

VAV-Compact unit – with VAV controller, dynamic Δp sensor and damper actuator

- Field of application: VAV units in comfort applications
- Application: VAV/CAV, position control
- Belimo D3, dynamic flow sensor
- Functional range differential pressure 0...500 Pa
- Control communicative
- Communication via KNX (S-Mode)
- Conversion of sensor signals
- Service socket for operating devices



Technical data

Electrical data	Nominal voltage	AC/DC 24 V
	Nominal voltage frequency	50/60 Hz
	Nominal voltage range	AC 19.2...28.8 V / DC 21.6...28.8 V
	Power consumption in operation	2 W
	Power consumption in rest position	1 W
	Power consumption for wire sizing	4 VA
	Power consumption for wire sizing note	I_{max} 8 A @ 5 ms
	Connection supply / control	Cable 1 m, 6x 0.75 mm ²
Data bus communication	Communicative control	KNX (S-Mode)
	Number of nodes	max. 64 per line segment, reduce number of nodes with connecting cable with short lines
	Communication medium	KNX TP
	Configuration mode	S-Mode
	Current consumption of KNX-Bus	max. 5 mA
Functional data	Torque motor	5 Nm
	V'max adjustable	20...100% of V'nom
	V'mid adjustable	>V'min...<V'max
	V'min adjustable	0...100% of V'nom (<V'max)
	Manual override	with push-button, can be locked
	Angle of rotation	95°
	Angle of rotation note	adjustable mechanical or electrical limitation
	Mechanical interface	Universal shaft clamp 6...20 mm
Measuring data	Position indication	Mechanical
	Measuring principle	Belimo D3, dynamic flow sensor
	Installation orientation	position-independent, no zeroing necessary
	Measuring range	-20...500 Pa
	Functional range differential pressure	0...500 Pa
	Maximum system pressure	1500 Pa
	Burst pressure	±5 kPa
	Height compensation	Adjustment of system height (range 0...3000 m above sea level)
Safety data	Condition measuring air	0...50°C / 5...95% RH, non-condensing
	Pressure tube connection	Nipple diameter 5.3 mm
	Protection class IEC/EN	III, Protective Extra-Low Voltage (PELV)
	Degree of protection IEC/EN	IP54

Technical data

Safety data	Degree of protection NEMA/UL	NEMA 2
	Enclosure	UL Enclosure Type 2
	EMC	CE according to 2014/30/EU
	Certification IEC/EN	IEC/EN 60730-1 and IEC/EN 60730-2-14
	Type of action	Type 1
	Rated impulse voltage supply / control	0.8 kV
	Pollution degree	3
	Ambient humidity	Max. 95% RH, non-condensing
	Ambient temperature	0...50°C [32...122°F]
	Storage temperature	-20...80°C [-4...176°F]
Weight	Weight	0.55 kg

Safety notes


- The device must not be used outside the specified field of application, especially not in aircraft or in any other airborne means of transport.
- Outdoor application: only possible in case that no (sea) water, snow, ice, insolation or aggressive gases interfere directly with the device and that it is ensured that the ambient conditions remain within the thresholds according to the data sheet at any time.
- Only authorised specialists may carry out installation. All applicable legal or institutional installation regulations must be complied with 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.
- Cables must not be removed from the device.
- The device contains electrical and electronic components and must not be disposed of as household refuse. All locally valid regulations and requirements must be observed.

Product features

Application The VAV-Compact unit is used for comfort applications for pressure-independent control of VAV units. See Technical brochure – VAV-Compact product range for volumetric flow applications.

Pressure measurement

The integrated D3 differential pressure sensor is also suitable for very small volumetric flows. The maintenance-free sensor technology enables a wide range of applications in the HVAC comfort area such as in residential buildings, offices, hotels, etc.

Actuators

For the various applications and damper designs, various actuator variants with torque 5, 10 or 20 Nm are available to the VAV unit manufacturer.

Control functions

Volumetric flow (VAV/CAV) or position control (Open Loop)

Product features

Application Variable Air Volume (VAV) Variable air volume control in the V'min...V'max range, demand-dependent via a modulating reference variable (analogue or bus), e.g. room temperature or CO₂ controller for energy-saving air conditioning of individual rooms or zones.

V'nom, Δp @ V'nom

OEM-specific calibration parameters, suitable for the VAV unit

Adjustment range Δp @ V'nom: 38...450 Pa

V'max (Max)

Maximum operating volumetric flow, adjustable 20...100% V'nom

V'min (Min)

Minimum operating volumetric flow, adjustable 0...100% V'nom

Application Constant Air Volume (CAV) Constant volumetric flow control. If required, via step switching (switching contacts) for constant volumetric flow applications.

Steps: CLOSE / Min / Max / OPEN

Application Position Control (Open Loop) Position control for integration of the VAV-Compact into an external VAV control loop. Transmitter and actuator unit.

Max

Range: 20...100 % rotation range

Min

Range: 0...100 % rotation range

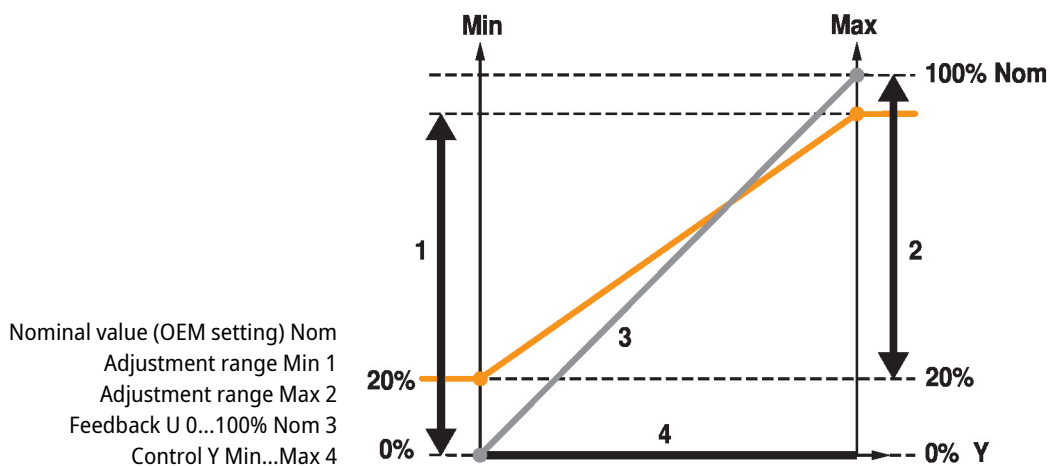
Demand Controlled Ventilation (DCV) Output of the demand signal (damper position) to the higher-level automation system – DCV function.

Bus operation The actuator is equipped with an integrated interface for KNX (S-Mode) and can be connected with all KNX devices that have corresponding data points available.

In bus mode, a sensor (0...10 V) can optionally be connected, e.g. a temperature sensor or a switching contact, for integration into the higher-level bus system.

Operating settings Control functions
Volumetric flow (VAV/CAV) or position control (Open Loop)

Operating settings Min/Max/Nom



Operating and service tools PC-Tool ZTH EU – can be locally plugged into the service socket or remotely via MP connection.

Accessories

Tools	Description	Type
	Service tool, with ZIP-USB function, for parametrisable and communicative Belimo actuators, VAV controller and HVAC performance devices	ZTH EU
	Belimo PC-Tool, Software for adjustments and diagnostics	MFT-P
	Connecting cable 5 m, A: RJ11 6/4 ZTH EU, B: 6-pin for connection to service socket	ZK1-GEN
	Connecting cable 5 m, A: RJ11 6/4 ZTH EU, B: free wire end for connection to MP/PP terminal	ZK2-GEN

Electrical installation

Wire colours:

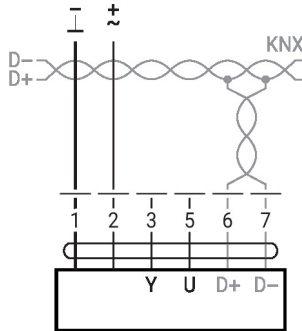
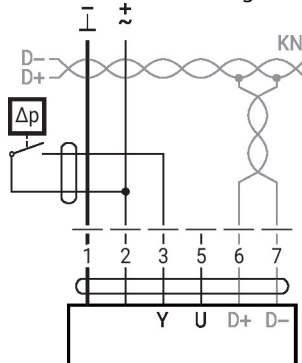
- 1 = black
- 2 = red
- 3 = white
- 5 = orange
- 6 = pink
- 7 = grey

Functions:

- D+ = KNX+ (pink > red)
- D- = KNX- (grey > black)

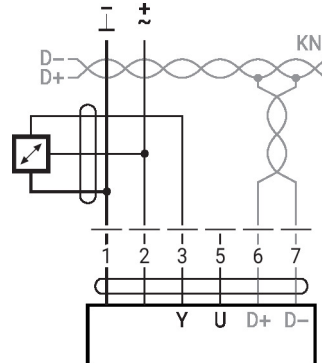
Wiring diagrams

Connection without sensor


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


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

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



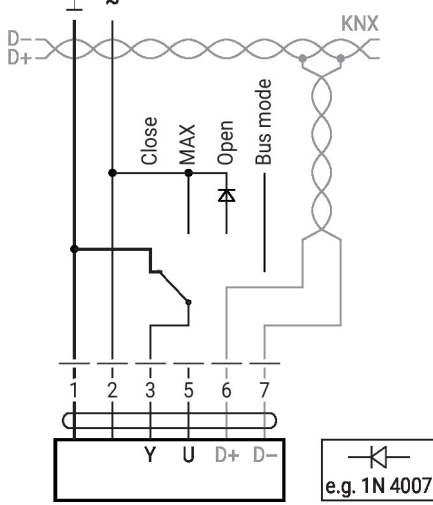
Possible voltage range: 0...32 V
Resolution 30 mV

- Switching current 16 mA @ 24 V
- Start point of the operating range must be parametrised on the MP actuator as ≥ 0.5 V

Functions

Functions with specific parameters (Parametrisation necessary)

Local override control



If no sensor is integrated, then connection 3 (Y) is available for a local override control.

Caution: Works only with AC 24 V supply!

Parameter and tool overview

Settings and tool function

Designation	Setting values, limits, explanations	Units	Tool		Remarks
			ZTH EU	P.C.-Tool	
System-specific data					
Position	16 characters, e.g. Office 4 6th OG ZL	String	r	r/w	
Designation	16 characters: Unit designation, etc.	String	r	r/w	
Address (MP)	PP		r/w	r/w	For KNX applications: PP
V'_{max}	20...100% [V'_{nom}]	m ³ /h / l/s / cfm	r/w	r/w	>= V'_{min}
V'_{mid}	V'_{min} ... V'_{max}	m ³ /h / l/s / cfm	r/w	r/w	
V'_{min}	0...100% [V'_{nom}]	m ³ /h / l/s / cfm	r/w	r/w	<= V'_{max}
Altitude of installation	0...3000	m	r/w	r/w	Adaptation of Δp sensor to altitude (meters above sea level)
Controller Settings					
Control function	Volumetric flow / Position control (Open Loop)		–	–	
Mode	0...10 / 2...10	V	r/w ²⁾	r/w	For KNX applications: 2...10
CAV function ²⁾	CLOSE/ V'_{min} / V'_{max} : Shut-off level CLOSE 0.1 V CLOSE/ V'_{min} / V'_{max} : Shut-off level CLOSE 0.5 V V'_{min} / V'_{mid} / V'_{max} : (NMV-D2M-comp.)		–	r/w	Not relevant for KNX applications
Positioning signal Y	Start value: 0.6...30; Stop value: 2.6...32	V	r	r/w	Not relevant for KNX applications
Feedback U	Volume / Damper position / Δp		–	r/w	Definition of feedback signal
Feedback U	Start value: 0...8; Stop value: 2...10	V	–	r/w	
Behaviour when switched on (Power-on)	No action / Adaptation / Synchronisation		–	r/w	
Synchronisation behaviour	Y=0% Y=100%		–	r/w	Synchronisation at damper position 0 or 100%
Bus fail position	Last setpoint / Damper CLOSE V'_{min} / V'_{max} / Damper OPEN		–	r/w	
Unit-specific settings					
V'_{nom}	0...60'000 m ³ /h	m ³ /h / l/s / cfm	r	r/(w) ¹⁾	Unit-specific setting value
$\Delta p@V'_{nom}$	38...450	Pa	r	r/(w) ¹⁾	Unit-specific setting value
Print function label			–	w	
Other settings					
Direction of rotation (for Y=100%)	cw/ccw		r/w ²⁾	r/w	Unit-specific setting value
Range of rotation	Adapted ⁴⁾ / programmed 30...95	°	–	r/w	
Torque	100 / 75 / 50 / 25	%	–	r/w	% of nominal torque

¹⁾ Write function accessible only for VAV manufacturers

²⁾ Access only via Servicing level 2

³⁾ CAV setting for MP operation

⁴⁾ Within the mechanical limitation

⁴⁾ The first time the supply voltage is switched on, i.e. at the time of initial commissioning, the actuator carries out an adaption, which is when the operating range and position feedback adjust themselves to the mechanical setting range. The actuator then moves into the required position in order to ensure the volumetric flow defined by the control signal.

Parameter and tool overview

Settings and tool function

Designation	Setting values, limits, explanations	Units	Tool		Remarks
			ZTH EU	PC-Tool	
Operating data					
Actual value / Setpoint		m ³ /h / l/s / cfm	r	r	T (Trend) display with print function and data saving to HD
Damper position		Pa / %	T		
Simulation	Damper OPEN/CLOSE V' _{min} / V' _{mid} / V' _{max} / Motor Stop		w	w	
Running times	Operating time, running time Ratio (relation)		-	r	
Alarm messages	Setting range enlarged, Mech. overload, Stop&Go ratio too high		-	r/w	
Serial number	Device ID		r	r	Incl. production date
Type	Type designation		r	r	
Version display	Firmware, Config. table ID		r	r	
Configuration data					
Print, send			-	yes	
Backup in file			-	yes	
Log data / Logbook	Activities log		-	yes	

KNX group objects

Name	Type	Flags					Data point type				Values range
		C	R	W	T	U	ID	DPT_Name	Format	Unit	
Setpoint	I	C	-	W	-	-	5.001	_percentage	1 Byte	%	[0...100] Resolution 0.4%
Override control	I	C	-	W	-	-	20.*	_enum	1 Byte	-	0 = no override 1 = Open 2 = Closed 3 = Min 4 = Mid 5 = Max
Reset	I	C	-	W	-	-	1.015	_reset	1 Bit	-	0 = no action 1 = reset
Adaptation	I	C	-	W	-	-	1.001	_switch	1 Bit	-	0 = no action 1 = adapt
Testrun	I	C	-	W	-	-	1.001	_switch	1 Bit	-	0 = no action 1 = Testrun
Min	I/O	C	R	W	-	-	5.001	_percentage	1 Byte	%	[0...100] Resolution 0.4%
Max	I/O	C	R	W	-	-	5.001	_percentage	1 Byte	%	[0...100] Resolution 0.4%
Relative position	O	C	R	-	T	-	5.001	_percentage	1 Byte	%	[0...100] Resolution 0.4%
Absolute position	O	C	R	-	T	-	8.011 7.011	_rotation_angle _length	2 Byte	° mm	[-32'768...32'768] [0...65'535]
Relative volumetric flow	O	C	R	-	T	-	5.001	_percentage	1 Byte	%	[0...100] Resolution 0.4%
Absolute volumetric flow	O	C	R	-	T	-	14.077	_volume_flux	4 Byte	m ³ /s	1.0 x 10 ⁻¹⁰ m ³ /s
Absolute volumetric flow	O	C	R	-	T	-	9.009	_air_flow	2 Byte	m ³ /h	1.0 x m ³ /h
Nominal volumetric flow	O	C	R	-	T	-	14.077	_volume_flux	4 Byte	m ³ /s	1.0 x 10 ⁻¹⁰ m ³ /s
Nominal volumetric flow	O	C	R	-	T	-	9.009	_air_flow	2 Byte	m ³ /h	1.0 x m ³ /h
Fault state	O	C	R	-	T	-	1.002	_boolean	1 Bit	-	0 = no error 1 = error
Overriden	O	C	R	-	T	-	1.002	_boolean	1 Bit	-	0 = not active 1 = active
Gear disengagement active	O	C	R	-	T	-	1.002	_boolean	1 Bit	-	0 = engaged 1 = disengaged
Service information	O	C	R	-	T	-	22.*	_bitset16	2 Byte	-	Bit 0 (1) Utilisation too high Bit 1 (2) Actuation path increased Bit 2 (4) Mechanical overload Bit 3 (8) - (Not used) Bit 4 (16) - (Not used) Bit 5 (32) - (Not used) Bit 6 (64) - (Not used) Bit 7 (128) - (Not used) Bit 8 (256) Internal activity Bit 9 (512) Bus monitoring triggered
Sensor value - Relative Humidity - Air Quality - Voltage mV - Value voltage scaled - Voltage scaled % - switch	O	C	R	-	T	-	9.007 9.008 9.020 7.* 5.001 1.001	_humidity _parts/million _voltage _pulses_length _percentage _switch	2 Byte 2 Byte 2 Byte 2 Byte 1 Byte -	% RH ppm mV mm % -	[0...670'760] [0...670'760] [-670'760...670'760] [0...65'535] [0...100] 0/1

KNX group objects

Setpoint	Specification of set volume or actuator position in % between the parameterised Min and Max limits. The operating mode is set by the manufacturer of the volumetric flow unit.
Override control	Overriding the setpoint with defined compulsions. As data point type, 1 Byte (without algebraic sign) is recommended (DPT 20.*)
Reset	Resetting the saved service messages (see KNX group object <i>Service information</i>).
Adaptation	Perform the adaptation. The first-time adaptation is performed by the manufacturer of the volumetric flow unit. An active adaptation is signaled in Bit 8 of <i>Service information</i> .
Testrun	Performance of a testrun that checks the entire operating range. An active testrun is signalled in Bit 8 of <i>Service information</i> . After completion, detected faults (mechanical overload, actuation path exceeded) are signalled in <i>Service information</i> .
Min	Minimum Limit (volumetric flow or position) in % of the nominal volumetric flow V_{nom} Caution: Changing the setting may result in malfunctions.
Max	Maximum Limit (volumetric flow or position) in % of the nominal volumetric flow V_{nom} Caution: Changing the setting may result in malfunctions.
Relative position	Current actuator position in %
Absolute position	Absolute position/stroke The data point type is to be selected depending on the type of movement: [°] DPT 8.011 [mm] DPT 7.011
Relative volumetric flow	Relative volumetric flow in % of the nominal volumetric flow V_{nom}
Absolute volumetric flow	Absolute volumetric flow in m^3/s and m^3/h
Nominal volumetric flow	Nominal volumetric flow in m^3/s and m^3/h The nominal volumetric flow is determined by the manufacturer of the volumetric flow unit.
Fault state	Collective fault based on Bit 0...Bit 7 of <i>Service information</i> .
Overridden	Signalling of an active override control (OPEN/CLOSED) The device can be commanded via the KNX group object <i>Override control</i> or via the forced switching at the input Y/3. Only the override controls OPEN and CLOSED are signalled.
Gear disengagement active	Signalling an active gear disengagement
Service information	Detailed information regarding instrument status As data point type, Bitset 16-Bit is recommended (DPT 22.*) Status information: Bit 0: Motor operation in relation to operating period too high Bit 1: Actuation path increased, e.g. defined end position exceeded Bit 2: Mechanical overload, i.e. defined end position not reached Bit 3...7: not used with this instrument type Bit 8: Internal activity (Synchronisation, Adaptation, Testrun, ...) Bit 9: Bus monitoring triggered Bit 0: Bit 7 are stored by the device and can be reset with the KNX group object <i>Reset</i> . As an alternative, they can be read as total fault status.
Sensor value	The representation of the sensor value is dependent on the parameterization. See section „KNX parameters – Sensor“

KNX parameters

Common

Setpoint with bus fail A setpoint can be defined for cases of communication interruption.

Values range: None (last setpoint)
Open
Closed
Mid

Factory setting: None (last setpoint)

The monitoring of the communication takes place for the KNX group objects *Setpoint* and *Override control*. If none of the objects is written within the parameterised monitoring time, the bus fail position is set and signalled in the *Service information* (Bit 9).

Bus monitoring time [min] Monitoring time for the detection of a communication interruption.

Values range: 1...120 min
Factory setting: -

Difference value for sending the actual values [%] Actual values (position, volumetric flow) are transferred at the time of a value change insofar as these change by the parameterised difference value. If the relative value changes by the difference value, not only the relative actual value but also the absolute actual value are transferred.

Values range: 0...100%
Factory setting: 5%

The transfer is deactivated with 0% in the event of a value change.

Repetition time [s] Repetition time for all position and sensor actual values. Status objects are not transferred except with a change.

Values range: 0...3'600 s
Factory setting: 0 = no periodic transmission

Sensor

Sensor type The input Y/3 can be used to connect a sensor. The sensor value is digitised and made available as KNX communication object.

Values range: No sensor
Active sensor (0...32 V)
Switching contact (0 / 1)
Humidity sensor (0...10 V corresponds 0...100%)
Air quality sensor CO2 (0...10 V corresponds 0...2'000 ppm)

Factory setting: No sensor

A switching to Y/3 is treated as local override switching in the absence of sensor parameterization.

Difference value for sending the sensor value The sensor value is transferred at the time of a value change insofar as this changes by the parameterised difference value.

Values range: 0...65'535
Factory setting: 1

The transfer is deactivated with 0 in the event of a value change. Without value change, the sensor value is sent because of the repetition time.

Output
(for sensor type „Active sensor“)

Only for „Active sensor“ sensor type

Values range: Sensor value mV (DPT 9.020)
Sensor value scaled (DPT 7.xxx)
Sensor value scaled % (DPT 5.001)

Factory setting: -

For „Sensor value mV“, the measured voltage is made available without processing. In the case of the scaled sensor values, a linear transformation can be defined with two points.

Polarity
(for sensor type «Switching contact»)

The polarity can be defined for the sensor type „Switching contact“.

Values range: Normal
Inverted

Factory setting: -

KNX workflows

Product database The product database for the import in ETS4 or higher is available at the Belimo website.

KNX workflows

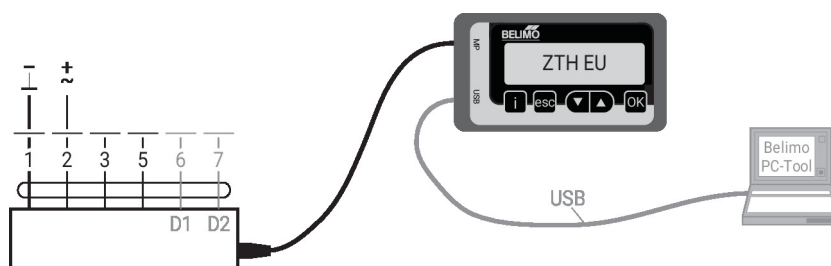
- Setting physical address** The programming of the physical address takes place by ETS and the programming button on the device.
 If the programming button is not accessible or accessible only with difficulty, then the address can be set using a point-to-point connection: "Overwrite Individual Address: 15.15.255"
 As a third possibility, the physical address can be programmed on the basis of the KNX series number (e.g. with Moov'n'Group). The KNX series number is placed on the device in two versions. One sticker can be removed for adhesion on the commissioning journal, for example.
- Firmware upgrade** The KNX firmware of the device is updated automatically with the programming of the application program if the product database has a more recent version.
 The first programming procedure takes somewhat longer in such cases (>1 min).
- Resetting to KNX factory settings** If necessary, the device can be reset manually to the KNX factory settings (physical address, group address, KNX parameters).
 For the reset, the programming button on the device must be pressed down for at least 5 s during start-up.

Installation notes

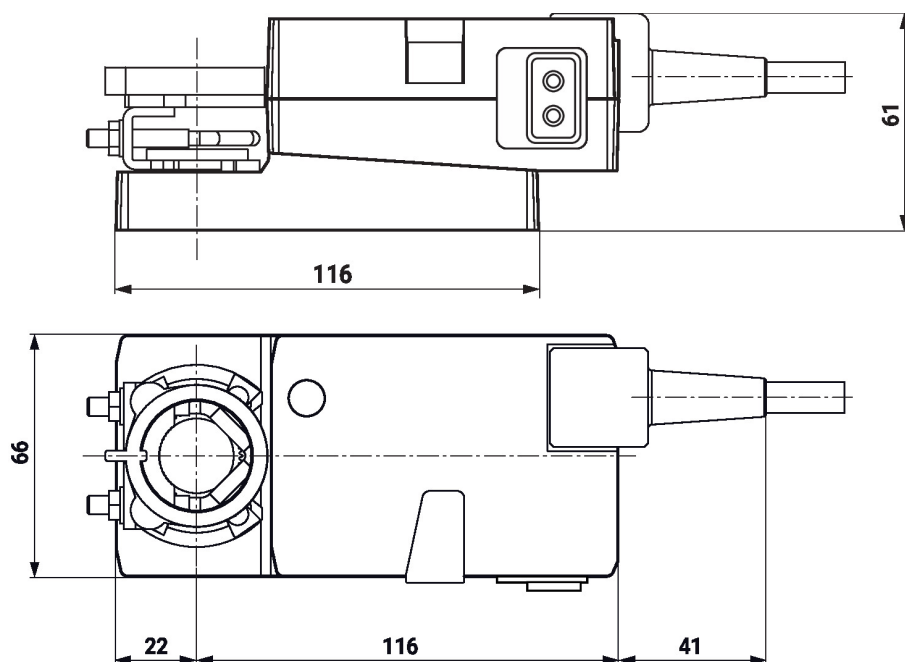
- Installation situation** Mounting VAV-Compact control equipment:
 The VAV-Compact is assembled, set and calibrated on the VAV unit in the factory by the VAV unit manufacturer.
 Installation of the VAV unit:
 The VAV unit must be installed according to the specifications of the VAV unit manufacturer.
 Installation specification Δp sensor:
 No restrictions, but it must be avoided that any condensation can run into the sensor and remain there.
 Accessibility of control equipment:
 Accessibility to the control equipment must be guaranteed at all times.
 Pressure tube connections:
 The pressure tube connections must not come into contact with liquids or greasing agents of any kind, this includes any residue inside or on the surface of the pressure tubes.
- Servicing** Cleaning work during installation, commissioning or maintenance
 Belimo VAV devices are maintenance-free. We recommend dry removal of dust from the outside of the housing if necessary.
 The duct system and the VAV units are maintained on the occasion of the cleaning intervals required by law or by the specific system. Please observe the following points.
 Cleaning work on the damper, differential pressure pickup devices and pressure tubes
 When cleaning the duct system or the VAV unit, remove the pressure tubes on the VAV controller so that it will not be affected.
 Using compressed air, e.g. blowing out the differential pressure pickup devices or pressure tubes
 Before doing this work, disconnect the differential pressure pickup devices or pressure tubes from the differential pressure sensor.
 Connecting the pressure tubes
 To ensure the correct installation of the pressure tubes, we recommend marking them with + or - before disassembly.

Service

Tool connection The actuator can be parametrised by ZTH EU via the service socket. For an extended parametrisation the PC tool can be connected.



Dimensions



Further documentation

- VAV-Compact product range for comfort applications
- Tool connections
- VAV-Universal application description
- Volumetric flow and pressure control from Belimo, product range overview