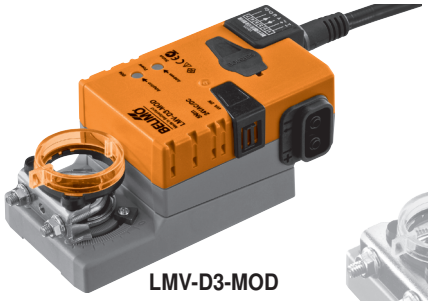
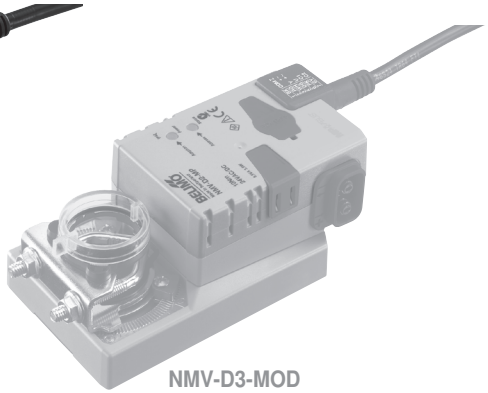
A pressure sensor, digital VAV controller and damper actuator all in one, providing a VAV-Compact solution with a communications capability for pressure-independent VAV systems in the comfort zone

- **Control function: VAV**
- **Communication via Modbus RTU (RS-485)**
- **Conversion of sensor signals**
- **Diagnostic socket for operating devices**



LMV-D3-MOD



NMV-D3-MOD

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 fitted with an integrated interface for Modbus RTU, receives its digital positioning signal from the superordinate Modbus-Master and returns the current status.

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 Modbus.

Parameterisable actuators
The factory settings cover the most common applications. As desired, individual parameters can be adapted for specific systems or servicing with a service tool (e.g. ZTH-GEN).
The Modbus communication parameters (address, baud rate, …) are set with the ZTH-GEN.
Pressing push-button 3 while connecting the supply voltage resets the communication parameters to the factory setting.
Quick addressing: The Modbus address can alternatively be set using push-buttons from 1 to 16. The value selected is added to the «Basic address» parameter and results in the effective Modbus address. For example, with a basic address of 140, Modbus addresses between 141 and 156 can be parameterised using quick addressing.

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 Modbus. 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 via Modbus.

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-D3-MOD	5 Nm	2 W	4 VA (max. 5 A @ 5 ms)	Approx. 500 g
NMV-D3-MOD	10 Nm	3 W	5 VA (max. 5 A @ 5 ms)	Approx. 700 g

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	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 Modbus networks
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 $\dot{V}_{nom}$
Data for Modbus	
Protocol	Modbus RTU (RS-485), not galvanically isolated
Number of nodes	Max. 32 (without repeater)
Transmission formats	1-8-N-2, 1-8-N-1, 1-8-E-1, 1-8-O-1 Default: 1-8-N-2
Baud rates	9 600, 19 200, 38 400, 76 800, 115 200 Bd Default: 38 400 Bd
Scheduling	120 Ω, can be switched
Parameterisation	Possible with the service tool ZTH-GEN, push-button-operated fast addressing 1 ... 16
Operation and servicing	Pluggable / PC-Tool (V3.7 or higher)
Push-button	Adaption / Addressing
LED display	– 24 V supply – Status / Bus function
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 according to 2004/108/EC
Mode of operation	Type 1 (according to EN 60730-1)
Rated impulse voltage	0.5 kV (according to EN 60730-1)
Control pollution degree	2 (according to EN 60730-1)
Ambient temperature	0 ... +50°C
Non-operating temperature	–20 ... +80°C
Ambient humidity range	5 ... 95% rH, non-condensating (according to EN 60730-1)
Maintenance	Maintenance-free

Safety notes

- **The actuator must not be used outside the specified field of application, especially 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 permitted to be disposed of as household refuse. All locally valid regulations and requirements must be observed.**

Modbus overview

Register

	No.	Adr	Register
In operation	1	0	**Setpoint [%]**
	2	1	**Override control**
	3	2	**Command**
	4	3	Actuator type
	5	4	Relative position [%]
	6	5	Absolute position [°] [mm]
	7	6	Relative volumetric flow [%] (only for VAV/EPIV)
	8	7	Absolute volumetric flow (pressure) [m^3/h] [l/min] [Pa] (only for VAV/EPIV)
	9	8	Sensor value [mv] [Ω] [–]
Service	101	100	Series number 1st part
	102	101	Series number 2nd part
	103	102	Series number 4th part
	104	103	Firmware version (Modbus module)
	105	104	Malfunction and service information
	106	105	**Min [%]**
	107	106	**Max [%]**
	108	107	**Sensor type**
	109	108	**Bus fail position**

- Registers in Bold can be written
- Registers <100 (In operation) which can be written are volatile and should therefore be updated periodically
- Registers >100 which can be written are non-volatile

Commands

All data is arranged in a table and addressed by 1..n (register) or 0..n-1 (address). No distinction is made between data types (Discrete Inputs, Coils, Input Registers, Holding Registers). As a consequence, all data can be accessed with the two commands for Holding Register. The commands for Discrete Inputs and Input Registers can be used as an alternative.

Standard commands:
Read Holding Registers [3]
Write Single Register [6]

Optional commands:
Read Discrete Inputs [2]
Read Input Registers [4]
Write Multiple Registers [16]

Note regarding Read Discrete Inputs
The command reads one or more bits and can alternatively be used for register 105 (Malfunction and service information). The start address to be used is 1664.

Modbus register description

Register 1: Setpoint

Setpoint for actuator setting or volumetric flow in hundredths of one percent,
i.e. 0…10 000 corresponds to 0…100%

Register 2: Override control

Overriding the setpoint with defined values

Override control	
0	None
1	Open
2	Close
3	Min
5	Max

Register 3: Command

Initiation of actuator functions for service and test; the register is reset automatically.

Command	
0	None
1	Adaption
2	Test run
3	Synchronisation
4	Reset actuator malfunctions

Register 4: Actuator type

Actuator type; the allocation may deviate from the basic category with some actuators.

Actuator type	
0	Actuator not connected / not known
1	Air/water actuators with/without safety function
2	Volumetric flow controller VAV / EPIV
3	Fire damper actuator

Register 5: Relative position

Relative position in hundredths of one percent,
i.e. 0 … 10 000 correspond to 0 … 100%

Register 6: Absolute position

Absolute position
0 … 10 000 (65535 if not supported by the actuator)
The unit depends on the device:
[°] for actuators with rotary movement
[mm] for actuators with linear movement

Register 7: Relative volumetric flow

Relative volumetric flow in hundredths of one percent of Vnom,
i.e. 0 … 10 000 correspond to 0 … 100%
This value is available only for VAV controllers and EPIV devices (actuator type: 2).
For all other types, 65535 will be entered.

Register 8: Absolute volumetric flow

Absolute volumetric flow
This value is available only for VAV controllers and EPIV devices (actuator type: 2).
For all other types, 65535 will be entered.
The unit depends on the device:
[m^3/h] for VAV controllers (or [Pa] for pressure applications)
[l/min] for EPIV devices

Register 9: Sensor value

Current sensor value; dependent on the setting in Register 108
The unit depends on the sensor type: [mv] [Ω] [-]

Register 101, 103: Series number

Each MP node has an unambiguous series number which is either impressed on or glued to the node. The series number consists of 4 segments, although only parts 1, 2 and 4 are displayed on Modbus.
Example: 00839-31324-064-008

Register 9	Register 10	Register 11
1st part	2nd part	4th part
00839	31234	008

Register 104: Firmware Version

Firmware version of Modbus module (VX.XX)
e.g. 101 V1.01

Modbus register description *(continued)*

Register 105: Malfunction and service information

The status information is split into messages about the actuator (malfunctions) and other service information.

	Bit	Description
Malfunctions (low byte)	0	Excessive utilisation
	1	Mechanical travel increased
	2	Mechanical overload
	3	–
	4	Safety-relevant faults (fire protection only)
	5	Damper test error (fire protection only)
	6	Duct temperature too high (fire protection only)
	7	Smoke detector tripped (fire protection only)
Service (high byte)	8	Internal activity (test run, adaption, …)
	9	Gear disengagement active
	10	Bus watchdog triggered
	11	–
	12	–
	13	–
	14	–
	15	–

The malfunction bits can be reset with Register 3 (command 4) or with the Belimo PC-Tool. Malfunctions 0 and 4 cannot be reset.

Register 106: Min / Vmin setting

Minimum limit (position or volumetric flow) in hundredths of one percent, i.e. 0…10 000 correspond to 0…100%
Caution: Changing the setting may result in malfunctions.

Register 107: Max / Vmax setting

Minimum limit (position or volumetric flow) in hundredths of one percent, i.e. 2000…10 000 correspond to 20…100%
Caution: Changing the setting may result in malfunctions.

Register 108: Sensor type

Sensor type connected to the actuator; in the absence of sensor specification, the switching at the Y input will have the effect of a local compulsion.

Sensor type	
0	None
1	Active sensor (mV)
2	Passive sensor 1 k (Ω)
3	Passive sensor 1 … 20 k (Ω)
4	Switching contact (0 / 1)

Note
After changing the sensor type, the actuator must always be restarted in order for correct sensor values to be read out.

Register 109: Bus fail position

Modbus communication is not monitored as standard. In the event of a breakdown in communication, the actuator retains the current setpoint.
The bus monitoring controls the Modbus communication. If neither the setpoint (Register 1) nor the override control (Register 2) is renewed within 120 seconds, the actuator controls to the bus fail position (closed / open).
Triggered bus monitoring is indicated in Register 105.

Bus fail position	
0	Last setpoint (no bus monitoring)
1	Fast close if time is exceeded
2	Fast open if time is exceeded

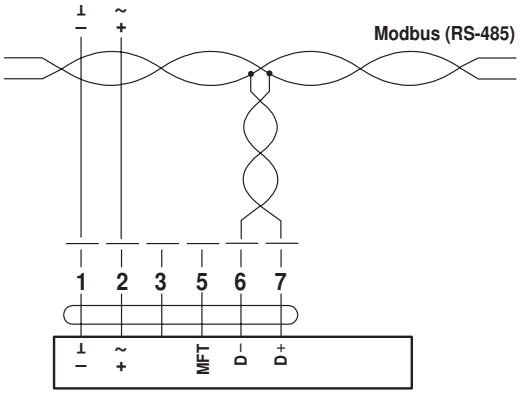
Electrical installation

Connection diagram for cable layout

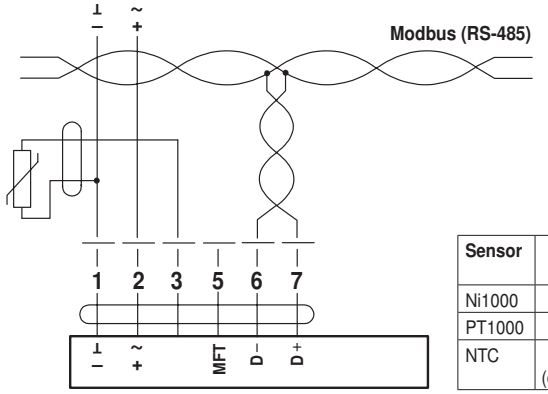
Note
Connection via safety isolating transformer.

Note
Modbus signal assignment:
C_1 = D– = A
C_2 = D+ = B
Power supply and communication are not galvanically isolated.
Interconnect ground signal of the devices.

Connection without sensor

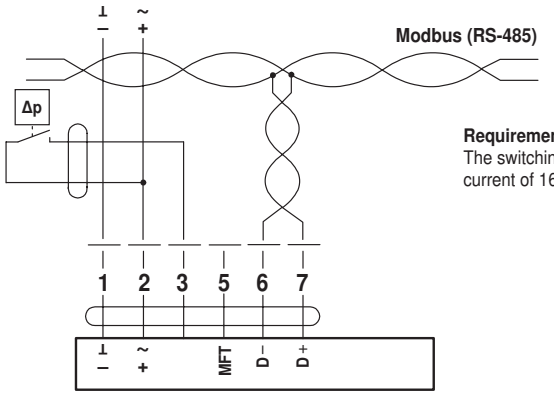


Connection with passive sensor, e.g. Pt1000, Ni1000, NTC



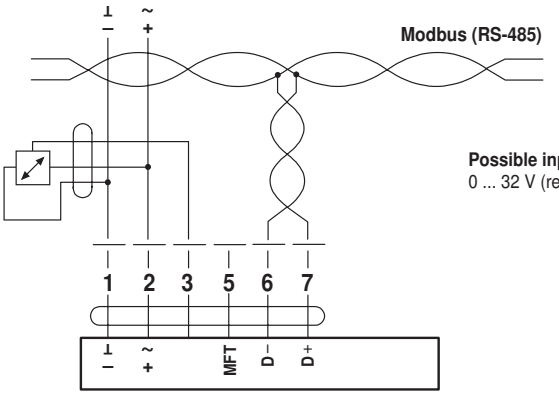
Sensor	Temperature range	Resistance range	Resolution
Ni1000	–28 ... +98 °C	850 ... 1600 Ω	1 Ω
PT1000	–35 ... +155 °C	850 ... 1600 Ω	1 Ω
NTC	–10 ... +160 °C (depending on type)	200 ... 50 kΩ	1 Ω

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



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

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



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

Tool connection

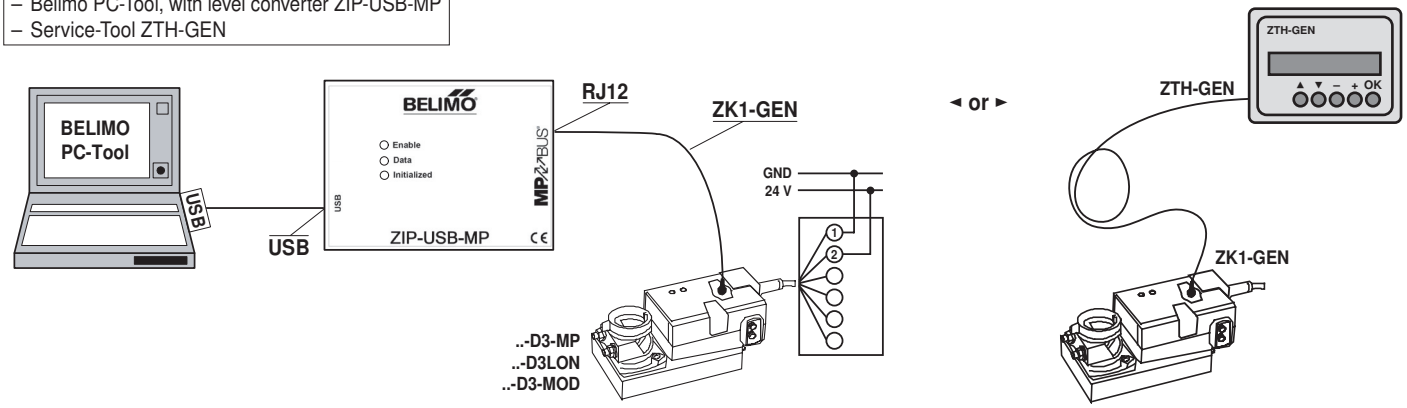
Setting and diagnostics

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

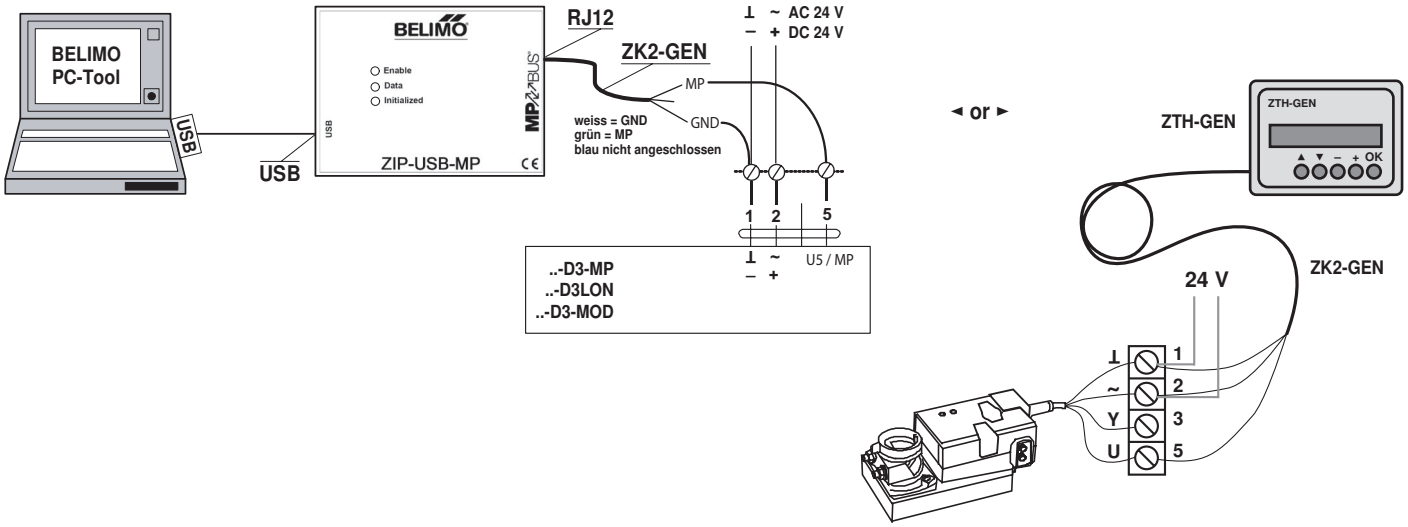
The service connection integrated in the VAV-Compact allows the console used to be connected quickly.

Belimo VAV operating and service devices
- Belimo PC-Tool, with level converter ZIP-USB-MP
- Service-Tool ZTH-GEN

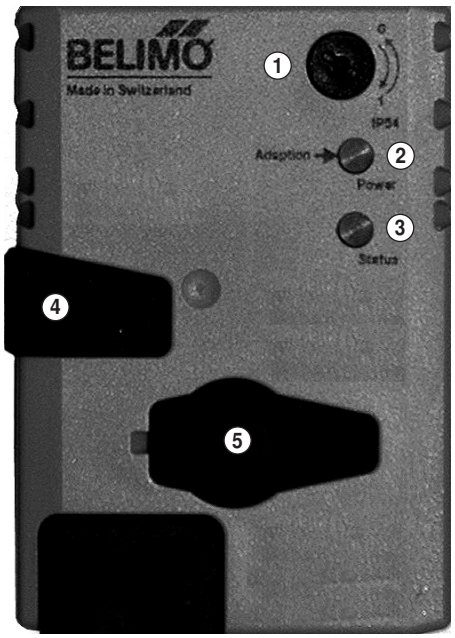


MP connection (5)

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) Direction of rotation switch

Switching over: Direction of rotation changes

(2) Push-button and LED display green

Off: No power supply or fault
Illuminated: In operation
Flashing: Address mode: pulses according to set address (1 ... 16) when starting: reset to factory setting (communication)
Press button: in standard mode: switches on angle of rotation adaptation
in address mode: confirmation of set address (1 ... 16)

(3) Push-button and LED display yellow

Off: The actuator is ready
Illuminated: Adaption or synchronising process active
or actuator in address mode (green LED indicator flashing)
Flickering: Modbus communication active
Press button: in operation (>3 s): switch address mode on and off
in address mode: address setting by pressing several times
when starting (>5 s): reset to factory setting (communication)

(4) Gear disengagement button

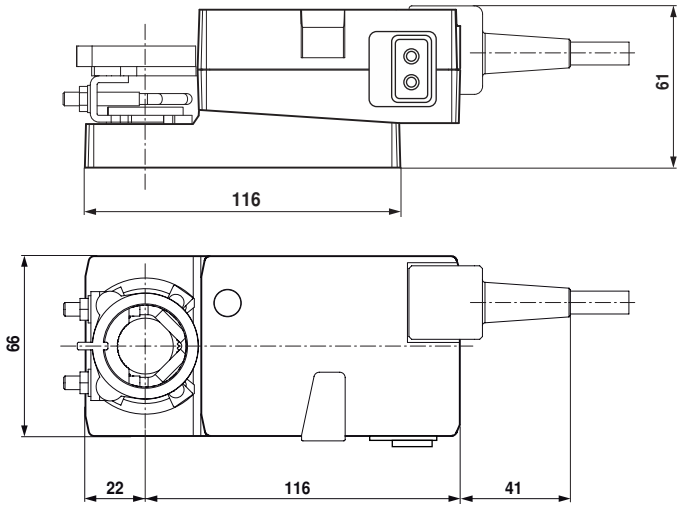
Press button: Gear disengaged, motor stops, manual override possible
Release button: Gear engaged, synchronisation starts, followed by standard operation

(5) Service plug

For connecting parameterising and service tools

Dimensions [mm]

Dimensional drawings LMV-D3-MOD



Dimensional drawings NMV-D3-MOD