Variable Air Volume Controllers OPTIMA

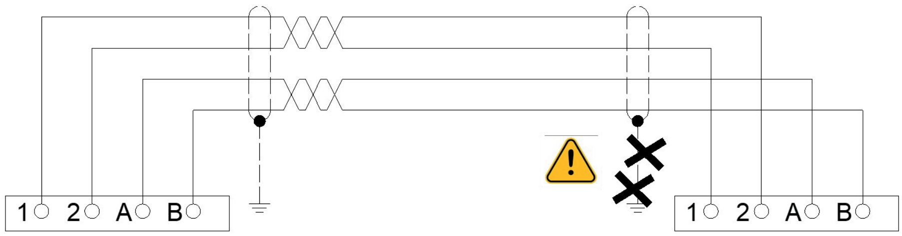
Cabling of the VAV Controllers OPTIMA

systemair

General

The cabling layout must be done accordingly the correct power rating and respecting all technica
and physical requirements.
The safety standards must be met, especially the short circuit protection by the correctly dimensioned
fuse or circuit breaker corresponding to the wiring cross-section.

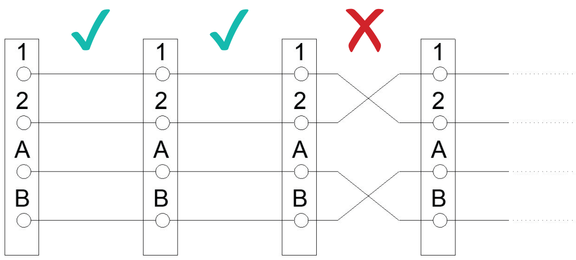
It is possible to use a single cable with multiple wires for power supply (DC or AC 24 V), analog signals (0...10 V) and bus communication (Modbus, BACnet, KNX). The wires in twisted pairs are recommended to be used. Minimum recommended bus wire cross-section is 0,8 mm^2 (Cu).
The cables with conductive screen are recommended when they are installed in spaces where electromagnetic interference is possible. The screen can be connected only on one cable end to the neutral potential or the earthing or the equipotential system. The other end of the cable must remain with non-connected screen.



Power Supply and Bus Connection Polarity

Regardless the power supply type AC or DC 24 V the polarity of the connection must be the same for all devices. Once the potential of the power supply was connected to the wire No.1 on the VAV device, all other VAV devices must have the wire No.1 connected to the same potential. Analogous is valid for the other potential connected to the wire No.2. If the polarity is not unitary assigned, the functionality and the of the VAV controllers will be affected.

Analogous principle is valid for the Bus communication. The polarity on the wires connected to the bus driver must match the polarity of the same wires connected to the VAV devices at the other cable end.



Power Rating

Conductor Cross-section Rating, Power Supplies

The voltage drop (ΔU) along the power supply wire must be kept in the required limits to maintain the reliable power supply for all connected devices. For this the sufficient source power and cable cross section rating must be done.
The power supply rating is based on the sum of all nominal/maximal power consumptions on the connected VAV devices. Please, refer to the power rating of the VAV device in the documentation. It is recommended that the power supply exceeds the power rating of the connected consumers (VAV devices) by at least 10%, ideally by more than 20%.
If the voltage drop causes the reduction of the supply voltage on the VAV devices close to the lower limit (typically AC 24 V -20%, see in the data sheet), the function of the device can be seriously affected or disabled. Exceeding the upper voltage limit (+20%) can have similar consequences. It is recommended to design the power supply and wiring so that the ±15% fluctuation limit around the nominal voltage AC 24 V is maintained.
The voltage drop depends on the cabling length, cross section and on the power consumption of the load (VAV devices). The corresponding calculation must be done.
The following calculation formulae can be used:

$$I = \frac{P}{U_{\mathrm{n}}}$$

$$\Delta U = \frac{2\,.\,\rho\,.\,L\,.\,\mathrm{I}}{A}$$

$$\Delta u = 100\,.\,\frac{\Delta U}{\mathrm{Un}}$$

$$U_L = U_n - \Delta U$$

I	(A)	Nominal electrical current through the power load
P	(VA)	Nominal power consumption of the load - Damper unit and damper actuator
UL	(V)	Voltage of the load
A	(mm^2)	Wire cross-section
l	(m)	Cable length (the calculation formula considers the complete wire length which is double the cable length (2.l). This is already expressed in the formula by the factor 2)
ρ	(Ω. mm^2/m)	Specific resistivity of the conductor
ΔU		Voltage drop on the cable
Δu	(%)	Voltage drop percentage
Un	(V)	Power supply voltage (V)

Note:

For simplicity and safe calculation result the power factor cos(Φ) is set to the value 1
(therefore not shown) in the equation.

Calculation example for 4 VAV controllers installed in the same locality powered through the same cable from the same power supply.

Given / assumed parameters:

Un = 24 V	Power supply AC voltage
P1 = 4 VA	VAV controller 1 power rating
P2 = 4 VA	VAV controller 2 power rating
P3 = 4 VA	VAV controller 3 power rating
P4 = 4 VA	VAV controller 4 power rating
P = P1 + P2 + P3 + P4 = 16 VA	Power consumption rating. It is recommended that the power supply device has power rating larger than this by at least 10%, ideally more than 20%.
ρ(Cu) = 0,018 Ω. mm^2/m	Specific resistance of copper at 20 °C ambient temperature
A = 0.8 mm^2	Wire cross section
l = 120 m	Cable length

Calculation:

$$I = \frac{P}{U} = \frac{16\ \text{VA}}{24\ \text{V}} = 0{,}667\ \text{A}$$

$$\Delta U = \frac{2\,.\,\rho\,.\,L\,.\,I}{A} = \frac{2\,.\,0{,}018\ \Omega.\frac{\text{mm}^2}{\text{m}}\,.\,120\ \text{m}\,.0{,}667\ \text{A}}{0{,}8\ \text{mm}^2} = 3{,}56\ \text{V}$$

$$\Delta u = 100.\ \frac{\Delta U}{U\text{n}} = 100\ .\ \frac{3{,}56\ \text{V}}{24\ \text{V}} = 14{,}83\%$$

$$U_L = U_n - \Delta U = 24\ \text{V} - 3{,}56\ \text{V} = 20{,}44\ \text{V}$$

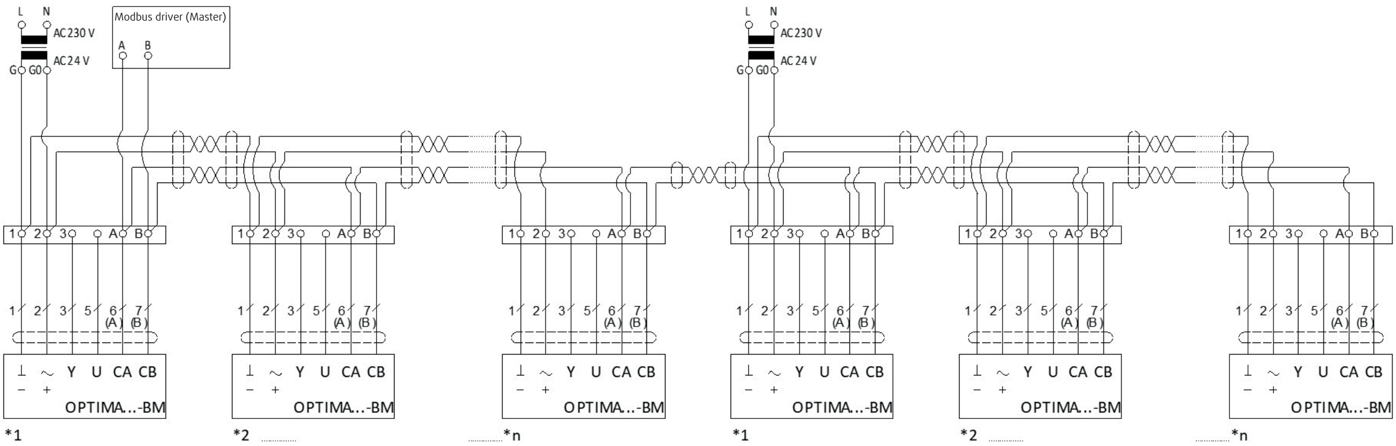
The voltage drop of 14,83 % reduces the supply voltage on the VAV controllers to 20,44 V. The voltage range for VAV controller is AC 24 V ± 20%. The lowest possible voltage is 19,2 V. The given power supply voltage is sufficient.

Cabling Layout

The structure of the cabling and power supply shall be defined accordingly to the rules and ratings mentioned above. A typical layout with Modbus communication is depicted in the diagram below. VAV devices with Communication on BACnet and KNX use the same cabling structure.

The Bus allows all common types of parallel device connection types like line, tree, ring, polygon or combination thereof. The bus length up to 300 m typically enables Modbus, BACnet or KNX communication on all Baud-rates. Larger bus lengths can require reduction of the Baud-rate. This is dependent not only on the VAV devices but mainly on the type and parameters of the bus driver. The maximum number of devices (addresses) connected to the bus line and eventual termination of the bus line depends on the type and parameters of the bus driver.

The power supply is divided into groups which enables to reduce the supply cable lengths, cross sections and voltage drop. This helps to makes the solution cost-effective and reliable.

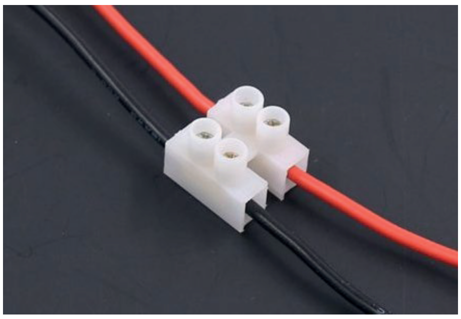


Avoiding Power Supply Problems

Regardless the correct layout and rating of the power supply sources and cabling some problems can occur in the installation.

Cable connections / Terminals:

Many thread-fixed terminals cannot maintain the fixing and contact force on the wire over longer time periods. This has a consequence in the increased electrical resistivity on the contact adding excessive voltage drop. Detailed maintenance is required to avoid this unwanted effect (tightening the terminal screws at least once in 6 months). The use of the spring terminals is strongly recommended since it practically solves this problem.



Thread-fixed terminal

Spring terminal