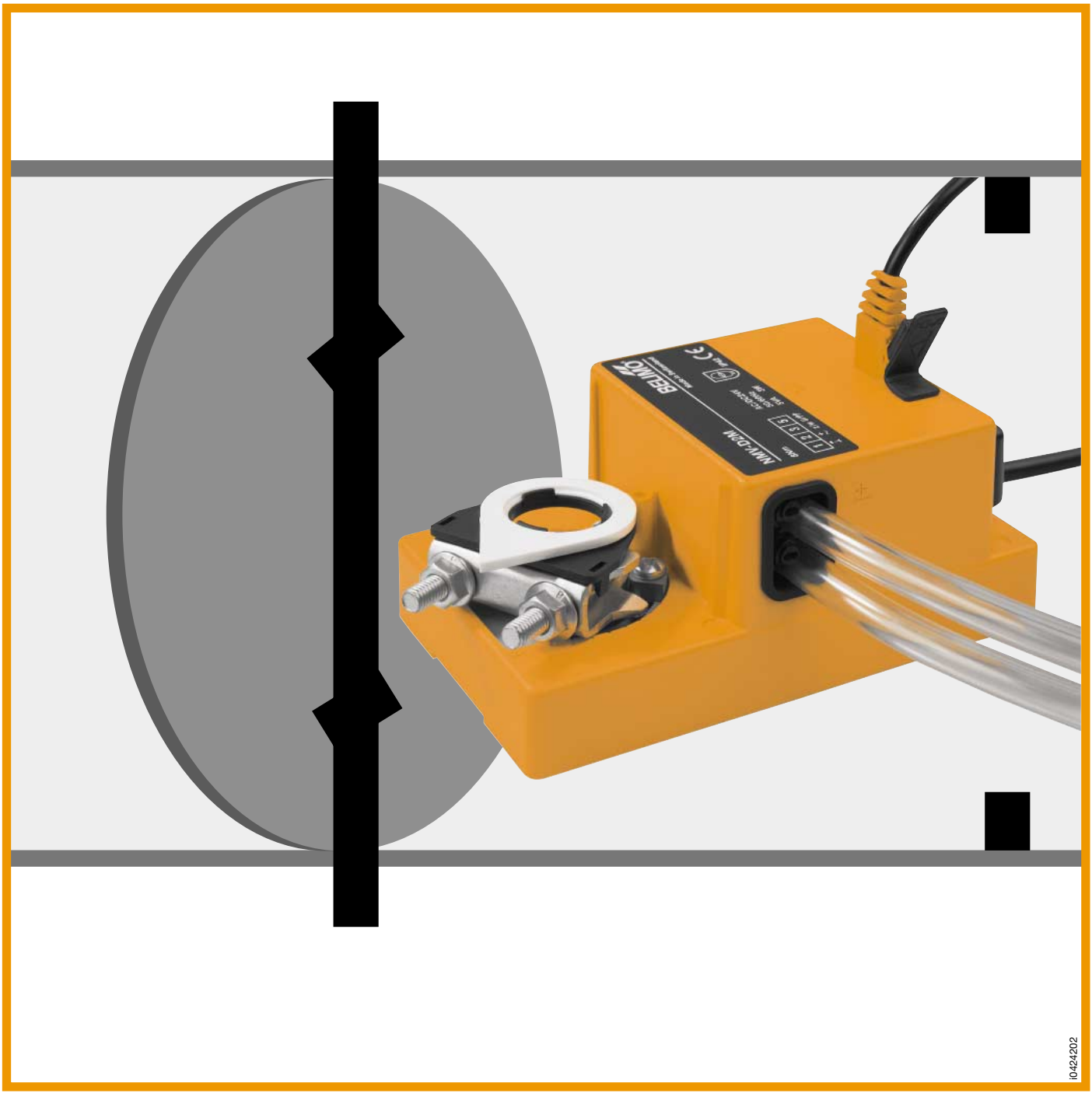
BELIMO

Actuators for heating,
ventilation, air-conditioning

4. NMV-D2M-1
Product Information
Air Volume Control

VAV Compact



The product range for air volume control

VAV-Compact

NMV-D2M

VAV-Universal

Sensor

VFP-100
VFP-300
VFP-600

VAV controller

VRD2

VRP

VRP-STP

Actuators

NM24-V

AM24-V

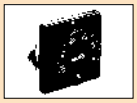
GM24-V

Actuators with safety function

LF24-V

AF24-V

General accessories: Positioner



SGF24

SGA24

SGE24

Room temperature controller

TRS
TRS-M
TRC
TRP

Adjuster

ZEV
ZEV Set

i0426205

Accessories for the NMV-D2M:

UK24LON
Interface for LonWorks® applications

MFT-H
Parameterizing device

PC-Tool
Parameterizing and service software

ZKS-VAV
Cable set for the NMV-D2M

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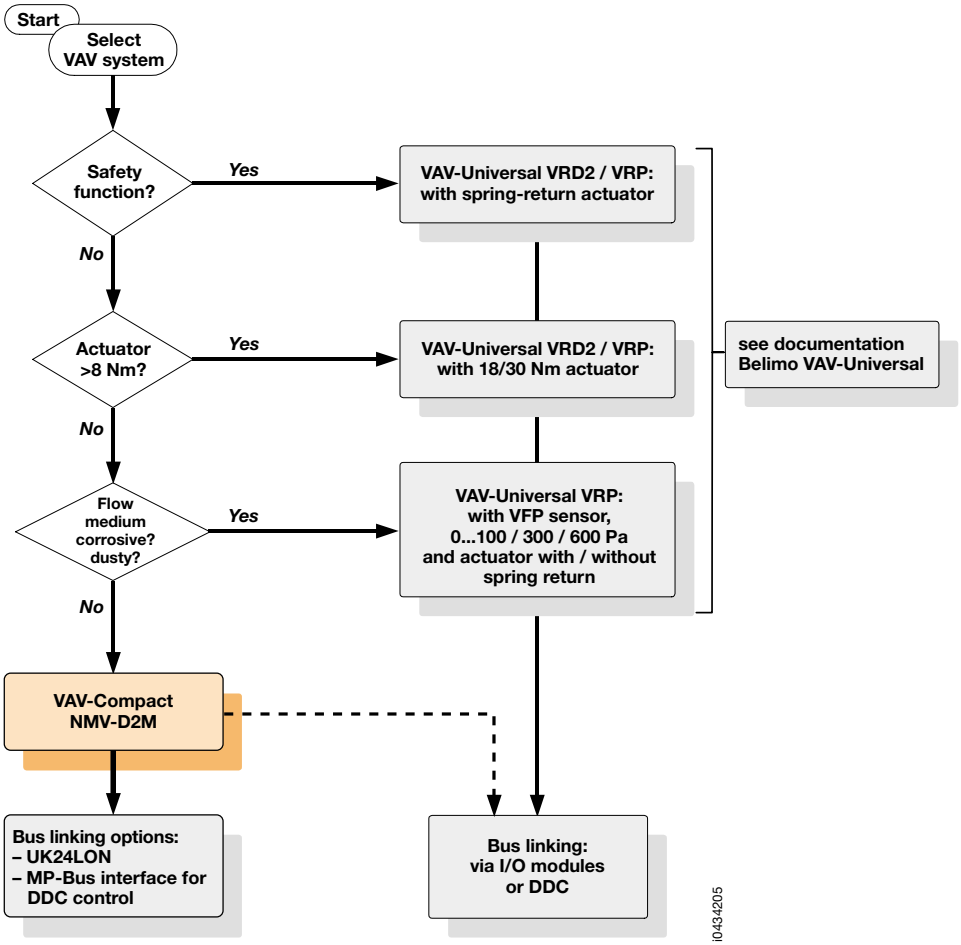
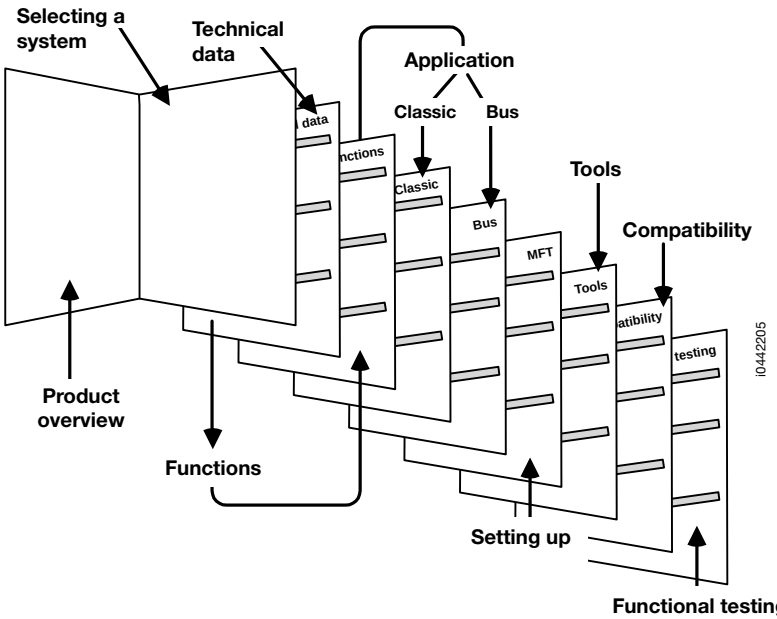
The right VAV system for any application



Structure of the documentation

The NMV-D2M documentation is structured according to application to allow direct access to the specific information that is needed. For this reason certain functions will be found described in several different places associated with particular applications.

The subdivisions



Contents

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Pressure sensor, digital controller and 8 Nm damper actuator all in one, providing a VAV-Compact solution with a communications capability

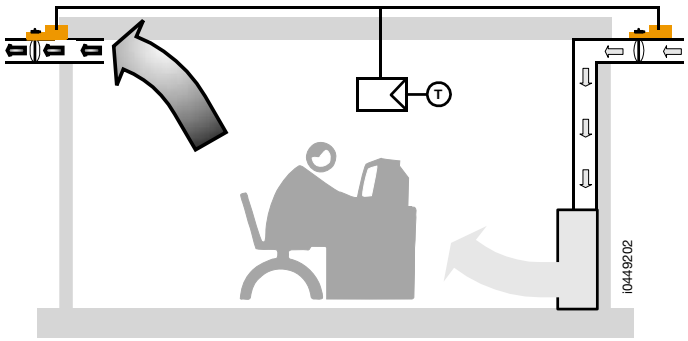
Variable/Constant volumetric flow for Master-Slave or Parallel applications

Classic control: DC 2...10 V / 0...10 V / adjustable voltage range

Bus control: For integrating into DDC control or LonWorks® systems – with additional connection facility for active sensors or switches

Diagnostic socket for operating devices

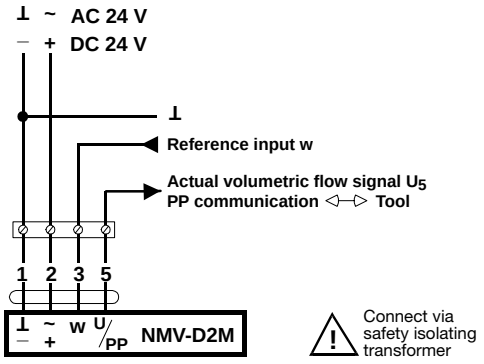
VAV application



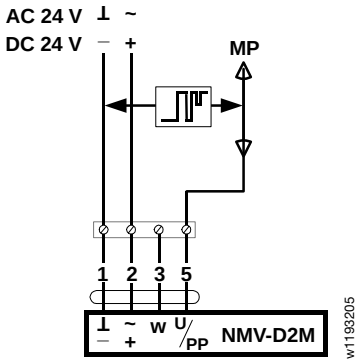
Wiring diagram

(Functional diagram see «Typical applications», pp. 17–20, 22, 24)

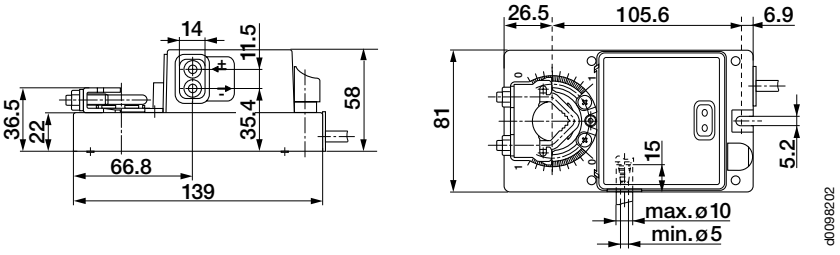
Classic control



Bus control



Dimensions



Important note:
It is the manufacturer of the VAV unit (the OEM) who is responsible for the correct installation and adjustment of the NMV-D2M controller and the overall accuracy of the VAV unit. When replacement units are ordered they are parameterized by the OEM before they leave the factory according to the requirements of the system in which they are to be used. This means that NMV-D2M controllers can only be sold through OEM channels.

Application

The VAV-Compact NMV-D2M controller has PI control characteristics and is used for the pressure independent control of VAV air control units. Stepped-mode constant flow control e.g. switch or clock program. Variable flow with modulating reference variable based on, for example, temperature, occupancy, room thermostat, DDC or LonWorks® system, allowing demand-related, energy-saving ventilation of individual rooms or zones of air-conditioning systems. Maintenance-free sensor technology, thoroughly proven in a great variety of previous applications, means that the controllers can offer total reliability and dependability in various climate conditions.

Variable volumetric flow: VAV

For variable-flow applications the operating range $\dot{V}_{MIN...}\dot{V}_{MAX}$ can be subdivided by selecting any of the following operating modes:
DC 2...10 V / 0...10 V / Adjustable.

Constant volumetric flow: CAV

The following operating modes are available for constant-flow applications:
CLOSE / $\dot{V}_{MIN}$ / $\dot{V}_{MID}$ / $\dot{V}_{MAX}$ / OPEN

Bus function: MP-Bus

Up to 8 Belimo MFT2 devices (VAV units/ damper actuators/valves) can be connected together over the MP-Bus and linked into the following systems:

- LonWorks® applications: All variables of Functional Profile 8110 are available in conjunction with the Belimo UK24LON Interface.
- DDC controllers with integrated MP-Bus protocol.

Additionally, an active sensor (0...10 V), e.g. a temperature sensor or a switch, can be linked into a higher level DDC or LonWorks® system via the MP-Bus.

Operating and service tools

- PC-Tool, MFT-H, ZEV – plugs into the NMV-D2M controller or the control cabinet
- PC-Tool or MFT-H – plugs into the UK24LON / DDC controller.

OEM factory settings

The NMV-D2M controller is mounted on the air control unit by the maker of the unit who then adjusts and tests it according to the requirements of the particular application involved.

Installing and connecting up

Mounted on an air control unit by an OEM, the NMV-D2M controller is connected by means of a 1 m long cable.

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Technical data

Function	Data		Page: class.	Page: Bus
Power supply				
Nominal voltage	AC 24 V 50/60 Hz	DC 24 V	14	22
Nominal voltage range	AC 19.2...28.8 V	DC 21.6...28.8 V	14	22
For wire sizing	5 VA (Imax. 8.3 A @ 5 ms)	3 W (Imax. 8.3 A @ 5 ms)	14	22–23
Power consumption	3 W	3 W	14	22
Differential-pressure sensor	2...~300 Pa (depends on OEM)		6	6
Operating pressure	max. 1000 Pa		6	6
Characterizing	linearized for specific differential pressure air probe and OEMs		6	6
Mounting position	any, no zero setting needed		6	6
Operating medium (see «Materials»)	SUPPLY/EXHAUST air for comfort applications and others with sensor-compatible media		6	6
Materials	PC+ABS to UL94-V0; stainless steel, DIN 1.4301 X10CrNiS1810; PP Santoprene		6	6
Measuring air conditions	0...+50°C / 5...95% rH, non-condensing		6	6
Applications VAV and CAV	– SUPPLY/EXHAUST air control units in stand-alone mode/master-slave/parallel connection for rooms with positive/negative or neutral air pressure – Air mixing units		9–11 17–20	9–11 25
Operating volumetric-flow				
$\dot{V}_{NOM}$	depending on OEM and type of VAV unit		7	7
$\dot{V}_{MAX}$	30...100% of $\dot{V}_{NOM}$		7	25
$\dot{V}_{MIN}$	*0...100% of $\dot{V}_{MAX}$ (see p. 8 «*Creep flow suppression; Minimum setting limit*»)		7–8	7–8
$\dot{V}_{MID}$	0...100% of ($\dot{V}_{MIN}$...$\dot{V}_{MAX}$)		7	
Classic control			14–20	
Mode for reference value input w *(Terminal 3)*	– DC 2...10 V / (4...20 mA with ext. 500Ω resistor) – DC 0...10 V / (0...20 mA with ext. 500Ω resistor) – adjustable DC 0...30 V	Resolution for $\dot{V}_{MIN}$...$\dot{V}_{MAX}$ (min. 100 kΩ input resistance)	18 17 19, 26	
Mode for actual volumetric flow U_5 (Terminal 5)	– DC 2...10 V – DC 0...10 V – adjustable DC 0...10 V	Resolution for 0...100% $\dot{V}_{NOM}$ (max. 0,5 mA)	18 17 19, 26	
Operating modes for CAV	CLOSE/$\dot{V}_{MIN}$/$\dot{V}_{MID}$*/$\dot{V}_{MAX}$/OPEN* (*only with AC 24 V)		7, 20	
Bus control – MP-Bus function				21–25
Addressing in bus mode	MP1...8 (classic control: PP)			21, 28
LonWorks®	with Belimo UK24LON Interface, 1...8 Belimo MFT2 devices (VAV / damper actuator / valve)			21
DDC controller	DDC controller with integrated MP interface (Your Belimo representative will be glad to inform you about DDC solutions with MP-Bus)			21
Sensor linking	active sensor with DC 0...10 V signal, e.g. temperature, humidity 2-point signal (contact rating 16 mA @ 24 V), e.g. switches, occupancy detector			21, 23 24, 26
Operation, Service	pluggable, with ZEV / MFT-H / PC-Tool		13, 28–32	13, 28–32
Communication	PP/MP-Bus, max. DC 15 V, 1200 baud		14	21–22
Actuator	brushless, non-blocking actuator with current reduction			
Torque	min. 8 Nm at nominal voltage, adjustable 2 / 4 / 6 / 8 Nm		27	27
Direction of rotation	cw ↷ / ccw ↶		27	27
Angle of rotation	95°, with adjustable mechanical limiting		12	12
Adaption setting	acquisition of angle of rotation and adaption of control range		12, 27	12, 27
Manual disengagement – multiple function	push-button, auto-return without affecting functions manual control, start function test, trigger angle of rotation adaption		12	12
Position indication	mechanical with pointer			
Spindle attachment	– spindle clamp, for round spindles 10...20 mm / square spindles 8...16 mm – form-fit, wide range of versions, e.g. 8 x 8 mm			
Connecting cable	1 m long, 4 x 0,75 mm². Optional: halogen-free cable		14	22
Ambient conditions	0...+50°C, 5...95% rH, non-condensing			
Non-operating temperature	–20...+80°C			
Protection class and tests				
Protection class / EMC	III (extra low voltage) / CE conforming to 89/336/EU			
Sound power level	max. 35 dB (A)			
Maintenance	maintenance-free			
Weight	900 g			

Index: class. = classic control; Bus = Bus-control

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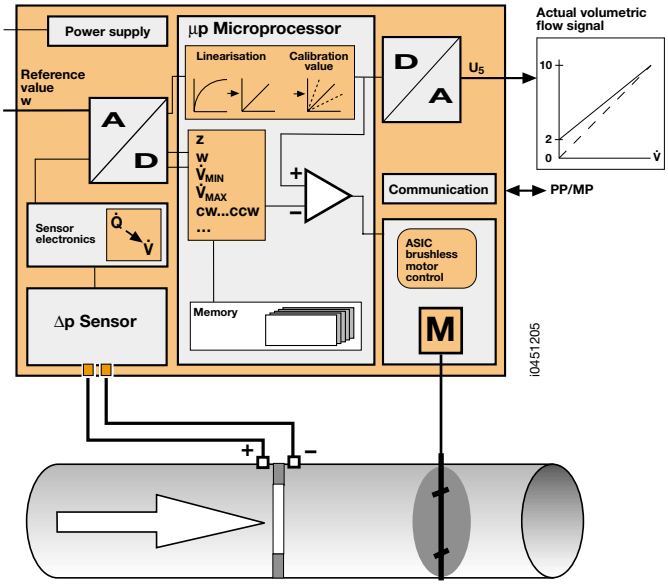
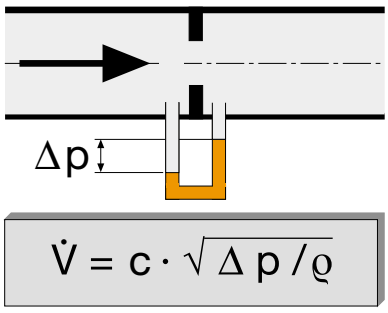
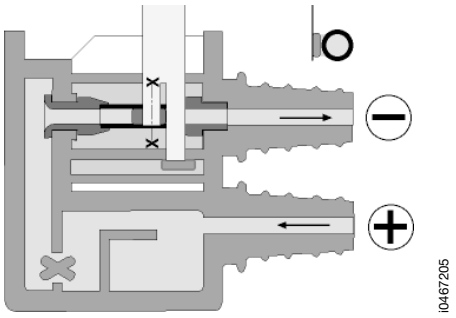




V̇ = Volumetric flow
c = Geometry-related constant of the baffle device (differential-pressure pick-up device, dimensions, etc.)
Δp = Differential pressure
ϱ = Density of the flow medium

Construction of the sensor



There are only three different materials in contact with the air flow:
– Sensor body PC + ABS to UL94-V0
– Nozzle tube chromium nickel steel
– Tube holder Santoprene

Flow medium

0...+ 50°C / 5...95% rH, non-condensing

Non-corrosive flow medium	Slightly corrosive flow medium	Sea air (containing salt)	Corrosive flow medium	Dust-laden flow medium
good suitability	good suitability	good suitability	Check composition and material compatibility	limited suitability

Check application with VAV-Universal

Mode of operation of the NMV-D2M

Block diagram

In the measuring section of the device (sensor electronics and linearization) the non-linear differential-pressure signal from the sensor is converted into a linear signal proportional to the volumetric flow. The reference signal w is conditioned as the setpoint signal depending on the setting operating volumetric flow $\dot{V}_{MIN}$ / $\dot{V}_{MAX}$. The instantaneous control deviation forms the positioning signal for the integrated actuator. The actual volumetric flow is available as the actual value signal for display purposes and for driving slave VAV controllers.
The specially-designed running-time logic of the NMV-D2M – in conjunction with a precision differential-pressure sensor – ensures excellent control quality from any VAV units that are so equipped.
Depending on the particular application it is possible to choose between a classic and an MP-Bus controlled NMV-D2M.

Measuring volumetric flow

The measurement of volumetric flow is based on a differential-pressure pick-up device that usually takes the form of an orifice plate, a venturi nozzle, a baffle ring or a measuring cross placed in the air ducting. Several different methods of measuring volumetric flow have established themselves in the market.

Reliable and accurate measurement of differential pressure – the key to precise volumetric flow control

The method of measuring differential pressure employed by Belimo allows a reliable measurement of a mean value to be obtained even when the inlet flow conditions are imperfect.
Each type of pick-up device used for measuring differential pressure has its own dynamic characteristics. The effect of the measuring device in calculating the volumetric flow is denoted as a device constant c. In actual practice it is apparent that, contrary to its name, the constant does not in fact remain constant but depends on the mass flow. Each type of differential-pressure pick-up device has a different amount of non-linearity depending on its construction and the physical relationships involved.

As the basis for the customized NMV-D2M VAV controller, Belimo ascertains the characteristics of the particular type of differential-pressure pick-up device employed by taking a series of reference measurements. Compensation is applied to the reference curve obtained in this way by using a linearization procedure developed by Belimo in-house. The procedure is called «characterizing».

Key features of the Belimo differential-pressure sensor D2

– Precise, proven thermo-anemonic principle of measurement with temperature compensation
– Wide measuring range, high accuracy in conjunction with ordinary manufacturer's differential-pressure pick-up device – also in the lower range – across the whole measuring range of ~2 to 300 Pa
– No zero setting needed during either commissioning or normal service
– Maintenance-free, proven technology for a wide variety of applications
– No retention of condensation in the sensor, i.e. can be mounted in any position
– Measurement unaffected by position, i.e. no mounting instructions needed
– Insensitive to contamination because the measuring element is placed outside the air flow.

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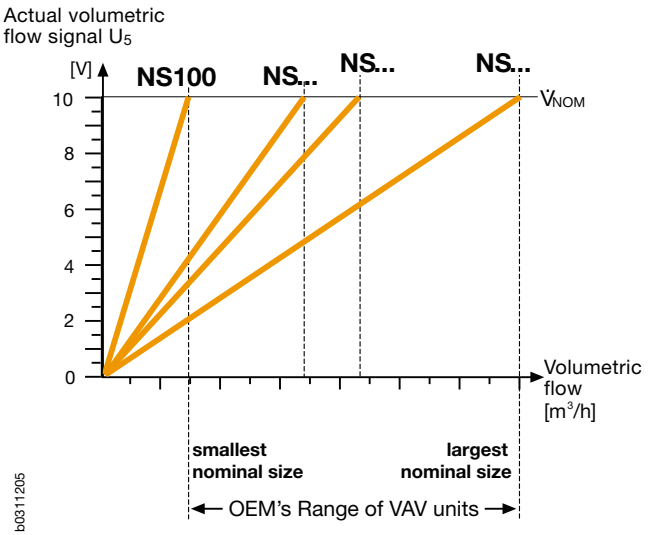
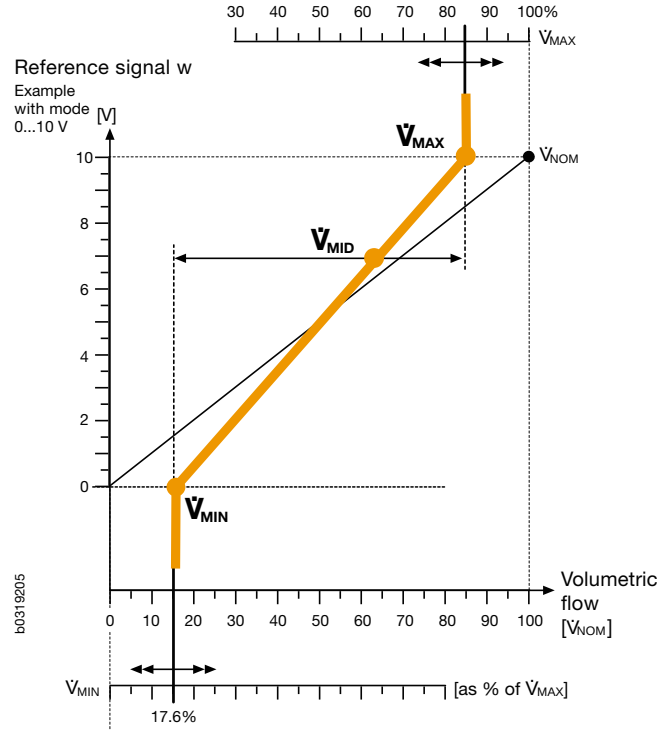


Nominal volumetric flow $\dot{V}_{NOM}$

Power and noise considerations dictate that the value of volumetric flow for a specific size of ducting should not exceed a certain limit. The binding value of nominal volumetric flow is defined by the manufacturer who is responsible for the correct functioning of his VAV units.

Setting the nominal value of volumetric flow – also known as setting the calibration value – adapts the NMV-D2M to the particular type of VAV unit involved. The size, nominal volumetric flow and operating parameters of the unit are taken into account and preset. $\dot{V}_{NOM}$ is the maximum possible volumetric flow of the VAV unit – at which the pressure drop and the noise level are within the permitted operating limits.
Belimo's method of active calibration, i.e. calibration by means of a reference value of volumetric flow, compensates for deviations caused by mechanical tolerances in the manufacturing process.
Since these values and the operating data of a particular VAV unit are unique, the procedure is carried out by the manufacturers of VAV units during assembly at the factory.

This method renders all other on-site adjustments and setting-up unnecessary – an important factor which helps to save time and reduces costs during installation and commissioning.



Setting operating volumetric flow $\dot{V}_{MIN}$ / $\dot{V}_{MID}$ / $\dot{V}_{MAX}$

The linear characteristic of the air volume controller allows easy setting-up of the operating rates of volumetric flow for the system. The setting-up is normally carried out by the manufacturer of the unit or during commissioning of the system. $\dot{V}_{MAX}$ provides the upper limit depending on the nominal value of volumetric flow. $\dot{V}_{MIN}$ can be set as a percentage of the required $\dot{V}_{MAX}$.

For constant-volume applications (CAV) there is a mid-position $\dot{V}_{MID}$ available for finer grading of control.

Function	Volumetric flow	Setting range
$\dot{V}_{NOM}$	nominal	OEM-specific value, according to VAV unit type and application
$\dot{V}_{MAX}$	maximum	30...100% of $\dot{V}_{NOM}$
$\dot{V}_{MIN}$	minimum	*0...100% of $\dot{V}_{MAX}$ (*OEM-dependent)
$\dot{V}_{MID}$	mid-position	0...100% [($\dot{V}_{MIN}$ – $\dot{V}_{MAX}$) + $\dot{V}_{MIN}$]

*The minimum setting of volumetric flow $\dot{V}_{MIN}$ depends on the actual VAV unit used.

See Functions: «Creep flow suppression and Minimum setting limit», Page 8).

Setting $\dot{V}_{MIN}$ 0%

The actuator overrides to close the damper when the minimum volumetric flow has been set to 0% and the reference signal reaches that value.

Setting devices

The following tools are available for setting the operating volumetric flow:
– ZEV Adjuster
– MFT-H Parameterizing device
– PC-Tool Parameterizing and service software.

OEM basic values

During the calibration procedure the manufacturer of the VAV unit sets up the operating volumetric flow that were calculated at the system planning stage.
The OEM basic values can be reactivated at any time by using the setting-device reset function.

Setting up

$$\dot{V}_{MAX}\,(\%) = \frac{\dot{V}_{MAX}\,(m^3/h)}{\dot{V}_{NOM}\,(m^3/h)} \cdot 100\%$$

$$\dot{V}_{MIN}\,(\%) = \frac{\dot{V}_{MIN}\,(m^3/h)}{\dot{V}_{MAX}\,(m^3/h)} \cdot 100\%$$

$$\dot{V}_{MID}\,(\%) = \frac{\dot{V}_{MID}\,(m^3/h) - \dot{V}_{MIN}\,(m^3/h)}{\dot{V}_{MAX}\,(m^3/h) - \dot{V}_{MIN}\,(m^3/h)} \cdot 100\%$$

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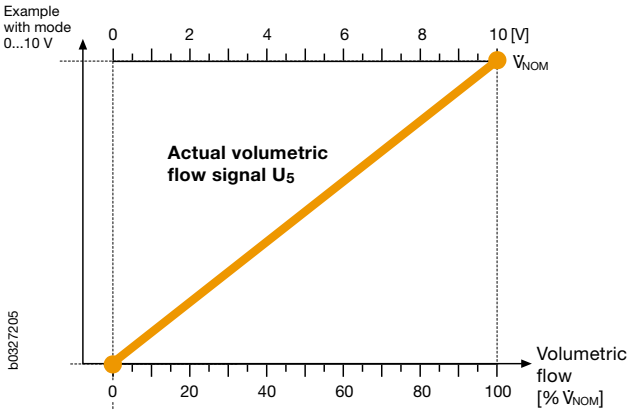
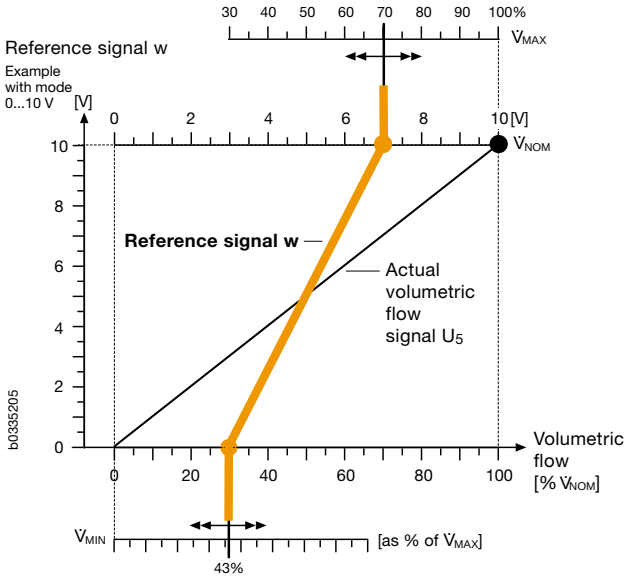


Actual volumetric flow signal U_5

The actual volumetric flow signal U_5 represents the actual value of volumetric flow measured through the differential-pressure sensor of the VAV unit.
This value corresponds to 0...100% of the set value of nominal volumetric flow. $\dot{V}_{NOM}$ is set by the unit manufacturer at the factory and is marked on the type plate of the VAV unit.

The actual volumetric flow signal U_5:
- **corresponds to 0...100% $\dot{V}_{NOM}$**
- **represents the actual value of volumetric flow**
- **is not affected by the $\dot{V}_{MIN}$ and $\dot{V}_{MAX}$ settings**
- **can be adapted in signal format by mode resp. variable setting.**

Note:
It is recommended that Terminal 5 (actual volumetric flow signal U_5/PP) of every VAV controller be run to the control cabinet so that setting and service work can be carried out without the need for direct access to the VAV controller.

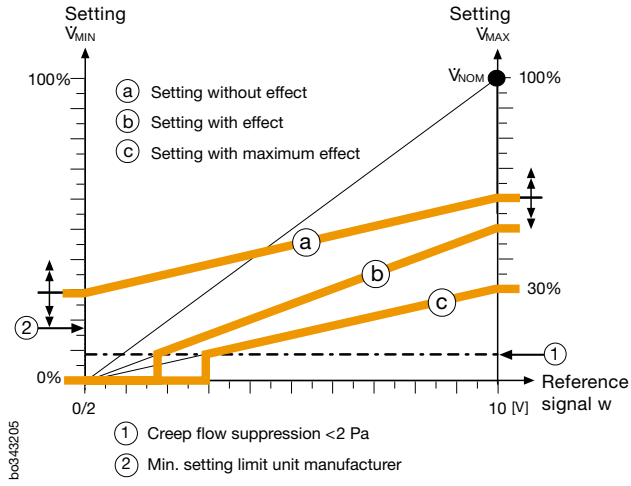


Reference signal w

By means of the reference signal w the volumetric flow can be modulated across the range of preset operating volumetric flow. This allows demand-sensitive ventilation control, of a lounge for example, whereby the volumetric flow can be increased from the minimum value (ventilation for hygiene purposes) to the maximum value according to the room temperature.

For this purpose the output signal from a reference controller or setpoint device is fed to the reference value input of the NMV-D2M. The signal modulates the flow within the preset range of operating values of volumetric flow.

The reference signal w:
- **is linear in the range $\dot{V}_{MIN}$...$\dot{V}_{MAX}$**
- **is used for controlling the NMV-D2M in VAV and CAV applications**
- **can be adapted in signal format by mode resp. variable setting.**



Creep flow suppression ①

The task of creep flow suppression is to suppress the differential-pressure signals around zero. This limiting is able to prevent undefined movements of the actuator within the pressure range below 2 Pa. It places a physical limit on the operating range due to the dynamic characteristics of the differential-pressure pick-up device in this range, the flow pattern of the flow medium and the response threshold of the sensor.

Minimum setting limit ② (depends on VAV unit)

Oversizing of a VAV unit can cause difficulties with controllability at the bottom of the range of operation. The manufacturer states the minimum permitted values of volumetric flow for his units, which is usually a differential pressure between ~5...12 Pa. Adhering to the setting of volumetric flow specified by the unit manufacturer prevents functional limitations in this range.

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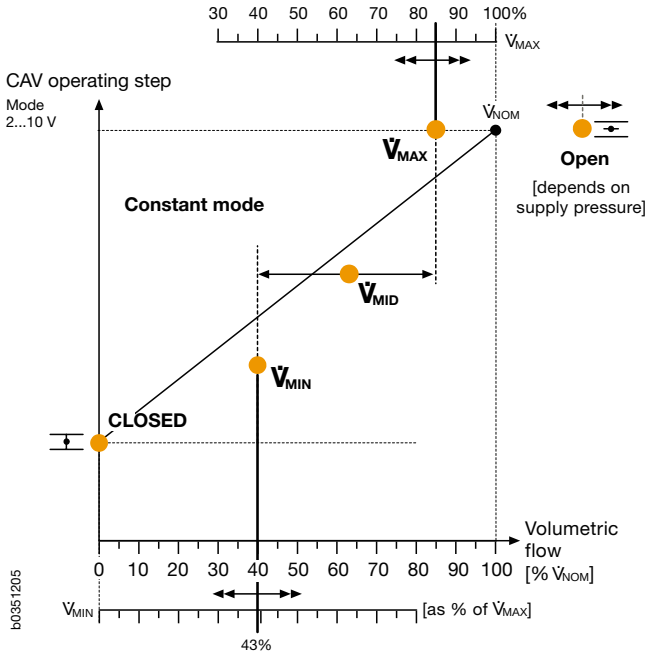
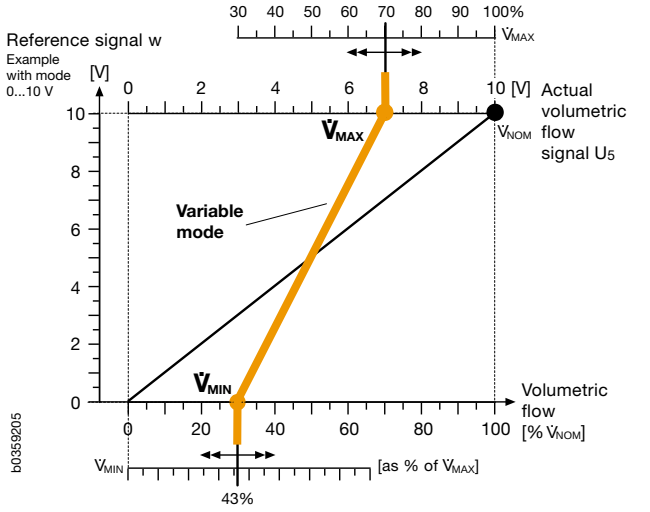
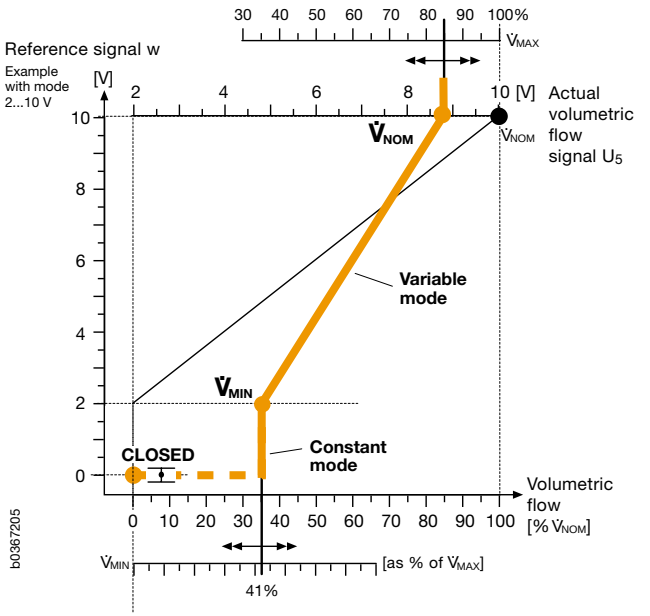






Mode of operation:
– Constant volumetric flow CAV
– Variable volumetric flow VAV

The NMV-D2M can be used for the two operating modes «constant volumetric flow» (CAV) and «variable volumetric flow» (VAV). In both cases the NMV-D2M functions as an independent control loop, i.e. any pressure fluctuations in the ducting system are detected and evened out automatically.

Constant volumetric flow CAV

With constant volumetric flow applications the NMV-D2M regulates the flow to the required constant value. If necessary, one single or several operating stages can be preset.

The following operating steps are available (Mode 2...10 V):
CLOSE / $\dot{V}_{MIN}$ / $\dot{V}_{MID}$ / $\dot{V}_{MAX}$ / OPEN.

– Shut-off operation – damper CLOSED:
The damper is moved to defined CLOSED (0%).

– Operating steps $\dot{V}_{MAX}$ / $\dot{V}_{MID}$ / $\dot{V}_{MIN}$:
The NMV-D2M provides fixed regulation of the preset volumetric flow.

– Uncontrolled operation – damper OPEN:
For maximum ventilation the damper can be opened 100%; air volumetric flow control is then inoperative.

Hint: $\dot{V}_{MID}$ and OPEN are not available with a DC 24 V power supply.

Note: «Typical application and connection» see Page 20.

Variable volumetric flow VAV

For variable volumetric flow operation the required value of volumetric flow is issued with a 0/2...10 V / adjustable range reference signal or over the bus system. The required volumetric flow is established linearly within the $\dot{V}_{MIN}$ ...$\dot{V}_{MAX}$ setting.

– Shut-off operation (CLOSED) with $\dot{V}_{MIN}$ 0%.
If shut-off becomes necessary during VAV operation it can be effected by setting $\dot{V}_{MIN}$ to 0%.

– Shut-off operation (CLOSED) with 0...10 V control in Mode 2...10 V:
In Mode 2...10 V the following functions can be obtained with a 0...10 V signal:

Reference signal w	Volumetric flow	Function
<0.1 V*	CLOSED	Damper CLOSED, VAV control inactive
0.2 ... 2 V	$\dot{V}_{MIN}$	Operating step $\dot{V}_{MIN}$ active
2 ... 10 V	$\dot{V}_{MIN}$ ...$\dot{V}_{MAX}$	Modulating operation $\dot{V}_{MIN}$ ...$\dot{V}_{MAX}$

*Hint: The controller/DDC must be able to regulate the reference signal to 0 V.

Note: «Typical application and connection» see pp. 17–19, 25.

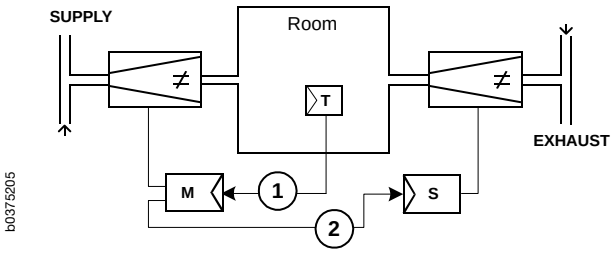
Variable volumetric flow with operating steps

When necessary it is possible to employ a mixed mode of operation – «Variable volumetric flow with operating steps».

Example: CLOSE / $\dot{V}_{MIN}$...$\dot{V}_{MAX}$ (Mode 2...10 V)

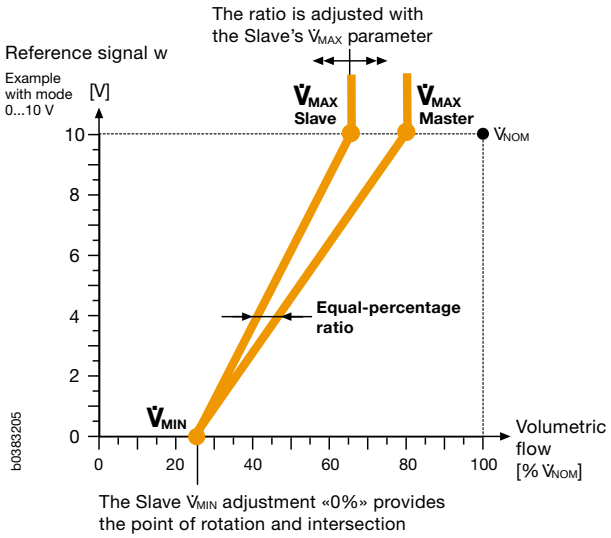
Variable mode
Operating step

Note: «Typical application and connection» see Page 18.



Principle

① The reference signal, e.g. room temperature controller, is connected to the Master input. The $\dot{V}_{MIN}$ and $\dot{V}_{MAX}$ settings are made at the Master controller.
② The actual volumetric flow signal from the Master acts as the reference signal for the Slave controller.
Depending on the particular application the Master is installed on either the supply side or the exhaust side. See «Selecting the Master controller».



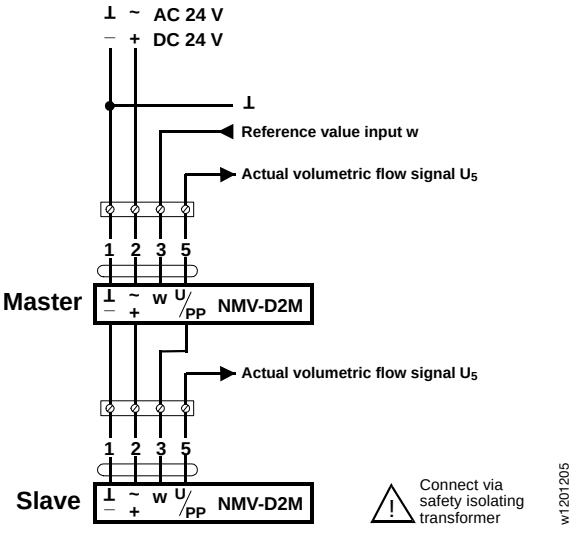
Selecting the Master controller

If both units have:
- different $\dot{V}_{NOM}$ settings, the one with the lower value of $\dot{V}_{NOM}$ will lead.
- identical $\dot{V}_{NOM}$ settings, the controller with the higher setting of air-quantity will be the Master:

– Positive room pressure
Master: Supply unit Slave: Exhaust unit

– Negative room pressure
Master: Exhaust unit Slave: Supply unit

Wiring diagram for a conventional M-S circuit



Master-Slave sequential circuit:

Room pressure ratio

In a Master-Slave circuit, also known as a sequential circuit, any variations in the Master air distribution system (e.g. low supply pressure due to a pressure control problem) are detected and transferred to the Slave. This ensures an equal-percentage supply/exhaust-air ratio.

In a Master-Slave relationship only one controller can be specified as the Master, but one Master can have several Slave controllers connected in parallel.

When are M-S circuits used?

- in systems with air volume controllers for the supply air and exhaust air that must work in sequence
- when there is an equal-percentage ratio between the supply air and the exhaust air.

Settings operating volumetric flow

The values of $\dot{V}_{MAX}$ and $\dot{V}_{MIN}$ used for the required value of volumetric flow are set at the Master and transferred to the Slave by means of the reference signal.

CAV applications

With constant-volumetric flow applications, operating step control (CLOSED / $\dot{V}_{MIN}$, etc.) is only connected to the Master controller.

Slave settings for a balanced room pressure ratio

The $\dot{V}_{MIN}$ setting at the Slave is always 0%. For a 1:1 room pressure ratio and identical size the setting of the Slave controller must be $\dot{V}_{MAX}$ 100% / $\dot{V}_{MIN}$ 0%.

Slave setting for an unbalanced room pressure ratio

The $\dot{V}_{MIN}$ setting at the Slave is always 0%.

The ratio of Slave volume to Master volume is preset with the $\dot{V}_{MAX}$ value of the Slave controller as follows:

$$\dot{V}_{MAX}\,S\% = \frac{\dot{V}_{MAX}\,S \cdot \dot{V}_{NOM}\,M}{\dot{V}_{MAX}\,M \cdot \dot{V}_{NOM}\,S} \cdot 100$$

$\dot{V}_{MAX}$ S% = $\dot{V}_{MAX}$ value in % to be set at the controller
$\dot{V}_{NOM}$ M = Nominal volume of the Master unit, in m³/h
$\dot{V}_{MAX}$ M = Maximal volume of the Master unit, in m³/h
$\dot{V}_{NOM}$ S = Nominal volume of the Slave unit, in m³/h
$\dot{V}_{MAX}$ S = Maximal volume of the Slave unit, in m³/h

Example

Required: Positive room pressure with 20% excess air

– Supply unit: $\dot{V}_{NOM}$ 1600 m³/h / $\dot{V}_{MAX}$ 1500 m³/h
– Exhaust unit: $\dot{V}_{NOM}$ 2400 m³/h / $\dot{V}_{MAX}$ 1200 m³/h

Calculate: $\dot{V}_{MAX}$ setting of Slave controller

$$\mathbf{53\%} = \frac{1200 \cdot 1600}{1500 \cdot 2400} \cdot 100$$

Wiring

When integrating into a DDC system through I/O modules it is possible, by wiring the actual volumetric flow signal U_5 of the Slave controller to an analogue input (AI), to monitor the functioning of both VAV units (sequential function).

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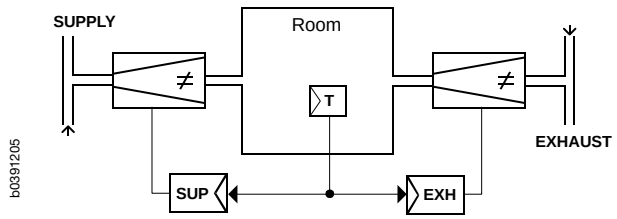
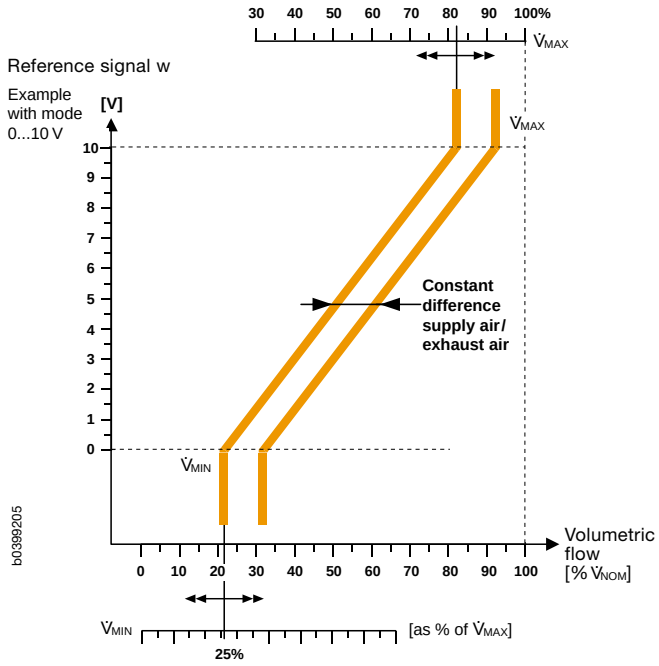


Principle

The reference signal of the temperature controller is connected in parallel with the reference value inputs w of the supply-air and exhaust-air controllers. The operating volumetric flow rates $\dot{V}_{MAX}$ and $\dot{V}_{MIN}$ are set at the two controllers.



Parallel circuit:

Room pressure ratio

In a parallel circuit the two VAV units are operated independently of each other with a common reference signal. The operating volumetric flow rates of the supply-air and exhaust-air units must be set to produce the required room pressure ratio.

The supply-air and exhaust-air controllers work in an open ratio, i.e. if a fault occurs in either of the two distribution systems supply air or exhaust air it will have an adverse effect on the room pressure ratio due to the nature of the system. In the worst-case situation the tolerances of the units can add together. This situation must be taken into account at the project design stage.

When are parallel circuits used?

- when there are air volume controllers working together on the supply-air and exhaust-air sides (controlled by the same reference value)
- when the supply-air and exhaust-air units are of different size and have different minimum and maximum volumetric flow settings
- when there is constant difference control between the supply air and exhaust air
- when a system incorporates several supply-air and exhaust-air units
- when a re-circulating-air system for an air tight room is required.

Settings operating volumetric flow

The values of $\dot{V}_{MAX}$ and $\dot{V}_{MIN}$ used for the required value of volumetric flow must be set at each air volume controller.

CAV applications

With constant-volumetric flow applications, operating step control (CLOSE/$\dot{V}_{MIN}$, etc.) is applied to both VAV controllers.

Settings for a balanced room pressure ratio

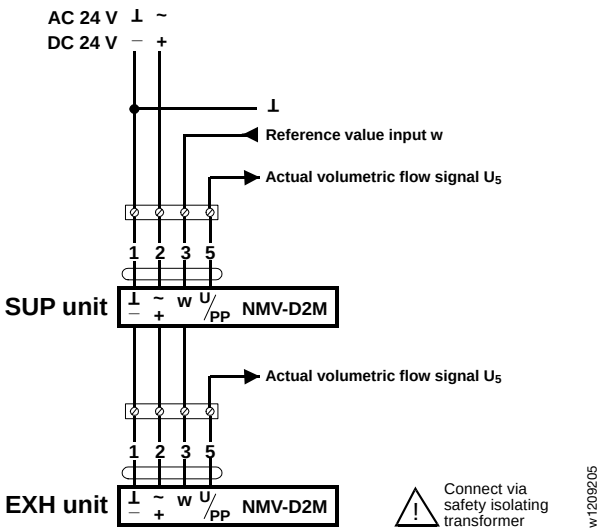
Due to the proportional relationship between the reference signal and the range of $\dot{V}_{MAX}$ and $\dot{V}_{MIN}$ values it is possible to operate VAV units of different nominal sizes and different setting ranges in parallel with each other.

Settings for an unbalanced room pressure ratio

The operating volumetric flow rates of the supply-air and exhaust-air units must be set according to the difference required:

- Positive room pressure
  SUP volumetric flow > EXH volumetric flow
- Negative room pressure
  EXH volumetric flow > SUP volumetric flow.

Wiring diagram for a classic parallel circuit



i0474202

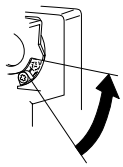
Manual operation

For commissioning purposes a damper blade can be moved manually by means of the push-button on the NMV-D2M. Such manual operation is possible at any time, even when the controller is powered up, without producing any adverse effects. In order to prevent any discrepancies during subsequent automatic operation, a synchronizing function is performed automatically after each manual operation.

Adaption

Adjusting the angle of rotation

The angle of rotation is adjusted by the manufacturer of the VAV unit – mechanically with the integral end-stops – to suit the available control range.



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Adapting the angle of rotation

With this function the positions of the upper and lower spindle end-stops are acquired and stored in the NMV-D2M. Running time and operating range are then adapted to the available angle of rotation. This sensing of the positions of the mechanical end-stops allows a smooth approach to the end positions which avoids rough treatment of the actuator and damper mechanisms.

The adaption procedure can be varied according to the particular type of application.

See «Setting up», Page 26.

Synchronization

Synchronizing the position calculation

In order to avoid permanent deviations arising from manual operation of the controller a synchronizing function is applied to the position calculation to ensure that the position control of the damper blade is correct.

This eliminates any deviations arising from manual operation of an NMV-D2M controller.

The synchronization also provides a simple check of proper functioning.

The synchronizing procedure can be varied according to the particular type of application.

Test function

For diagnostic purposes a test run can be initiated by means of a PC-Tool or MFT-H device.

This will cause the NMV-D2M controller to run to the following operating points:

- $\dot{V}_{MIN}$
- $\dot{V}_{MAX}$
- actual operating point issued (reference signal).

Bus function

When necessary, a standard NMV-D2M actuator can be linked into a digital control system or a LonWorks® system via the MP-Bus. This function can be activated by assigning the appropriate bus address (range 1...8).

Wiring diagram and functional description:
see «Bus control», Page 21.

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Adjustable functions

The Belimo VAV air volume controller is based on Belimo's new «4-in-1» technology. In addition to the well-known standard VAV function it is also possible to set up other functions tailored to specific installations by using a suitable parameterizing device.

See «Setting up», Page 26.

Operating devices and service tools

The following operating devices and service tools are available for setting up and operating the Belimo NMV-D2M VAV-Compact controller:

ZEV Adjuster (for classic applications only)

p0119202

Use
For the local correction of operating flow rate settings in VAV installations employing classic control.

Function
- For setting operating flow rates $\dot{V}_{MIN}$ / $\dot{V}_{MAX}$
- For selecting operating mode 0...10 V / 2...10 V
- For re-setting operating volumetric flow to OEM basic values
- For displaying reference value / actual value deviations.

MFT-H Parameterizing device

p0120202

Use
For assigning parameters to all Belimo MFT actuators and VAV-Compact NMV-D2M controllers. For operating flow rate setting in VAV installations employing classic control or bus operation.

Function
- For setting operating flow rates $\dot{V}_{MIN}$ / $\dot{V}_{MID}$ / $\dot{V}_{MAX}$
- For selecting operating mode 0...10 V / 2...10 V / adjustable
- For re-setting operating volumetric flow to OEM basic values
- For displaying reference value / actual value deviations
- For assigning parameters
- For address setting in bus systems.

PC-Tool Parameterizing and service software

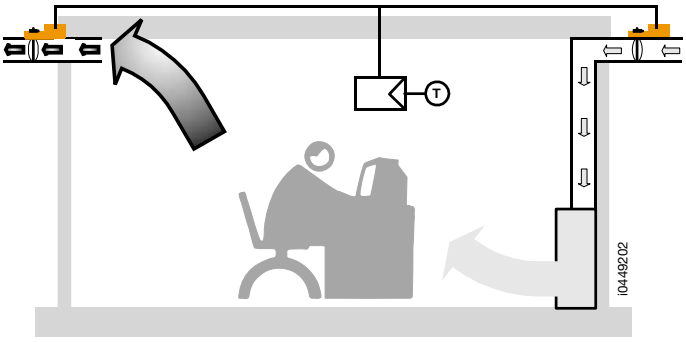
p0121202

Use
For assigning parameters to all Belimo MFT actuators and VAV-Compact NMV-D2M controllers. For operating flow rate setting in VAV installations employing conventional control or bus mode operation.

Function
- For setting operating flow rates $\dot{V}_{MIN}$ / $\dot{V}_{MID}$ / $\dot{V}_{MAX}$
- For selecting operating mode 0...10 V / 2...10 V / adjustable
- For re-setting operating volumetric flow to OEM basic values
- For displaying reference value / actual value deviations
- For assigning parameters
- For address settings in bus systems
- For computing and displaying trend and log data
- For displaying volumetric flow in m^3/h, l/s, ft^3/min (cfm).

Functional description:
See separate documentation on ZEV / MFT-H / PC-Tool.

Wiring diagram:
See «Tools», Page 29.



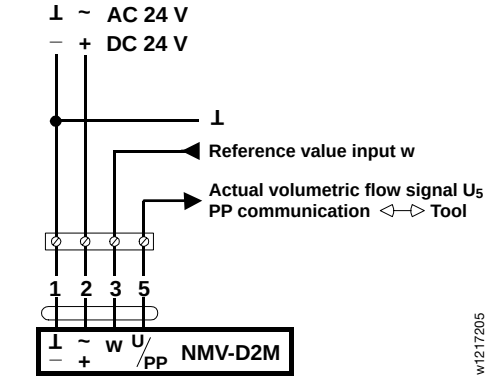
Although it possesses a bus capability, the Belimo VAV-Compact controller NMV-D2M can also be used in classic mode.

Mode of operation

Variable volumetric flow – VAV
In this case the NMV-D2M is driven by a standard modulating control signal, e.g. 0...10 V, to regulate the volumetric flow required at any specific moment.

Constant volumetric flow – CAV
In this case the NMV-D2M maintains the preset value of volumetric flow constant, according to the selected operating step. Multi-step modes of operation are easy to create with a step-by-step control system.

Wiring diagram



⚠ Connect via safety isolating transformer

Note:
It is recommended that Terminal 5 – the actual volumetric flow signal (U_5 / PP) – of each VAV controller be run to the control cabinet because it will enable setting and service work to be carried out without having to have direct access to the VAV controllers themselves.

Restrictions with DC 24 V operation
If the NMV-D2M is powered with DC 24 V, operating steps $\dot{V}_{MID}$ and OPEN cannot be used.
See «CAV: single-step or multi-step operation (Mode 2...10 V)», Page 20.

Maximum conductor length for bus linking
See «Bus control», Page 21.

Wiring / Conductor lengths

Power supply AC 24 V

Nominal voltage	AC 24 V, 50/60 Hz
Nominal voltage range	AC 19.2...28.8 V
For wire sizing	5 VA (Imax. 8.3 A @ 5 ms)
Power consumption	3 W
Connecting cable	1 m long, 4 x 0.75 m²

Conductor length when using an AC power supply
The length of the connecting lead is a function of the power input and the cross-section of the conductor. For the NMV-D2M to function properly the following guide values must be adhered to:

Power supply	Max. length	Conductor cross-section
AC 24 V	200 m	1.5 mm²

If other additional devices are being supplied over the same connecting lead this fact must be taken into account when selecting the appropriate cross-section.

Power supply DC 24 V

Nominal voltage	DC 24 V
Nominal voltage range	DC 21.6...28.8 V
For wire sizing	3 W (Imax. 8.3 A @ 5 ms)
Power consumption	3 W
Connecting cable	1 m, 4 x 0.75 m²

Conductor length when using a DC power supply
The length of the connecting lead is a function of the power input and the cross-section of the conductor. For the NMV-D2M to function properly the following guide values must be adhered to:

Power supply	Max. length	Conductor cross-section
DC 24 V	50 m	1.5 mm²

If other additional devices are being supplied over the same connecting lead this fact must be taken into account when selecting the appropriate cross-section.

Communications connection PP/MP – U_5

In addition to providing the signal for displaying the actual volumetric flow, Terminal 5 can also be used as a temporary connection for operating devices and service tools.
These devices and tools are connected either through the diagnostic socket on the NMV-D2M or by means of the connecting lead *(see «Tools», pp. 29–32).*
For this reason there must be easy access to the connecting lead so it is recommended that the U_5 signal be run to the room controller or to the control cabinet terminals. This will allow operation from a central point without it being necessary to have direct access to the NMV-D2M.

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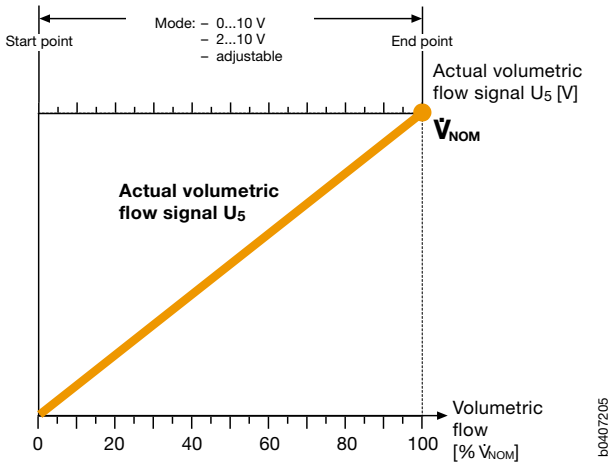


Actual volumetric flow signal U_5

The actual volumetric flow signal U_5:
- **corresponds to 0...100% $\dot{V}_{NOM}$**
- **shows the instantaneous actual value of volumetric flow**
- **is not affected by the $\dot{V}_{MIN}$ and $\dot{V}_{MAX}$ settings**
- **can be adapted in signal format through the Mode resp. variable settings**
- **several NMV-D2Ms can not be connected together in classic control application.**

Effect of mode setting on the U_5 signal
The actual volumetric flow signal U_5 is influenced by the setting of the operating range. This means that if Mode has been set to 0...10 V the display range of the U_5 signal will be 0...10 V, or 2...10 V in Mode 2...10 V.

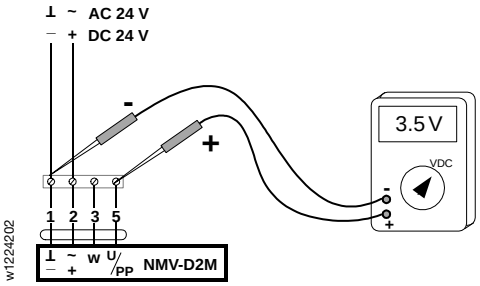
Adjustable actual volumetric flow signal
The U_5 signal can be adapted for special applications with feedback signal U_5.

Adjustable operating range

Start point	DC 0.0 ... 8 V
End point	DC 2.0 ... 10 V

See «Settings», Page 26.

Connecting a voltmeter



Determining air volumetric flow rate from the U_5 signal
This can be done using the actual volumetric flow signal U_5 and an ordinary voltmeter.

The two equations show how the corresponding value of volumetric flow can be calculated from the voltmeter reading:

Equation for Mode 0...10 V

$$\dot{V} = \frac{U_5 \cdot \dot{V}_{NOM}}{10}$$

Example: Mode 0...10 V

To calculate: the instantaneous volumetric flow rate

Voltage measured at U_5: 3.5 V $\dot{V}_{NOM}$: 2500 m³/h

$\frac{3.5 \cdot 2500}{10} = 875$ Therefore, the instantaneous volumetric flow rate is **875 m³/h**

Equation for Mode 2...10 V

$$\dot{V} = \frac{U_5 - 2.0}{8.0} \cdot \dot{V}_{NOM}$$

Example: Mode 2...10 V

To calculate: the instantaneous volumetric flow rate

Voltage measured at U_5: 6.0 V $\dot{V}_{NOM}$: 3300 m³/h

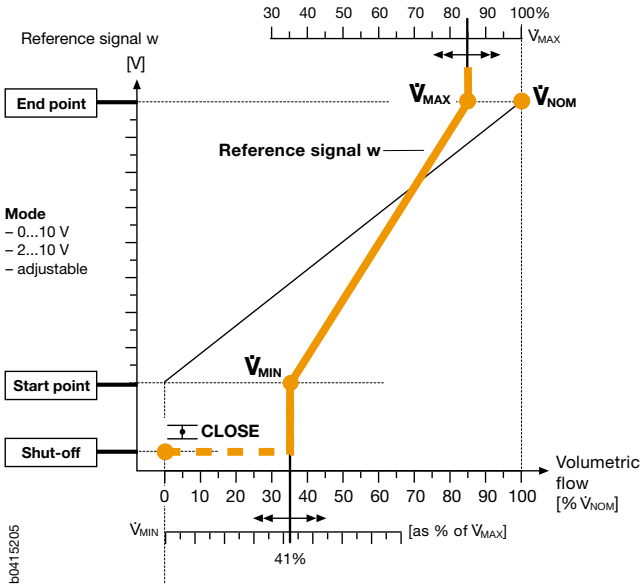
$\frac{6.0 - 2.0}{8.0} \cdot 3300 = 1650$ Therefore, the instantaneous volumetric flow rate is **1650 m³/h**

Note:
It is recommended that Terminal 5 – the actual volumetric flow signal (U_5 / PP) – of each VAV controller be run to the control cabinet because it will enable setting and service work to be carried out without having to have direct access to the VAV controllers themselves.

Determining Mode from the U_5 signal
If there is no suitable tool available the Mode can be ascertained using the U_5 signal and an ordinary voltmeter:

Label the +/– pressure hoses and disconnect them from the NMV-D2M unit.
Allow the sensor to cool down for 2 or 3 minutes, measure the U_5 signal and then reconnect the pressure hoses.

Reading	*Mode*
0 V	0...10 V
2 V	2...10 V
x V	variable MFT setting



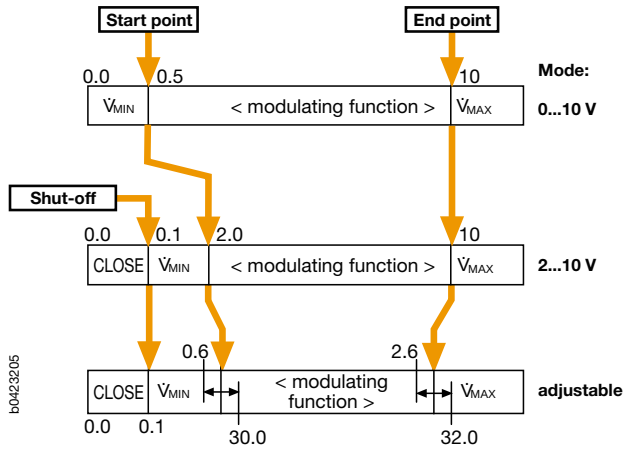
Reference signal w – Effect of Mode on the modulating operating range

The reference signal w:
- **provides control in the $\dot{V}_{MIN}$ to $\dot{V}_{MAX}$ range**
- **controls the NMV-D2M in VAV and CAV applications**
- **can be adapted in signal format through the Mode resp. variable settings.**

Effect of Mode setting on the reference signal
The reference signal w is influenced by the setting of the operating range, i.e. if Mode has been set to 0...10 V the functional range of the reference signal will be 0...10 V, or 2...10 V in Mode 2...10 V.

Mode 0...10 V – shut-off operation
Shut-off operation is only possible when the $\dot{V}_{MIN}$ setting is 0%

Mode 2...10 V – shut-off operation
For shut-off operation the controller / DDC must be able to reduce the reference signal to 0 V.

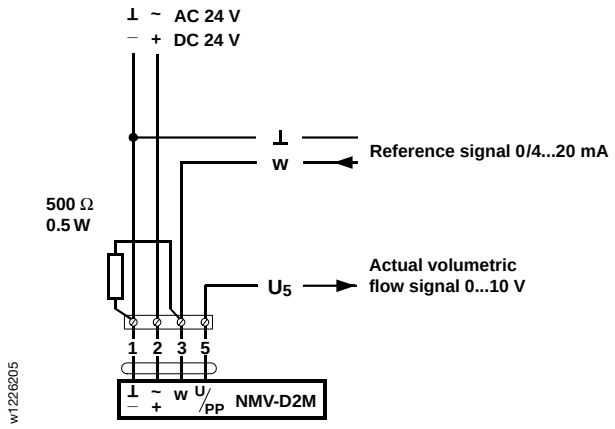


Adjustable
The reference signal can be adapted for special applications such as when using non-Belimo products.

Operating range $\dot{V}_{MIN}$...$\dot{V}_{MAX}$
Start point DC 0.6...30 V
End point DC 2.6...32 V

Note:
- The End point must be at least 2 V above the Start point.
- The Start point must be set so that the operating step $\dot{V}_{MIN}$ is not adversely affected.

For further information see «Setting up», Page 26.



Control by 0...20 / 4...20 mA signal
This is possible with a 500 Ω resistor.

Mode settings:
– 4...20 mA Mode: 2...10 V
– 0...20 mA Mode: 0...10 V

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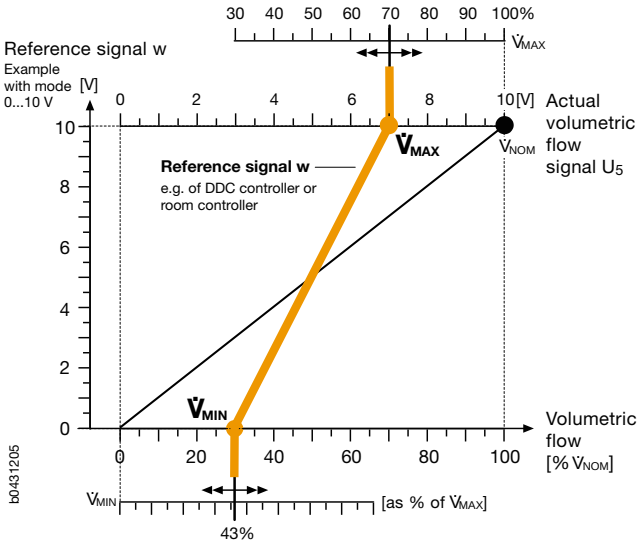
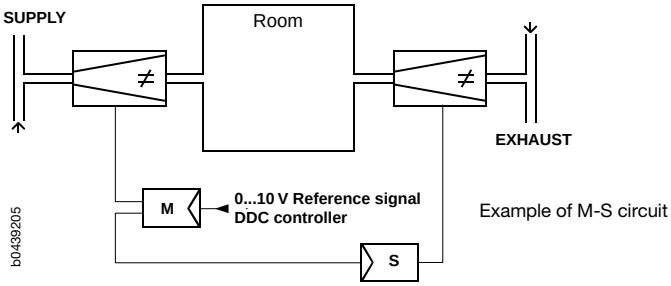
Mode setting: 0...10 V



VAV: Modulating control 0...10 V



Example of M-S circuit

Function

Variable volumetric flow application with 0...10 V control by DDC/PLC or room controller.

The air flow rate is regulated variably – within the preset range of flow rates from $\dot{V}_{MIN}$ and $\dot{V}_{MAX}$ – to the reference value issued by the DDC or room controller.

The reference signal is normally based on room temperature, air quality or a combination of the two. Occupancy control or a timer can be incorporated into the reference signal if necessary. Application with Master-Slave or parallel control.

See «Functions», pp. 10 and 11.

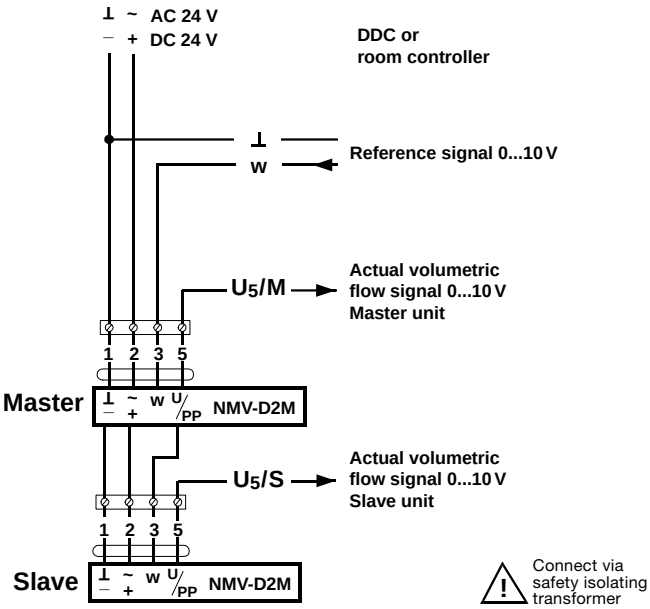
Application

A version of installation for economic operation with high comfort levels suitable for control by room controller, DDC/PLC and conventional integration into building management systems via I/O devices:

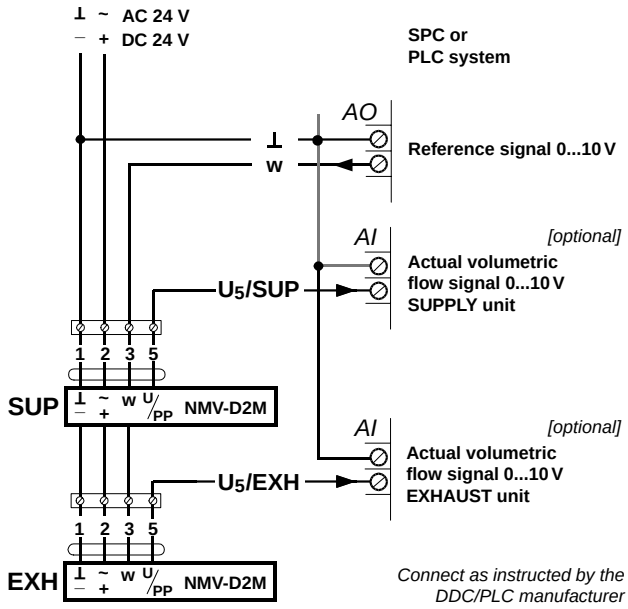
- conference rooms, offices
- presentation and counter rooms
- hotel rooms
- patient wards in hospitals.

Control

by room controller / DDC 0...10 V
in a Master-Slave circuit



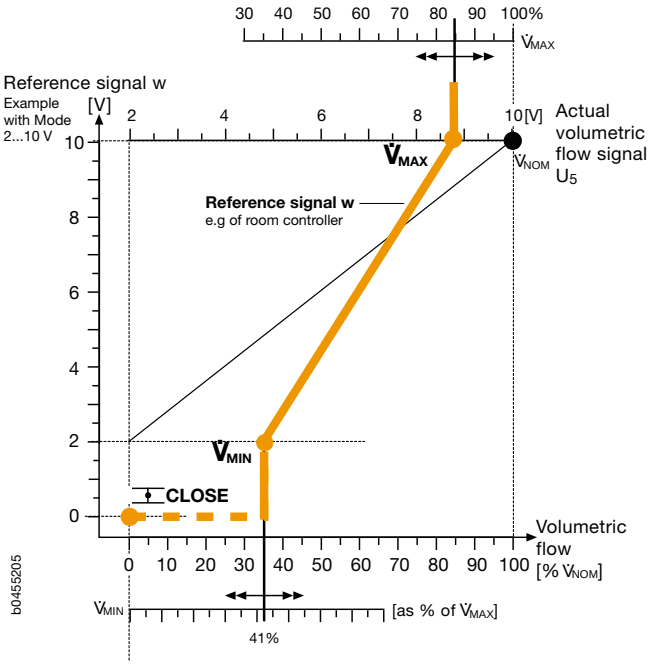
for integration in DDC/PLC via I/O devices
in a parallel circuit



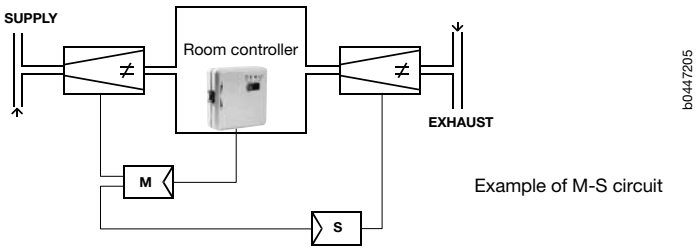
Restrictions

Shut-off operation only possible with $\dot{V}_{MIN}$ set to 0%.

Mode setting: 2...10 V



VAV: Modulating control 2...10 V



Example of M-S circuit

Function

Variable volumetric flow application with 2...10 V control, e.g. by Belimo TR.. room controller.

The air flow rate is regulated variably – within the preset range of volumetric flow rates from $\dot{V}_{MIN}$ and $\dot{V}_{MAX}$ – to the reference value issued by the room controller, positioner, etc.

The reference signal is normally based on room temperature. Occupancy control, energy hold off, etc. can be incorporated into the reference signal if necessary. It is very easy to produce combinations with operating step control with this operating mode, e.g. for shut-off operation.
Application with Master-Slave or parallel control.

See «Functions», pp. 10 and 11.

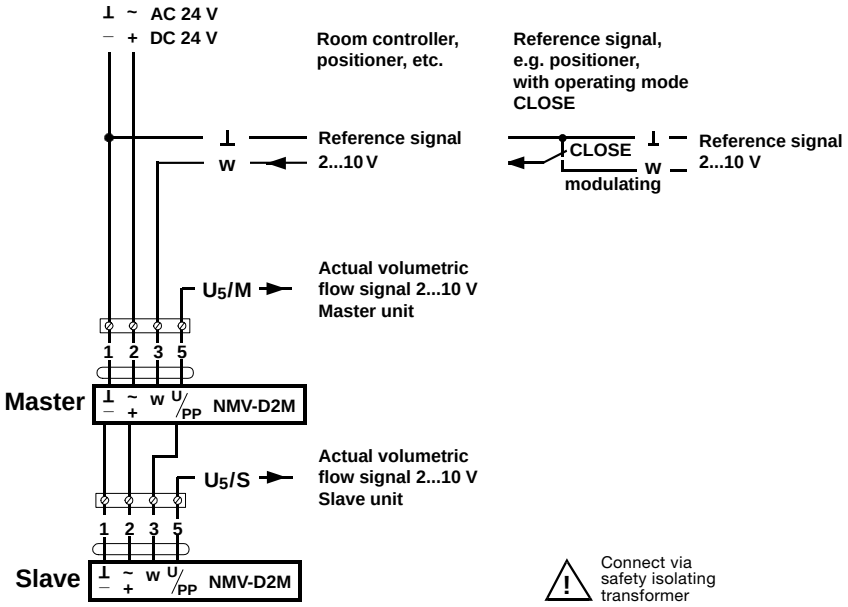
Application

A version of installation for economic operation with high comfort levels suitable for control by positioner, room controller, DDC/SPC and conventional integration into building management systems via I/O devices:

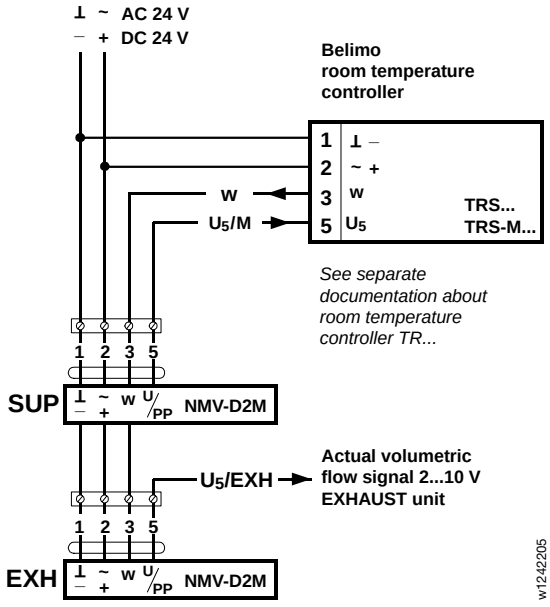
- conference rooms, offices
- presentation and counter rooms
- hotel rooms
- patient wards in hospitals.

Control

2...10 V control
in a Master-Slave circuit



Belimo TR... room temperature controller
in a parallel circuit



Restrictions

For shut-off operation the controller/DDC system must be able to set the reference signal to 0%.

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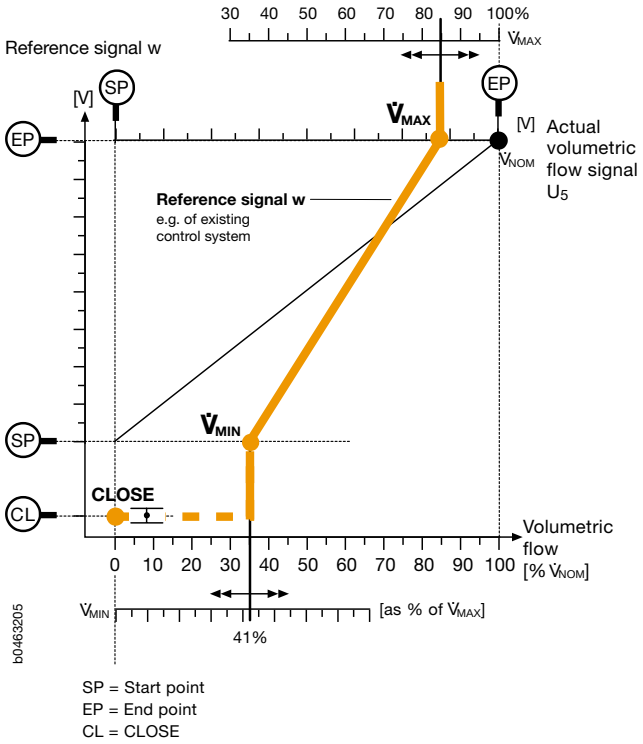
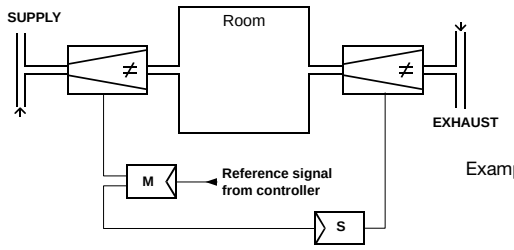
Mode setting: adjustable



VAV: Modulating control with adjustable operating range



Example of M-S circuit

Function

Variable volumetric flow application with a special reference signal, suitable for converting existing installations.

The air flow rate is regulated variably – within the preset range of volumetric flow rates from $\dot{V}_{MIN}$ and $\dot{V}_{MAX}$ – to the reference value issued by the room controller, positioner, etc.

This allows the operating range of the NMV-D2M to be easily adapted to the available reference signal. 0...10 V control with shut-off operation or sequence-forming are a simple matter to implement.
Application with Master-Slave or parallel control.

See «Functions», pp. 10 and 11.

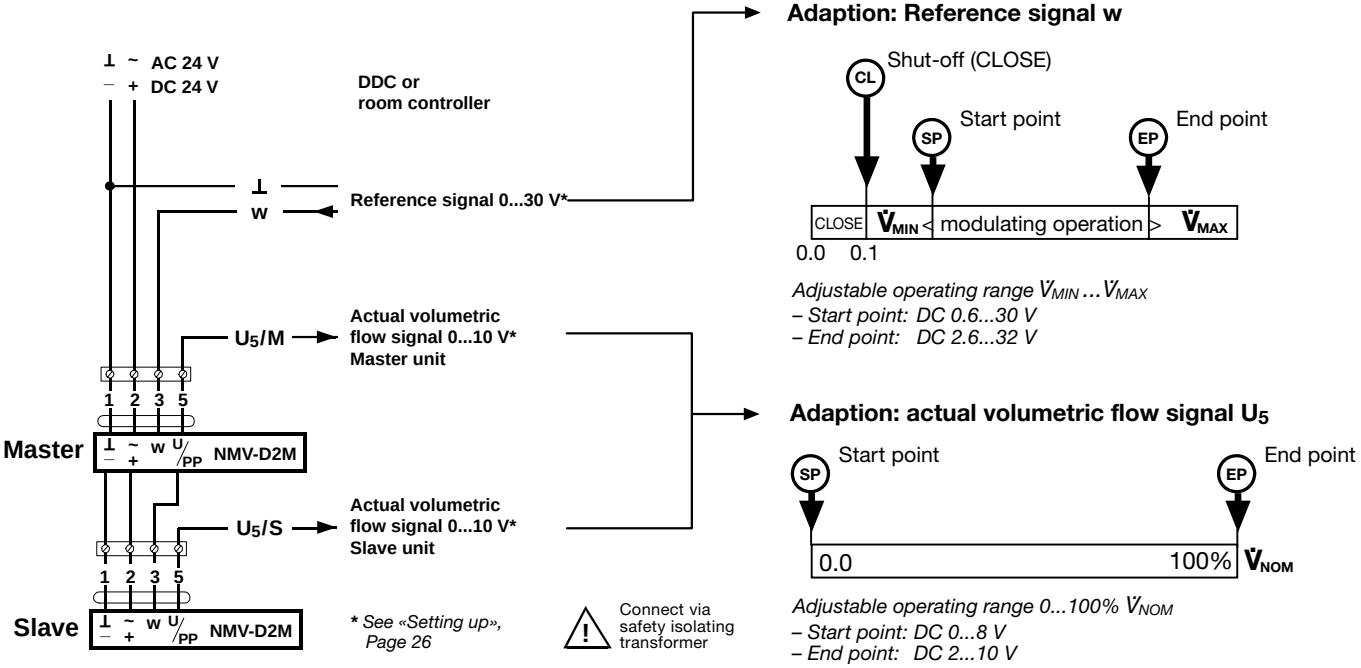
Application

A version of installation for economic operation with high comfort levels suitable for control by existing control systems with a special reference signal:

- conference rooms, offices
- presentation and counter rooms
- hotel rooms
- patient wards in hospitals.

Control

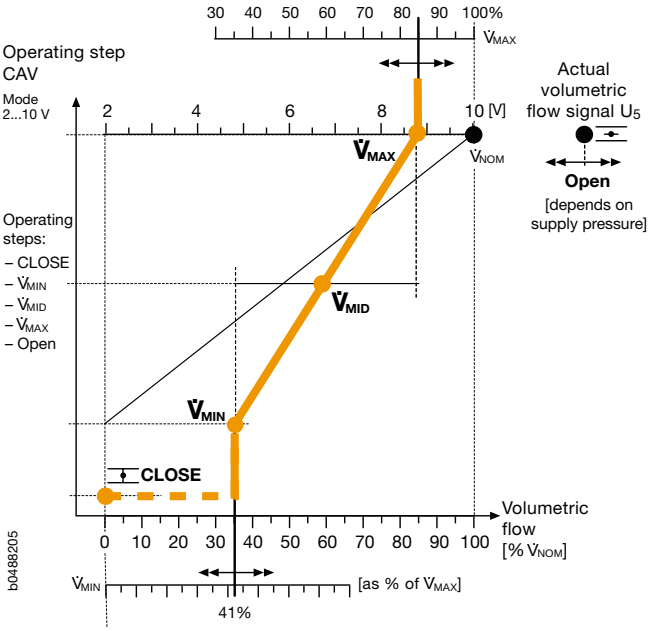
Control by variable signal, incl. shut-off operation
in a Master-Slave circuit



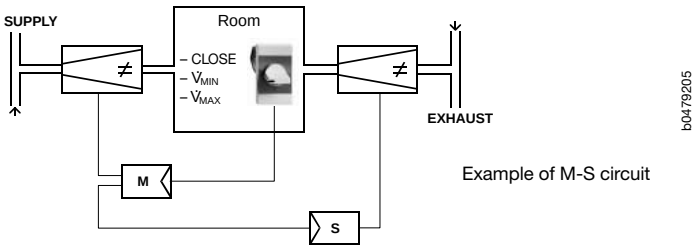
Restrictions

Signal start and span	The Start point is 0.6 V, the minimum signal span is 2.0 V.
Actual volumetric flow signal U_5	The U_5 signal can be set to a maximum of 10 V *(see «Setting up», Page 26).*

Mode setting: 2...10 V



CAV: Single-step or multi-step operation (Mode 2...10 V)



Example of M-S circuit

Function

Constant volumetric flow system (CAV), single-step/multi-step operation. Operating steps: CLOSE / V̇MIN / V̇MID / V̇MAX / OPEN.

The air flow rate is regulated to a constant value – the preset reference value. In multi-step operation the individual steps can be selected by, say, a switch, a timer, an occupancy switch, an air quality control system or a combination of any of them. Application with Master-Slave or parallel control.

See «Functions», pp. 10 and 11.

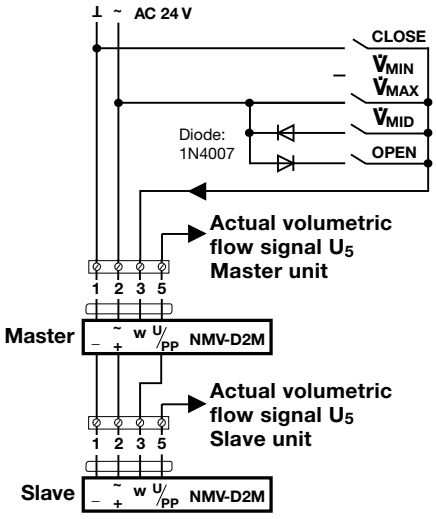
Application

Cost-effective versions of installations for economic operation:

- conference rooms, basic ventilation and occupancy sensing for increasing the number of air changes
- offices, basic ventilation and comfort control by timer, night cool-down
- WCs and auxiliary rooms, lighting-controlled (with after-run)
- shut-off operation, e.g. when unused (occupancy switches), energy hold off (window switches) or malfunction
- open position for cool-down or heat-up, be removed (uncontrolled operation, volumetric flow depends on supply pressure.

Control

by relay contacts or switches
in a Master-Slave circuit (Mode 2...10 V)

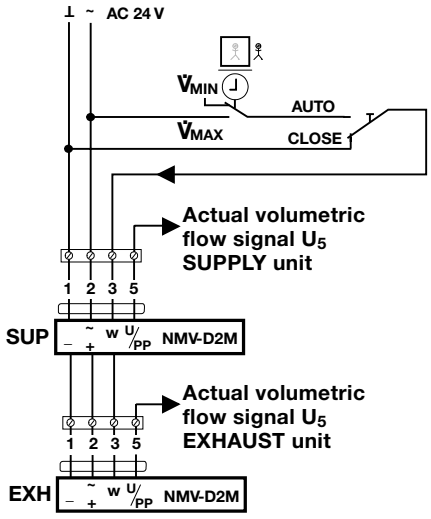


Note:

- V̇MIN –> all contacts open, i.e. Terminal 3 open
- V̇MID and OPEN are not available when a DC 24 V power supply is used
- With multi-step operation the individual operating steps must be interlocked with each other
- With a common 24 V power supply several NMV-D2M's can be controlled by a single operating step system if necessary. Note: Do not interchange the Ground conductor.

Connect via safety isolating transformer

with CLOSE-Auto switch
(clock/occupancy switch: V̇MIN <—> V̇MAX)
in a parallel circuit



Restrictions

Mode: 0...10 V	Although it can also be used for CAV applications, the CLOSED operating step is not then available.
DC 24 V power supply	When a DC 24 V power supply is employed, operating steps V̇MID and OPEN cannot be used.
Customized versions	Some customized versions employ operating step controls that differ from those of the standard NMV-D2M. Clarify with the manufacturer of the unit.

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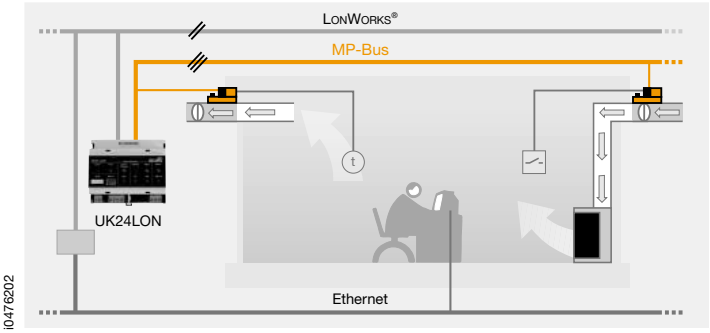
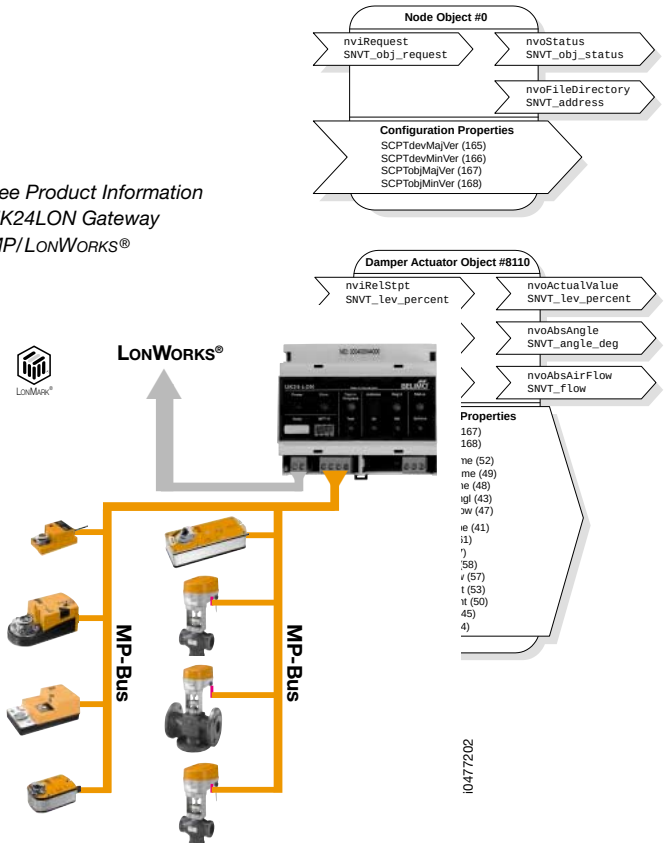


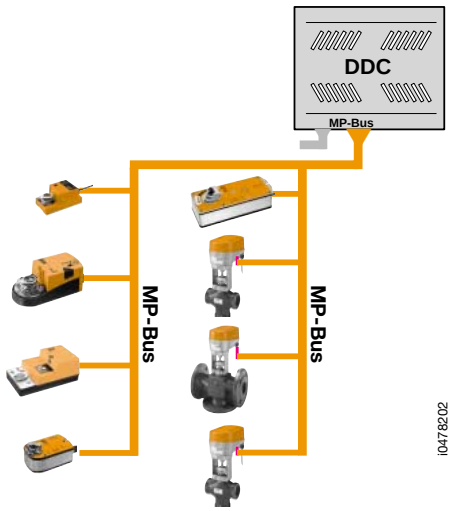
The NMV-D2M VAV-Compact controller can be controlled either conventionally or over an MP-Bus. The latter allows links to LonWorks® and DDC systems to be provided very easily and cost-effective.

Mode of operation

In bus mode the NMV-D2M controller receives its reference signal from the higher level control system over the MP-Bus and regulates the air flow to the required value. The shift to MP-Bus mode is automatic as soon as an MP address has been assigned to the NMV-D2M.
One active sensor or switch can be connected to each NMV-D2M. This input value can be used by the higher level control system for VAV control purposes, e.g. room temperature or other applications.

See Product Information
UK24LON Gateway
MP/LonWorks®





MP-Bus linking to LonWorks®/ DDC systems

MP-Bus

Through the integrated communication facility the NMV-D2M can be linked over a Belimo MP-Bus to a maximum of 8 Belimo MFT2 actuators (damper actuator, valve actuator, VAV-Compact). MFT2 devices receive their digital control signal over the MP-Bus from the higher level Bus-Master and run to the appropriate position.
Bus function is automatically achieved as soon as the MFT2 actuator has been assigned an MP address (1...8) over the MP-Bus.

See «Setting up», Page 26.

Linking to a LonWorks® system

The UK24LON is Belimo's Gateway unit that has been approved by LonMark® for connection to its systems. Its task is to allow a Belimo MP-Bus to be linked to a LonWorks® system. Up to 8 MFT2 actuators can be connected to the MP-Bus side.

Via the UK24LON unit the actuators are controlled digitally over the MP-Bus and provide a feedback signal of their current operating status at any moment. In the UK24LON unit the digital information on control and feedback is converted to standard network variables (SNVTs) so that the actuator functions can be linked directly into the LonWorks® system.

Damper Actuator Object #8110
The actuator object allows the functions of the MFT2 actuators to be replicated on the LonWorks® network side. There are 8 of these objects in the UK24LON unit, i.e. one for each MFT2 actuator. One sensor can be linked to each MFT2 actuator. The sensor values are transferred to the LonWorks® network by means of the Open Loop Sensor Object.

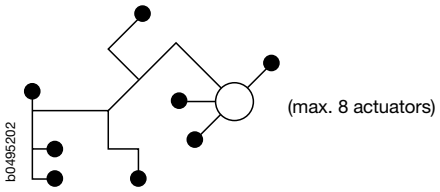
Linking to a DDC system

Various manufacturers of DDC/PLC systems are already offering devices with an integral Belimo MP-Bus. This means, of course, that these devices can be in direct digital communication with the connected MFT2 actuators.

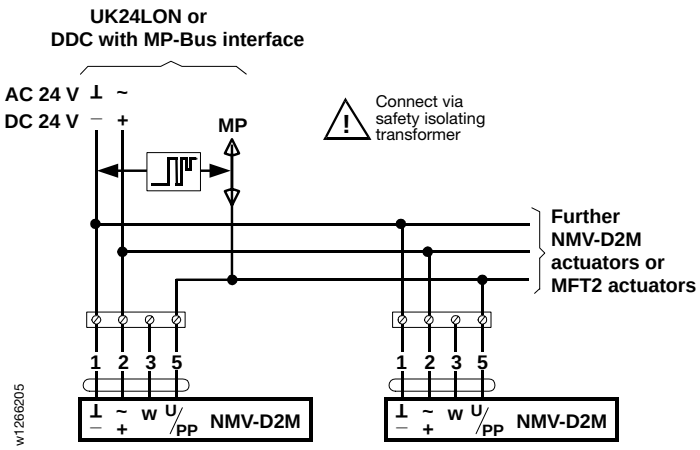
Sensor linking
The sensor linking can also be used with DDC systems.

MP-Bus protocol
Belimo will be happy to provide any DDC system manufacturers who would like to integrate the MP-Bus protocol into their controllers with the necessary technical specification.

Please get in touch with your local regional Belimo agent or representative if you would like the specification or any other information on linking to DDC systems.



Wiring diagram



MP-Bus: Connection / Power supply / Conductor length

Topology
Any required bus topology can be employed for the maximum of 8 actuators that can be connected; there are no restrictions.
The following arrangements can be used:
star/radial, ring, tree or mixed.

Connection
The network employs a 3-core link (MP communication and 24 V power supply). No special cables or terminating resistors are needed.
The power required can be provided either through the bus conductor or from a local power supply.

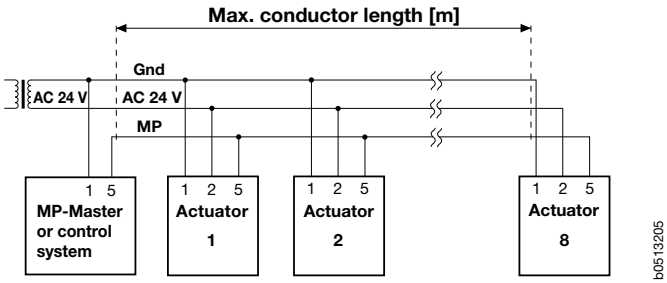
MP-Bus network
Up to 8 MFT2 actuators can be connected to a network (AM24-MFT, NM24-MFT, AF24-MFT, NMV-D2M, etc.).

AC or DC power supplies

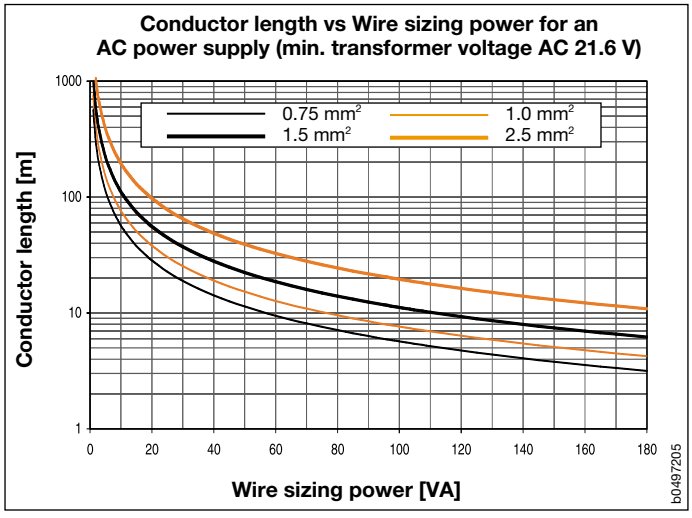
Nominal voltage	AC 24 V, 50/60 Hz	DC 24 V
Nominal voltage range	AC 19.2...28.8 V	DC 21.6...28.8 V
For wire sizing	5 VA (Imax. 8.3 A @ 5 ms)	3 W (Imax 8.3 A @ 5 ms)
Power consumption	3 W	3 W
Connecting cable	1 m long, 4 x 0.75 mm²	1 m long, 4 x 0.75 mm²

MP-Bus conductor length
The lengths of conductor that can be used are limited (calculate as shown below):
- by the total power rating of the MFT2 actuators connected, e.g. NMV-D2M 5 VA / 3 W
- by the type of power supply (AC 24 V or DC 24 V)
- by the cross-sectional area of the conductor

MP-Bus conductor length, AC 24 V supplied via bus conductor



Total wire sizing power for MFT2 actuators [VA]



Calculating maximum conductor lengths (AC 24 V)
The values of wire sizing power (VA) of the NMV-D2M being used, and any additional MFT2 actuators, must be added together. The corresponding lengths of conductor can be read off from the diagram.

Example:
MP-Bus with 4 NMV-D2M controllers

Total wire sizing power:
4 x 5 VA = 20 VA

Read off from the curves as follows:
- Conductor with core Ø 0.75 mm²: **length 28 m**
- Conductor with core Ø 1.0 mm²: **length 40 m**
- Conductor with core Ø 1.5 mm²: **length 54 m**
- Conductor with core Ø 2.5 mm²: **length 90 m**

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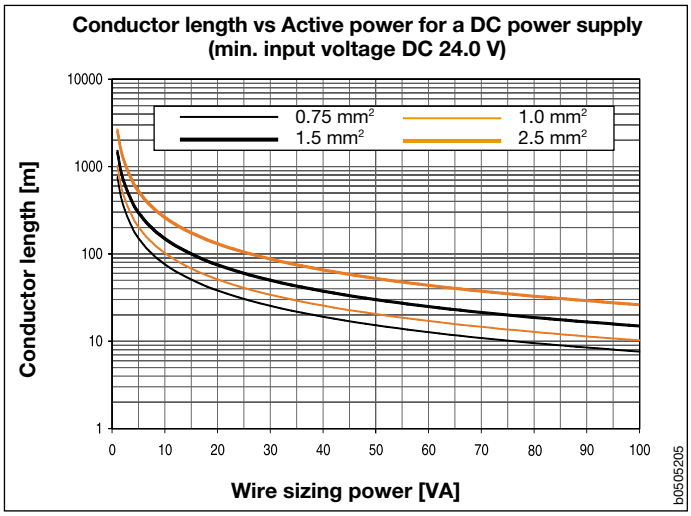
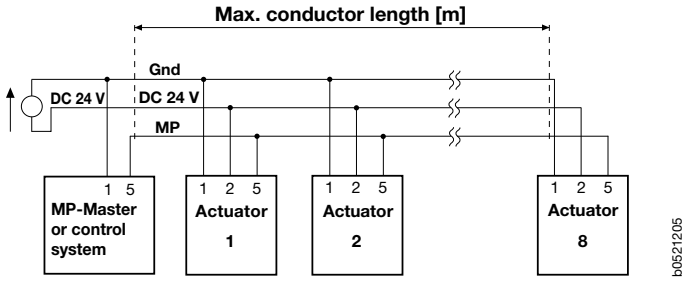
Total power consumption of MFT2 actuators [W]



MP-Bus conductor length, DC 24 V supplied via bus conductor



Calculating maximum conductor lengths

The values of power consumption (W) of the NMV-D2M being used, and any additional MFT2 actuators, must be added together. The corresponding lengths of conductor can be read off from the diagram.

Example:
MP-Bus with 4 in No. NMV-D2M controllers

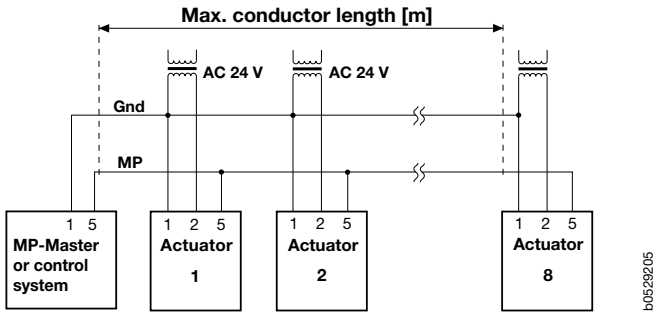
Total wire sizing power:
4 x 3 W = 12 W

Read off from the curves as follows:
- Conductor with core Ø 0.75 mm²: **length 60 m**
- Conductor with core Ø 1.0 mm²: **length 80 m**
- Conductor with core Ø 1.5 mm²: **length 115 m**
- Conductor with core Ø 2.5 mm²: **length 200 m**

Maximum bus conductor length, with local AC 24 V power supply

Core Ø mm²	Max. conductor length [m]
0.75	800
1.0	
1.5	

Bus conductor length with local AC 24 V power supply



If the NMV-D2M or the actuators are supplied with AC 24 V power locally from a separate transformer the conductor lengths can be increased very substantially. The values of length listed in the table are applicable regardless of the rating data of the actuators that are connected.

Linkable sensor signals

- active sensors (0...10 V / 0...32 V signal)
- switching contacts (2-point signal)

Restrictions on passive sensors

In contrast to the other MFT2 devices (AM24-MFT2, etc.) the NMV-D2M cannot work together with passive sensors.

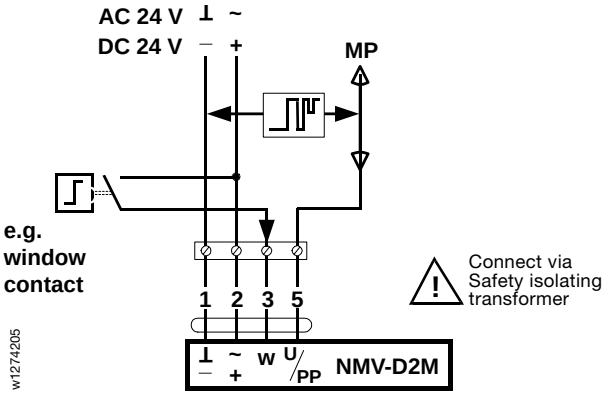
Sensor linking

In bus mode the NMV-D2M is able to have an additional sensor independent of the VAV control circuit linked to it.

The sensor signal is connected to the reference input (Terminal 3) that is not used in bus mode. In this function the NMV-D2M serves as an analogue/digital converter for transferring the sensor signal to the higher level system via the MP-Bus.

The higher level system must be able to recognize the physical address (which sensor to which NMV-D2M) and interpret the corresponding sensor signal.

In order to avoid circulating currents the sensors should be connected via a separate conductor. At least the ground conductor (GND) of the sensor should be separated from that carrying the power supply over as long a distance as possible.



Linking a switching contact to the NMV-D2M (2-point signal)
The NMV-D2M permits the connection of external switching contacts to perform a variety of functions in the higher level control system, e.g. window switches for energy hold off when there are windows open, light switches (auxiliary contacts) for demand-sensitive standby circuits.

Cycle time
Typically 2...8 seconds depending on the number of actuators and sensors connected.

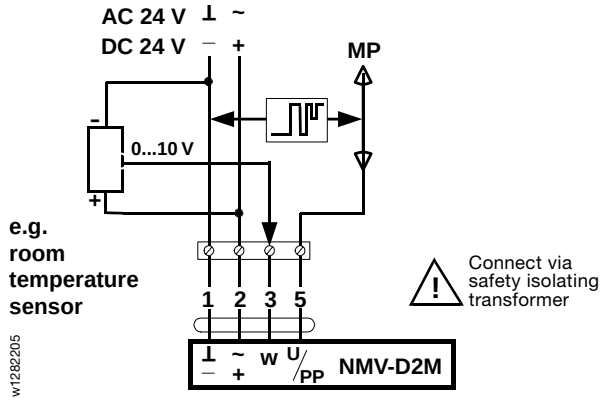
Requirements for switching contacts
The switching contact must be able to provide reliable switching of a current of 16 mA @ 24 V.

Adjusting reference signal w for switch linking
So that the operating status of a switch connected into the system can be interpreted reliably by the NMV-D2M, the start point of the operating range must be set as follows:

– Start point: DC 0.6 V ⎫ It is essential for the Start point
– End point: DC 10 V ⎭ to be set to 0.6 V.

A PC-Tool or MFT-H Device is used for adjusting the reference value input w of the NMV-D2M for linking a switching contact.

See «Setting up», Page 26.



Linking an active sensor to the NMV-D2M
The NMV-D2M allows active sensors with a sensor signal of DC 0...10 V (DC 0...32 V) to be integrated into the system in order to perform additional functions in the higher level control system, e.g. temperature sensing for monitoring minimum room temperature and/or demand-sensitive air volume control, CO_2 sensing for demand-sensitive air volume control. A PC-Tool or MFT-H device is used for adjusting the reference signal input w of the NMV-D2M to the operating range of the appropriate sensor.

See «Setting up», Page 26.

Cycle time
Typically 2...8 seconds depending on the number of actuators and sensors connected.

Description of the active sensors
Sensors with an active sensor signal of DC 0...10 V (adjustable operating range DC 0...32 V).

See «Setting up», Page 26.

MFT adjustment of reference signal w for active sensor linking
– Start point: DC 0.6 V ⎫ Setting according to the operating
– End point: DC 10...32 V ⎭ range of the sensor.

See «Setting up», Page 26.

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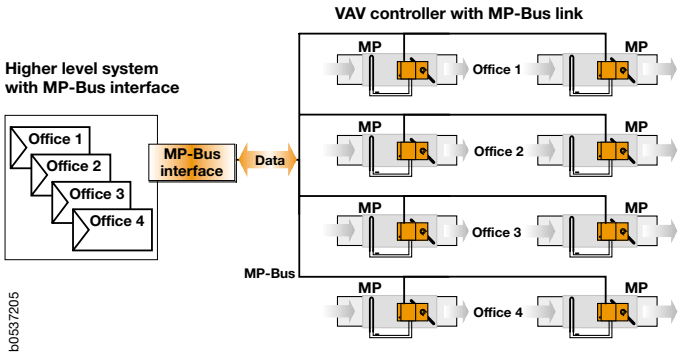

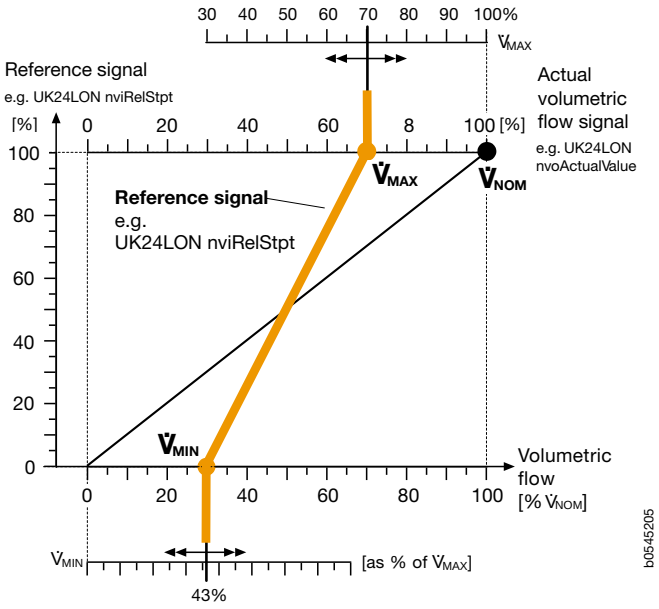

Reference value and actual volumetric flow in bus mode

In bus mode the NMV-D2M receives the necessary digital reference signal over the MP-Bus. The corresponding signals for actual volumetric flow are then transferred from the NMV-D2M to the higher level control system over the MP-Bus.

Example: Installation with Master-Slave function
The actual value of volumetric flow is acquired from the Master VAV controller of the higher level system and issued to the Slave as a reference signal.
For integrating into a LonWorks® system these operations are defined via Damper Actuator Object #8110. The Belimo UK24LON Gateway unit allows up to 8 MFT2 actuators, e.g. NMV-D2M, conforming to this standard to be connected.

For integrating into a DDC system a number of manufacturers offer control equipment with an integral MP-Bus interface.
For further information get in touch with your local Belimo agent or representative.

Adjusting the operating volumetric flow $\dot{V}_{MIN}$ / $\dot{V}_{MAX}$

The reference values issued over the MP-Bus are within the $\dot{V}_{MIN}$ and $\dot{V}_{MAX}$ settings of the NMV-D2M.
$\dot{V}_{MAX}$ provides the upper limit value in relation to the nominal value of volumetric flow. $\dot{V}_{MIN}$ can be adjusted as a percentage of the preset value of $\dot{V}_{MAX}$.

Function	Volum. flow	Adjustment range
$\dot{V}_{NOM}$	nominal	OEM-specific value, depending on application and type of VAV unit
$\dot{V}_{MAX}$	maximum	30...100% of $\dot{V}_{NOM}$
$\dot{V}_{MIN}$	minimum	0*...100% of $\dot{V}_{MAX}$ (*OEM-dependent)

*The minimum setting of volumetric flow $\dot{V}_{MIN}$ depends on the type of VAV unit used and is also affected by creep flow suppression.
See «Creep flow suppression / Minimum setting limit», Page 8.

Open adjustment of operating volumetric flow
An open setting of $\dot{V}_{MIN}$ / $\dot{V}_{MAX}$ can be used if necessary, i.e. by setting $\dot{V}_{MIN}$ 0% / $\dot{V}_{MAX}$ 100%.

In this case the limiting of the volumetric flow has to be effected in the higher level control system. This operational setting allows the limiting of volumetric flow to be adjusted without having to change the parameters of the VAV controller.
It also means that responsibility for the limiting function transfers from the OEM to the supplier / integrator of the system.

Master-Slave and parallel control

Master-Slave control
Master-Slave control is effected through the higher level control system, i.e. this reads the actual value of volumetric flow at the Master unit and processes it to produce a reference value for the Slave unit.

Parallel control
When VAV units are operated in parallel the reference values of the SUPPLY and EXHAUST units are fed in parallel to the two VAV controllers.

See «Functions», Pages 10 and 11.

Positive and negative room pressure

If an installation is planned to have a positive or negative room pressure it will be necessary to take the room pressure ratio into account when the reference value is being calculated.

See «Functions», Pages 10 and 11.

Setting up

Mode of operation
The parameters for reference value, actual volumetric flow signal, etc. can be adjusted individually when necessary for each VAV-Compact NMV-D2M. The parameters needed can be set by the OEM or on-site using the PC-Tool software module «NMV-D2M» or the MFT-H Parameterizing device.

Detailed information is provided in the:
• PC-Tool help file
• MFT-H operating instructions.

Reference signal w

Notes:

U_5 signal adaption
This setting only affects the reference value signal. Adaption of the actual volumetric flow signal U_5 must be adjusted by means of the *actual volumetric flow U_5* parameter.

ZEV Adjuster
«DC variable» adjustments cannot be programmed with the ZEV Adjuster.
For this reason the ZEV Adjuster can only be used for the following applications with classic installations:

– VAV 0/2...10 V control
– CAV with operating steps (Mode 2...10 V)

– Reference signal w (Terminal 3)

Range	Function
DC 2...10 V	Operating range 2...10 V for $\dot{V}_{MIN...}\dot{V}_{MAX}$
DC 0...10 V	Operating range 0...10 V for $\dot{V}_{MIN...}\dot{V}_{MAX}$
DC variable	User-defined operating range for $\dot{V}_{MIN...}\dot{V}_{MAX}$ Start point: DC 0.6...30 V End point: DC 2.6...32 V

– Linking switch to NMV-D2M

Range	Function
DC variable	Start point: DC 0.6 V End point: DC 10 V

– Linking active sensor to NMV-D2M

Range	Function		
DC variable	Start point:	DC 0 V	*see sensor*
	End point:	DC 10...32 V	*manufacturer's data*

Actual volumetric flow signal U_5

Notes:

Reference signal w – signal adaption
This setting only affects the actual volumetric flow signal U_5. Adaption of the reference signal must be implemented by means of the reference signal w parameter.

ZEV Adjuster
«Variable» adjustments cannot be programmed with the ZEV Adjuster.
For this reason the ZEV Adjuster can only be used for the following applications with classic installations:

– VAV 0/2...10 V control
– CAV with operating steps (Mode 2...10 V)

The NMV-D2M must be PP-addressed (classic control) so that the actual volumetric flow signal U_5 function can be used.

With the NMV-D2M the U_5 signal is used exclusively for displaying the actual volumetric flow signal, either for the purpose of measurement (and indication) or as a reference signal in Master-Slave applications.

Range	Function
DC 2...10 V	Operating range 2...10 V for 0...100% $\dot{V}_{NOM}$
DC 0...10 V	Operating range 0...10 V for 0...100% $\dot{V}_{NOM}$
DC variable	User-defined operating range for 0...100 $\dot{V}_{NOM}$, Start point: DC 0...8 V / End point: DC 2...10 V

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Operating volumetric flow

The operating volumetric flow preset by the OEM at the factory can be adapted when necessary to suit actual operating conditions.

Setting	Function
Maximum	$\dot{V}_{MAX}$ parameter (30...100% of $\dot{V}_{NOM}$)
Minimum	$\dot{V}_{MIN}$ parameter (*0...100% of $\dot{V}_{MAX}$) *(lower setting is OEM-dependent, see also Function «Creep flow suppression», Page 8)*
Intermediate value	$\dot{V}_{MID}$ parameter (0...100% of $\dot{V}_{MIN...}\dot{V}_{MAX}$ range)

Movement

Warning:

Setting torque and direction of operation
These values are preset by the manufacturer of the VAV unit (OEM) at the factory.
Any changes to the factory settings can lead to malfunctioning of the unit.

– Torque **Adapting the torque to a VAV unit**

This function allows the maximum value of torque of the NMV-D2M to be reduced.

Step	Function	
100%	Nominal value of torque active	min. 8 Nm
75%	75% of torque active	ca. 6 Nm
50%	50% of torque active	ca. 4 Nm
25%	25% of torque active	ca. 2 Nm

– Direction of operation **Direction of rotation of damper blade**

The setting of the direction of operation defines the direction in which the damper blade rotates when the reference signal w increases –> OPEN.

Rotation	Function	MFT-H designation
ccw ↶	opens counter-clockwise	Normal
cw ↷	opens clockwise	Reverse

Note:

Setting adaption and synchronization
The recommended settings should only be changed under exceptional circumstances.

– Adaption **Triggering criteria**

Adaption of the control characteristics to the available actuating range.

Setting	Function	Remarks
Manual (2x)	Adaption triggered by pressing the manual button twice	Recommended setting
Off	Adaption deactivated	
Automatic on Power-ON and manual (2x)	Adaption triggered by: – power failure – pressing the manual button twice	

– Synchronization **Triggering criteria**

Synchronizing the calculation of position.

Setting	Function	Remarks
0% manual (1x)	Synchronization to CLOSED – at first commissioning – on pressed manual button	Recommended setting
0% manual (1x) and Power-ON	Synchronization to CLOSED – at each power-up – on power failure – on pressed manual button	
100% manual (1x) and Power-ON	Synchronization to OPEN – at each power-up – on power failure – on pressed manual button	

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Actuator identification

– Position **16-character text field**

16-character text string for a specific plant designation:
e.g. field address, plant designation, diagram position.
Entries can only be made by PC-Tool. In the case of the MFT-H this string is only displayed.

NMV-D2M addressing (PP / MP01...08)

When an NMV-D2M is integrated into a bus system it must be assigned a unique MP-Bus address. If address assignment for NMV-D2Ms is performed on-site there are two alternative methods that can be employed:

Addressing with acknowledgement function (manual disengagement push-button)
- Select the required address (PP or MP1...MP8) in the *MP-Address* field (e.g. MP3)
- Select the «Addressing with acknowledgement function»
- Press the OK key. PC-Tool will respond with the following request:
  Actuate the acknowledgement function –> Manual disengagement push-button.

Addressing via Serial No. (see sticker on NMV-D2M)
- In the dialogue box, select the required address (PP or MP1...MP8) in the *MP-Address* field (e.g. MP3)
- Select the «Addressing with known Serial No.» method
- Enter the Serial No. with a bar code reader or at the input field
- Press the OK key.

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Tools

There are various ways of making adjustments and operating the different items of equipment. The simplest method of operation is with the well-known ZEV Adjuster which has two potentiometers for setting the operating volumetric flow.

With the MFT-H Parameterizing device it is possible to display and adjust the parameters of all MFT2 items of equipment, including the NMV-D2M.

The easiest method of operation is by using the Belimo PC-based software PC-Tool. All the parameters can be displayed, adjusted and, if necessary, printed out by means of the «NMV-D2M» software module.

Full documentation for the various operating devices is available separately. Short descriptions of the tools are included here.

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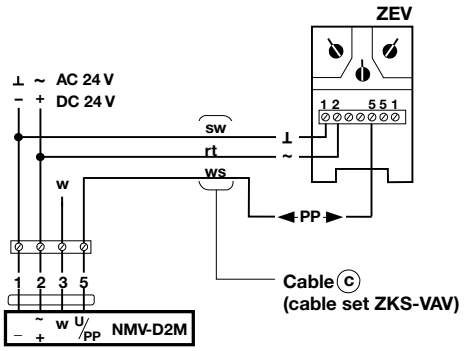
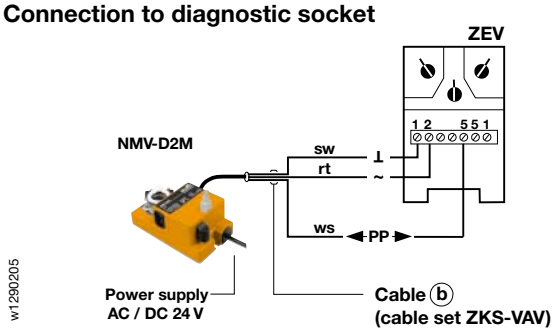
Technical data
See Description 4.A12-980122-E ZEV Connection and Operation

Connection by terminals, in control cabinet or connection box



Connection to diagnostic socket



Note:
The read function (LED indicator) for mode setting does not work in conjunction with NMV-D2M units.

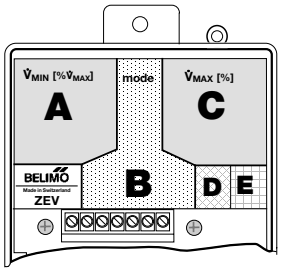
Notes:
- The mode of the NMV-D2M can be set with the ZEV Adjuster to 2...10 V or 0...10 V
- The «Const» mode setting of the ZEV Adjuster is not used in conjunction with the NMV-D2M (CAV applications -> 2...10 V)
- Variable settings of the reference value input w and the actual volumetric flow signal U_5 cannot be displayed or adjusted with the ZEV Adjuster
- As long as the U/MP terminal of the NMV-D2M is connected to the ZEV Adjuster the feedback signal U_5 will not correspond to the actual value of volumetric flow.

ZEV Adjuster

Application
For making local on-site corrections to the operating volumetric flow in VAV/CAV systems with classic control. The ZEV Adjuster is not suitable for use with bus systems.

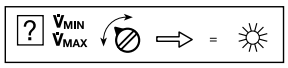
Application
- Setting operating values of volumetric flow $\dot{V}_{MAX}$ / $\dot{V}_{MIN}$
- Selecting operating mode 0...10 V / 2...10 V
- Functional check of control circuit
  display reference value/actual value deviation
- For re-setting operating volumetric flow to OEM basic values.

Operating controls

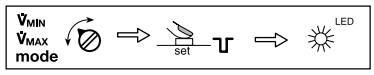


A $\dot{V}_{MIN}$ operating volumetric flow
B Mode selection
Mode selection with the ZEV Adjuster acts on the reference value input and the actual volumetric flow signal
The «Const» setting cannot be used for the NMV-D2M
C $\dot{V}_{MAX}$ operating volumetric flow
D Operating volumetric flow
reference value/actual value comparison
E For re-setting operating volumetric flow to OEM basic values.

Operation

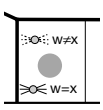


Turn the rotary knob slowly until the indicator LED lights up.
If the LED flashes it means that the value set in the NMV-D2M is higher.



Set the value with the appropriate rotary knob and press the associated «Set» button briefly. A positive «write» process is then indicated by the LED lighting up.

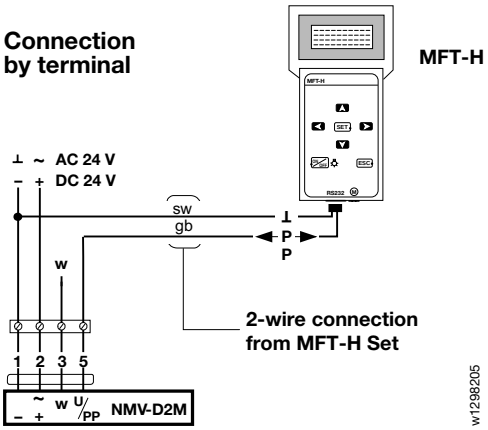
Functional check of control circuit



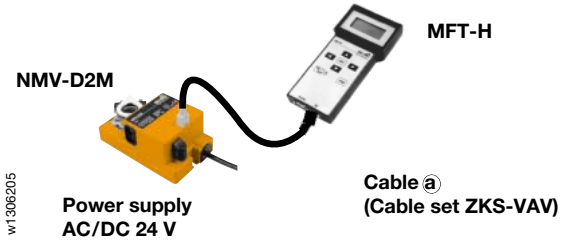
Green LED ON	—> Actual value equal to Reference value
Green LED flashing	—> Actual value not equal to Reference value
– dark	—> Volumetric flow too low
– bright	—> Volumetric flow too high

Technical data
See Description 4.A123-MFT-H-2/E
Operating Instructions MFT-H

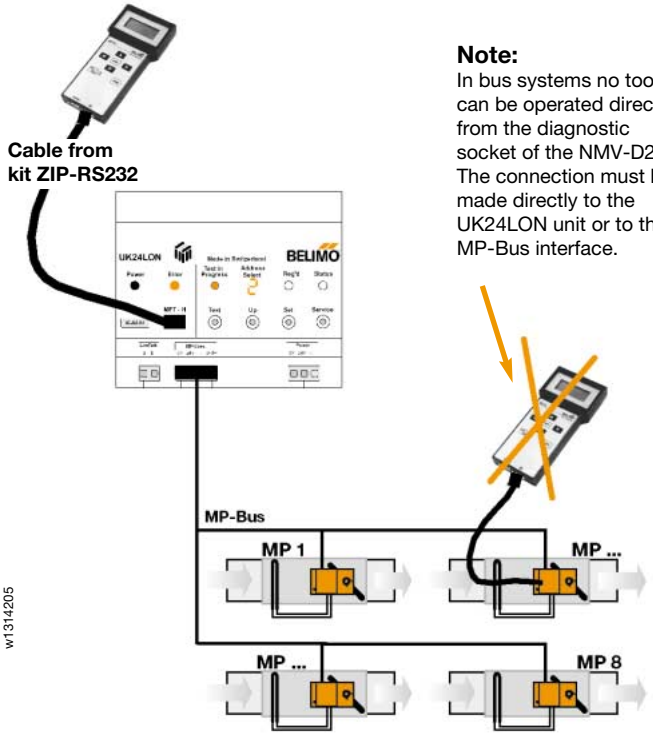
Connection by terminal



Connection to diagnostic socket
(classic control)



Connection for bus systems
(e.g. UK24LON)

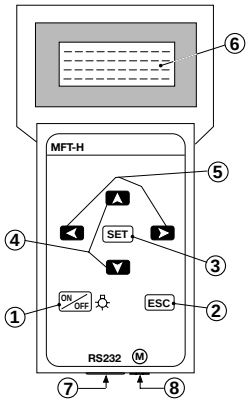


Note:
In bus systems no tools can be operated directly from the diagnostic socket of the NMV-D2M. The connection must be made directly to the UK24LON unit or to the MP-Bus interface.

MFT-H Parameterizing device

Application
For assigning parameters to all MFT2 actuators, including the NMV-D2M. For setting operating volumetric flow in VAV/CAV systems with classic or bus mode control.

Functions
- Setting operating volumetric flow $\dot{V}_{MAX}$ / $\dot{V}_{MIN}$ / $\dot{V}_{MID}$
- Selecting reference signal 0...10 V / 2...10 V / adjustable
- Selecting actual volumetric flow signal 0...10 V / 2...10 V / adjustable
- Setting torque value
- Adaption characteristics / Synchronization setting
- Direction of operation of damper actuator
- Functional check of control circuit
- Addressing in bus systems (PP / MP1...8)
- Test function
- For re-setting operating volumetric flow to OEM basic values.



Operating controls	Action / Function
① **ON/OFF** switch and display illumination	On/Off switching, press briefly once Display illumination, press min. 2 s (MFT-H must already be On)
② **ESC** back key	Press briefly: 1 step (level) back
③ **SET** memory key	Jump to selected menu Program selected command
④ ▼ ▲ Direction keys	Line selection, when there are more than 3 selection points. One press of a key scrolls one line. The longer a key is held depressed, the faster the scrolling. An audible signal is given when the final menu line is reached.
⑤ ◀ ▶ Direction keys	Select several adjacent setting points
⑥ **LCD display**	4-line
⑦ **RS 232 connection**	Level converter PP or MP to RS232
⑧ **M**	Connect MFT2 actuator

Note for classic control applications:
As long as the U/MP terminal of the NMV-D2M is connected to the MFT-H Parameterizing device, the U_5 signal will not correspond to the actual value of volumetric flow.

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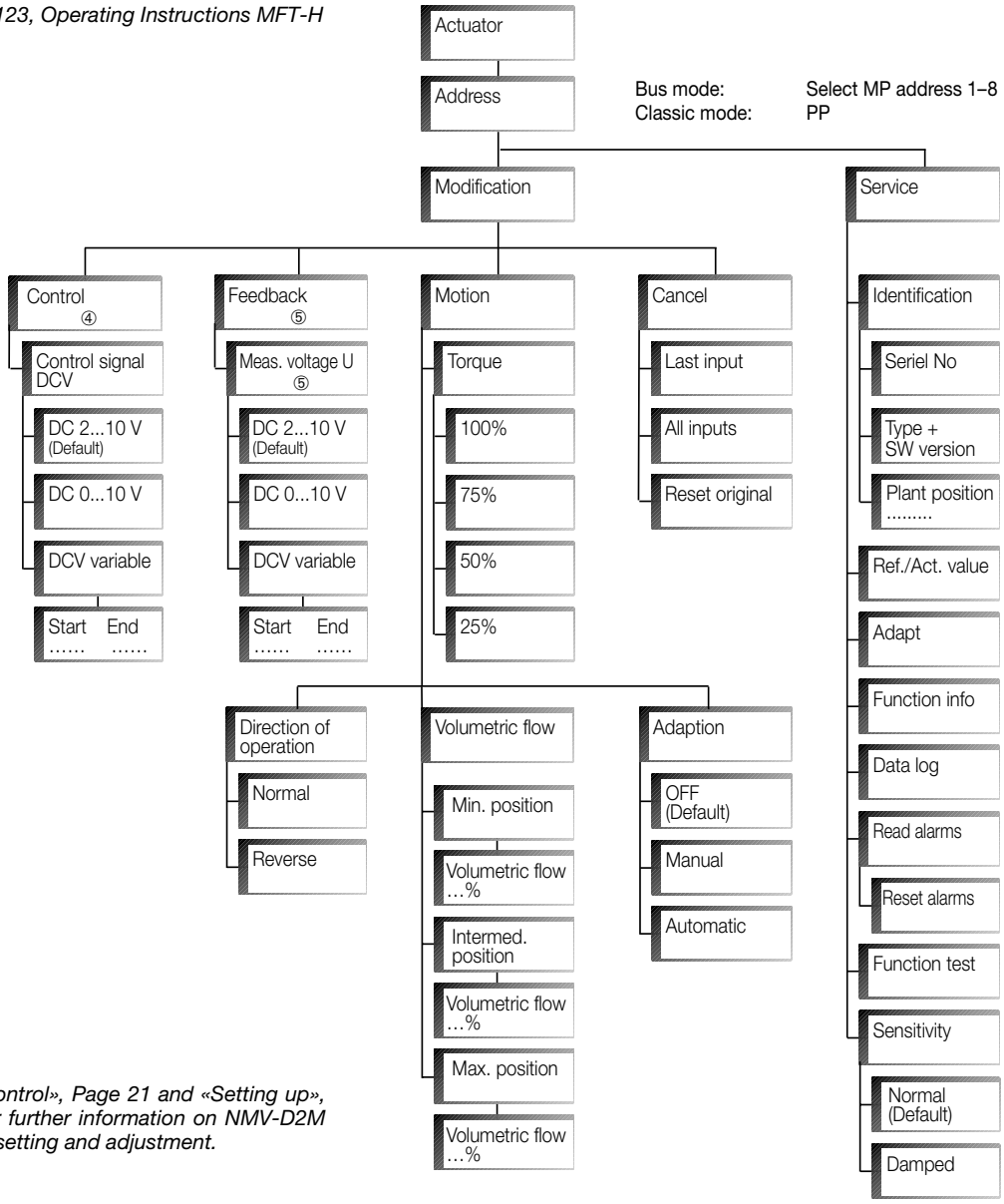
Menu tree for the NMV-D2M

See Description
2.+ 4.+ 6. A123, Operating Instructions MFT-H



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See «Bus Control», Page 21 and «Setting up», Page 26, for further information on NMV-D2M facilities for setting and adjustment.

MP addressing with MFT-H device

Either PP or MP 1...8 can be selected in the «Address» menu.

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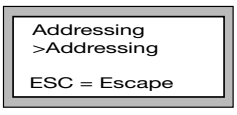
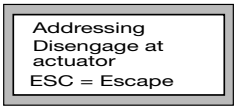
1. Use the keys ▼ ▲ to select the required address (e.g. MP address 4)



2. Press the **SET** key and the following display will appear .....

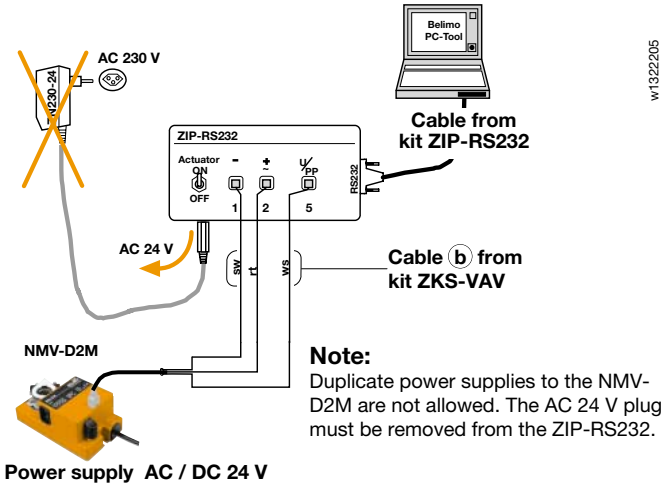


3. Trigger the acknowledgement function at the NMV-D2M:
   Press the manual button of the NMV-D2M once

4. Message «Actuator being programmed...» appears

Connection to diagnostic socket
(classic control application)

NMV-D2M powered from installation



Note:
Duplicate power supplies to the NMV-D2M are not allowed. The AC 24 V plug must be removed from the ZIP-RS232.

PC-Tool Parameterizing and service software

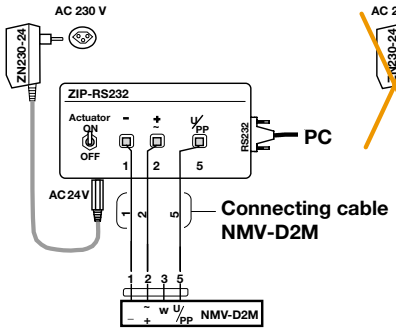
Application
For assigning parameters to all Belimo MFT2 actuators, including the NMV-D2M VAV-Compact controller. For setting operating values of volumetric flow in VAV systems with classic control or bus systems.

Function
- Selecting reference signal 0...10 V / 2...10 V / adjustable
- Selecting actual volumetric flow signal 0...10 V / 2...10 V / adjustable
- Setting operating volumetric flow $\dot{V}_{MIN}$ / $\dot{V}_{MID}$ / $\dot{V}_{MAX}$
- Setting torque value
- Adaption characteristics / Synchronization setting
- Direction of operation of damper actuator
- Functional check of control circuit
- Entering actuator identification: field address (16 characters)
- Addressing in bus mode (PP / MP1...8)
- Actuator information, operating data / alarms
- Test function
- Trend data recording
- Log data recording
- Print function.

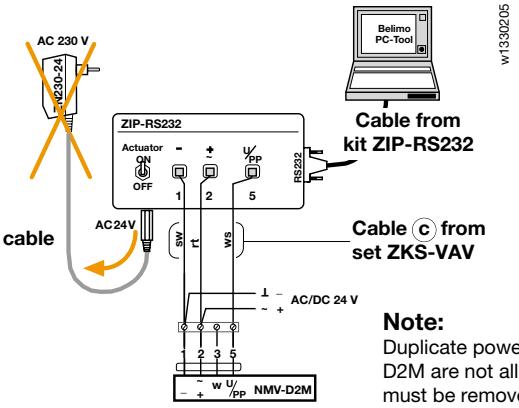
Technical data / Operation
See «PC-Tool» description.

Direct connection in control cabinet or connection box
(classic control application)

NMV-D2M powered from ZIP-RS232



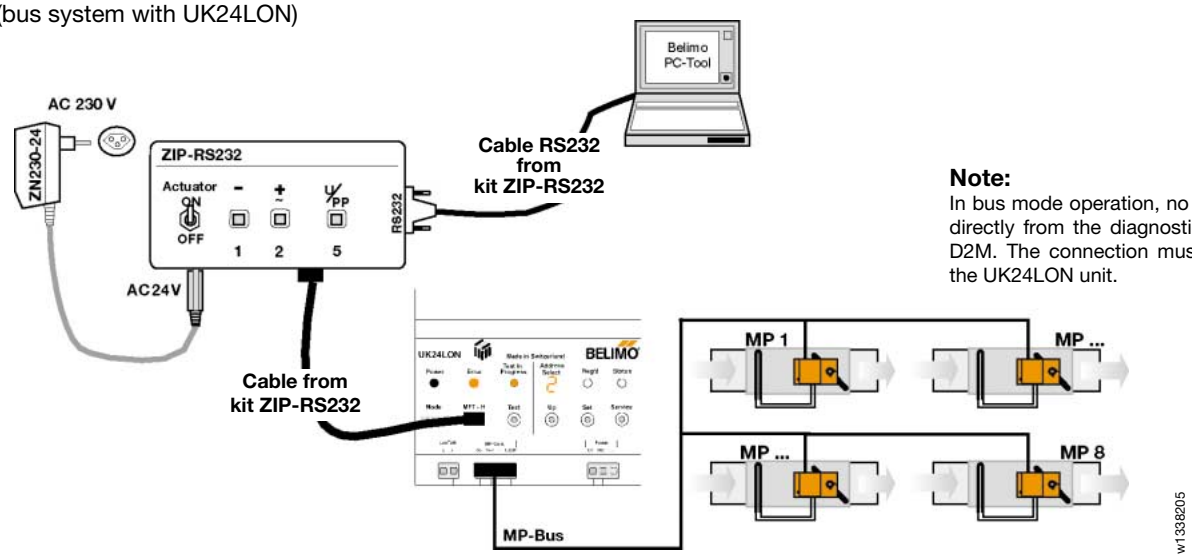
NMV-D2M powered from installation



Note for classic control applications:
As long as the U/MP terminal of the NMV-D2M is connected to the ZIP-RS232/PC-Tool the U_5 signal will not correspond to the actual value of volumetric flow.

Note:
Duplicate power supplies to the NMV-D2M are not allowed. The AC 24 V plug must be removed from the ZIP-RS232.

Connection to UK24LON
(bus system with UK24LON)



Note:
In bus mode operation, no tools can be operated directly from the diagnostic socket of the NMV-D2M. The connection must be made directly to the UK24LON unit.

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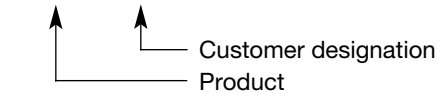
Designation

NMV-D2M xxx



Note:
Please enquire from your local Belimo agent or representative if you have any questions regarding compatibility or electrical control systems associated with the NMV-D2M when working in conjunction with other Belimo or non-Belimo products.

Compatibility: NMV-D2M customized versions

Customized versions of the NMV-D2M are specially designed products intended for use by the manufacturers of VAV units (OEMs). Such versions are adapted specifically to suit the OEM's arrangements of pick-up devices, damper spindles and fixing systems. The operating step control systems of some customized versions differ from those of the standard NMV-D2M units.

Therefore, replacement customized versions can only be obtained through the manufacturers of the particular VAV units concerned.

Compatibility with VAV products

	Belimo VAV Product Range				
Function NMV-D2M	**NMV-D2**	**VRD2**	**VRP+VFP...**	**SBG24 [4])**	**VSW3 [5])**
NMV-D2M as replacement for	1:1 fully replaceable	partly replaceable[1])	no	–	–
NMV-D2M combinable with	yes	yes[2])	yes[3])	yes	yes

1) VAV-Universal VRD2:
   – with KM24-V or NM24-V, replaceable by NMV-D2M, although diagram must be checked.
   – check dimensions when replacing KM24-V
   – 2...10 V / 0...10 V, match mode setting to VRD2 setting
   – control of the operating steps must be checked (diagram and function) with applications in parallel mode.
2) Control of the operating steps must be checked (diagram and function) with applications in parallel mode.
3) Mode 2...10 V. Control of the operating steps must be checked (diagram and function) with applications in parallel mode.
4) SBG24 adapter for connecting to controllers with a 0...20 V phasecut output, e.g. SCS.
5) VSW3 adapter for connecting to controllers with a 3-point output.

Compatibility with operating and service devices / interfaces

	Belimo operating and service devices / interface			
	ZEV	**MFT-H**	**PC-Tool**	**UK24LON**
NMV-D2 (old version)	yes	no	no	no
NMV-D2M	yes[1]) [2])	yes	yes	yes

[1]) Mode selection 0...10 V / 2...10 V, the write setting function is operable, but is not displayed. MFT functions cannot be set.
[2]) The ZEV Adjuster cannot be used for NMV-D2M in bus systems.

Compatibility with Belimo positioners and room temperature controller

	SGF24	**SGA24**	**SGE24**	**TR...**
NMV-D2M	yes	yes	yes	yes

Replacing old Belimo VAV controllers

Enquire from your local Belimo agent or representative when replacing old Belimo VAV controllers such as VR1, VR2, NMV24-V and NMV24-D.

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The first part of this section deals with the various options available for checking the proper functioning of the NMV-D2M VAV-Compact controller.
The second part describes how to analyse malfunctions in installations and how to rectify them.

Function Check

The function check described in the first part is subdivided into three levels. This always allows a properly-directed check to be carried out for whatever purpose, e.g. commissioning, system servicing or system malfunctions.

Test	Description	Application
Level 1	simple go/no-go test	classic and bus control
Level 2	function test with voltmeter	classic control
Level 3	function test with MFT-H / PC-Tool	bus control

«Level 1» Function Check

(classic and bus control)

The «Level 1» Function Check offers users a simple way of checking the proper functioning of the NMV-D2M. The check can be performed via telephone support by the plant operator himself, during which checks are either carried out step-by-step over the telephone or the Level 1 diagram is transmitted by fax.

Checking of the settings and the actual control function of the NMV-D2M is dealt with in the subsequent Level 2 and Level 3 Function Checks.

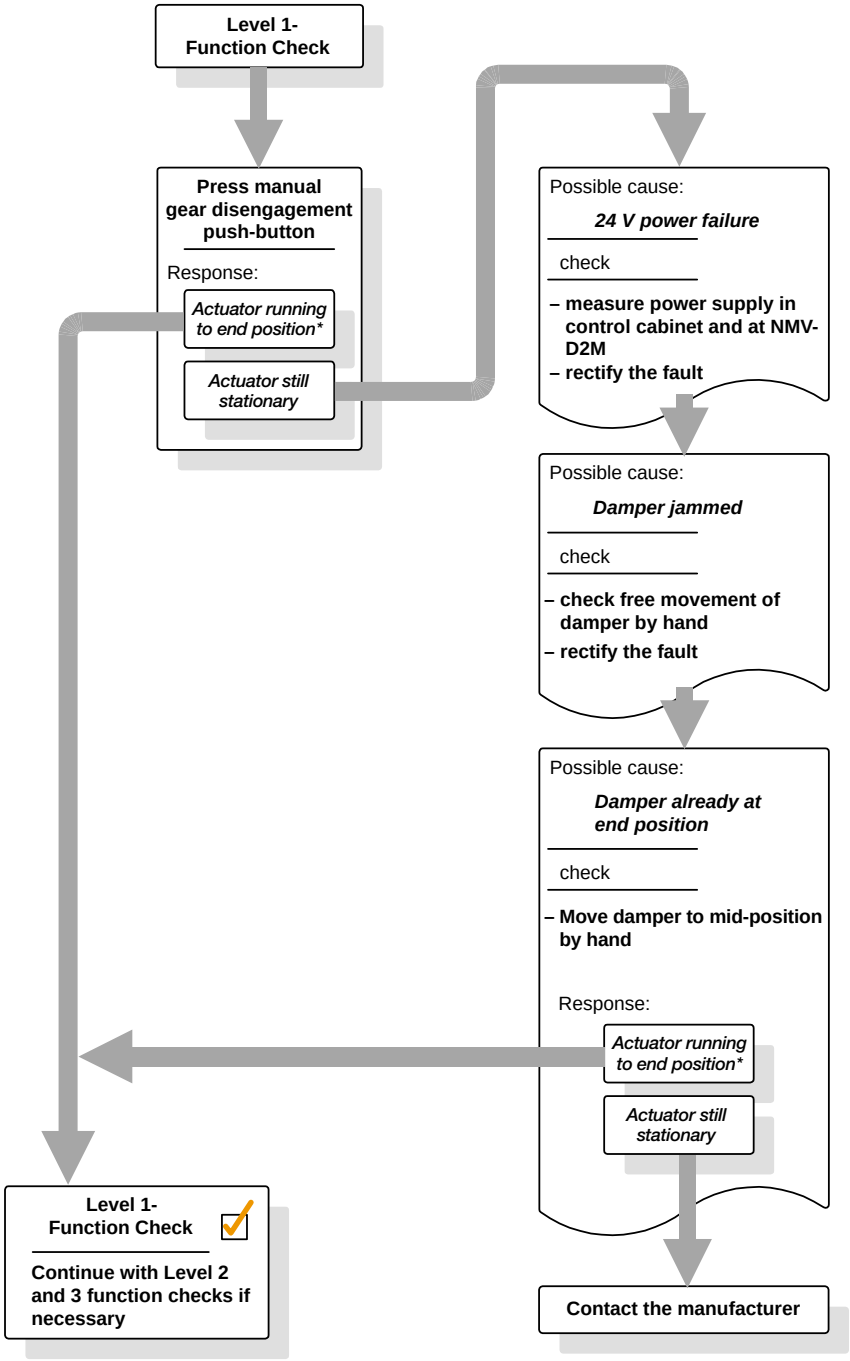
Auxiliary items
– Level 1 Function Check (instructions)
– Voltmeter for checking 24 V power supply

***) Note:**

– **End position**
actuator runs to end position and back to reference position
– End position:
– CLOSED (factory setting)
– synchronizing position 0% or 100%
– **Action when manual push-button is pressed twice**

When the manual push-button is pressed twice, angle-of-rotation adaption is executed if that particular function has been enabled.
The actuator runs to CLOSED – OPEN – Reference position.

Test function PC-Tool / MFT-H
A function test can be initiated with the Belimo PC-Tool or the MFT-H.
So NMV-D2M runs to $\dot{V}_{MIN}$ – V_{MAX} – Reference position.



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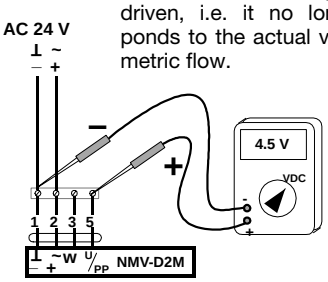
Auxiliary items
- Level 2 Function Check (instructions)
- Voltmeter, if no service tool is available
- Service tool (ZEV, MFT-H or PC-Tool) necessary if the operating volumetric flow $\dot{V}_{MIN}$/$\dot{V}_{MAX}$ need to be adjusted. Otherwise the test can be performed with a voltmeter.

Actual volumetric flow signal U_5
Determining the volumetric flow by means of the U_5 voltage. When a service tool is connected to the NMV-D2M, the U_5 signal is overdriven, i.e. it no longer corresponds to the actual value of volumetric flow.



Equation for Mode 0...10 V

$$\dot{V} = \frac{U_5 \cdot \dot{V}_{NOM}}{10}$$

Equation for Mode 2...10 V

$$\dot{V} = \frac{U_5 - 2.0}{8.0} \cdot \dot{V}_{NOM}$$

Ascertaining the mode without a service tool
If there is no service tool available the mode can be ascertained from the U_5 signal using a voltmeter.
- label the +/– pressure hoses and disconnect them from the NMV-D2M
- allow the sensor to cool down for 2 or 3 minutes
- measure the U_5 signals (Terminals 1 and 5)
- reconnect the pressure hoses.

Reading	*Mode*
0 V	0...10 V
2 V	2...10 V
X V	adjustable value

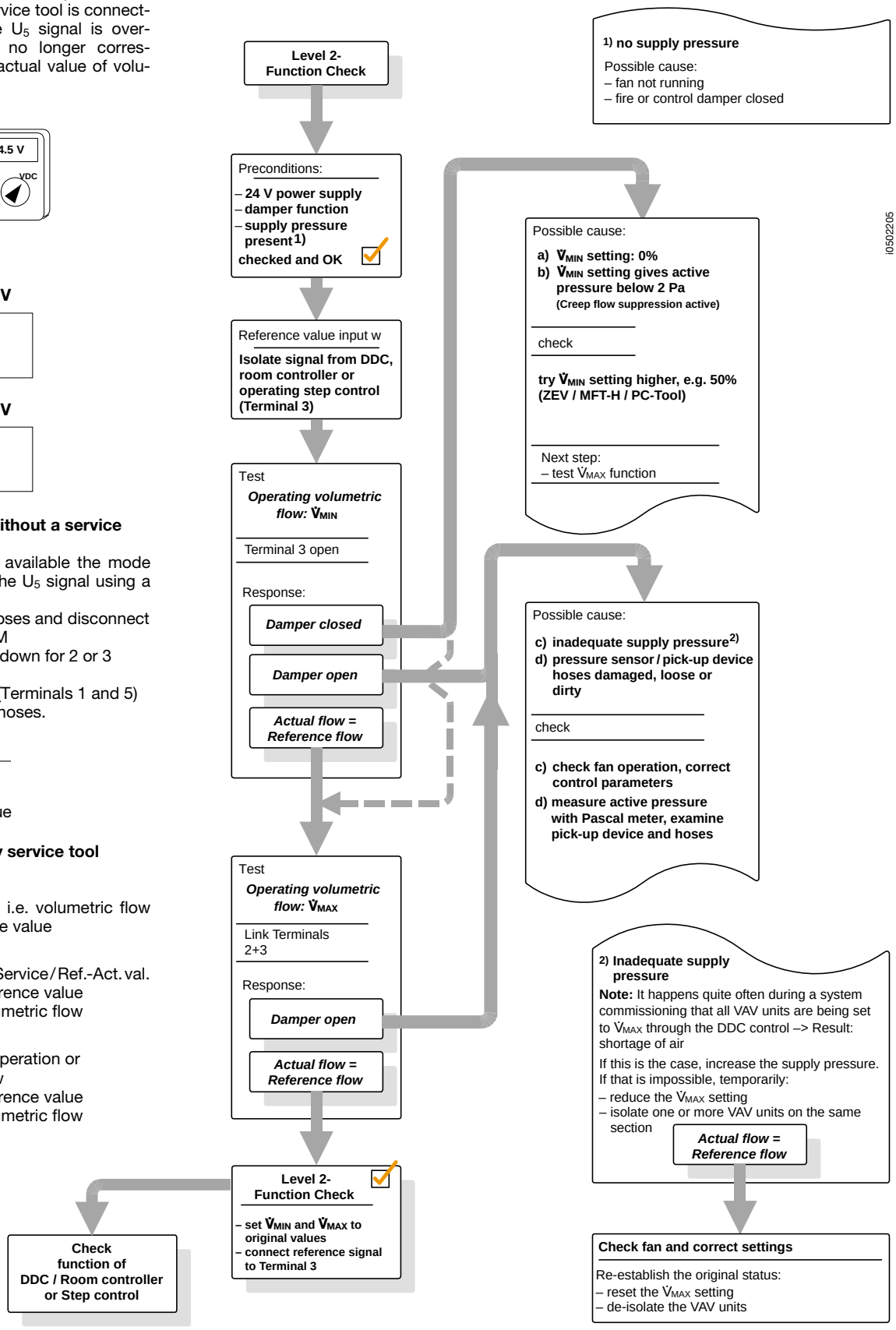
Volumetric flow check by service tool

- **ZEV**
  LED indicator lights up, i.e. volumetric flow corresponds to reference value
- **MFT-H**
  Menu: Actuator / Service / Ref.-Act. val.
  Ref. flow: active reference value
  Actual value: actual volumetric flow
- **PC-Tool**
  Menu: Service / Operation or Trend-view
  Ref. flow: active reference value
  Actual value: actual volumetric flow

«Level 2» Function Check

(classic control)

The «Level 2» Function Check offers users a way of verifying the classic NMV-D2M control functions. It requires the whole air-conditioning system, including fan control, to be fully operational.



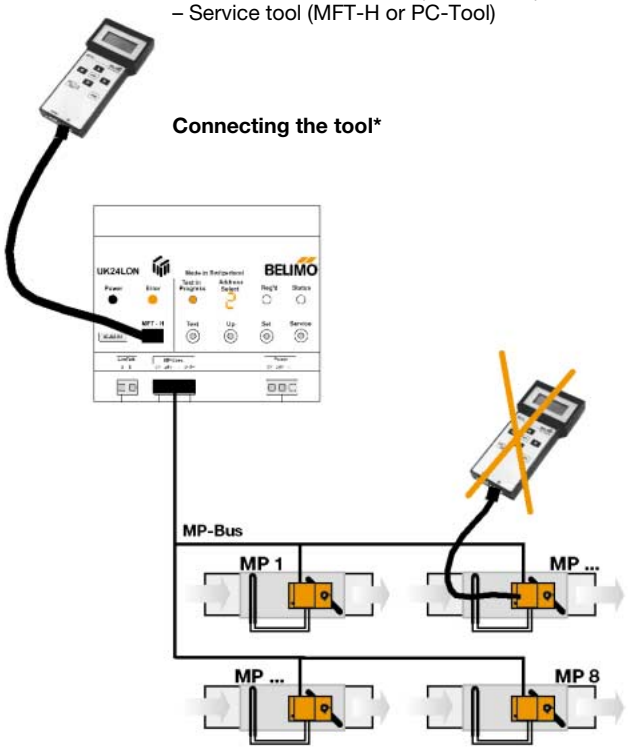
«Level 3» Function Check

(bus control)

The «Level 3» Function Check offers users a way of verifying the NMV-D2M basic functions in a bus system. It requires the whole air-conditioning system, including fan control, to be fully operational.

Auxiliary items
– Level 3 Function Check (instructions)
– Service tool (MFT-H or PC-Tool)

Connecting the tool*



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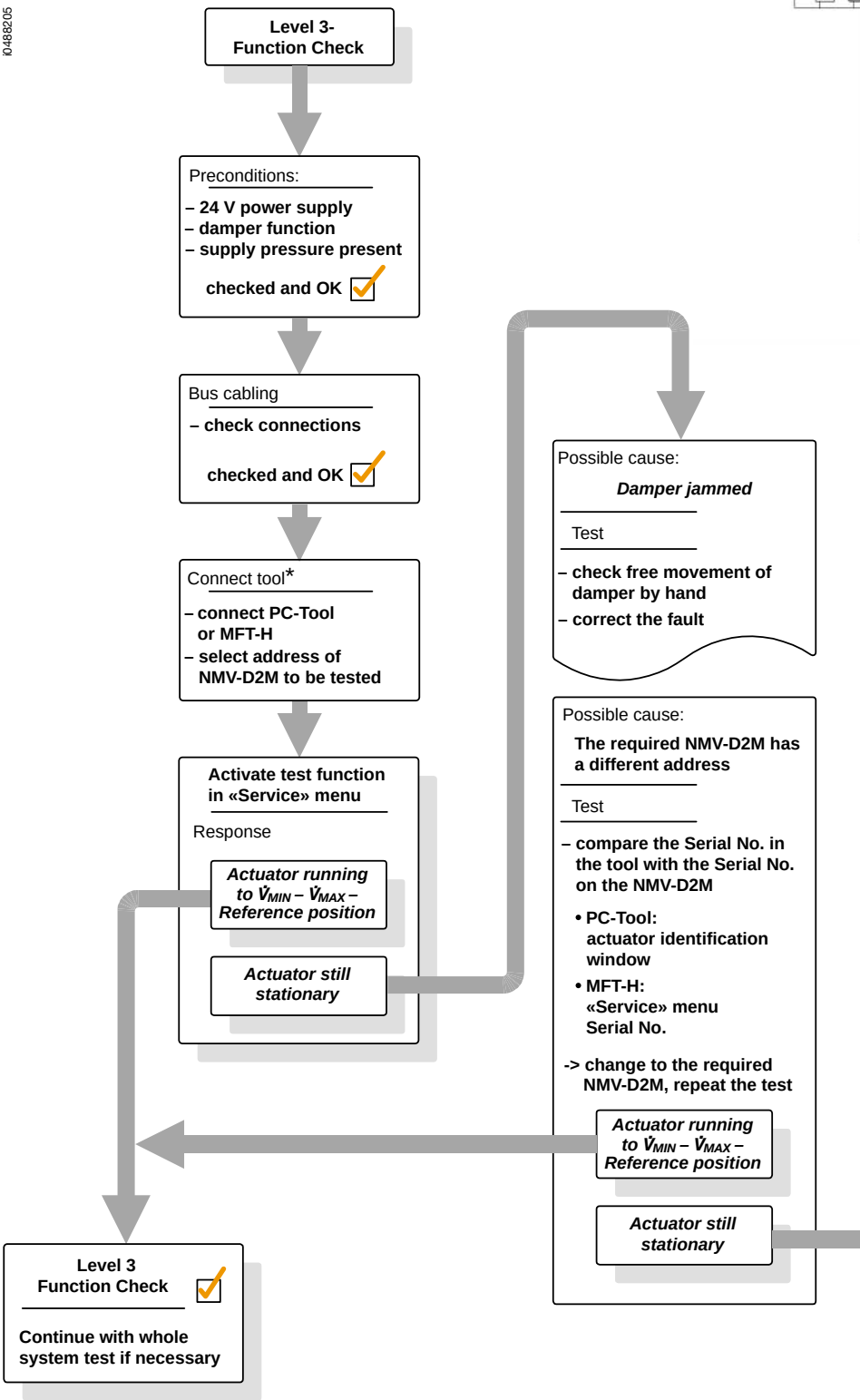

***) Note:**
In bus systems no tools can be operated directly from the diagnostic socket of the NMV-D2M.
The connection must be made directly to the MFT-H socket of the UK24LON unit.

In a bus system the NMV-D2M controllers are controlled digitally, i.e. over the MP-Bus.

Voltmeter
In a bus system a voltmeter cannot be used for ascertaining the actual value of volumetric flow.

ZEV Adjuster
This device cannot be used for communicating with an NMV-D2M over an MP-Bus, i.e. the ZEV Adjuster cannot be used in a bus system.

Either an MFT-H or a PC-Tool must be used for diagnostic purposes and for making adjustments.

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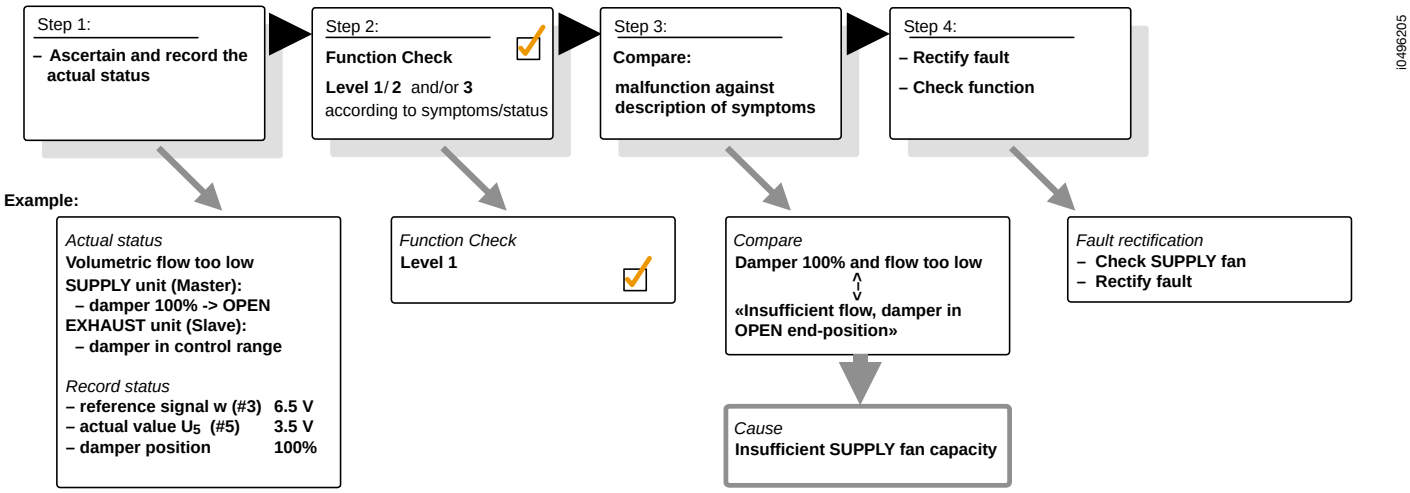
Analysing malfunctions

The following is a description of the symptoms and causes of problems and possible ways of solving them.
Past experience has shown that most malfunctions do not occur in the hardware of the air volume controllers themselves but in their settings, adjustments or control systems. In order to be able to rectify malfunctions efficiently it is advisable to employ a properly structured procedure:



Possible symptoms, their descriptions, causes and rectification

Insufficient volumetric flow, damper in OPEN end-position

Symptom	*Possible cause*	*Fault rectification procedure*
Reference flow not being achieved despite the damper being 100% OPEN (at end-stop)	Fan failure	Check the fan and its control systems and rectify any fault
	Fire damper triggered, i.e. CLOSED	Check that all fire dampers and shut-off dampers between the fan and the VAV unit are OPEN
	Insufficient fan capacity	Measure the capacity of the fan and increase it if necessary, e.g. by increasing the setpoint of the frequency converter
	When a system is being commissioned, several or all rooms are often set (manually) to their maximum volumetric flow with the result that the fan cannot provide the necessary capacity (the simultaneity factor)	Cancel override control and/or reduce the reference signal

Insufficient volumetric flow, damper Master OPEN / Slave CLOSED

Symptom	*Possible cause*	*Fault rectification procedure*
Reference flow not being achieved: – Master unit damper OPEN – Slave unit damper CLOSED	With VAV units in a Master-Slave circuit: – air shortage at the Master (fan defective or OFF), i.e. damper is 100% OPEN – Slave not receiving a reference signal from the Master because the latter is not measuring an actual value of flow –> damper CLOSED	Check the fan in the Master unit section and rectify any faults
		Check that all fire dampers and shut-off dampers between the fan and the Master unit are OPEN

No volumetric flow, damper in CLOSED end-position

Symptom	*Possible cause*	*Fault rectification procedure*
Reference flow not being achieved, damper CLOSED although a reference signal is present	Actual setpoint or $\dot{V}_{MIN}$ setting corresponding to the differential pressure <2 Pa. The damper is CLOSED as a result of the *Creep flow suppression* function	Increase the $\dot{V}_{MIN}$ parameter Adjust the reference signal or the NMV-D2M mode setting
Instead of moving to the $\dot{V}_{MIN}$ value the damper CLOSES (0%)	NMV-D2M in the 2...10 V mode setting is being controlled by a 0...10 V reference signal	Change the NMV-D2M mode setting to 0...10 V

Volumetric flow too high (damper open)

Symptom	Possible cause	Fault rectification procedure
Actual flow too high, damper at OPEN end-stop	Pinched pressure hose	Check the pressure hoses: – label the +/– connections – disconnect the hoses from the NMV-D2M – blow out the hoses
	Pick-up device, pressure hose or pressure sensor dirty Note: The differential-pressure sensor of the NMV-D2M will only need to be cleaned under exceptional circumstances	Check the various items and clean them if necessary: – label the +/– connections – disconnect the hoses from the NMV-D2M – clean and blow out the pick-up device – blow out the hoses – blow out the pressure sensor of the NMV-D2M. Connect a hand pump to the negative connector. Remove any dirt that emerges – replace the pressure hoses – perform a function check

Volumetric flow too low, damper in control range

Symptom	Possible cause	Fault rectification procedure
Required flow not being achieved	Reference signal (DDC, room controller) limited by the software	Check the reference signal (DDC, room controller) and adjust the limiting
	NMV-D2M in the 2...10 V mode setting is being controlled by a 2...10 V reference signal	Correct the NMV-D2M mode setting

Volumetric flow too high, damper in control range

Symptom	Possible cause	Fault rectification procedure
Permanent deviation of the flow from the reference signal (too high)	NMV-D2M in the 0...10 V mode setting is being controlled by a 2...10 V reference signal	Adjust the reference signal or change the NMV-D2M mode setting

Room positive/negative pressure, damper in control range

Symptom	Possible cause	Fault rectification procedure
Undesirable positive or negative pressure in the room	Spindle clamp loose, rotating without damper	Check the attachment of the spindle clamp
	Room pressure ratio incorrectly set	Check the settings operating volumetric flow
	Master-Slave application with limited operating volumetric flow for the Slave controller	Check the settings operating volumetric flow With a balanced room pressure the Slave setting is: $\dot{V}_{MIN}$ 0% / $\dot{V}_{MAX}$ 100% (with equal nominal sizes and air flow rates)
	Incorrect wiring, confusion of VAV units (Master-Slave or parallel circuit) Example: SUPPLY office a with EXHAUST office b SUPPLY office b with EXHAUST office a	Check and correct the wiring
	VAV units with Master-Slave setting are being controlled in parallel	

Air volume controller not responding to reference signal

Symptom	Possible cause	Fault rectification procedure
The VAV controller is regulating to a fixed value but is not responding to changes in the reference signal	There is no reference for the 0/2...10 V reference signal, i.e. no ground (GND) connection	Measure the signals at NMV-D2M Terminals 1 (GND) to 3 (0/2...10 V) Check and correct the wiring
	The polarities of the reference signal and ground (GND) have been confused	Measure the signals at NMV-D2M Terminals 1 (GND) to 3 (0/2...10 V) Check and correct the wiring
	The AC 24 V connections have been confused. When several devices are connected to the same AC 24 V transformer the connections must be in-phase	Check and correct the wiring
	Operating step (override control) active	Check the control system

Damper not moving

Symptom	Possible cause	Fault rectification procedure
Damper not moving	Spindle clamp loose, rotating without the damper	Check the attachment of the spindle clamp

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