# BELIMO

**Communicative damper actuator for adjusting dampers in technical building installations**
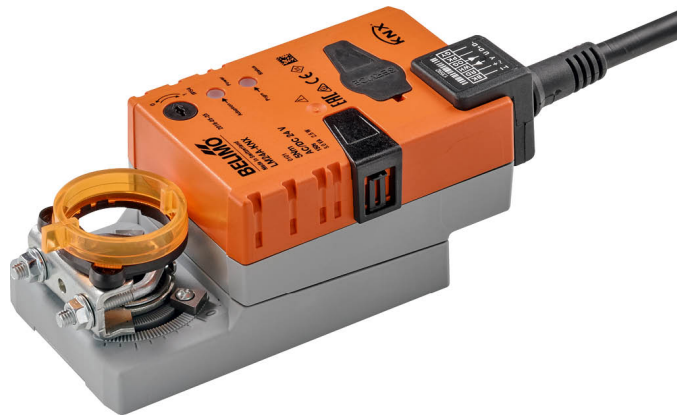
• Torque motor 5 Nm
• Nominal voltage AC/DC 24 V
• Control communicative
• Communication via KNX (S-Mode)
• Conversion of sensor signals



## Technical data

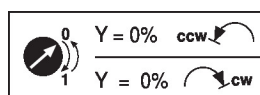| | | |
|---|---|---|
| **Electrical data** | Nominal voltage | AC/DC 24 V |
| | Nominal voltage frequency | 50/60 Hz |
| | Nominal voltage range | AC 19.2...28.8 V / DC 21.6...28.8 V |
| | Power consumption in operation | 2.5 W |
| | Power consumption in rest position | 1.3 W |
| | Power consumption for wire sizing | 5 VA |
| | Connection supply / control | Cable 1 m, 6 x 0.75 mm² |
| **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 |
| | Operating mode | S-Mode |
| | Current consumption of KNX-Bus | max. 5 mA |
| **Functional data** | Torque motor | 5 Nm |
| | Torque variable | 25%, 50%, 75% reduced |
| | Position accuracy | ±5% |
| | Direction of motion motor | selectable with switch 0/1 |
| | Direction of motion note | Y = 0%: At switch position 0 (ccw rotation) / 1 (cw rotation) |
| | Direction of motion variable | electronically reversible |
| | Manual override | with push-button, can be locked |
| | Running time motor | 150 s / 90° |
| | Running time motor variable | 35...150 s |
| | Adaptation setting range | manual |
| | Adaptation setting range variable | No action<br>Adaptation when switched on<br>Adaptation after pushing the manual override button |
| | Override control, controllable via bus communication | MAX (maximum position) = 100%<br>MIN (minimum position) = 0%<br>ZS (intermediate position) = 50% |
| | Override control variable | MAX = (MIN + 32%)...100%<br>MIN = 0%...(MAX – 32%)<br>ZS = MIN...MAX |
| | Sound power level, motor | 35 dB(A) |
| | Parametrisation | with service tool ZTH EU<br>Fast addressing 1...16 via push button possible |
| | Mechanical interface | Universal shaft clamp 6...20 mm |
| | Position indication | Mechanical, pluggable |
| **Safety data** | Protection class IEC/EN | III, Safety Extra-Low Voltage (SELV) |

| Safety data | Degree of protection IEC/EN | IP54 |
| --- | --- | --- |
| | 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 | -30...50°C [-22...122°F] |
| | Storage temperature | -40...80°C [-40...176°F] |
| | Servicing | maintenance-free |
| Weight | Weight | 0.55 kg |

## Safety notes

⚠

- This device has been designed for use in stationary heating, ventilation and air-conditioning systems and must not be used outside the specified field of application, especially 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 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.
- To calculate the torque required, the specifications supplied by the damper manufacturers concerning the cross-section, the design, the installation situation and the ventilation conditions must be observed.
- 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

| | |
| --- | --- |
| **Mode of 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. |
| **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 KNX. |
| **Parametrisable 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 EU) or the ETS planning and commissioning tool. |
| **Simple direct mounting** | Simple direct mounting on the damper shaft with a universal shaft clamp, supplied with an anti-rotation device to prevent the actuator from rotating. |
| **Manual override** | Manual override with push-button possible (the gear train is disengaged for as long as the button is pressed or remains locked). |
| **Adjustable angle of rotation** | Adjustable angle of rotation with mechanical end stops. |
| **High functional reliability** | The actuator is overload protected, requires no limit switches and automatically stops when the end stop is reached. |
| **Home position** | The first time the supply voltage is switched on, i.e. at the time of commissioning, the actuator carries out a synchronisation. The synchronisation is in the home position (0%). |
| | The actuator then moves into the position defined by the control signal. |

| **Adaptation and synchronisation** | An adaptation can be triggered manually by pressing the "Adaptation" button or with the PC-Tool. Both mechanical end stops are detected during the adaptation (entire setting range). |
|---|---|
| | Automatic synchronisation after pressing the manual override button is configured. The synchronisation is in the home position (0%). |
| | The actuator then moves into the position defined by the control signal. |
| | A range of settings can be adapted using the PC-Tool (see MFT-P documentation) |

## Accessories

| Electrical accessories | Description | Type |
|---|---|---|
| | Auxiliary switch 1 x SPDT add-on | S1A |
| | Auxiliary switch 2 x SPDT add-on | S2A |
| | Feedback potentiometer 140 Ω add-on | P140A |
| | Feedback potentiometer 200 Ω add-on | P200A |
| | Feedback potentiometer 500 Ω add-on | P500A |
| | Feedback potentiometer 1 kΩ add-on | P1000A |
| | Feedback potentiometer 2.8 kΩ add-on | P2800A |
| | Feedback potentiometer 5 kΩ add-on | P5000A |
| | Feedback potentiometer 10 kΩ add-on | P10000A |

| Mechanical accessories | Description | Type |
|---|---|---|
| | Shaft extension 170 mm ø10 mm for damper shaft ø6...16 mm | AV6-20 |
| | Shaft clamp one-sided, clamping range ø6...20 mm, Multipack 20 pcs. | K-ELA |
| | Shaft clamp one-sided, clamping range ø6...10 mm, Multipack 20 pcs. | K-ELA10 |
| | Shaft clamp one-sided, clamping range ø6...13 mm, Multipack 20 pcs. | K-ELA13 |
| | Shaft clamp one-sided, clamping range ø6...16 mm, Multipack 20 pcs. | K-ELA16 |
| | Anti-rotation mechanism 180 mm, Multipack 20 pcs. | Z-ARS180 |
| | Form fit insert 8x8 mm, Multipack 20 pcs. | ZF8-LMA |
| | Form fit insert 10x10 mm, Multipack 20 pcs. | ZF10-LMA |
| | Form fit insert 12x12 mm, Multipack 20 pcs. | ZF12-LMA |
| | Form fit insert 8x8 mm, with angle of rotation limiter and position indication, Multipack 20 pcs. | ZFRL8-LMA |
| | Form fit insert 10x10 mm, with angle of rotation limiter and position indication, Multipack 20 pcs. | ZFRL10-LMA |
| | Form fit insert 12x12 mm, with angle of rotation limiter and position indication, Multipack 20 pcs. | ZFRL12-LMA |
| | Position indicator, Multipack 20 pcs. | Z-PI |

| 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 |
| | Adapter for Service-Tool ZTH | MFT-C |
| | 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
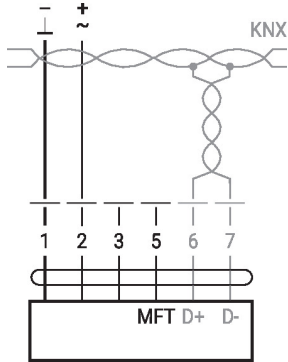
**Supply from isolating transformer.**

**Wire colours:**
1 = black
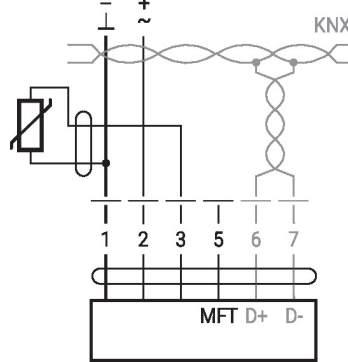2 = red
3 = white
5 = orange
6 = pink
7 = grey

**Functions:**
D+ = KNX+ (pink > red)
D- = KNX- (grey > black)
The connection to the KNX line should take place via WAGO connecting terminals 222/221.
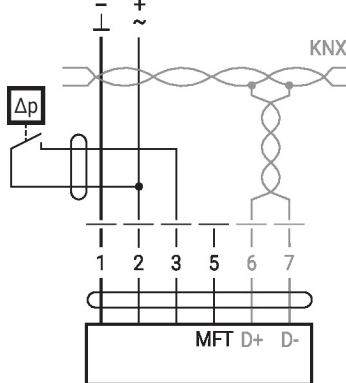
## Wiring diagrams

Connection without sensor



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



| Ni1000 | −28...+98°C | 850...1600 Ω [2] |
|--------|-------------|------------------|
| PT1000 | −35...+155°C | 850...1600 Ω [2] |
| NTC | −10...+160°C [1] | 200 Ω...60 kΩ [2] |

1) depending on type
2) Resolution 1 Ohm
Compensation of the measured value is recommended

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
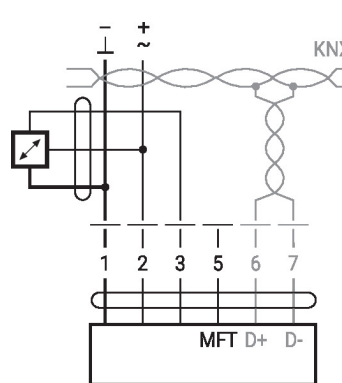


Possible voltage range: 0...32 V
Resolution 30 mV

## 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]<br>Resolution 0.4% |
| Setpoint Heating | I | C | – | W | T | – | 5.001 | _percentage | 1 Byte | % | [0…100]<br>Resolution 0.4% |
| Setpoint Cooling | I | C | – | W | – | – | 5.001 | _percentage | 1 Byte | % | [0…100]<br>Resolution 0.4% |
| Override control | I | C | – | W | – | – | 20.* | _enum | 1 Byte | – | 0 = no override<br>1 = Open<br>2 = Closed<br>3 = Min<br>4 = Mid<br>5 = Max |
| Reset | I | C | – | W | – | – | 1.015 | _reset | 1 Bit | – | 0 = no action<br>1 = reset |
| Adaptation | I | C | – | W | – | – | 1.017 | _switch | 1 Bit | – | 0 = no action<br>1 = adapt |
| Testrun | I | C | – | W | – | – | 1.017 | _switch | 1 Bit | – | 0 = no action<br>1 = Testrun |
| Min | I/O | C | R | W | – | – | 5.001 | _percentage | 1 Byte | % | [0…100]<br>Resolution 0.4% |
| Max | I/O | C | R | W | – | – | 5.001 | _percentage | 1 Byte | % | [0…100]<br>Resolution 0.4% |
| Relative position | O | C | R | – | T | – | 5.001 | _percentage | 1 Byte | % | [0…100]<br>Resolution 0.4% |
| Absolute position | O | C | R | – | T | – | 8.011<br>7.011 | _rotation_angle<br>_length | 2 Byte | °<br>mm | [–32'768…32'768]<br>[0…65'535] |
| Fault state | O | C | R | – | T | – | 1.002 | _boolean | 1 Bit | – | 0 = no fault<br>1 = fault |
| Overridden | O | C | R | – | T | – | 1.002 | _boolean | 1 Bit | – | 0 = not active<br>1 = active |
| Gear disengage-ment active | O | C | R | – | T | – | 1.002 | _boolean | 1 Bit | – | 0 = engaged<br>1 = disengaged |
| Service information | O | C | R | – | T | – | 22.* | _bitset16 | 2 Byte | – | Bit 0 (1) Excessive utilisation<br>Bit 1 (2) Mechanical travel increased<br>Bit 2 (4) Mechanical overload<br>Bit 3 (8) – (Not used)<br>Bit 4 (16) – (Not used)<br>Bit 5 (32) – (Not used)<br>Bit 6 (64) – (Not used)<br>Bit 7 (128) – (Not used)<br>Bit 8 (256) Internal activity<br>Bit 9 (512) Bus watchdog triggered |
| Sensor value<br>– Resistance R<br>– Temperature<br>– Relative Humidity<br>– Air Quality<br>– Voltage mV<br>– Voltage scaled<br>– Voltage scaled %<br>– Switch<br>– Dewpoint control | O | C | R | – | T | – | 14.060<br>9.001<br>9.007<br>9.008<br>9.020<br>7.*<br>5.001<br>1.001<br>1.001 | _resistance<br>_temperature<br>_humidity<br>_parts/million<br>_voltage<br>_pulses_length<br>_percentage<br>_switch<br>_switch | 4 Byte<br>2 Byte<br>2 Byte<br>2 Byte<br>2 Byte<br>2 Byte<br>1 Byte<br>–<br>– | Ω<br>°C<br>% RH<br>ppm<br>mV<br>mm<br>%<br>–<br>– | –<br>[–273…670'760]<br>[0…670'760]<br>[0…670'760]<br>[–670'760…670'760]<br>[0…65'535]<br>[0…100]<br>0/1<br>0/1 |

## KNX group objects (continuation)

| | |
|---|---|
| **Setpoint** | Specification of actuator position in **%** between the parameterised Min and Max limits.<br>Recommended for 2-way and 3-way ball valves. |
| **Setpoint Heating** | Specification of the valve position for the heating sequence of a 6-way ball valve.<br>The heating setpoint can be specified in the range from 0...100%.<br>The flow can be limited with the Max communication object.<br>The setpoint object (heating/cooling) with the last command is preferred. |
| **Setpoint Cooling** | Specification of the valve position for the cooling sequence of a 6-way ball valve.<br>The cooling setpoint can be specified in the range from 0...100%.<br>The flow can be limited with the Min communication object.<br>The setpoint object (heating/cooling) with the last command is preferred. |
| **Override control** | Overriding the setpoint with defined override states.<br>As data point type, 1 Byte (unsigned) is recommended (DPT 20.*) |
| **Reset** | Resetting the stored service messages<br>(see KNX group object *Service information*). |
| **Adaptation** | Perform the adaptation.<br>An active adaptation is signaled in Bit 8 of *Service information*. |
| **Testrun** | Performance of a testrun that checks the entire operating range.<br>An active adaptation is signaled in Bit 8 of *Service information*. After completion, detected faults (mechanical overload, mechanical travel increased) are signaled in *Service information*. |
| **Min** | Minimum Limit (position) in **%**.<br>Caution: Changing the setting may result in malfunctions. |
| **Max** | Maximum Limit (position) in **%**.<br>Caution: Changing the setting may result in malfunctions. |
| **Relative position** | Current actuator position in **%** |
| **Absolute position** | Absolute position/stroke<br>The data point type is to be selected depending on the type of movement:<br><br>[°]      DPT 8.011<br>[mm]    DPT 7.011 |
| **Fault state** | Collective fault based on Bit 0...Bit 7 of *Service information*. |
| **Overridden** | Signaling of an active override control (OPEN/CLOSED)<br>The device can be commanded via the KNX group object *Override control* or via the forced switching at the input Y/3. Only the override controls OPEN and CLOSED are signaled. |
| **Gear disengagement active** | Signaling an active gear disengagement |
| **Service information** | Detailed information regarding device status<br>As data point type, Bitset 16-Bit is recommended (DPT 22.*)<br>Status information:<br><br>Bit 0:      Motor operation in relation to operating period too high<br>Bit 1:      Mechanical travel increased, e.g. defined end position exceeded<br>Bit 2:      Mechanical overload, i.e. defined end position not reached<br>Bit 3...7: not used with this device type<br>Bit 8:      Internal activity (Synchronisation, Adaptation, Testrun, ...)<br>Bit 9:      Bus watchdog triggered<br>Bit 0:      Bit 7 are stored by the device and can be reset with the KNX group object *Reset*. As an alternative, the several bits can be read as collective fault state. |
| **Sensor value** | The representation of the sensor value is dependent on the parameterization.<br>See section „KNX parameters – Sensor" |

## KNX parameters

**Common**

| | |
|---|---|
| **Setpoint at bus failure** | A setpoint can be defined for cases of communication interruption. |

| | |
|---|---|
| Values range: | None (last setpoint)<br>Open<br>Closed<br>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 signaled in the *Service information* (Bit 9).

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

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

**Setpoint Mode** Two operating modes can be selected.

| | |
|---|---|
| „Common object mode" | Recommended for operation with 2-way and 3-way ball valves and damper actuators.<br>Corresponds to the control of the actuator with a setpoint of 0...100%. |
| „Heating and Cooling separated" | Explicitly for the control of the valve actuator with 6-way ball valve.<br>Two setpoints are available as communication objects.<br>One setpoint for heating and one setpoint for cooling.<br>These two setpoints are used by the valve actuator in accordance with the 6-way valve characteristic curve for controlling heating and cooling sequences. |

**Increment for value update [%]** 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 |

## KNX workflows

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

**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.

## Operating controls and indicators
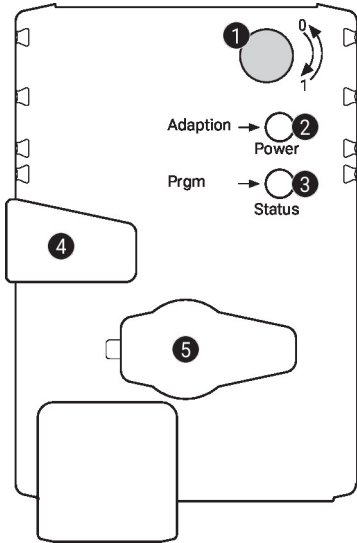
**1** **Direction of rotation switch**

Switch over: Direction of rotation changes

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

Off: No power supply or malfunction

On: In operation

Press button: Triggers angle of rotation adaptation, followed by standard mode

**3** **Push-button and LED display yellow**

Off: The actuator is ready

On: Adaptation or synchronisation process active or actuator in programming mode (KNX)

Flashing: Connection test (KNX) active

Press button: In operation (>3 s): Switch the programming mode on and off (KNX)

When starting (>5 s): Reset to factory setting (KNX)

**4** **Manual override button**

Press button: Gear train disengages, motor stops, manual override possible

Release button: Gear train engages, synchronisation starts, followed by standard mode

**5** **Service plug**
For connecting parametrisation and service tools

## Service

**Quick addressing**

1. Press the "Address" button until the green "Power" LED is no longer illuminated. LED flashes in accordance with the previously set address.

2. Set the address by pressing the "Address" button the corresponding number of times (1...16).

3. The green LED flashes in accordance with the address that has been entered (...16). If the address is not correct, then this can be reset in accordance with Step 2.

4. Confirm the address setting by pressing the green "Adaptation" button.

If no confirmation occurs for 60 seconds, then the address procedure is ended. Any address change that has already been started will be discarded.

The resulting BACnet MS/TP and Modbus RTU address is made up of the set basic address plus the short address (e.g. 100+7=107).
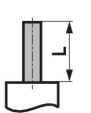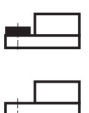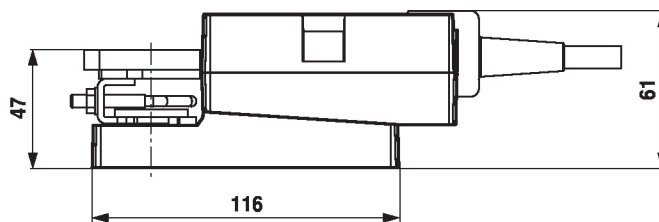
**Tools connection**

The actuator can be parametrised by ZTH EU via the service socket.

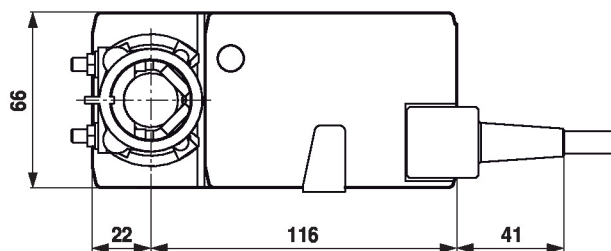For an extended parametrisation the PC tool can be connected.
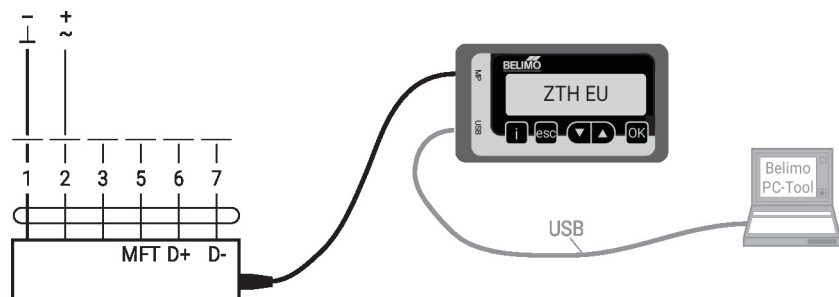
## Dimensions

### Spindle length

| | | |
|---|---|---|
| | | Min. 37 |
| | | - |

### Clamping range

| ⊙↕ | ▪↕ | ◇↕ |
|---|---|---|
| 6...20 | ≥6 | ≤20 |

47

61

116

66

22 | 116 | 41

## Further documentation

• Tool connections
• General notes for project planning

## Application notes

• For digital control of actuators in VAV applications patent EP 3163399 must be considered.