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

Products no longer available
The product range for air volume control

**VAV-Compact**
- NMV-D2M
- Sensor
- VAV controller
- Actuators
  - Actuators with safety function
- General accessories:
  - Positioner
  - Room temperature controller
  - Adjuster

**VAV-Universal**
- VFP-100
- VFP-300
- VFP-600
- VRD2
- VRP
- VRP-STP
- NM24-V
- AM24-V
- GM24-V
- LF24-V
- AF24-V
- TRS
- TRS-M
- TRC
- TRP
- ZEV
- ZEV Set
- SGF24
- SGA24
- SGE24

**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

*Products no longer available*
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

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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

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 $V_{\text{MIN}}...V_{\text{MAX}}$ 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 / $V_{\text{MIN}}$ / $V_{\text{MED}}$ / $V_{\text{MAX}}$ / 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.

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.
### Technical data

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<thead>
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<th>Data</th>
<th>Page</th>
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<tr>
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<td></td>
<td></td>
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<tr>
<td>Nominal voltage</td>
<td>AC 24 V / 50/60 Hz / DC 24 V</td>
<td>14</td>
</tr>
<tr>
<td>Nominal voltage range</td>
<td>AC 19.2...28.8 V / DC 21.6...28.8 V</td>
<td>14</td>
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<tr>
<td>For wire sizing</td>
<td>5 VA (I_max. 8.3 A @ 5 ms)</td>
<td>14</td>
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<tr>
<td>Power consumption</td>
<td>3 W</td>
<td>14</td>
</tr>
<tr>
<td><strong>Differential-pressure sensor</strong></td>
<td>2...~300 Pa (depends on OEM)</td>
<td>6</td>
</tr>
<tr>
<td>Operating pressure</td>
<td>max. 1000 Pa</td>
<td>6</td>
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<tr>
<td>Characterizing</td>
<td>linearized for specific differential pressure air probe and OEMs</td>
<td>6</td>
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<tr>
<td>Mounting position</td>
<td>any, no zero setting needed</td>
<td>6</td>
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<td>Operating medium (see «Materials»)</td>
<td>SUPPLY/EXHAUST air for comfort applications and others with sensor-compatible media</td>
<td>6</td>
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<td><strong>Materials</strong></td>
<td>PC+ABS to UL 94V0, stainless steel, DIN 1.4301 X10CrNiS1810; PP Santoprene</td>
<td>6</td>
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<td>0...+50°C / 5...95% rH, non-condensing</td>
<td>6</td>
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<td><strong>Applications VAV and CAV</strong></td>
<td>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</td>
<td>9-11</td>
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<td>according to VAV unit and type of VAV unit</td>
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<td>brushless, non-blocking actuator with current reduction</td>
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<td>clockwise / counterclockwise</td>
<td>27</td>
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<td>95°, with adjustable mechanical limiting</td>
<td>12</td>
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<td>acquisition of angle of rotation and adaption of control range</td>
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<td>push-button, auto-return without affecting functions</td>
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<td>mechanical with pointer</td>
<td>12</td>
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<td><strong>Connecting cable</strong></td>
<td>1 m long, 4 x 0.75 mm², Optional: halogen-free cable</td>
<td>14</td>
</tr>
<tr>
<td><strong>Ambient conditions</strong></td>
<td>0...+50°C, 5...95% rH, non-condensing</td>
<td>22</td>
</tr>
<tr>
<td><strong>Non-operating temperature</strong></td>
<td>≤-20...+80°C</td>
<td>5</td>
</tr>
</tbody>
</table>

**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

*Products no longer available*
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 \( V_{\text{MIN}} \) to \( V_{\text{MAX}} \). 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.

**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
- Check application with VAV-Universal

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**Diagram notes**

- \( \Delta p \) = Differential pressure
- \( \varrho \) = Density of the flow medium
- \( V = c \cdot \sqrt{\Delta p / \varrho} \)

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**Table:**

<table>
<thead>
<tr>
<th>Flow medium</th>
<th>Corrosive flow medium</th>
<th>Dust-laden flow medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>good suitability</td>
<td>Check composition and material compatibility</td>
<td>limited suitability</td>
</tr>
<tr>
<td>good suitability</td>
<td>good suitability</td>
<td>limited suitability</td>
</tr>
<tr>
<td>good suitability</td>
<td>good suitability</td>
<td>limited suitability</td>
</tr>
</tbody>
</table>

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**Legend:**

- \( D \) = Linearization of the flow signal
- \( U_{\text{g}} \) = Communication
- \( P / M \) = Power supply
- \( M \) = Microprocessor
- \( A \) = Sensor electronics
- \( Q \) = Voltage
- \( M_{\text{MIN}} \) to \( M_{\text{MAX}} \) = Setting operating volumetric flow
- \( w \) = Reference value
- \( c \) = Geometry-related constant of the baffle device (differential-pressure pick-up device, dimensions, etc.)
- \( \varrho \) = Density of the flow medium
- \( V \) = Volumetric flow

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**Environmental conditions:**

- Non-corrosive
- Slightly corrosive
- Sea air
- Corrosive
- Dust-laden

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**Material compatibility:**

<table>
<thead>
<tr>
<th>Flow medium</th>
<th>Good suitability</th>
<th>Limited suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0...+ 50°C / 5...95% rH, non-condensing</td>
<td>good suitability</td>
<td>limited suitability</td>
</tr>
</tbody>
</table>
Functions: Setting operating volumetric flow

Nominal volumetric flow $V_{\text{NOM}}$

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. $V_{\text{NOM}}$ 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 $V_{\text{MIN}} / V_{\text{MID}} / V_{\text{MAX}}$

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. $V_{\text{MAX}}$ provides the upper limit depending on the nominal value of volumetric flow. $V_{\text{MIN}}$ can be set as a percentage of the required $V_{\text{MAX}}$.

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

<table>
<thead>
<tr>
<th>Function</th>
<th>Volumetric flow</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{\text{NOM}}$</td>
<td>nominal</td>
<td>OEM-specific value, according to VAV unit type and application</td>
</tr>
<tr>
<td>$V_{\text{MAX}}$</td>
<td>maximum</td>
<td>30…100% of $V_{\text{NOM}}$</td>
</tr>
<tr>
<td>$V_{\text{MIN}}$</td>
<td>minimum</td>
<td>0…100% of $V_{\text{NOM}}$ (*OEM-dependent)</td>
</tr>
<tr>
<td>$V_{\text{MID}}$</td>
<td>mid-position</td>
<td>0…100% [(V$<em>{\text{MAX}} - V</em>{\text{MIN}}$) + V$_{\text{MIN}}$]</td>
</tr>
</tbody>
</table>

*The minimum setting of volumetric flow $V_{\text{MIN}}$ depends on the actual VAV unit used. See Functions: «Creep flow suppression and Minimum setting limit», Page 8).

Setting $V_{\text{MIN}}$ 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.
Functions: Actual volumetric flow signal $U_5$ / Reference signal $w$

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, $V_{NOM}$, 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% $V_{NOM}$
- represents the actual value of volumetric flow
- is not affected by the $V_{MIN}$ and $V_{MAX}$ 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 $V_{MIN}$...$V_{MAX}$
- 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.
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):
- Shut-off operation
  - damper CLOSED: The damper is moved to defined CLOSED (0%).
- Operating steps
  - VMIN...VMAX:
    - 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: VMIN and OPEN are not available with a DC 24 V power supply.*

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

**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 VMIN...VMAX setting.

- Shut-off operation (CLOSED) with VMIN 0%.
  - If shut-off becomes necessary during VAV operation it can be effected by setting VMIN 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:

<table>
<thead>
<tr>
<th>Reference signal w</th>
<th>Volumetric flow</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.1 V*</td>
<td>CLOSED</td>
<td>Damper CLOSED, VAV control inactive</td>
</tr>
<tr>
<td>0.2 ... 2 V</td>
<td>VMIN</td>
<td>Operating step VMIN active</td>
</tr>
<tr>
<td>2 ... 10 V</td>
<td>VMIN, VMAX</td>
<td>Modulating operation VMIN, VMAX</td>
</tr>
</tbody>
</table>

*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 / VMIN, VMAX (Mode 2...10 V)

*Note: «Typical application and connection» see Page 18.*
**Master-Slave sequential circuit**

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 V.\text{MAX} and V.\text{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 / V.\text{MIN}, etc.) is only connected to the Master controller.

**Slave setting for a balanced room pressure ratio**

The V.\text{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 V.\text{MAX} 100% / V.\text{MIN} 0%.

**Slave setting for an unbalanced room pressure ratio**

The V.\text{MIN} setting at the Slave is always 0%. The ratio of Slave volume to Master volume is preset with the V.\text{MAX} value of the Slave controller as follows:

\[
\text{V.\text{MAX S}} = \text{V.\text{MAX M}} \times \left( \frac{\text{V.\text{NOM S}}}{\text{V.\text{NOM M}}} \right)
\]

**Calculate:**

\[
\text{V.\text{MAX S}} = \text{V.\text{MAX M}} \times \left( \frac{\text{V.\text{NOM S}}}{\text{V.\text{NOM M}}} \right)
\]

**Example**

**Required:** Positive room pressure with 20% excess air

- Supply unit: V.\text{NOM} 1600 m³/h / V.\text{MAX} 1500 m³/h
- Exhaust unit: V.\text{NOM} 2400 m³/h / V.\text{MAX} 1200 m³/h

**Calculate:**

\[
\text{V.\text{MAX S}} = \frac{1600}{1200} \times 1500 = 2000 
\]

**Wiring diagram for a conventional M-S circuit**

- When integrating into a DDC system through I/O modules, it is possible, by wiring the actual volumetric flow signal U5 of the Slave controller to an analogue input (Al), to monitor the functioning of both VAV units (sequential function).

**Wiring diagram for a conventional M-S circuit with control**

- The Slave V.\text{MIN} adjustment «0%» provides the point of rotation and intersection.
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 $V_{\text{MAX}}$ and $V_{\text{MIN}}$ 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/$V_{\text{MIN}}$, 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 $V_{\text{MAX}}$ and $V_{\text{MIN}}$ 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.

**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 $V_{\text{MAX}}$ and $V_{\text{MIN}}$ are set at the two controllers.

**Wiring diagram for a classic parallel circuit**

[Diagram showing wiring connections]
Adaption

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.


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:

- $V_{\text{MIN}}$
- $V_{\text{MAX}}$
- 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).

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.
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:

**Use**

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

**Function**

- For setting operating flow rates $V_{\text{MIN}} / V_{\text{MAX}}$
- 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.

**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 $V_{\text{MIN}} / V_{\text{MID}} / V_{\text{MAX}}$
- 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.

**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 $V_{\text{MIN}} / V_{\text{MID}} / V_{\text{MAX}}$
- 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 m³/h, l/s, ft³/min (cfm).

Functional description:

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

Wiring diagram:

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 / 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 (I_max. 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:

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Max. length</th>
<th>Conductor cross-section</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC 24 V</td>
<td>200 m</td>
<td>1.5 mm²</td>
</tr>
</tbody>
</table>

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 (I_max. 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:

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Max. length</th>
<th>Conductor cross-section</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC 24 V</td>
<td>50 m</td>
<td>1.5 mm²</td>
</tr>
</tbody>
</table>

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 – U₅**

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 U₅ 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.

---

**Note:**
It is recommended that Terminal 5 – the actual volumetric flow signal (U₅/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 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**
Actual volumetric flow signal U₅

The actual volumetric flow signal U₅:
- corresponds to 0...100% \( V_{\text{NOM}} \)
- shows the instantaneous actual value of volumetric flow
- is not affected by the \( V_{\text{MIN}} \) and \( V_{\text{MAX}} \) 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 U₅ signal
The actual volumetric flow signal U₅ 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 U₅ signal will be 0...10 V, or 2...10 V in Mode 2...10 V.

Adjustable actual volumetric flow signal
The U₅ signal can be adapted for special applications with feedback signal U₅.

Adjustable operating range
Start point DC 0.0 ... 8 V
End point DC 2.0 ... 10 V

Determining air volumetric flow rate from the U₅ signal
This can be done using the actual volumetric flow signal U₅ 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

\[
V = \frac{U_5 \cdot V_{\text{NOM}}}{10}
\]

Equation for Mode 2...10 V

\[
V = \frac{U_5 - 2.0}{8.0} \cdot V_{\text{NOM}}
\]

Note:
It is recommended that Terminal 5 – the actual volumetric flow signal (U₅/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 U₅ signal
If there is no suitable tool available the Mode can be ascertained using the U₅ 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 U₅ signal and then reconnect the pressure hoses.

<table>
<thead>
<tr>
<th>Reading</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 V</td>
<td>0...10 V</td>
</tr>
<tr>
<td>2 V</td>
<td>2...10 V</td>
</tr>
<tr>
<td>x V</td>
<td>variable MFT setting</td>
</tr>
</tbody>
</table>

Example: Mode 0...10 V
To calculate: the instantaneous volumetric flow rate
Voltage measured at U₅: 3.5 V \( V_{\text{NOM}}: 2500 \text{ m}^3/\text{h} \)
\[
3.5 \cdot \frac{2500}{10} = 875 \quad \text{Therefore, the instantaneous volumetric flow rate is 875 m}^3/\text{h}
\]

Example: Mode 2...10 V
To calculate: the instantaneous volumetric flow rate
Voltage measured at U₅: 6.0 V \( V_{\text{NOM}}: 3300 \text{ m}^3/\text{h} \)
\[
6.0 - 2.0 \cdot \frac{3300}{8.0} = 1650 \quad \text{Therefore, the instantaneous volumetric flow rate is 1650 m}^3/\text{h}
\]
Reference signal w – Effect of Mode on the modulating operating range

The reference signal w:
• provides control in the \( V_{\text{MIN}} \) to \( V_{\text{MAX}} \) 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 \( V_{\text{MIN}} \) 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 \( V_{\text{MIN}}, V_{\text{MAX}} \)
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 \( V_{\text{MIN}} \) 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 \( \Omega \) resistor.

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

Products no longer available
VAV: Modulating control 0...10 V

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 $V_{\text{MIN}}$ and $V_{\text{MAX}}$ – 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.

Restrictions
Shut-off operation only possible with $V_{\text{MIN}}$ set to 0%.
VAV: Modulating control 2...10 V

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

The airflow rate is regulated variably - within the preset range of volumetric flow rates from V MIN and 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%.
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 \( V_{\text{MIN}} \) and \( V_{\text{MAX}} \) 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

Adaption: Reference signal \( w \)

Shut-off (CLOSE)
Start point
End point

Adjustable operating range \( V_{\text{MIN}} \ldots V_{\text{MAX}} \)
- Start point: DC 0.6...30 V
- End point: DC 2.6...32 V

Adaption: actual volumetric flow signal \( U_5 \)

Start point
End point

Adjustable operating range 0...100% \( V_{\text{NOM}} \)
- Start point: DC 0...8 V
- End point: DC 2...10 V

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

Mode setting: 2...10 V

Function
Constant volumetric flow system (CAV), single-step/multi-step operation. Operating steps: CLOSE / V.MIN / V.MID / V.MAX / 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:
- V.MIN -> all contacts open, i.e. Terminal 3 open
- V.MID 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

Restrictions
Mode: 0...10 V
DC 24 V power supply
Customized versions

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

**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.


**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.
**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
- 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, AP24-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 (I-max. 8.3 A @ 5 ms)
- 3 W (I-max 8.3 A @ 5 ms)
- Power consumption 3 W
- Connecting cable 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

**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
Bus control: Conductor lengths / Sensor linking

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

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.

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.


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, CO₂ 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.


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).


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.

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 $V_{\text{MIN}} / V_{\text{MAX}}$

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

<table>
<thead>
<tr>
<th>Function</th>
<th>Volum. flow</th>
<th>Adjustment range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{\text{ROM}}$</td>
<td>nominal</td>
<td>OEM-specific value, depending on application and type of VAV unit</td>
</tr>
<tr>
<td>$V_{\text{MAX}}$</td>
<td>maximum</td>
<td>30...100% of $V_{\text{ROM}}$</td>
</tr>
<tr>
<td>$V_{\text{MIN}}$</td>
<td>minimum</td>
<td>0...100% of $V_{\text{MAX}}$ (*OEM-dependent)</td>
</tr>
</tbody>
</table>

*The minimum setting of volumetric flow $V_{\text{MIN}}$ 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 $V_{\text{MIN}} / V_{\text{MAX}}$ can be used if necessary, i.e. by setting $V_{\text{MIN}} 0\% / V_{\text{MAX}} 100\%$.

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: Reference signal w / Actual volumetric flow signal U5

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

- Reference signal w (Terminal 3)

<table>
<thead>
<tr>
<th>Range</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC 2...10 V</td>
<td>Operating range 2...10 V for (V_{\text{MIN}}, V_{\text{MAX}})</td>
</tr>
<tr>
<td>DC 0...10 V</td>
<td>Operating range 0...10 V for (V_{\text{MIN}}, V_{\text{MAX}})</td>
</tr>
<tr>
<td>DC variable</td>
<td>User-defined operating range for (V_{\text{MIN}}, V_{\text{MAX}})</td>
</tr>
<tr>
<td></td>
<td>Start point: DC 0.6...30 V</td>
</tr>
<tr>
<td></td>
<td>End point: DC 2.6...32 V</td>
</tr>
</tbody>
</table>

- Linking switch to NMV-D2M

<table>
<thead>
<tr>
<th>Range</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC variable</td>
<td>Start point: DC 0.6 V</td>
</tr>
<tr>
<td></td>
<td>End point: DC 10 V</td>
</tr>
</tbody>
</table>

- Linking active sensor to NMV-D2M

<table>
<thead>
<tr>
<th>Range</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC variable</td>
<td>Start point: DC 0 V see sensor</td>
</tr>
<tr>
<td></td>
<td>End point: DC 10...32 V manufacturer’s data</td>
</tr>
</tbody>
</table>

Actual volumetric flow signal U5

The NMV-D2M must be PP-addressed (classic control) so that the actual volumetric flow signal U5 function can be used.

With the NMV-D2M the U5 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.

<table>
<thead>
<tr>
<th>Range</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC 2...10 V</td>
<td>Operating range 2...10 V for 0...100% (V_{\text{NOM}})</td>
</tr>
<tr>
<td>DC 0...10 V</td>
<td>Operating range 0...10 V for 0...100% (V_{\text{NOM}})</td>
</tr>
<tr>
<td>DC variable</td>
<td>User-defined operating range for 0...100 (V_{\text{NOM}}), Start point: DC 0.8 V End point: DC 2...10 V</td>
</tr>
</tbody>
</table>

Notes:

- **Reference signal w – signal adaption**
  This setting only affects the reference value signal. Adaption of the actual volumetric flow signal U5 must be adjusted by means of the actual volumetric flow U5 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)

- **Actual volumetric flow signal U5**
  The NMV-D2M must be PP-addressed (classic control) so that the actual volumetric flow signal U5 function can be used.
  With the NMV-D2M the U5 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.
Setting up: Operating volumetric flow / Movement

### Operating volumetric flow

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

<table>
<thead>
<tr>
<th>Setting</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>( V_{\text{MAX}} ) parameter (30...100% of ( V_{\text{NOM}} ))</td>
</tr>
<tr>
<td>Minimum</td>
<td>( V_{\text{MIN}} ) parameter (*0...100% of ( V_{\text{MAX}} ))&lt;br&gt;*lower setting is OEM-dependent, see also Function «Creep flow suppression», Page 8</td>
</tr>
<tr>
<td>Intermediate</td>
<td>( V_{\text{MID}} ) parameter (0...100% of ( V_{\text{MIN}}...V_{\text{MAX}} ) range)</td>
</tr>
</tbody>
</table>

### Movement

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

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

<table>
<thead>
<tr>
<th>Step</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>Nominal value of torque active min. 8 Nm</td>
</tr>
<tr>
<td>75%</td>
<td>75% of torque active ca. 6 Nm</td>
</tr>
<tr>
<td>50%</td>
<td>50% of torque active ca. 4 Nm</td>
</tr>
<tr>
<td>25%</td>
<td>25% of torque active ca. 2 Nm</td>
</tr>
</tbody>
</table>

#### – 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 \( \rightarrow \) OPEN.

<table>
<thead>
<tr>
<th>Rotation</th>
<th>Function</th>
<th>MFT-H designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ccw</td>
<td>opens counter-clockwise</td>
<td>Normal</td>
</tr>
<tr>
<td>cw</td>
<td>opens clockwise</td>
<td>Reverse</td>
</tr>
</tbody>
</table>

#### – AdaptionTriggering criteria

Adaption of the control characteristics to the available actuating range.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Function</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual (2x)</td>
<td>Adaption triggered by pressing the manual button twice</td>
<td>Recommended setting</td>
</tr>
<tr>
<td>Off</td>
<td>Adaption deactivated</td>
<td></td>
</tr>
</tbody>
</table>
| Automatic on Power-ON and manual (2x) | Adaption triggered by:  
- power failure  
- pressing the manual button twice |                                    |

#### – SynchronizationTriggering criteria

Synchronizing the calculation of position.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Function</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| 0% manual (1x) and Power-ON | Synchronization to CLOSED  
- at first commissioning  
- on pressed manual button | Recommended setting                   |
| 100% manual (1x) and Power-ON | Synchronization to OPEN  
- at each power-up  
- on power failure  
- on pressed manual button |                                    |

---

**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.

**Note:**

**Setting adaption and synchronization**

The recommended settings should only be changed under exceptional circumstances.
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.

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.
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 $V_{\text{MAX}}$, $V_{\text{MIN}}$
- 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.

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.

Functional check of control circuit

- Green LED ON $\Rightarrow$ Actual value equal to Reference value
- Green LED flashing $\Rightarrow$ Actual value not equal to Reference value
- dark $\Rightarrow$ Volumetric flow too low
- bright $\Rightarrow$ Volumetric flow too high

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.
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 \( V_{\text{MAX}} / V_{\text{MIN}} / V_{\text{MID}} \)
- 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
1. ON/OFF switch and display illumination
2. ESC back key
3. SET memory key
4. Direction keys
5. Direction keys
6. LCD display
7. RS 232 connection
8. M

Action / Function
- On/Off switching, press briefly once
- Display illumination, press min. 2 s (MFT-H must already be On)
- Jump to selected menu
- Program selected command
- 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.
- Select several adjacent setting points
- 4-line
- Level converter PP or MP to RS232
- Connect MFT2 actuator

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.

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 U5 signal will not correspond to the actual value of volumetric flow.
**MP addressing with MFT-H device**

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

1. Use the keys \( \text{\textasciicircum} \text{\textasciicircum} \) to select the required address (e.g. MP address 4)

2. Press the \text{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

---

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

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

NMV-D2M powered from 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 \( V_{MIN} / V_{MAX} \)
• 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.

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.

Note:
As long as the U/MP terminal of the NMV-D2M is connected to the ZIP-RS232/PC-Tool the \( U5 \) 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.
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

<table>
<thead>
<tr>
<th>Function</th>
<th>NMV-D2M</th>
<th>VMV-D2</th>
<th>VRD2</th>
<th>VRP+VFP...</th>
<th>SBG24</th>
<th>VSW3</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMV-D2M</td>
<td>1:1 fully replaceable</td>
<td>partly replaceable</td>
<td>no</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>combinable with</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
</tbody>
</table>

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) Mode 2...10 V. Control of the operating steps must be checked (diagram and function) with applications in parallel mode.

3) SBG24 adapter for connecting to controllers with a 0...20 V phasecut output, e.g. SCS.

4) VSW3 adapter for connecting to controllers with a 3-point output.

Compatibility with operating and service devices / interfaces

<table>
<thead>
<tr>
<th>Belimo operating and service devices /interface</th>
<th>ZEV</th>
<th>MFT-H</th>
<th>PC-Tool</th>
<th>UK24LON</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMV-D2 (old version)</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>NMV-D2M</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>SFF24</th>
<th>SGA24</th>
<th>SGE24</th>
<th>TR...</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMV-D2M</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

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.
Function Check: Level 1

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 analyze 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.

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>simple go/no-go test</td>
<td>classic and bus control</td>
</tr>
<tr>
<td>Level 2</td>
<td>function test with voltmeter</td>
<td>classic control</td>
</tr>
<tr>
<td>Level 3</td>
<td>function test with MFT-H / PC-Tool</td>
<td>bus control</td>
</tr>
</tbody>
</table>

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 adaptation 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 $V_{MIN} - V_{MAX} – Reference position.$

«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 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 \( \nu_{\text{MIN}}/\nu_{\text{MAX}} \) 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 over-driven, i.e. it no longer corresponds to the actual value of volumetric flow.

AC 24 V

\[ \begin{align*}
\text{Equation for Mode 0...10 V} & \quad V = U_5 - 2.0 \cdot \nu_{\text{OM}} \\
\text{Equation for Mode 2...10 V} & \quad \nu = \frac{U_5 - 2.0}{8.0} \cdot \nu_{\text{OM}}
\end{align*} \]

Ascertainment of 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
  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.

Possible cause:
- a) \( \nu_{\text{MIN}} \) setting: 0%
- b) \( \nu_{\text{MAX}} \) setting gives active pressure below 2 Pa (Creep flow suppression active)
- c) inadequate supply pressure
- d) pressure sensor/pick-up device hoses damaged, loose or dirty
- e) check fan operation, correct control parameters
- f) measure active pressure with Pascal meter, examine pick-up device and hoses

Test
Operating volumetric flow \( \nu_{\text{MIN}} \)

Terminal 3 open

Response:
- Damper closed
- Damper open

Actual flow = Reference flow

Test
Operating volumetric flow \( \nu_{\text{MAX}} \)

Link Terminals 2+3

Response:
- Damper open

Actual flow = Reference flow

Level 2 Function Check
- set \( \nu_{\text{MIN}} \) and \( \nu_{\text{MAX}} \) to original values
- connect reference signal to Terminal 3

Check function of DDC / Room controller or Step control

Check fan and correct settings
Re-establish the original status:
- reset the \( \nu_{\text{MIN}} \) setting
- de-isolate the VAV units

Note: If this is the case, increase the supply pressure. If that is impossible, temporarily:
- reduce the \( \nu_{\text{MAX}} \) setting
- isolate one or more VAV units on the same section
«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.

**Preconditions:**
- 24 V power supply
- Damper function
- Supply pressure present
  checked and OK ✔

**Bus cabling**
- check connections
  checked and OK ✔

**Connect tool**
- connect PC-Tool or MFT-H
- select address of NMV-D2M to be tested

**Activate test function in «Service» menu**

**Response**
- Actuator running to \( \bar{V}_{\text{MIN}} \) – \( \bar{V}_{\text{MAX}} \) – Reference position
- Actuator still stationary

**Possible cause:**
- Damper jammed
  - check free movement of damper by hand
  - correct the fault

**Possible cause:**
- The required NMV-D2M has a different address
  - compare the Serial No. in the tool with the Serial No. on the NMV-D2M
  - PC-Tool: actuator identification window
  - MFT-H: «Service» menu
    Serial No.
  - change to the required NMV-D2M, repeat the test

**Actuator running to \( \bar{V}_{\text{MIN}} \) – \( \bar{V}_{\text{MAX}} \) – Reference position**
- Actuator still stationary

**Contact the manufacturer**

*) 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.
Analyzing 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:

**Analysing malfunctions**

**Possible symptoms, their descriptions, causes and rectification**

### Insufficient volumetric flow, damper in OPEN end-position

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Fault rectification procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference flow not being achieved despite the damper being 100% OPEN (at end-stop)</td>
<td>Fan failure</td>
<td>Check the fan and its control systems and rectify any fault</td>
</tr>
<tr>
<td></td>
<td>Fire damper triggered, i.e. CLOSED</td>
<td>Check that all fire dampers and shut-off dampers between the fan and the VAV unit are OPEN</td>
</tr>
<tr>
<td></td>
<td>Insufficient fan capacity</td>
<td>Measure the capacity of the fan and increase it if necessary, e.g. by increasing the setpoint of the frequency converter</td>
</tr>
<tr>
<td></td>
<td>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)</td>
<td>Cancel override control and/or reduce the reference signal</td>
</tr>
</tbody>
</table>

### Insufficient volumetric flow, damper Master OPEN / Slave CLOSED

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Fault rectification procedure</th>
</tr>
</thead>
</table>
| 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

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Fault rectification procedure</th>
</tr>
</thead>
</table>
| Reference flow not being achieved, damper CLOSED although a reference signal is present | Actual setpoint or $\dot{V}_{\text{in}}$ setting corresponding to the differential pressure <2 Pa. The damper is CLOSED as a result of the Creep flow suppression function | Increase the $\dot{V}_{\text{in}}$ parameter
Adjust the reference signal or the NMV-D2M mode setting |
| Instead of moving to the $\dot{V}_{\text{in}}$ 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)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Fault rectification procedure</th>
</tr>
</thead>
</table>
| 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 | 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

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

### Volumetric flow too high, damper in control range

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

### Room positive/negative pressure, damper in control range

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Fault rectification procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undesirable positive or negative pressure in the room</td>
<td>Spindle clamp loose, rotating without damper</td>
<td>Check the attachment of the spindle clamp</td>
</tr>
<tr>
<td></td>
<td>Room pressure ratio incorrectly set</td>
<td>Check the settings operating volumetric flow</td>
</tr>
<tr>
<td></td>
<td>Master-Slave application with limited operating volumetric flow for the Slave controller</td>
<td>Check the settings operating volumetric flow</td>
</tr>
<tr>
<td></td>
<td>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</td>
<td>Check and correct the wiring</td>
</tr>
<tr>
<td></td>
<td>VAV units with Master-Slave setting are being controlled in parallel</td>
<td></td>
</tr>
</tbody>
</table>

### Air volume controller not responding to reference signal

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Fault rectification procedure</th>
</tr>
</thead>
</table>
| 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

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Fault rectification procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damper not moving</td>
<td>Spindle clamp loose, rotating without the damper</td>
<td>Check the attachment of the spindle clamp</td>
</tr>
</tbody>
</table>
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VAV systems for individual room air control

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Water applications

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