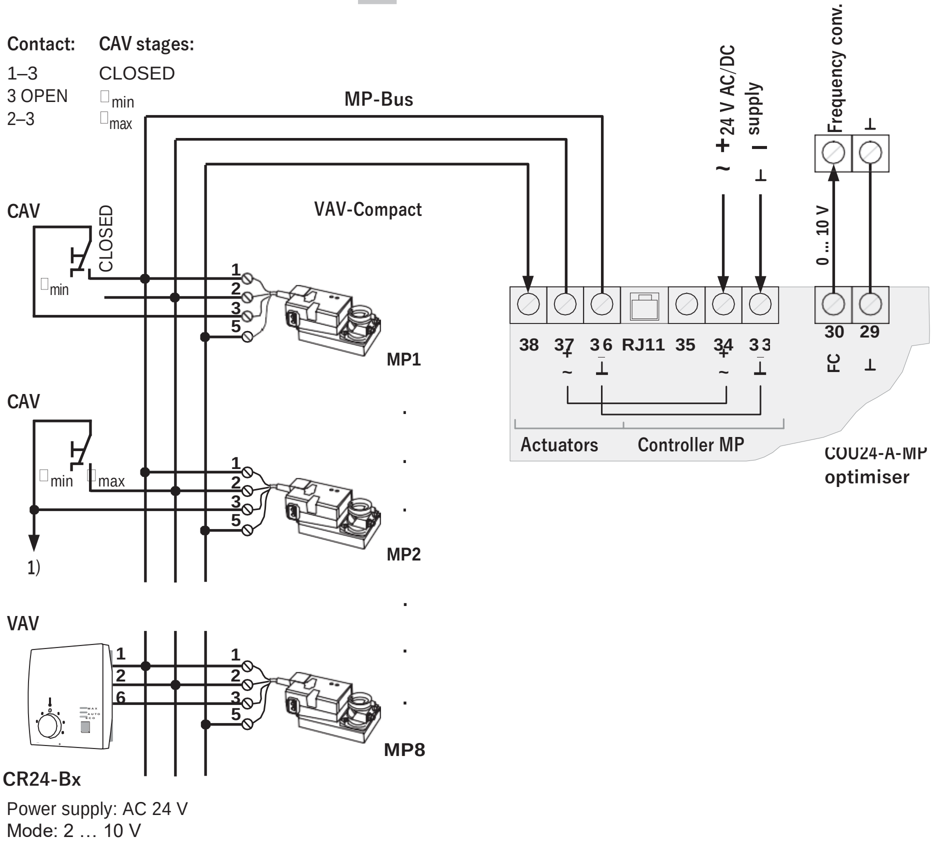
The CAV step control CLOSED / $\dot{V}_{min}$ / $\dot{V}_{max}$ is connected directly to the VAV controller and controls the volumetric flow to the step required, e.g. depending on room occupancy. The optimiser records the damper position and regulates the fan performance using the 0 … 10 V frequency converter output.



Connection and setting

COU24-A-MP	
Setpoint input	AiMP 2 … 10 V

VAV-Compact	
Mode	2 … 10 V
CAV function	NMV-D2M comp.



Can be combined with AiMP CR24 integration

VAV-Compact	
Mode	2 … 10 V

Restrictions

– OPEN damper and $\dot{V}_{mid}$ intermediate position are not available!
– When combining with CR24, a 24 V DC supply is not possible!

Application note

1) Supply and exhaust air system combination:
Parallel wiring of the VAV-Compact connection 3 (Y) to the exhaust air VAV-Compact. For example see page 31

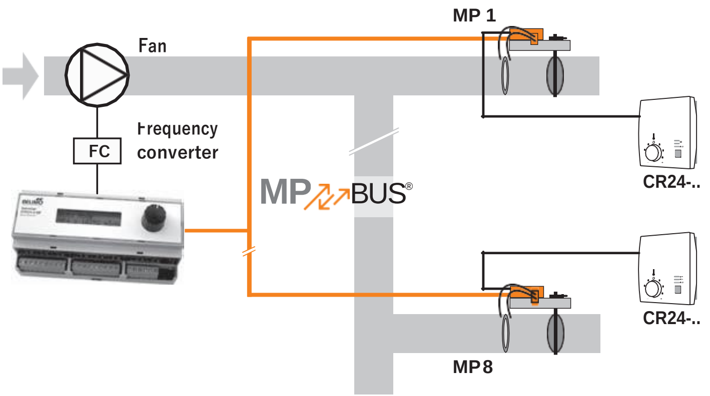
In systems with more than 8 VAV controllers, several optimisers can be interconnected via a cascade function.

System	Function, Control	Connection	Type
VAV	CR24 room temperature controller, CLOSED / $\square_{min} \dots \square_{max}$	to VAV-Compact	AiMP

Connection to VAV-Compact
Type: AiMP

The CR24-B.. room temperature controller is connected directly to the VAV controller and manages the volumetric flow in the $\square_{min} \dots \square_{max}$ range.
As an option, the room solution can be connected using
- energy hold off,
- stand-by
- boost mode or
- summer/winter compensation.

The optimiser records the demand for ventilation via the damper position and regulates the fan performance using the 0 … 10 V frequency output.

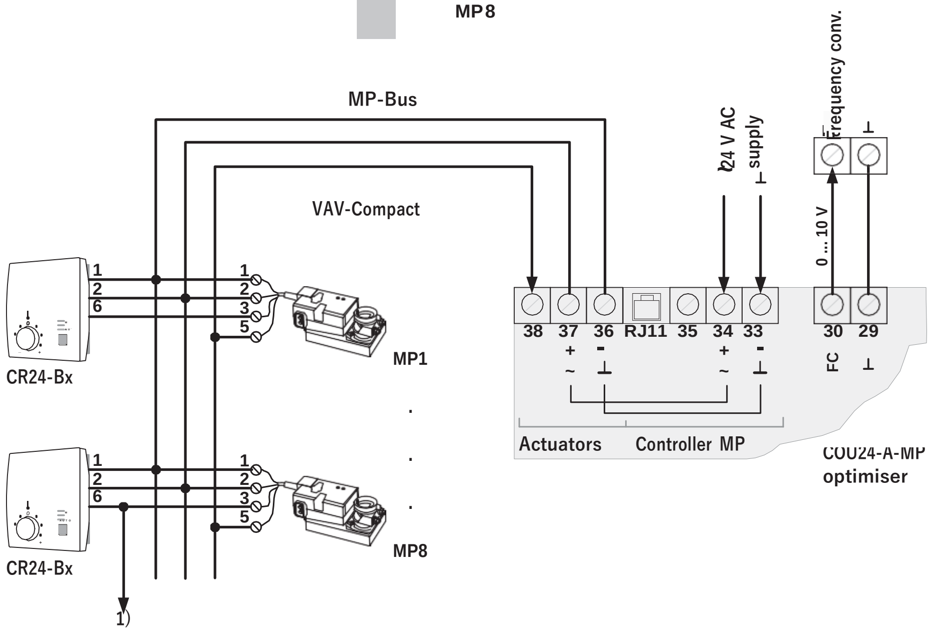


Connection and setting

COU24-A-MP	
Setpoint input	AiMP 2 … 10 V

VAV-Compact	
Mode	2 … 10 V

Note
CR24 needs a 24 V AC supply.



Application note

1) Supply and exhaust air system combination:
Parallel wiring of the VAV-Compact connection 3 (Y) to the exhaust air VAV-Compact. For example see page 31

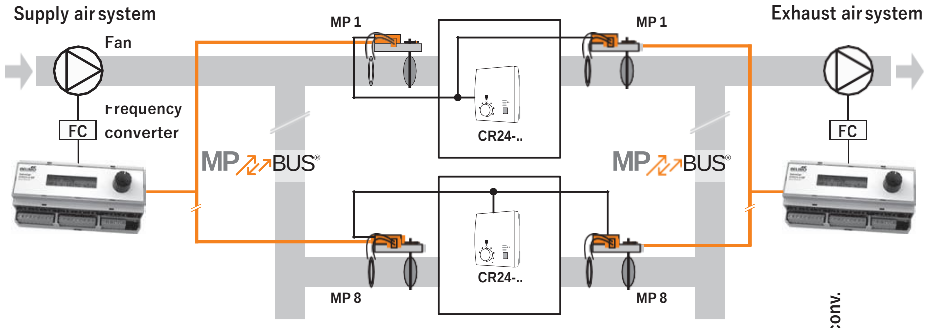
In systems with more than 8 VAV controllers, several optimisers can be interconnected via a cascade function.

System	Function, Control	Connection	Type
VAV parallel connection	CR24 room temp. controller, CLOSED / $\dot{V}_{min}$ … $\dot{V}_{max}$	to VAV-Compact	AiMP

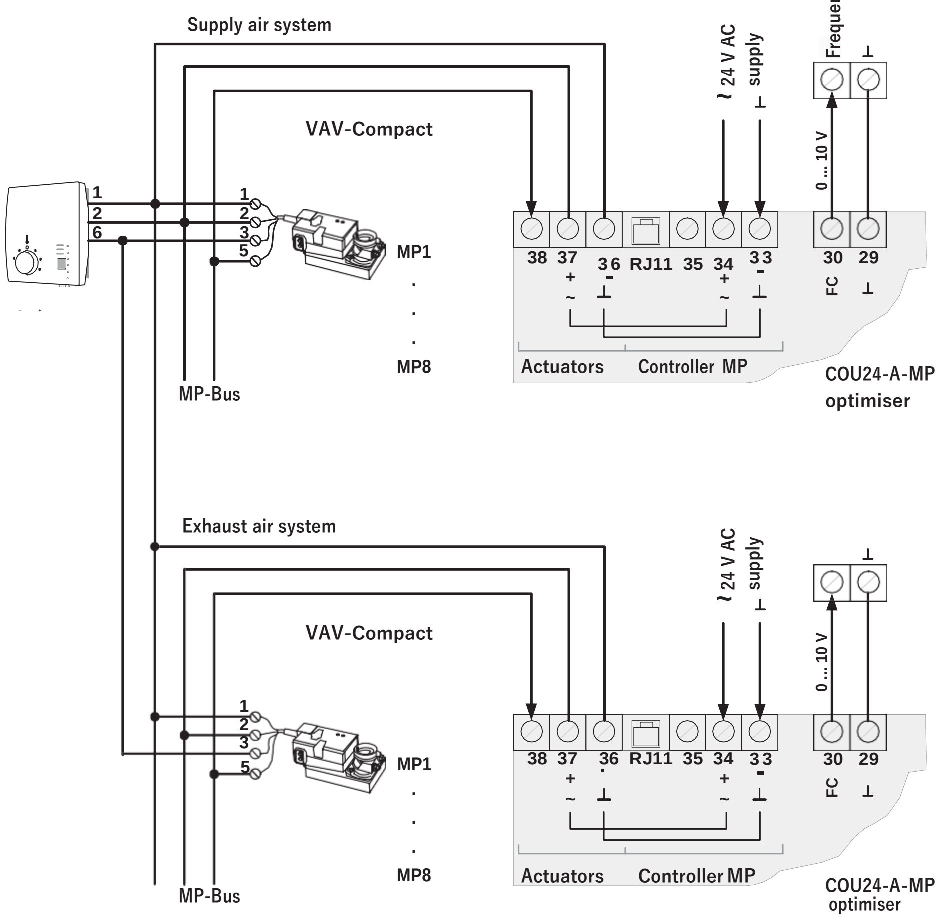
Connection to VAV-Compact
Type: AiMP

The CR24-B.. room temperature controller is connected directly to the VAV controller and manages the volumetric flow in the $\dot{V}_{min}$ … $\dot{V}_{max}$ range.
As an option, the room solution can be connected using
– energy hold off,
– stand-by
– boost mode or
– summer/winter compensation.

The optimiser records the demand for ventilation via the damper position and regulates the fan performance using the 0 … 10 V frequency output.



Connection and setting



Optimiser supply air	
COU24-A-MP	
Setpoint input	AiMP 2 … 10 V

VAV-Compact	
Mode	2 … 10 V

Optimiser exhaust air	
COU24-A-MP	
Setpoint input	AiMP 2 … 10 V

VAV-Compact	
Mode	2 … 10 V

Note
CR24 needs a 24 V AC supply.

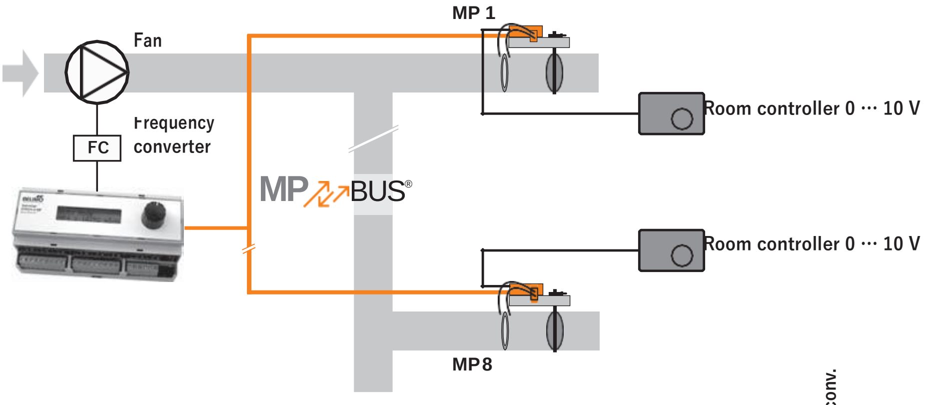
Application note

In systems with more than 8 VAV controllers, several optimisers can be interconnected via a cascade function.

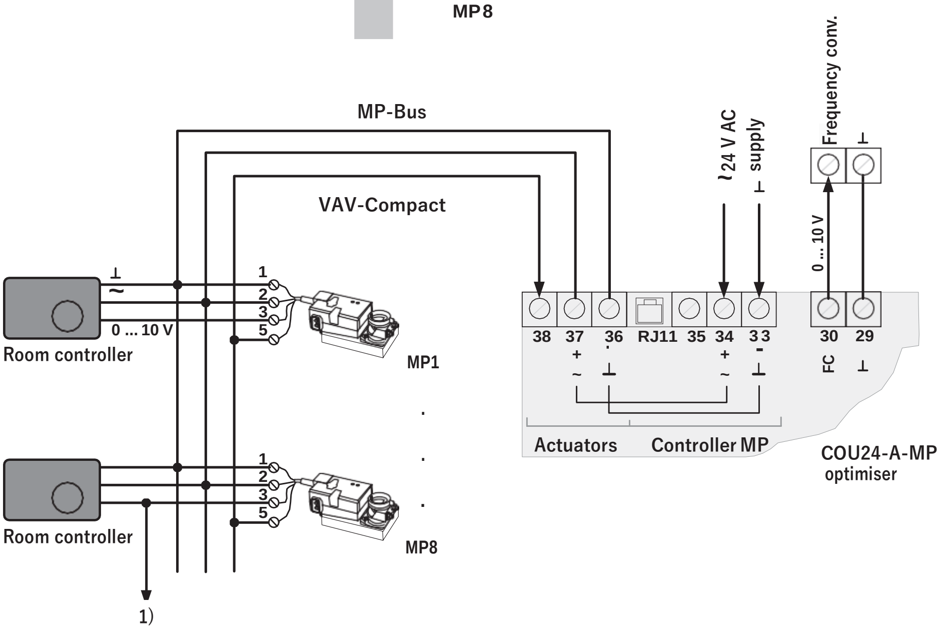
System	Function, Control	Connection	Type
VAV	0 ... 10 V room temperature controller, • min ··· • max	to VAV-Compact	AiMP

Connection to VAV-Compact
Type: AiMP

The room controller with a 0 … 10 V output is connected directly to the VAV controller and manages the volumetric flow in the □min … □max range.
The optimiser records the demand for ventilation via the damper position and regulates the fan performance using the 0 … 10 V frequency output.



Connection and setting



COU24-A-MP	
Setpoint input	AiMP 0 … 10 V

VAV-Compact	
Mode	0 … 10 V

Note
Room controller connection in accordance with manufacturer's documents.

Application note

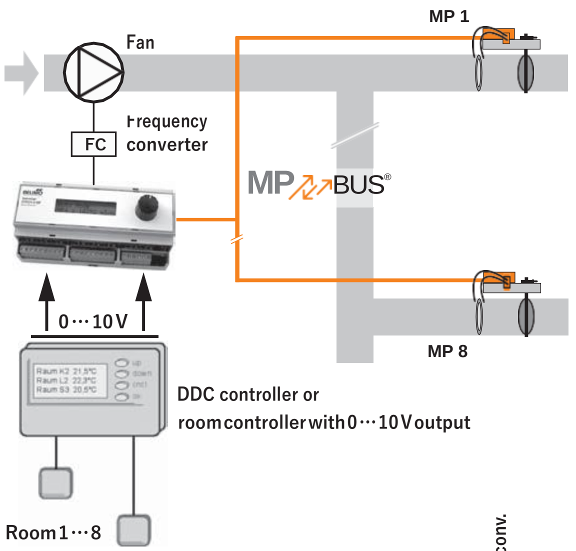
1) Supply and exhaust air system combination:
Parallel wiring of the VAV-Compact connection 3 (Y) to the exhaust air VAV-Compact. For example see page 31

In systems with more than 8 VAV controllers, several optimisers can be interconnected via a cascade function.

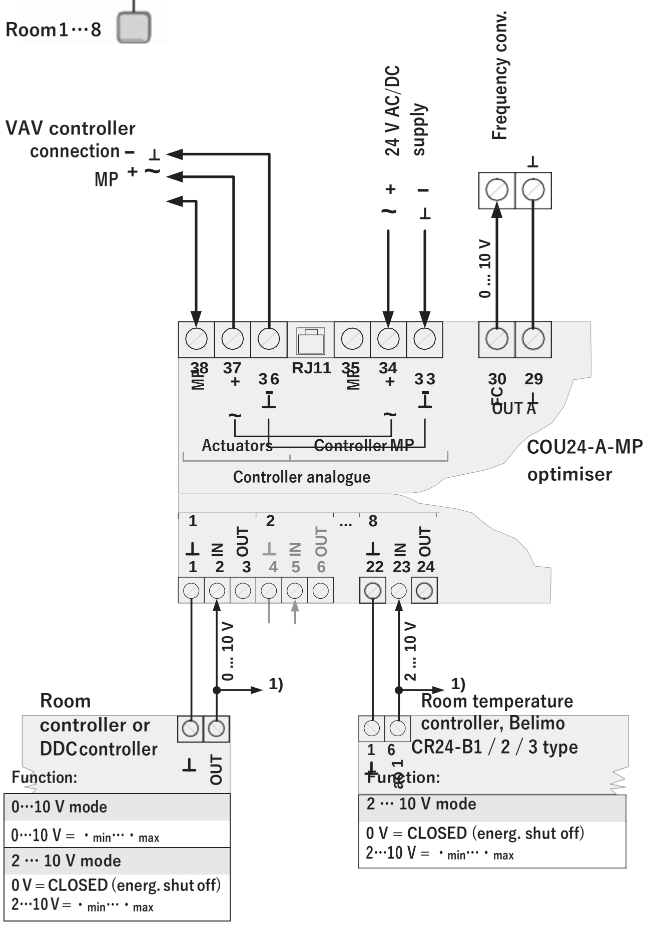
System	Function, Control	Connection	Type
VAV	0 … 10 V DDC / room temperature controller, $\dot{V}_{min} \dots \dot{V}_{max}$	Optimiser analogue input	Ain

Connection to optimiser analogue input
Type: Ain

The 0 … 10 / 2 … 10 V demand signals of a DDC or individual room controllers are wired to the optimiser and manage the volumetric flow in the $\dot{V}_{min} \dots \dot{V}_{max}$ range.
By connecting the optimiser input (2 … 10 V mode), the damper can be shut off with a 0 V signal.
The optimiser records the demand for ventilation via the damper position and regulates the fan performance using the 0 … 10 V frequency output.



Connection and setting



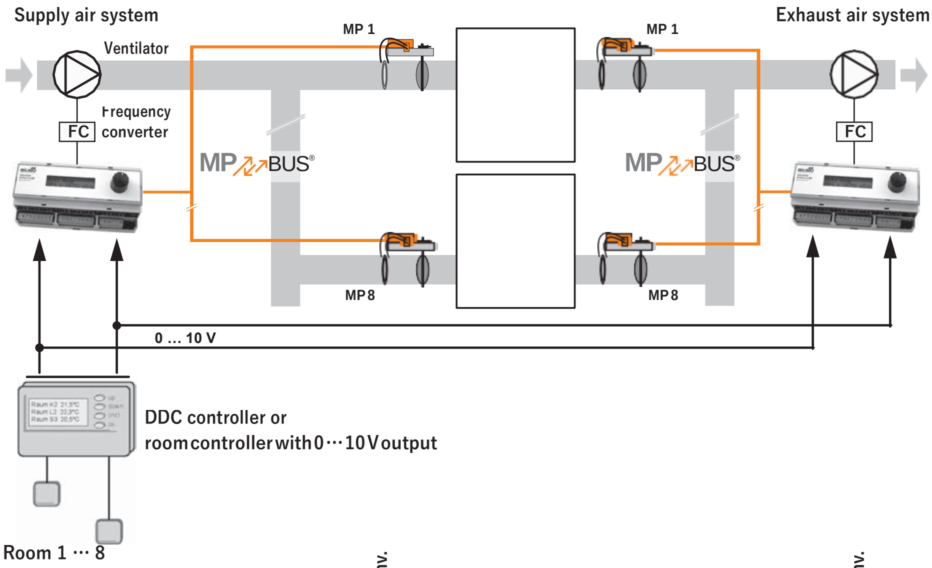
Function: $\dot{V}_{min} \dots \dot{V}_{max}$	
COU24-A-MP	
Setpoint input	Ain 0 … 10 V

Function: CLOSED / $\dot{V}_{min} \dots \dot{V}_{max}$	
COU24-A-MP	
Setpoint input	Ain 2 … 10 V

System	Function, Control	Connection	Type
VAV parallel connection	0 ... 10 V DDC / room temp. controller, · $_{min}$ ··· · $_{max}$	Optimiser analogue input	Ain

Connection to optimiser analogue input
Type: Ain

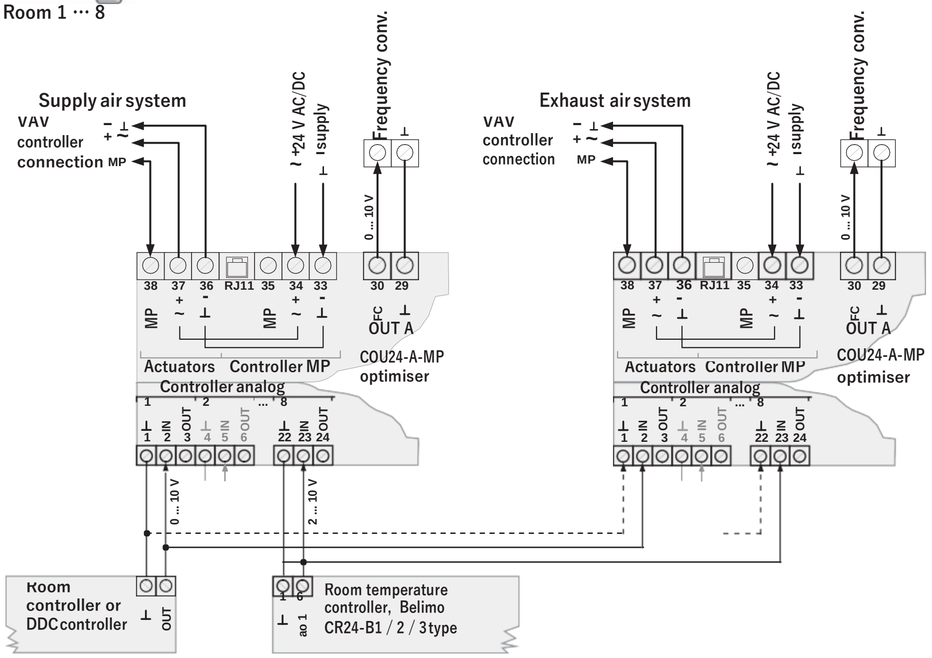
The demand signals of a DDC or individual room controllers are wired as 0 … 10 V signals to the optimiser and manage the volumetric flow in the □$_{min}$ … □$_{max}$ range.
The optimiser records the demand for ventilation via the damper position and regulates the fan performance using the 0 … 10 V frequency output.



Connection and setting

Function: · $_{min}$ ··· · $_{max}$	
COU24-A-MP	
Setpoint input	Ain 0 … 10 V

Function: CLOSED / · $_{min}$ ··· · $_{max}$	
COU24-A-MP	
Setpoint input	Ain 2 … 10 V



Function:

0···10 V mode
0···10 V = · $_{min}$··· · $_{max}$
2 ··· 10 V mode
0 V = CLOSED (energ. shut off) 2···10 V = · $_{min}$··· · $_{max}$

Function:

2 ··· 10 V mode
0 V = CLOSED (energ. shut off) 2···10 V = · $_{min}$··· · $_{max}$

Application note In systems with more than 8 VAV controllers, several optimisers can be interconnected via a cascade function.

System	Function, Control	Connection	Type
VAV	Optimiser with DDC as MP master	Optimiser controller MP	MP

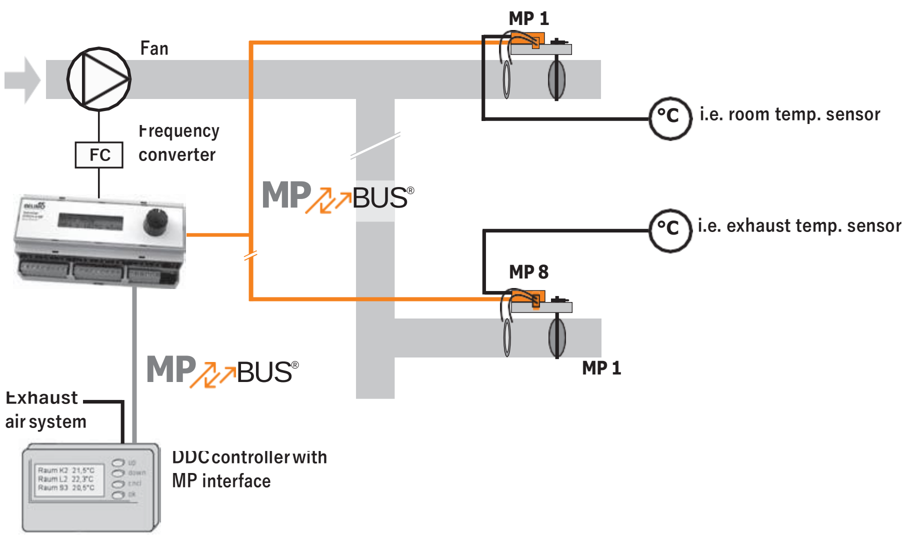
Connection to optimiser controller MP
Type: MP

The reference signal for the VAV controllers is transfered from the DDC controller – acting as the MP master – via the MP bus to the VAV-Compact.

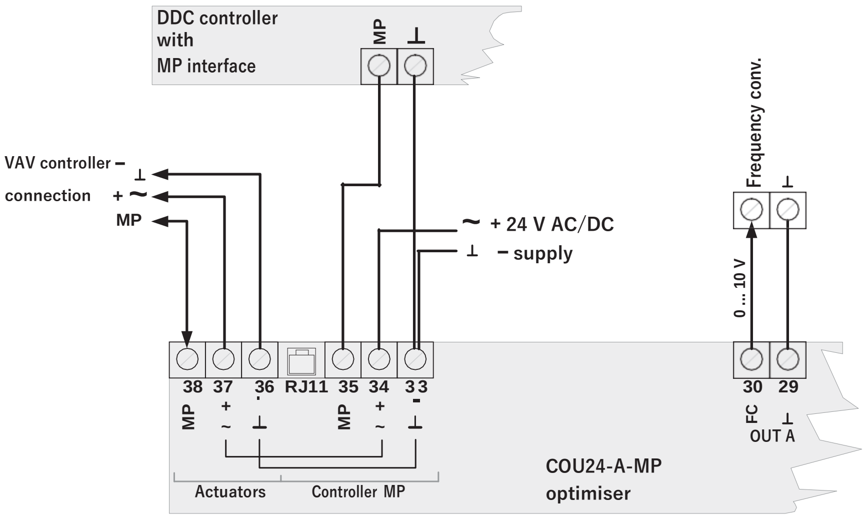
Via the optimiser, all data relating to the

- VAV controller (actual value, $\square_{min}$, $\square_{max}$, etc.)
- sensor integration (switch, sensor) are available.

Regardless of the DDC integration, the optimiser records the damper position of the VAV units and regulates the fan performance using the 0 … 10 V frequency converter output.



Connection and setting



COU24-A-MP	
Setpoint input	MP

Application note

Supply and exhaust air system combination:

- the exhaust air system is managed using a separate optimiser circuit.
- the supply / exhaust air system is linked in the DDC control system.

In systems with more than 8 VAV controllers, several optimisers can be interconnected via a cascade function.

System	Function, Control	Connection	Type
VAV	Optimiser with UK24LON/EIB as MP master	Optimiser controller MP	MP

Connection to optimiser controller MP
Type: MP

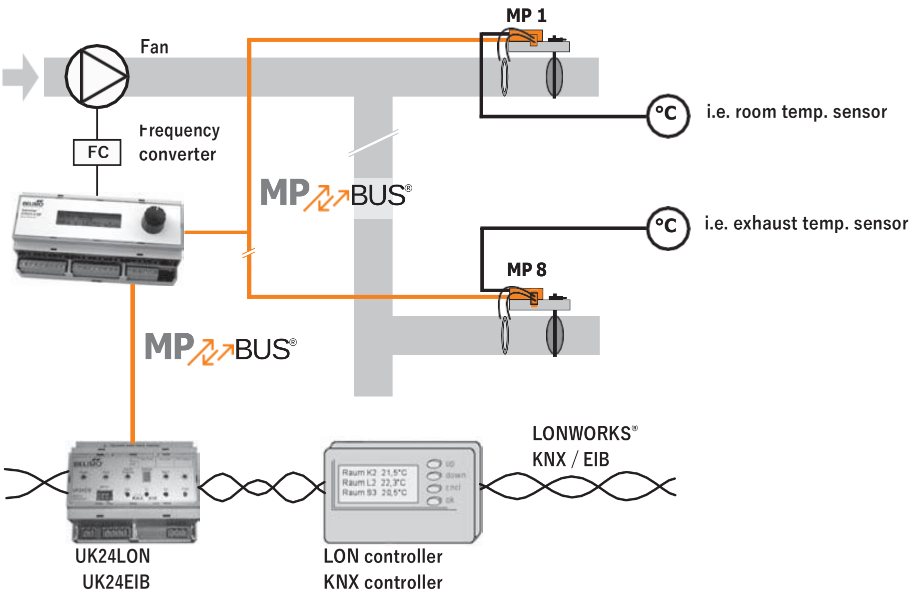
The reference signal for the VAV controllers is transfered from the UK24LON – acting as the MP master – via the MP bus to the VAV-Compact.

Via UK24LON, all data relating to the two profiles
– damper actuator object #8110
– sensor open loop object #1 are available.

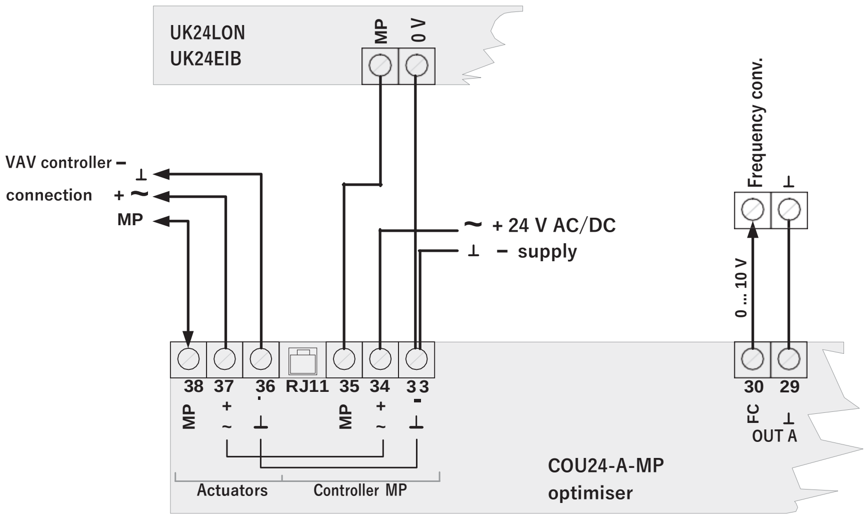
Regardless of the LON integration, the optimiser records the damper position and regulates the fan performance using the 0 … 10 V frequency converter output.

EIB/Konnex applications

The same functionality as when using the EIB/KNX gateway UK24EIB is available for this application.



Connection and setting



Note
The optimiser does not need an MP address.

COU24-A-MP	
Setpoint input	MP

Application note

Supply and exhaust air system combination:
– the exhaust air system is managed using a separate optimiser circuit.
– the supply / exhaust air system is linked in the superordinate LON and/or Konnex control system.

In systems with more than 8 VAV controllers, several optimisers can be interconnected via a cascade function.

System	Function, Control	Connection	Type
VAV	Optimiser with cascade connection	CASC/FC terminals	AiMP/Ain/MP

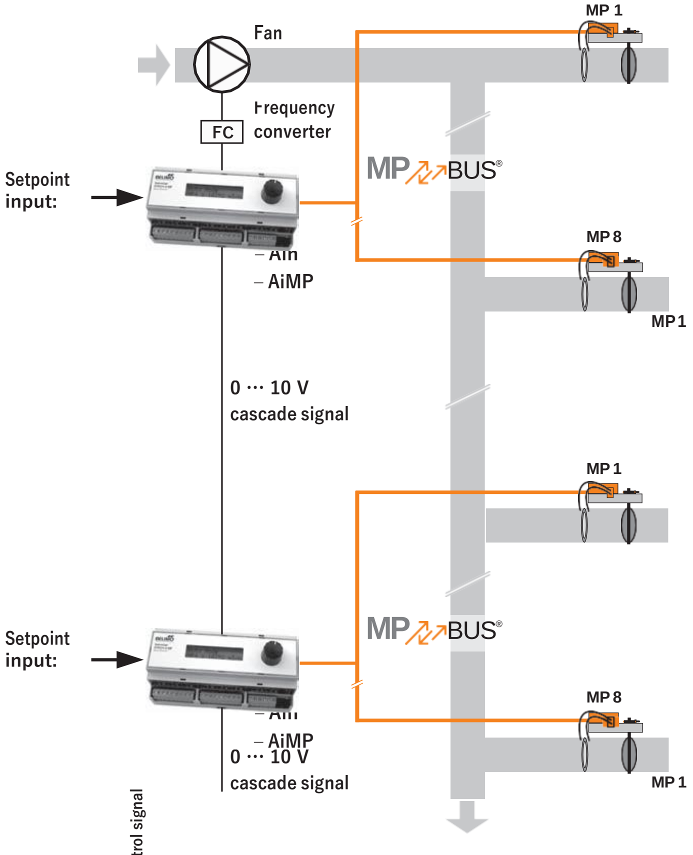
Connection to CASC/FC terminals
Type: AiMP / Ain / MP

If the system is so large that several optimisers have to be used, these are connected via the 0 … 10 V cascade signal. The cascade connection is used by the connected optimiser to transfer the demand signals.

Setpoint setting 1) in cascade function

All applications and/or setpoint input settings can be operated in a cascade connection.

Even mixed systems, e.g.
- optimiser 1: AiMP
- optimiser 2: Ain are permitted

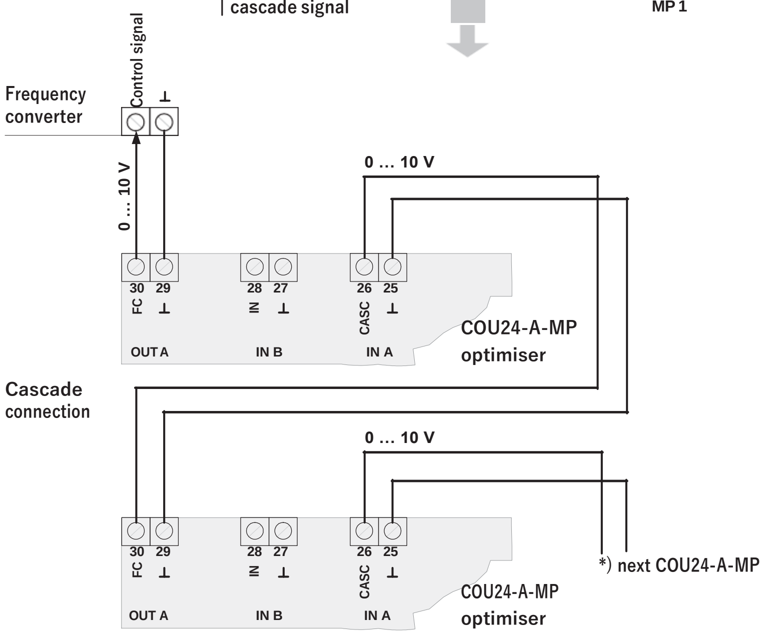


Cascade connection and setting

First optimiser with frequency converter connection	
COU24-A-MP	
Setpoint input	1)
Cascade	ON

··· other optimisers ···	
COU24-A-MP	
Setpoint input	1)
Cascade	ON

··· last optimiser	
COU24-A-MP	
Setpoint input	1)
Cascade	OFF



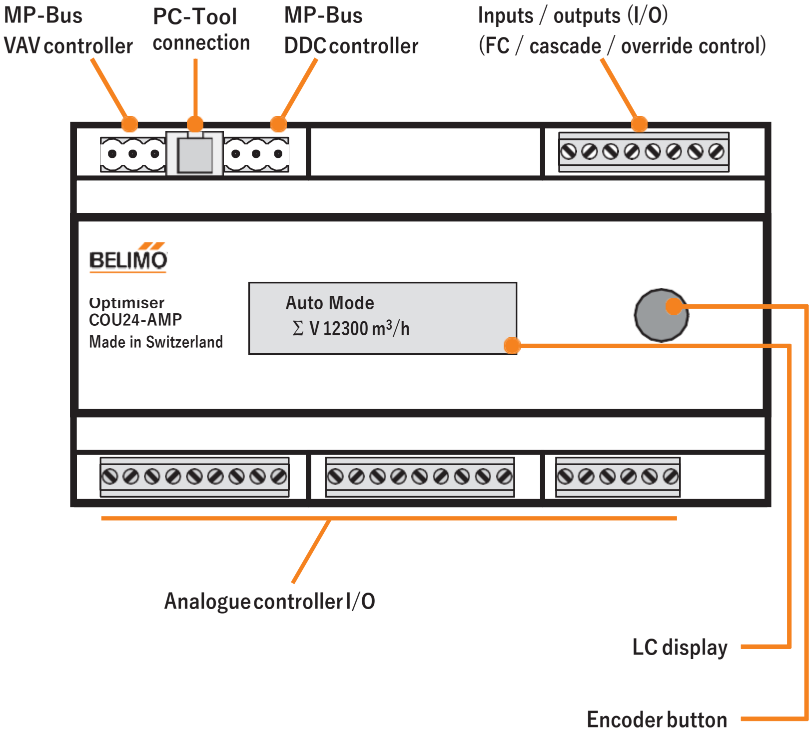
Restrictions The supply and exhaust air system cannot be connected using the cascade function!

Application note Supply and exhaust air system combination: For examples see page 23

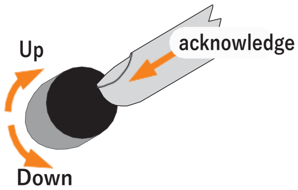
Optimiser operation

The operating elements of the COU24-A-MP are an encoder button and a 2-line LC display.

Operating controls and indicators



Principle of the encoder button

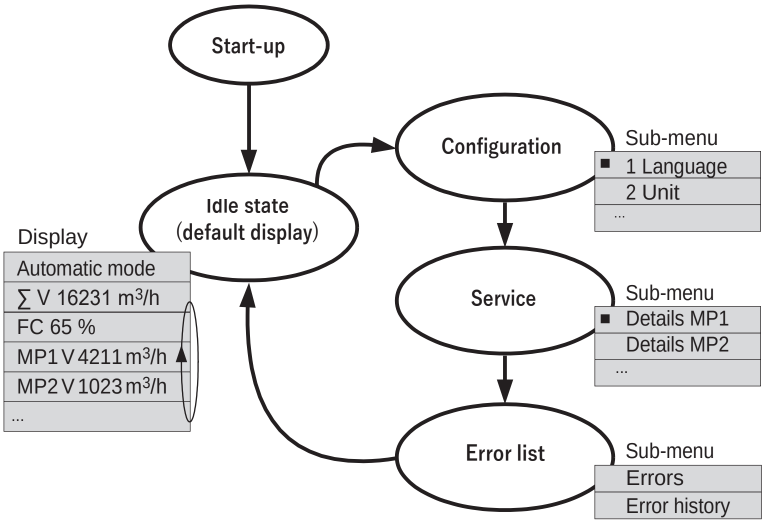


The encoder button on the COU24-A-MP has three functions:
– Adjust and select (up / down)
– Confirm (acknowledge)

Symbol on LCD		Meaning
	– Display: – Actions:	Current position (cursor) Select the current position by acknowledging (pressing) the encoder button, e.g. select a sub-meu
▲	Scrollbar:	Show more menu options (up)
▼	Scrollbar:	Show more menu options (down)
▶	Action:	Edit a field / value with down, e.g. decrement the value
◀	Action:	Edit a field / value with up, e.g. increment the value

Optimiser operation *(continued)*

Menu structure



Function	Menu options	Meaning
Start-up	Device start after power ON	
	OPTIMISER **Startup**	System start-up display
	HW version: Rev ... **SW version:**	Shows the version numbers
	PowerOn-adaption **Σ V**	1 Power ON adaption active 2 Topology data is read from the MP-Bus
	Auto mode **Σ V**	2 Topology data is read from the MP-Bus
Idle state	Automatic / manual operation	
	Auto mode **Σ V xxxxxx m3/h** **FC xx %** **MP1 V xxxxxx m³/h** **MP...** **MP8 V xxxxxx m³/h** **Σ V xxxxxx m³/h** **...**	1 Automatic or manual operation Optimiser operating status 2 Alternating display: ∑V xxxxxx m³/h Total volumetric flow FC xx % Frequency converter / cascade output signal MPxV xxxxxx m³/h Volume of MP1 ... 8 ∑V xxxxxx m³/h Total volumetric flow ...
Idle state	MP device status messages	
	2 **MP1 V -**	2 [-] MP address #1 does not exist on MP-Bus
	2 **MP3 V ...**	2 [...] Reading MP device #3
	2 **MP!8 V xxxxxx m³/h**	2 [!] MP device #8 error

Optimiser operation *(continued)*

Function	Menu options	Meaning

Configuration Show and set operating parameters

1 Language

Language

Active English	Active language setting
new German	German
new English	English

2 Units

Unit

Unit m³/h	Active setting
New l/s	l/s
New m³/h	m³/h

3 Setpoint Input

Setpoint Input

SPI Auto (Ain) – Active setpoint input setting
New Automatic – Sets the setpoint input to the «Auto-detect» function
New Manual MP – Sets the setpoint input for the MP controller (DDC with MP interface)

New Manual Ain – Sets the setpoint input to the analogue input
- └▶ Next
  - └▶ All AIs ON 1)
    - └▶ OK
      - └▶ Change
        - └▶ Next
          - └▶ AI range xxx
          - └▶ New 0-10V Setting for room controller with 0 … 10 V = □min … □max
          - └▶ New 2-10V Setting for CR24-B... with 0/2 … 10 V = CLOSED / □min … □max

All AIs OFF1)	All AIs deactivated
All AIs ON	All AIs activated
AI1 ON / OFF	AIs switched ON/OFF individ.

New Manual AiMP – Sets the setpoint input for signal connection via VAV-Compact
- └▶ NextNext
  - └▶ All AIs ON 1)
    - └▶ OK
      - └▶ Change
        - └▶ Next
          - └▶ AI range xxx
          - └▶ New 0-10V Setting for CAV / room controller with 0 … 10 V = □min … □max
          - └▶ New 2-10V Setting for CAV / CR24-B... 0/2 … 10 V = CLOSED / □min … □max

All AIs OFF	Deactivates all AIs
All AIs ON	Activates all AIs
AI1 ON / OFF	Switches AIs ON/OFF individ.

SPI Auto – Setpoint input «Auto-detect» function
If this setting is activated, the optimiser automatically detects whether a PC-Tool or a DDC with an MP interface is connected.

SPI Auto (Ain)/(MP) – Detection result: (Ain) = Analogue control
(MP) = PC-Tool or MP master

SPI Manual (···) – This setting sets the input to a function that cannot be changed. If **SPI Manual** is set, it is not possible to use the RJ12 connection (PC-Tool connection).
Exception: **Manual MP**

4 Actuators
5 Application
6 Freq. Converter
7 Cascade Link
8 Manual Mode
9 Set Defaults
10 Advanced

Note
All settings other than those in sub-menu 8 (Manual Mode) are stored. They are not lost even if the power supply fails

1) This option can be used to activate or deactivate either one or all analogue inputs.

Optimiser operation *(continued)*

Function	Menu options	Meaning
1 Language 2 Unit 3 Setpoint Input		
4 Actuators	**Actuators**	The MP-Bus topology is read
	MP1 Present	A device with the address MP1 has been detected
	MP2 Present	Ditto for MP2
	└▶ 00xxxxxxxxxxxxxx	Shows the serial number of MP2
	└▶ De-address MP2	De-addresses the device with the address MP2 (the address is reset to PP)
	MP3 ···	
	···	
	MP6 ···	
	MP7 Not Present	MP7 does not exist
	MP8 Not Present	Ditto for MP8
	└▶ Press MP8	The VAV contr. is addressed with the address button
	└▶ Press	The VAV controller is set to MP8 by pressing the address button
	└▶ SerNoMP8	The VAV controller is addressed by means of the serial number
	└▶ SerNoMP2Enter	The serial number of the required VAV controller for MP8 must be entered. The serial number is printed on every VAV controller.
5 Application	**Application**	
	VAV Application	Active optimiser application
	New PosCtrl Ap	Positions control (application not included in this documentation)
	New VAV Appl	VAV application – fan optimiser
	Next	
	└▶ **Min/Max MP1**	MP1 – □min / □max setting
	└▶ Minimum MP1	MP1 – □min
	xxx m³/h	Change MP1 – □min
	└▶ Maximum MP1	MP1 – □max
	xxx m³/h	Change MP1 – □max
	└▶ OK	Apply setting
	└▶ Min/Max MP2	
	└▶ Min/Max MP3	
6 Freq. Converter	**Freq. Converter**	**Note:** The frequency converter reference signal can be limited by specifying a minimum value (Set FC Min) for mixed applications with mechanical air volume controllers.
	Range 0.0-10.0V	*Operating range defined for the frequency converter output*
	Set FC Min	Minimum limit for the output signal
	Set FC Max	Maximum limit for the output signal
7 Cascade	**Cascade**	
	Cascade OFF	*Active cascade input setting*
	Enable Link	Activates the cascade input
	Disable Link	Deactivates the cascade input
8 Manual 9 Defaults 10 Advanced		

Optimiser operation *(continued)*

Function	Menu options	Meaning

Show operating data

- Details MP1
- ...
- Details MP 8
- FC / Cascade

Detail MPx

- MPx V xxxxx m3/h	(Actual volumetric flow)
- Position xx %	(Damper angle)
- Vmin xxxxx m^3/h	(□$_{min}$ setting)
- Vmax xxxxx m^3/h	(□$_{max}$ setting)

FC / Cascade

- FC xx,x V	(Frequency converter output)
- Cascade xx,x V	(Cascade input)
- FC min xx,x V	(Output limit)
- FC max xx,x V	(Max. output limit)

Show error list

- Errors
- Error History

Error List	Shows all active errors. Active errors are checked by the optimiser cyclically, cleared automatically and entered in the error history list.
Errors	
└▶ MP1 OK	VAV controller MP1 – no active errors
└▶ MP…	
└▶ MP2 error 10	VAV controller MP2 – error 10 active
└▶ MP8 OK └▶ (not applicable)	A VAV controller with the address MP8 does not exist on the MP-Bus
Error History	Shows the 10 most recent messages
└▶ 1	Newest message
└▶ …	
└▶ 10	Oldest message The error history list contains up to 10 messages. If an eleventh message occurs, the oldest message is deleted.
└▶ Clear history	The history list is cleared

Errors Errors are displayed with a numeric code. Refer to the VAV-Compact Product Information for a detailed description.

Error condition	Errors (error codes) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Stop & go ratio > 20%	■		■		■		■		■		■		■		■
2 Setting range too large		■	■			■	■			■	■			■	■
4 Overload, set position not reached				■	■	■	■					■	■	■	■
8 Mechanical overload								■	■	■	■	■	■	■	■

Example: Display shows MP2 error 10

Error condition	Errors (error codes) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Stop & go ratio > 20%	■		■		■		■		■		■		■		■
2 Setting range too large		■	■			■	■			■	■			■	■
4 Overload, set position not reached				■	■	■	■					■	■	■	■
8 Mechanical overload								■	■	■	■	■	■	■	■

MP-Bus – VAV controller addresses

The MP-Bus is the Belimo master/slave bus. Up to 8 slaves (VAV-Compact NMV-D2M, L/N/SMV-D2-MP or VRP-M controllers) can be connected to an MP master device such as the COU24-A-MP. Each MP slave must be assigned a unique MP address between MP1 to MP8 before it can be operated on the MP-Bus.
Belimo VAV controllers are set to PP (point-to-point) addressing on delivery. PP is the required conventional control setting for CAV/VAV functions with 0 … 10 / 2 … 10 V signals.

Pre-addressing with Belimo PC-Tool V3.1

VAV controllers can be pre-addressed with the PC-Tool (address / de-address device). Pre-addressed VAV controllers are automatically detected and read as soon as they are connected to the COU24-A-MP optimiser.

Addressing with COU24-A-MP

The COU24-A-MP optimiser has two addressing functions:
– Address assignment with the address pushbutton
– Address assignment with the serial number.
It also has a de-addressing function for resetting to PP.

Addressing with DDC as MP master
The connected VAV controllers cannot be addressed / de-addressed using the optimiser if the optimiser setpoint input is set to SPI Auto (MP) or SPI Manual (MP).
Display: «Optimiser is not Address-Master!»
The VAV controllers must be addressed on the MP master in this application.

Address assignment with the address pushbutton

Menu option: Configuration ¦ 4 Actuators
This menu option causes the MP-Bus topology to be read (Find actuators…) and displayed:

Display	*Meaning*
MP1 found	Device with the address MP1 found
MP2 not found	Device with the address MP2 not found
MP…	

Procedure
a) MP2 not present — *Select*
– Press MP2 — *Select*
– SerNoMP2
b) Press the address pushbutton on the VAV controller
– Display: MP2 successful
This function can also be used to change the address of a VAV controller easily.

Address assignment with the serial number

Menu option: Configuration ¦ 4 Actuators
This menu option causes the MP-Bus topology to be read (Find actuators…) and displayed:

Display	*Meaning*
MP1 present	Device with the address MP1 found
MP2 not present	Device with the address MP2 not found
MP…	

Procedure
a) MP2 not present — *Select*
– Press MP2
– SerNoMP2 — *Select*
b) SerNoMP2Enter — *Select*
– Display: ………………..
– SerNoMP2 — ▶0◀
c) Enter the serial number (sticker on the VAV controller)
(Select the number with left / right and press to confirm) e.g: 0054810027146142
d) Set Addr MP2 — *Select*

Commissioning

Prerequisites

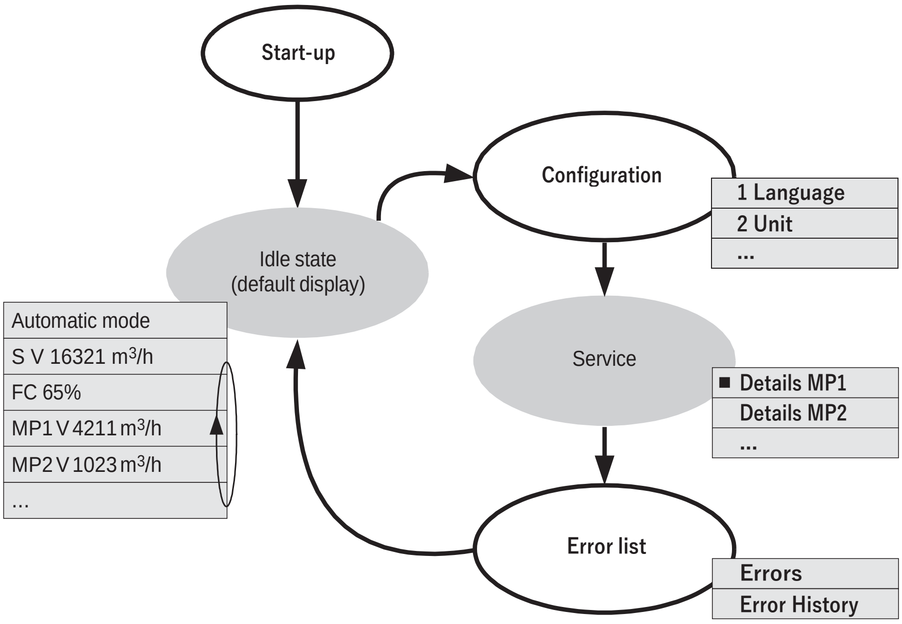
Check the installation and connections of all components
- MCR system, incl. switchgear assembly (control cabinet)
- Frequency converter and fans, incl. protective equipment
- Fire control system (enabling, fire dampers)
- VAV units, incl. room control CAV units, incl. step control
  If analogue control is selected, make sure that the signals of the DDC / room controllers are present at the appropriate terminals (controller analogue - MPx = terminal group x).
- Electrical commissioning of the above components and system assemblies
- Commissioning and functional checking of the above components and system assemblies

Checking, and if necessary modifying, the parameter settings of the COU24-A-MP optimiser

Select the [Configuration] menu
- Language and unit — Check, and if necessary set
- Setpoint input — Check, and if necessary adjust to 0 … 10 or 2 … 10 V analogue signal
- Actuators — Assign MP addresses according to topology
- Application — Check, and if necessary set to VAV
- Freq. Converter — Check, and if necessary set signal limit
- Cascade — Cascade function required? If so, select ON
- Manual — Check, and if necessary set to automatic

Functional check on the optimiser display

Functional check on the optimiser display



Optimiser manual mode
(Menu: Configuration ¦ 8 Manual)
When the system is powered down, the settings entered in the Manual menu are reset to automatic.

Optimiser power up behaviour
The power ON adaption starts automatically when the 24 V supply is switched on. The frequency converter output is set to 10% for the duration of this process and cannot be changed.

Changing the operating volumetric flow setting $\dot{V}_{min}$ / $\dot{V}_{max}$ on the VAV controllers
(Menu: Configuration ¦ 5 Application)
Confirm the VAV application, then scroll down. Select the MP address, then check and if necessary modify the $\dot{V}_{min}$ / $\dot{V}_{max}$ settings.

VAV controller settings – using PC-Tool

Apart from assigning the MP address, no settings are necessary on the VAV controllers. The controllers are calibrated and set to the appropriate system values by the manufacturer of the VAV / CAV units.

VAV-Compact L/NMV-D2M / VRP-M system solution
The on-board service socket is not available when these devices are operated on the MP-Bus.
Procedure:
– Disconnect the devices from the MP-Bus (MP connection)
– Connect the PC-Tool

The VAV controllers can be addressed, and the $\square_{min}$ / $\square_{max}$ operating volumetric flow settings checked and corrected, directly on the optimiser. The Belimo PC-Tool can be used for all other settings. It can be connected either locally on the VAV-Compact controller or directly on the optimiser.

PC-Tool connection

a) On the optimiser (RJ12)
   – The setpoint input must be set to Manual MP.
   – Access to all 8 MP devices.
   – The setpoint input must then be reset to the correct setting.

Note
The optimiser and the fan regulator are not impaired by an MP-Bus failure!

b) On the VAV-Compact L/N/SMV-D2-MP / LHV-D2-MP
   If the PC-Tool is connected locally to the service socket of the VAV-Compact, it can be used to set this MP device. No other MP devices can be accessed.

c) On the L/NMV-D2M / VRP-M controller
   Please note: The service socket on the VAV controller cannot be used while the system is operating (bus collision).
   The VAV controller must first be disconnected from the MP-Bus. This is possible either on the VAV controller itself or at the optimiser MP connection. If the VAV controller is disconnected at the MP connection on the optimiser, all 8 MP devices can be accessed.

Available functions

– Show / adjust parameters
  All parameters of the connected VAV controller can be read, written and logged.

– Simulation / Setpoint-actual value / Trend function
  If a Tool influences the VAV controller that is connected to the optimiser, operation of this optimiser may be impaired, e.g. if the pre-selected operating mode or setpoint is overridden during operation. This does not constitute a Tool or VAV controller malfunction. In this case, the display can be very difficult to interpret. For this reason, it is advisable to refrain from activating the simulation function with the PC-Tool while the optimiser is operating.

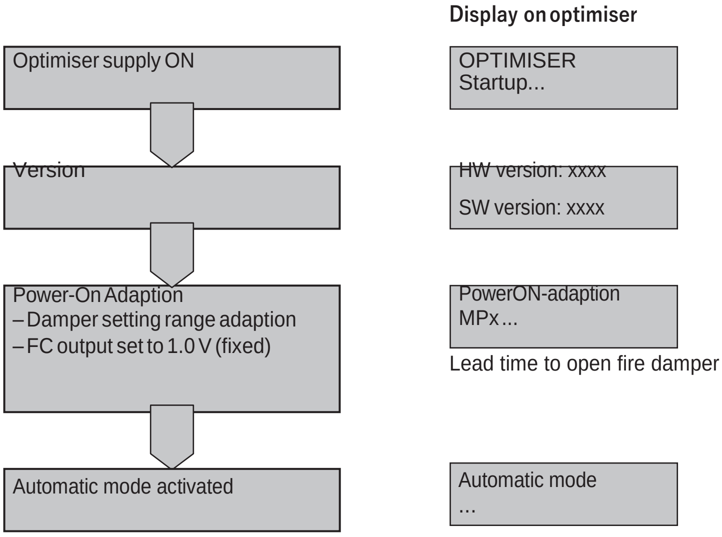
Note on ZTH-VAV (ZEV)
The ZTH-VAV (ZEV) VAV setting device cannot be used in an MP-Bus installation (optimiser, bus cable) because it is only PP-capable. It can be connected locally to the Tool socket on the L/N/SMV-D2-MP at any time, however, although not to the predecessor model L/NMV-D2M.

Power ON start behaviour

A defined power ON function is stored in the optimiser when the VAV system solution is started (power ON), to ensure that damper position control functions correctly. The optimiser and the VAV controllers have the following start behaviour:

Note
The power ON adaption is an optimiser function that cannot be deactivated.
Advantages:
- Lead time to open the fire damper after a power failure
- Initialisation and comparison of the damper diagram

The damper position is one of the control variables for the optimiser function and this information is consequently important. The adaption behaviour that can be set in the VAV-Compact has no influence on the power ON function used by the optimiser. The override control input is deactivated during the power ON adaption!



Note
The optimiser parameters can be set / checked in the Configuration menu during the power ON adaption.

Override control

Note
The override control input is deactivated during the power ON adaption in order to avoid malfunctions.

The optimiser has an override control input (IN B - terminal 28) to facilitate higher-level control functions (e.g. emergency operation to support smoke extraction, override OFF function). The input is wired with a 0 ... 10 V signal as shown in the table below.

Function

Signal at IN B input (terminal 28)	Function	Override control, effecting: Frequency converter (terminal 30)	Override control, effecting: VAV controller (MP-Bus) 1)
10 V	Off	Output signal: 0 V	dampers CLOSED
Input open	Auto	Control mode: 0 ... 10 V	VAV operation
0 V	Emergency operation	Output signal: 10 V	Dampers OPEN

1) Acting on all connected VAV controllers

Override control input function during power ON adaption

The override control input is deactivated during the power ON adaption!

VAV-Compact bus fail function

In the event of an MP-Bus failure (fault, MP-Bus cable unplugged), the VAV-Compact responds in accordance with the defined bus fail behaviour.

Response to bus failure

It is possible to define the response to an MP-Bus failure, essential maintenance work, faults, etc. on each VAV-Compact controller. This setting can be displayed or changed in PC-Tool Version V3.1 or higher.
The following functions are available:
- CLOSED
- □min
- □max
- OPEN
- Last value (default setting, last setpoint command received from the bus master).

VAV / CAV system in mixed operation with mechanical CAV units

For systems with a mixed configuration (VAV units with VAV-Compact and mechanical CAV units), a minimum output voltage can be set on the optimiser if necessary in order to safeguard the supply to the CAV units.

Settings:

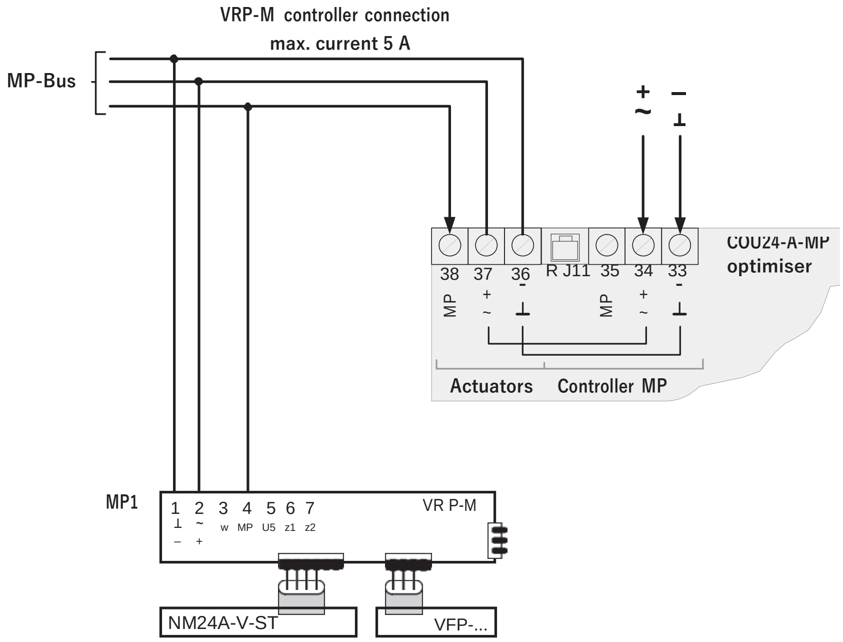
Menu:	Configuration ¦ 6 Freq. Converter ¦ Set FC Min
Range:	0.0 ... 10.0 V

Optimiser operation with VRP-M solution

VRP-M in optimiser operation
A VRP-M can be integrated in a COU24-A-MP application as of VRP-M Firmware Version V3.x (available in Q3/2006).
VRP-M version information:
– Device rear
– VRP-M Tool ¦ Expert ¦ System Info VRP-M Firmware > 03xx

The VRP-M system solution can also be integrated in the COU24-A-MP optimiser as a VAV application. Apart from a few system-specific differences, this application functions in basically the same way as applications with a VAV-Compact controller. VRP-M must not be used with a fast-running actuator for the optimiser function!
The various differences and system characteristics are explained below.
The functions and applications of the VRP-M solution are described in a separate VRP-M Product information (www.belimo.com).

VRP-M connection

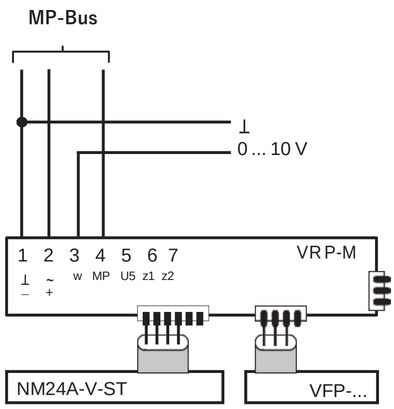


Topology and length of the MP-Bus cable
See page 16 … 18
The power ratings of the actuators and pressure sensors must be taken into account!

Applications

VAV application with direct integration 0 ... 10 V signal

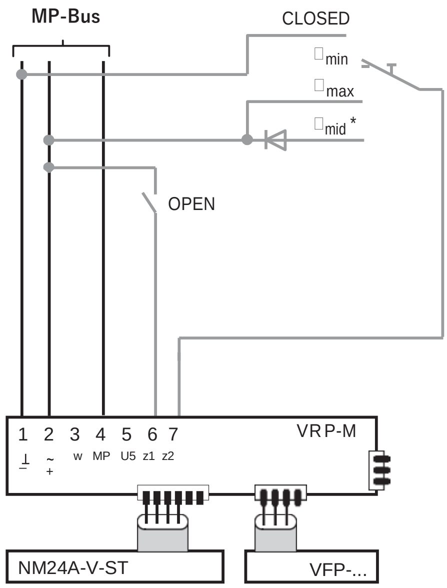
Function:
0 … 10 V = $\dot{V}_{min}$ … $\dot{V}_{max}$



COU24-A-MP setting for this function:	
Setpoint input:	AiMP ¦ 0 ... 10 V

CAV application with direct signal connection on the VRP-M integration

Function:
CLOSED, $\dot{V}_{min}$, $\dot{V}_{max}$, $\dot{V}_{mid}$, OPEN



COU24-A-MP setting for this function:	
Setpoint input:	Ain ¦ 0 ... 10 V

* Function not available with DC 24 V supply!

Optimiser operation with VRP-M solution *(continued)*

Mixed operation with VAV-Compact

Applications with a mixed configuration are essentially possible. Account must be taken of the VAV-Compact control, the VRP-M solution and the setpoint input setting on the COU24-A-MP.

Actuator

Actuators with position feedback (four connections), e.g. NM24A-V-ST, must be used for all damper position-oriented optimiser solutions. It is thus not possible to use the three-wire L/N/SM24-V-ST actuators and the L/AF24-V.

> **Note**
> Fast-running damper actuators LMQ24A-SRV-ST / NMY24A-SRV-ST / NMQB24-SRV-ST must not be used to integrate a VRP-M with an optimiser!

Using PC-Tool in optimiser VRP-M applications

The PC-Tool VRP-M module can be connected in two ways:

a) Locally to the Tool connection on the VRP-M controller:
   The VRP-M must be disconnected from the MP-Bus while the Tool is in use, in order to prevent data collisions on the MP-Bus (two bus masters).

b) To the RJ12 Tool connection on the optimiser:
   Optimiser setpoint input setting for using the Tool: Manual MP

The Tool cannot be plugged into the RJ12 connection if the setpoint input is set to Manual Ain / Manual AiMP. In this case, the setpoint can be temporarily switched to Manual MP.

Note: The $\square_{min}$ / $\square_{max}$ settings of the VRP-M can be displayed and changed directly on the optimiser LCD.

> **Tool connection on VRP-M**
> The VPR-M must be temporarily disconnected from the MP-Bus while the VRP-M Tool connection is in use (connection 4).

> **Caution!**
> Changing the setting of the setpoint input manually directly influences the function of the fan optimiser and the connected VAV controllers.
> If the setpoint input setting is changed temporarily, e.g. in order to connect a Tool, it must be reset to the correct value for the application afterwards.

MP addressing

The VRP-M controllers are addressed in the same way as VAV-Compact controllers. The Set button on the VRP-M to the right of the pressure sensor connection is used as an acknowledge button for address assignment.

> **Addressing with DDC as MP master**
> The connected VRP-Ms cannot be addressed / de-addressed using the optimiser if the optimiser setpoint input is set to SPI Auto (MP) or SPI Manual (MP).
> Display: «Optimiser is not the address master!»
> The VAV controllers must be addressed directly on the MP master or with the PC-Tool in this application.

Fan Optimiser COU24-A-MP VAV application Setting data

Project: ____________________ Control cabinet: ____________________ Date / signature: ____________________

System: ____________________ Frequency converter: ____________________ Function: ☐ SUPPLY AIR fan ☐ EXHAUST AIR fan

Configuration menu		Default setting	Setting option		Remarks
1	**Language**	EN	☐ DE	☐ EN	
2	**Units**	m^3/h	☐ m^3/h	☐ l/s	
3	**Setpoint input**	Automatic, 0 … 10 V	☐ Automatic		
			☐ Manual MP	☐ 0 … 10 V	
			☐ Manual Ain	☐ 2 … 10 V	
			☐ Manual AiMP		
4	**Actuators**	–			
5	**Application**	VAV application	☐ VAV application		
6	**Frequency converter**	0 … 10 V	– FC minimum – FC maximum	☐ 0 … 10 V _____ V start _____ V stop	
7	**Cascade**	OFF	☐ OFF	☐ ON	
8	**Manual mode**	–	–	–	*Settings are not saved!*
9	**Default values**	–	–	–	*Reset to default*
10	**Advanced**	–	–	–	

4 Actuators – MP bus assignment / Volumetric flow setting

Designation		LMV-D2M	NMV-D2M	LMV-D2-MP	LHV-D2-MP	NMV-D2-MP	SMV-D2-MP	$\square_{nom}$	$\square_{min}$	$\square_{max}$	Function
	MP1										
	MP2										
	MP3										
	MP4										
	MP5										
	MP6										
	MP7										
	MP8										

All inclusive.

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