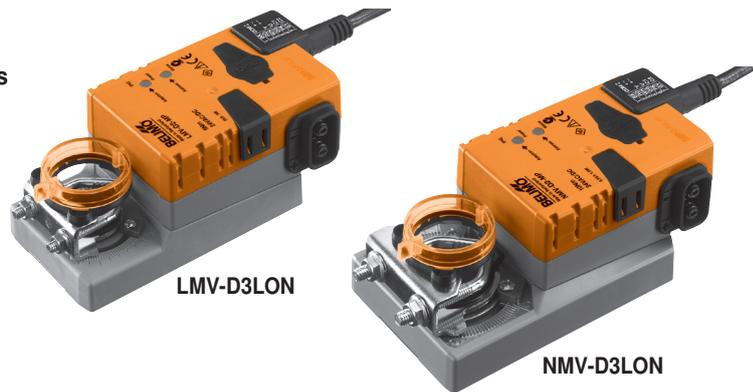# BELIMO®

A pressure sensor, digital VAV controller and damper actuator all in one, providing a VAV-Compact solution with a communications capability for pressure-independent VAV systems in the comfort zone

- Control function: VAV
- Control: LONWORKS®
- Integrated temperature controller
- Integration in LONWORKS® systems
- Conversion of sensor signals
- Service button and LEDs for servicing and commissioning
- Diagnostic socket for operating devices

LMV-D3LON

NMV-D3LON

LONMARK®

Brief description

Application	The digital VAV-Compact has PI control characteristics and is used for pressure-independent control of VAV units in the comfort zone.
Mode of operation	The actuator is equipped with an integrated interface for LONWORKS®. The actuator can be connected and controlled directly with LONWORKS® via transceiver FTT-10A.
Converter for sensors	Connection option for a sensor (passive or active sensor or switching contact). In this way, the analogue sensor signal can be easily digitised and passed along to LONWORKS®.
Integrated temperature controller	The actuator has an integrated temperature controller (Thermostat Object LONMARK® #8060). This makes it easy to implement individual room control solutions. The controller can be set using the LNS plug-in available from Belimo.
Pressure measurement	Maintenance-free, dynamic, differential pressure sensor, proven in a wide range of applications, suitable for use in offices, hospital wards, alpine hotels or cruise liners.
Actuator	Two versions are available, depending on the size of the VAV unit: 5 or 10 Nm.
VAV – variable volumetric flow	The VAV-Compact is supplied with its modulating setpoint by a room temperature controller via LONWORKS®. This facilitates demand-related, power-saving ventilation in individual rooms or zones of air conditioning systems. The operating range ($\dot{V}_{min}$ and $\dot{V}_{max}$) can be set either locally with PC-Tool or ZTH-GEN or by using the LNS plug-in available from Belimo.
Operating and service devices	Belimo PC-Tool or Service-Tool ZTH-GEN, pluggable on the VAV-Compact.
Assembly and connection	The VAV-Compact device, which is assembled on the unit by the OEM, is connected using the prefabricated connecting cable.
OEM factory settings	The VAV-Compact is mounted on the VAV unit by the unit manufacturer, who adjusts and tests it according to the application. The VAV-Compact is sold exclusively via the OEM channel for this reason.

Type listing

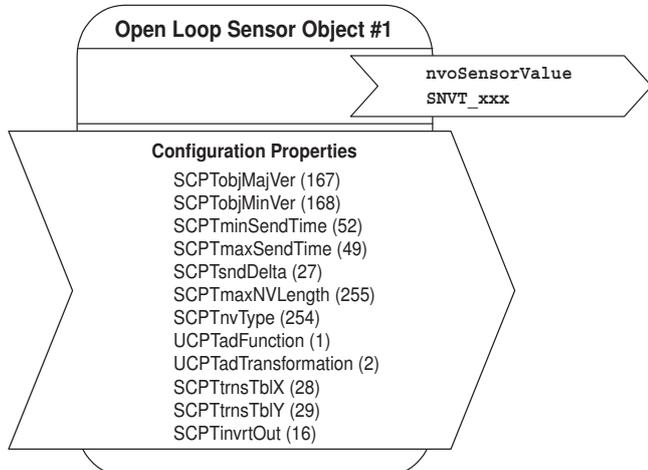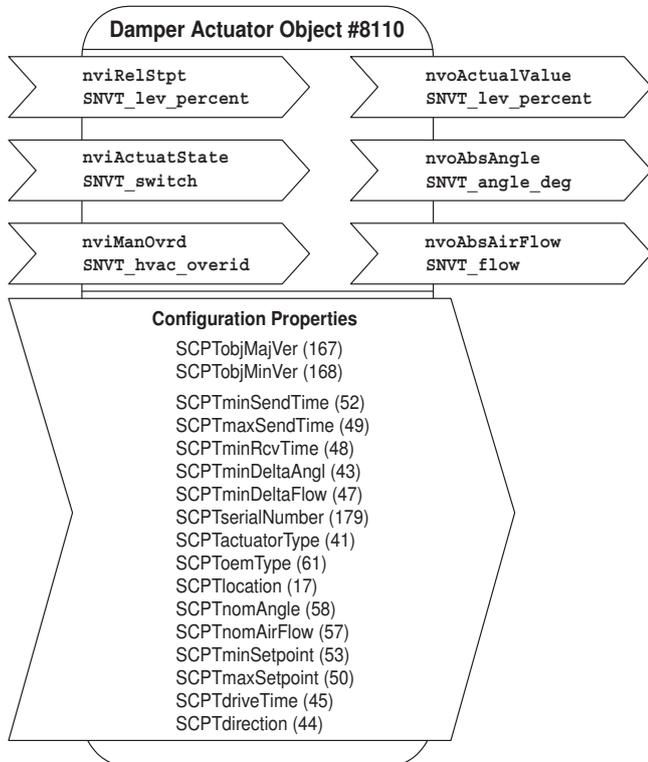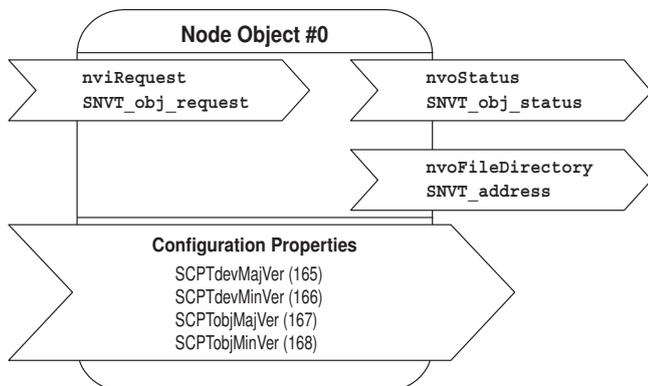| Type	Torque	Power consumption	For wire sizing	Weight
LMV-D3LON	5 Nm	2.5 W	4.5 VA (max. 5 A @ 5 ms)	Approx. 500 g
NMV-D3LON	10 Nm	3 W	5.5 VA (max. 5 A @ 5 ms)	Approx. 700 g

Safety notes

⚠️

- **The device is not allowed to be used outside the specified field of application, especially not in aircraft or in any other airborne means of transport.**
- **It may only be installed by suitably trained personnel. Any legal regulations or regulations issued by authorities must be observed during installation.**
- **The device may only be opened at the manufacturer's site. It does not contain any parts that can be replaced or repaired by the user.**
- **The cable must not be removed from the device.**
- **When calculating the required torque, the specifications supplied by the damper manufacturers (cross-section, design, installation site), and the air flow conditions must be observed.**
- **The device contains electrical and electronic components and is not allowed to be disposed of as household refuse. All locally valid regulations and requirements must be observed.**

BELIMO

Technical data

Supply

Nominal voltage	AC 24V, 50/60 Hz DC 24V
Power supply range	AC 19.2 ... 28.8V DC 21.6 ... 28.8V

Differential pressure sensor

Differential pressure sensor	0 ... 600 Pa
Overload Capability	±3000 Pa
Installation position	Any, no reset necessary
Operating medium	Supply and exhaust air in the comfort zone and in applications with sensor-compatible media
Materials in contact with medium	Glass, Epoxy resin, PA, TPE
Measuring air conditions	0 ... +50°C / 5 ... 95% rH, non-condensating

Application	SUPPLY AIR/EXHAUST AIR VAV units, integrated in LONWORKS® System

Operating volumetric flow

$\dot{V}_{nom}$	OEM-specific nominal volumetric flow setting, suitable for the VAV unit
$\dot{V}_{max}$	20 ... 100% of $\dot{V}_{nom}$
$\dot{V}_{min}$	0 ... 100% of $\dot{V}_{nom}$

Control

Control	LONWORKS® (Connection 6 + 7)
Actual value signal U_5 (Connection 5)	– adjustable: 2 ... 10V or 0 ... 10V – adjustable: Volumetric flow, damper position or differential pressure } Max. 0.5 mA

Bus function LONWORKS®

Certified	in accordance with LONMARK® 3.3
Processor	Neuron 3150
Transceiver	FTT-10A, compatible with LPT-10
Functional Profile as per LONMARK®	Damper Actuator Object #8110 / Open Loop Sensor Object #1 / Thermostat Object #8060
LNS plug-in for actuator / sensor / controller	Can be run with any LNS-based integration tool (min. for LNS 3.x)
Service key and status LED	in accordance with LONMARK® guidelines
Conductors, cables	Conductor lengths, cable specifications and topology of the LONWORKS® network in accordance with the ECHELON® guidelines

Operation and servicing

Operation and servicing	Pluggable / PC-Tool (V3.1 or higher)
Communication	LONWORKS®
Push-button	Adaption / Addressing
LED display	– 24V supply – Status / Bus function

Actuator

Actuator	Brushless, non-blocking actuator with current reduction
Direction of rotation	ccw / cw
Angle of rotation	95°◁, adjustable mechanical or electronic limiting
Adaption	Adjustment range coverage and resolution to control range
Manual disengagement	Push-button self-resetting without functional impairment
Position indication	Mechanical with pointer
Sound intensity	Max. 35 dB (A)
Damper rotation	– Clamp, axis round 10 ... 20 mm / axis square 8 ... 16 mm – Positive fit in various versions, e.g. 8 x 8 mm
Connection	Cable, 6 x 0.75 mm²

Safety

Protection class	**III** Safety extra-low voltage
Degree of protection	IP54
EMC	CE acc. to 89/336/EEC
Mode of operation	Type 1 (as per EN 60730-1)
Rated impulse voltage	0.5 kV (as per EN 60730-1)
Control pollution degree	2 (as per EN 60730-1)
Ambient temperature	0 ... +50°C
Non-operating temperature	–20 ... +80°C
Ambient humidity range	5 ... 95% rH, non-condensating (in accordance with EN 60730-1)
Maintenance	Maintenance-free

Functional Profile as per LONMARK®

The LON-capable VAV controller is certified by LONMARK®. The functions of the VAV controller are provided with LONWORKS® network as standardised network variables in accordance with LONMARK®. The Node Object #0, the Damper Actuator Object #8110, the Open Loop Sensor Object #1 and the Thermostat Object #8060 are implemented in the actuator.

Node Object #0

nviRequest
SNVT_obj_request

nvoStatus
SNVT_obj_status

nvoFileDirectory
SNVT_address

Configuration Properties
SCPTdevMajVer (165)
SCPTdevMinVer (166)
SCPTobjMajVer (167)
SCPTobjMinVer (168)

Damper Actuator Object #8110

nviRelStpt
SNVT_lev_percent

nvoActualValue
SNVT_lev_percent

nviActuatState
SNVT_switch

nvoAbsAngle
SNVT_angle_deg

nviManOvrd
SNVT_hvac_overid

nvoAbsAirFlow
SNVT_flow

Configuration Properties
SCPTobjMajVer (167)
SCPTobjMinVer (168)

SCPTminSendTime (52)
SCPTmaxSendTime (49)
SCPTminRcvTime (48)
SCPTminDeltaAngl (43)
SCPTminDeltaFlow (47)
SCPTserialNumber (179)
SCPTactuatorType (41)
SCPToemType (61)
SCPTlocation (17)
SCPTnomAngle (58)
SCPTnomAirFlow (57)
SCPTminSetpoint (53)
SCPTmaxSetpoint (50)
SCPTdriveTime (45)
SCPTdirection (44)

Open Loop Sensor Object #1

nvoSensorValue
SNVT_xxx

Configuration Properties
SCPTobjMajVer (167)
SCPTobjMinVer (168)
SCPTminSendTime (52)
SCPTmaxSendTime (49)
SCPTsndDelta (27)
SCPTmaxNVLength (255)
SCPTnvType (254)
UCPTadFunction (1)
UCPTadTransformation (2)
SCPTtrnsTblX (28)
SCPTtrnsTblY (29)
SCPTinvrtOut (16)

Note
More detailed information on the functional profiles can be found on the website of LonMARK® (www.lonmark.org).

Node object #0

The node object contains the object status and object request functions.

nviRequest   **SNVT_obj_request**
Input variable for requesting the status of a particular object in the node.

nvoStatus   **SNVT_obj_status**
Output variable that outputs the current status of a particular object in the node.

nvoFileDirectory   **SNVT_address**
Output variable that shows information in the address range of the Neuron chip.

Damper actuator object #8110

The actuator object is used to display the functions of the actuator on the page of the LONWORKS® network.

nviRelStpt   **SNVT_lev_percent**
Via this input variable, the set volume is specified for the VAV controller in % $\dot{V}_{Nom}$ of the VAV unit. This variable is normally linked to the output variable of an HVAC controller.

nviActuateState   **SNVT_switch**
Via this input variable, a preset volume is specified for the VAV controller (in % $\dot{V}_{Nom}$ of the VAV unit). Note on priority: The variable which was most recently active, either nviActuatorState or nviRelStpt, has priority.

nviManOvrd   **SNVT_hvac_overid**
Via this input variable, the actuator can be manually overridden to be set at a particular position or to a particular volume (in % $_{Nom}$).

nvoActualValue   **SNVT_lev_percent**
This output variable shows the current volume (in % $_{Nom}$ of the VAV unit) and can be used for control circuit feedback or for displaying positions.

nvoAbsAngle   **SNVT_angle_deg**
This output variable shows the current damper angle of the corresponding VAV unit and can be used for control and display purposes.

nvoAbsAirFlow   **SNVT_flow**
This output variable shows the current volumetric flow through the corresponding VAV unit and can be used for control and display purposes.

Open Loop Sensor Object #1

One sensor can be connected to the VAV controller. An active sensor (output 0 ... 32V) or a switch (on/off) can be connected. In the case of the open loop sensor object, the measured sensor values are transferred to the LONWORKS® network.
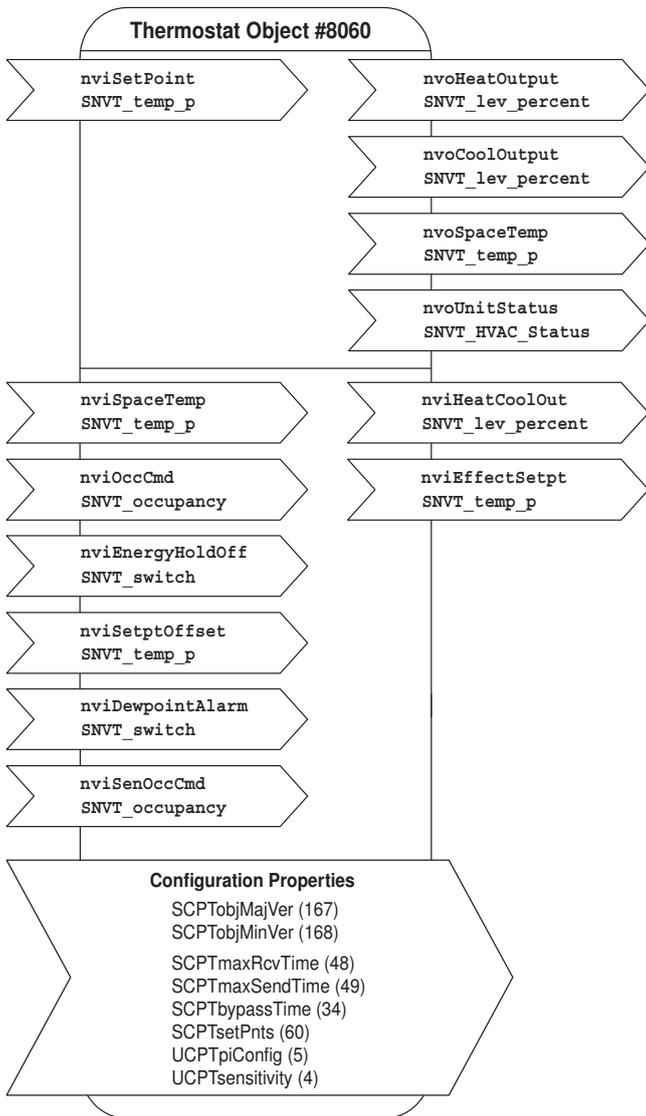
nvoSensorValue   **SNVT_xxx**
This output variable shows the current sensor value. Depending on the connected sensor, the output variable can be configured via the sensor plug-in and specifically adapted to the system.

The SNVT_.. can be configured as:		
SNVT_temp_p	SNVT_lev_percent	SNVT_lux
SNVT_temp	SNVT_abs_humid	SNVT_press_p
SNVT_switch	SNVT_enthalpy	SNVT_smo_obscur
SNVT_flow	SNVT_ppm	SNVT_power
SNVT_flow_p	SNVT_rpm	SNVT_elec_kwh

Functional Profile as per LONMARK®   (continued)

Individual room control solutions can be implemented with the thermostat object LONMARK® #8060. An LNS plug-in is available for configuring the regulation parameters.

Thermostat Object #8060

Thermostat Object #8060

nviSetPoint   SNVT_temp_p
Setpoint specification for the controller from the higher-level system or the room control unit. If this variable is not linked, then the local setpoints of the controller object apply (can be adjusted via plug-in).
The setpoint specification from the higher-level system influences the setting on the controller as follows:
Example: Comfort setpoint for heating = 21 °C and Comfort setpoint for cooling = 23 °C. The median point between heating and cooling is thus 22 °C. Now, if the external setpoint (nviSetPoint) is 23 °C, then the heating setpoint will shift to 22 °C and the cooling set point to 24 °C. The setpoints for Pre-Comfort heating and cooling will also be shifted accordingly.

nviSpaceTemp   SNVT_temp_p
Room temperature from external room sensor. It is imperative that this variable be linked; typically, it is linked with the variable of the sensor object.

nviOccCmd   SNVT_occupancy
Occupancy specification from the command centre (for the function, see the table entitled «Functions Inputs Occupancy» page 5).

nviEnergyHoldOff   SNVT_switch
In the case of active EnergyHoldOff, the controller will be set to the Building Protection setpoints.

nviSetPtOffset   SNVT_temp_p
Shifting of the room control unit. If the nviSetPoint is linked, then this input has an influence on the variable value of nviSetPoint, i.e. it corrects it. Otherwise, the Comfort and Pre-Comfort setpoints for heating and cooling will be adjusted directly by the amount of the shift (compare example with nviSetPoint).

nviDewpointAlarm   SNVT_switch
In the case of active DewpointAlarm, the controller will be set to the building protection setpoints. The cooling sequence is deactivated.

nviSenOccCmd   SNVT_occupancy
Occupancy specification from the local occupancy switch (for the function, see the table entitled «Functions Inputs Occupancy» page 5).

nvoHeatOutput   SNVT_lev_percent
Control signal for heating.

nvoCoolOutput   SNVT_lev_percent
Control signal for cooling.

nvoSpaceTemp   SNVT_temp_p
Displays the room temperature of the nviSpaceTemp. If nviSpaceTemp is not linked, then the variable will display the value 0x7FFF.

nvoUnitStatus   SNVT_HVAC_Status
Displays the operating mode of the controller (in accordance with Functional Profile #8060).

nvoHeatCoolOut   SNVT_lev_percent
Depicts the heating and cooling sequence for controlling the 6-way characterised control valves (see illustration, page 5).
This outlet runs parallel to the
nvoCoolOutput or the nvoHeatOutput, respectively.
Cooling = 33 … 0%
Valve closed 33 … 66%
Heating = 66 … 100%

nvoEffectSetpt   SNVT_temp_p
Shows the actual setpoint of the controller.

Thermostat Object #8060

nviSetPoint
SNVT_temp_p

nvoHeatOutput
SNVT_lev_percent

nvoCoolOutput
SNVT_lev_percent

nvoSpaceTemp
SNVT_temp_p

nvoUnitStatus
SNVT_HVAC_Status

nviSpaceTemp
SNVT_temp_p

nviHeatCoolOut
SNVT_lev_percent

nviOccCmd
SNVT_occupancy

nviEffectSetpt
SNVT_temp_p

nviEnergyHoldOff
SNVT_switch

nviSetptOffset
SNVT_temp_p

nviDewpointAlarm
SNVT_switch

nviSenOccCmd
SNVT_occupancy

Configuration Properties
SCPTobjMajVer (167)
SCPTobjMinVer (168)

SCPTmaxRcvTime (48)
SCPTmaxSendTime (49)
SCPTbypassTime (34)
SCPTsetPnts (60)
UCPTpiConfig (5)
UCPTsensitivity (4)

Note
A restart is necessary after accessing network variables for the purpose of rewriting them or after deleting links in order to initialise the variables.

Functional Profile as per LONMARK®	*Continued*

Functions Inlets Occupancy

Note
The function nviOccCmd has a higher priority than the function nviSenOccCmd.

Occupancy specification from nviOccCmd command centre	Occupancy switch nviSenOccCmd	Room operating status	Comfort extension
OC_OCCUPIED	OC_OCCUPIED	Comfort	
	OC_UNOCCUPIED	Comfort	
	OC_NUL (default)	Comfort	
OC_STANDBY	OC_OCCUPIED	Bypass	Occupied time is modified by the amount of the bypass time (comfort time) (can be adjusted in the plug-in)
	OC_UNOCCUPIED	Pre-comfort	
	OC_NUL (default)	Pre-comfort	
OC_UNOCCUPIED	OC_OCCUPIED	Building protection	
	OC_UNOCCUPIED	Building protection	
	OC_NUL (default)	Building protection	
OC_NUL (default)	OC_OCCUPIED	Comfort	
	OC_UNOCCUPIED	Pre-comfort	
	OC_NUL (default)	Comfort	

Function nvoHeatCoolOut

Typical application
Heating / cooling with Belimo
6-way characterised control valve.

Note chilled ceiling application
The nvoHeatCoolOutput is set into the neutral zone (50%) in the event that the temperature does not reach the dew point.

nvoHeatCoolOut
SNVT_lev_percent
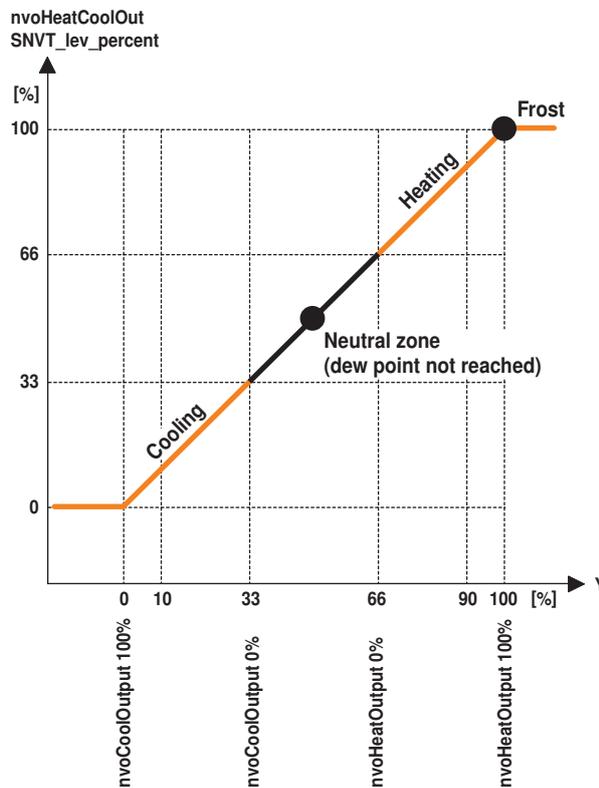
Notes
More detailed information on the Functional Profiles can be found on the website of LONMARK® (www.lonmark.org).

Override control with the SNVT nviManOvrd

Functions	state	variable used	air flow controller
	HVO_OFF	--	no reaction
	HVO_POSITION	percent	no reaction
	HVO_FLOW_VALUE	flow	0 ... nciNomAirFlow (liter/sec). The value 0xFFFF represents invalid data.
	HVO_FLOW_PERCENT	percent	0% ... +100.00% (0.005%). The value 0x7FFF represents invalid data.
	HVO_OPEN	--	full open
	HVO_CLOSE	--	full closed
	HVO_MINIMUM	--	configured flow
	HVO_MAXIMUM	--	configured flow
	all others	--	not supported

Note
The basic setting is «HVO_OFF».
This value is loaded when the power supply is
switched on.

Example	Function	Description
	HVO_OFF	Temperature controller setpoints are active
	HVO_OPEN	All VAV units are fully open (e.g. flushing operation or night cooling)
	HVO_CLOSE	All VAV units are completely closed (dampers close when system is switched off)
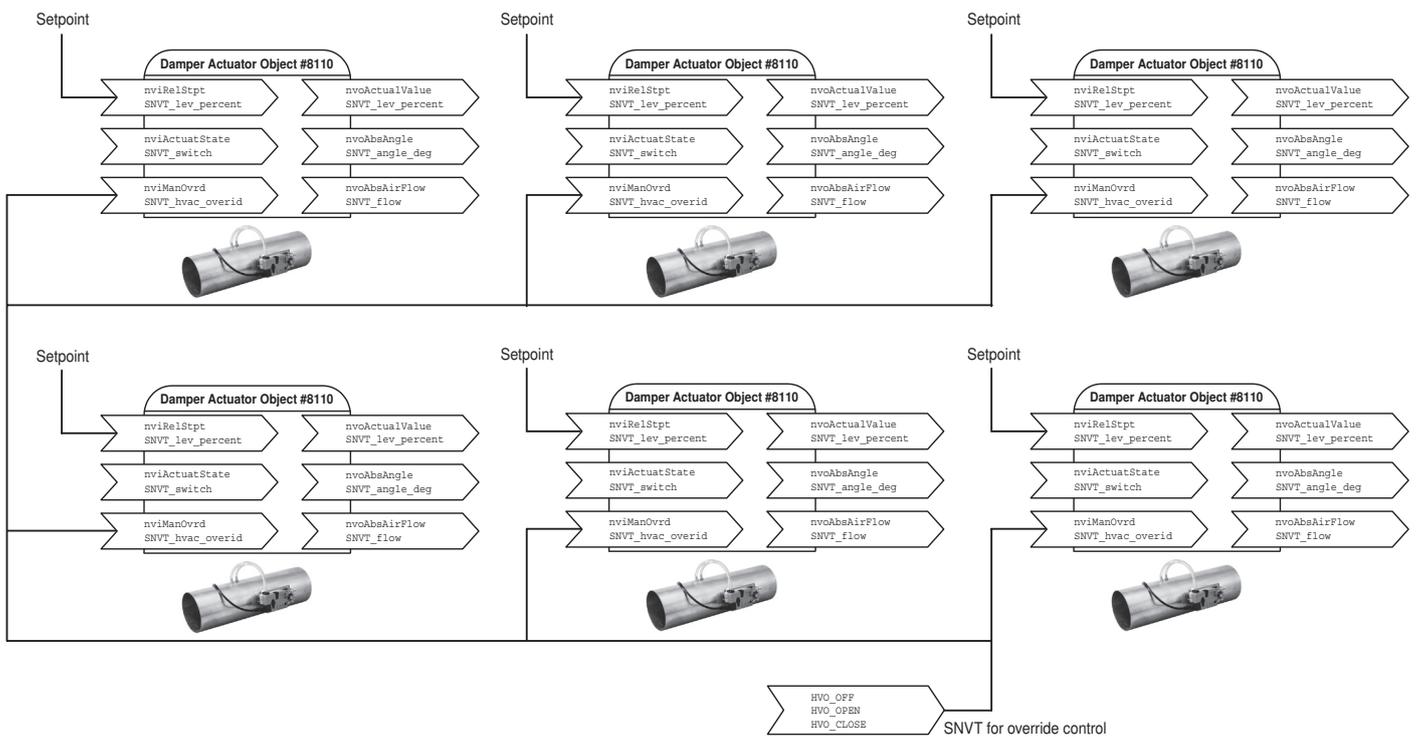
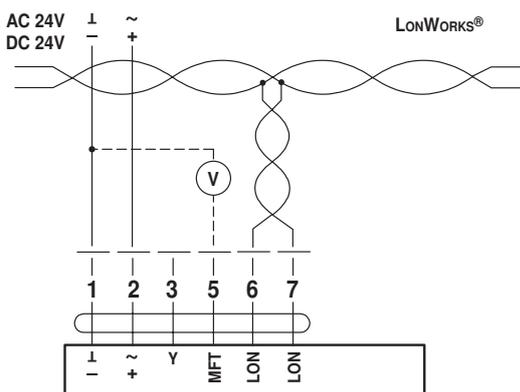## Electrical installation

Wiring diagrams

Note
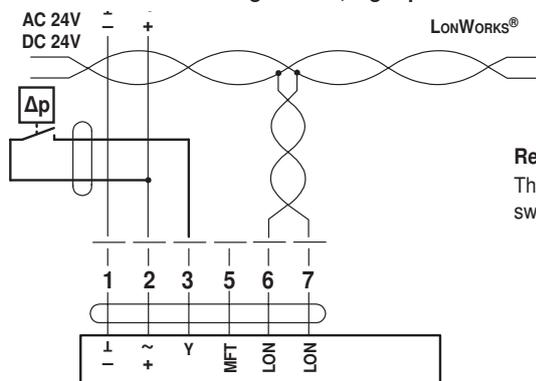Connect via safety isolation transformer. ⚠

Note
The current volumetric flow (0/2 ... 10V corresponds to 0 ... 100% V'nom) can be measured with a voltmeter at connection 5 (U).
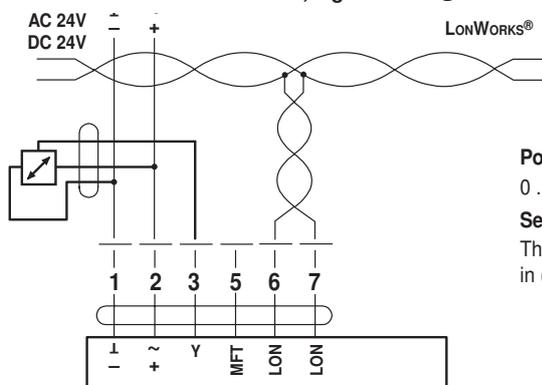
VAV controllers

AC 24V / DC 24V — LONWORKS®

| 1 | 2 | 3 | 5 | 6 | 7 |
| ⊥ − | ~ + | Y | MFT | LON | LON |

Connection with switching contact, e.g. Δp-monitor

AC 24V / DC 24V — LONWORKS®

Δp

| 1 | 2 | 3 | 5 | 6 | 7 |
| ⊥ − | ~ + | Y | MFT | LON | LON |

Requirements for switching contact:
The switching contact must be able to accurately switch a current of 16 mA at 24V.

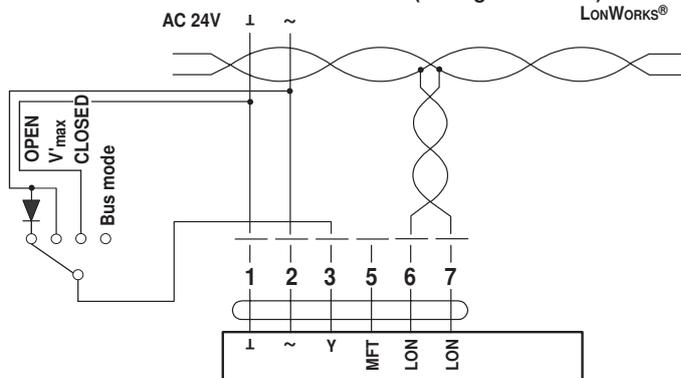**Connection with active sensor, e.g. 0 ... 10V @ 0 ... 50°C**

AC 24V / DC 24V — LONWORKS®

| 1 | 2 | 3 | 5 | 6 | 7 |
| ⊥ − | ~ + | Y | MFT | LON | LON |

Possible input voltage range:
0 ... 32V (resolution 30 mV)

Sensor scaling:
The sensors can be scaled with the sensor plug-in (sensor table)

VAV controller with local override control (analogue override)

AC 24V — LONWORKS®

OPEN / V'max / CLOSED / Bus mode

| 1 | 2 | 3 | 5 | 6 | 7 |
| ⊥ − | ~ | Y | MFT | LON | LON |

Note
If no sensor is integrated, then connection 3 (Y) is available for the protective circuit of a local override control.
Options: CLOSED, V'max, OPEN
Note: Functions only with nominal voltage AC 24V.

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Tool connection

|	
Setting and diagnostics	Setting and the diagnostics of the connected VAV-Compact controller can be checked and set quickly and easily with the Belimo PC-Tool or the Service-Tool ZTH-GEN.
On-board service connection	The service connection integrated in the VAV-Compact allows the console used to be connected quickly.

Belimo VAV operating and service devices
– Belimo PC-Tool, with level converter ZIP-232-KA
– Service-Tool ZTH-GEN
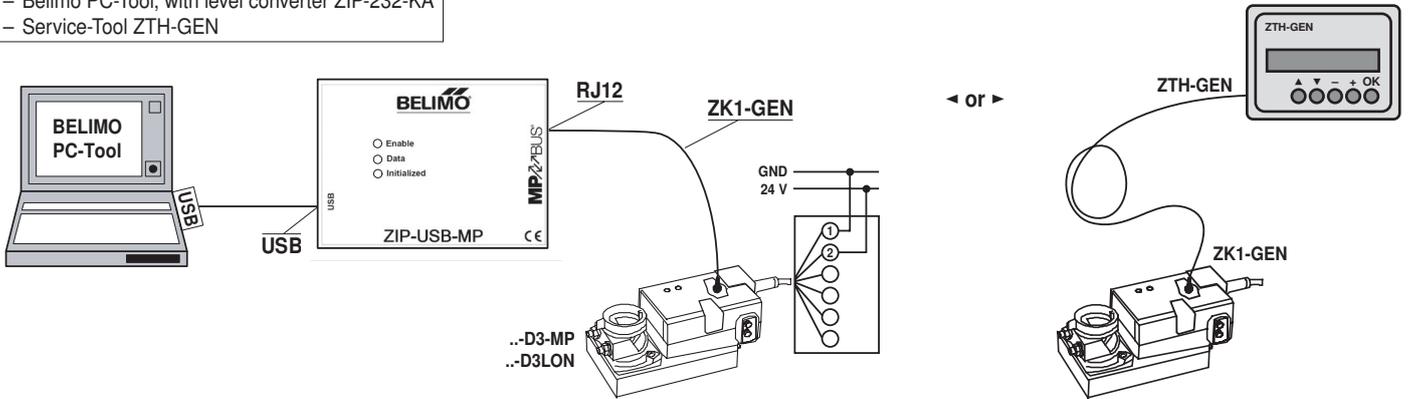
|	
MP connection (5)	The VAV-Compact can also communicate (connection wire 5) with the Service-Tools via the MP connection. The connection can be established during operation on site, i.e. in the connection socket, at the tool socket of the Belimo room temperature controller CR24 or on the floor or control cabinet terminals.
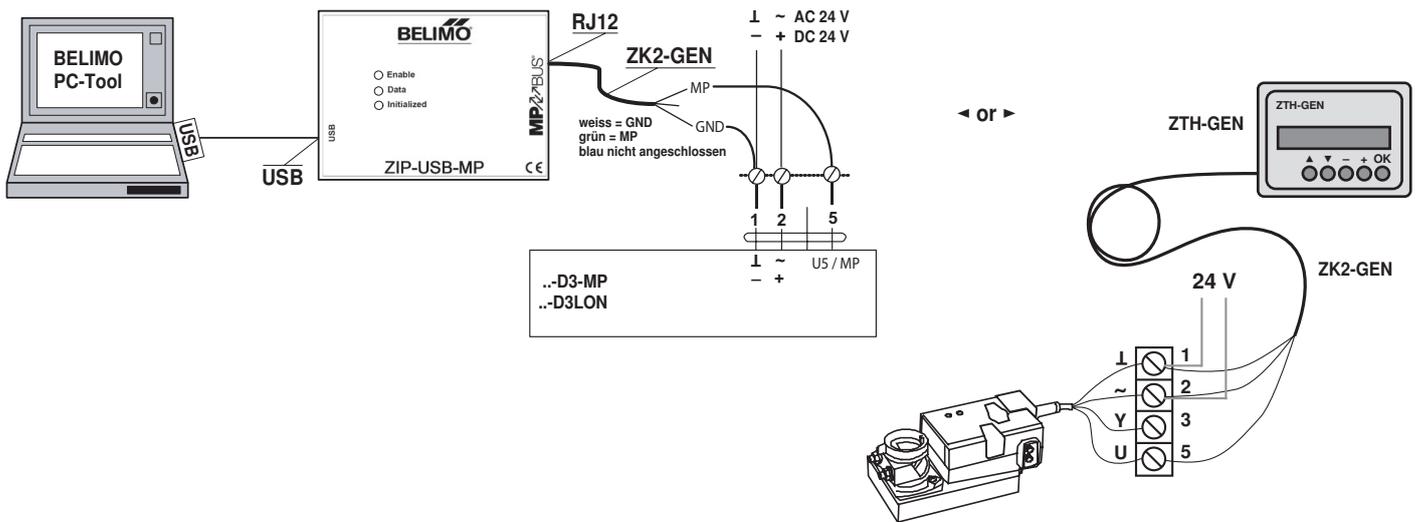
Operating controls and indicators

① **Push-button and green LED display**

Off:	No voltage supply or fault
Green, on:	Operation
Press key:	Switches on angle of rotation adaption followed by standard operation

② **Service button for commissioning with LONWORKS® and LED display yellow for LON status**

Off:	The damper actuator is integrated ready-for-operation in the LONWORKS® network.
Yellow, on:	No application software is loaded in the actuator.
Yellow, flashing:	The actuator is ready-for-operation, but not integrated in the LONWORKS® network.
(flashing interval 2 s)	(unconfigured).
Other flashing codes:	A fault is present in the actuator.
Press key:	Service Pin Message will be sent to the LONWORKS® network.

③ **Gear disengagement key**

Press key:	Gear disengaged, motor stops, manual override possible
Release key:	Gear engaged, synchronisation starts, followed by standard operation

④ **Service plug**

Connecting Belimo PC-Tool and Service-Tool, respectively (see page 8)

For a more detailed description, see the S4-VAV-Compact product information.

Dimensions [mm]

Dimensional drawings LMV-D3LON
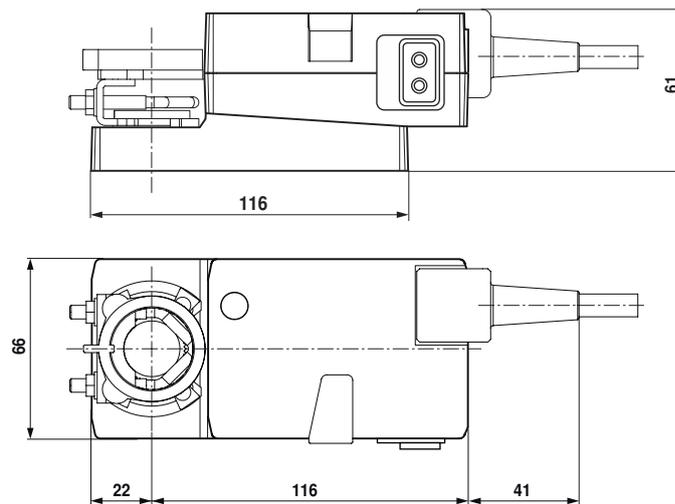
Dimensional drawings NMV-D3LON