

OPEN AIR™

**Air damper actuators**

**GDB16...1  
GLB16...1**

Rotary version, modulating, AC 24 V



Electric motor-driven actuators, modulating for DC 0...10 V control signals, nominal torque 5 / 10 Nm, AC 24 V operating voltage, self-adaptation of the rotational angle range, DC 0...10 V feedback signal for position indication, mechanically adjustable working range between 0...90°, pre-wired with connecting cables of 0.9 m. Type-specific variations with adjustable control signal for offset and span and with adjustable auxiliary switches for supplementary functions.

**Use**

In ventilating and air conditioning plants to actuate air dampers

- for connections to controllers with DC 0...10 V modulating output signals
- with nominal torque of
  - 5 Nm for damper areas of approx. up to 0.8 m<sup>2</sup> and
  - 10 Nm for damper areas of approx. up to 1.5 m<sup>2</sup>

**Type summary**

AC 24 V operating voltage					
Torque	Control signal	Standard application (Offset and span not adjustable)		Application with adjustable control signal (For offset and span)	
		no auxiliary switches	with auxiliary switches	no auxiliary switches	with auxiliary switches
5 Nm	DC 0...10 V	GDB161.1E	GDB166.1E	GDB163.1E	GDB164.1E
10 Nm	DC 0...10 V	GLB161.1E	GLB166.1E	GLB163.1E	GLB164.1E

**Ordering**

Auxiliary switches **cannot later be integrated**. For this reason, order the type that includes the desired options.

**Delivery**

Individual parts such as position indicator and other mounting materials for the actuator are delivered separately and require additional mounting.

Connecting cables

The actuator comes with 0.9 m long pre-wired connecting cables.

<b>Accessories, spare parts</b>	• Rotary/linear set with lever	<b>ASK71.5</b>
	• Rotary/linear set with lever and mounting plate	<b>ASK71.6</b>
	• Spare parts are supplied on demand.	

## Equipment combinations

These actuators can be connected to all control devices that transmit a modulating DC 0...10 V signal and that comply with all relevant safety requirements.

## Functions

### Basic functions

Rotational movement	<ul style="list-style-type: none"> <li>• The actuator's rotational movement direction (clockwise or counterclockwise) can be selected using the DIL switch for rotational direction.</li> <li>• As soon as the device receives an input signal (&gt; 0 V), the actuator moves toward "90°". As long as the control signal is constant, the actuator remains in its current position.</li> <li>• When the control signal is interrupted, but operating voltage is still supplied, the actuator returns to the "0" position of the selected direction of movement.</li> <li>• On operating voltage failure, the actuator remains in its current position.</li> </ul>
Position indication	<ul style="list-style-type: none"> <li>• Mechanical: The position indicator inserted in the housing coupling bushing indicates the rotational angle position of the air damper.</li> <li>• Electric: The electronics generate an output voltage of DC 0...10 V that is proportional to the rotational angle (0...90° or 90°...0). This voltage can be used for the position indication. With the DIL switch, the line of action for this voltage can be selected as either inverted and non-inverted operating function (refer to "Commissioning notes").</li> </ul>
Manual adjustment	When no voltage is supplied, you can disengage the gear train and manually adjust the actuator or the air damper by means of the red slider.
Mechanical limitation of rotational angle	The rotational angle can be limited stepless between 0° and 90°.
Self-adaption of rotational angle range	<p>The actuator automatically determines the mechanical end of range for the rotational angle on:</p> <ul style="list-style-type: none"> <li>• active self-adaptation (with DIL switch) every 24 hours</li> <li>• active self-adaptation and restart after voltage failure</li> <li>• switch-on and switch-off for self-adaptation when operating voltage is supplied</li> </ul> <p>The electronic calibrates the control signal as per the set rotational angle range for the following types:</p> <ul style="list-style-type: none"> <li>– GDB / GLB161.1E and 166.1E on DC 0...10 V</li> <li>– GDB / GLB163.1E and 164.1E with selected values for offset <math>U_0</math> and span <math>\Delta U</math> (see "Technical design")</li> </ul>
Note	The output voltage for the position indication is not impacted, i.e., the complete 100 % span (nominal rotational angle 90°) corresponds to DC 0...10 V.
Actuator response on damper blocking	<p>If the actuator</p> <ul style="list-style-type: none"> <li>– is stopped by blocked dampers</li> <li>– and if the difference between control signal Y and the output signal U exceeds DC 0.2 V, motor voltage is turned off after 20 s. A periodic restart occurs every 24 hours.</li> </ul>

### Type-specific functions

Adjustable control signal (operating function)	<p>Offset <math>U_0</math> and span <math>\Delta U</math> can be adjusted using two potentiometers (see "Technical design"). Actuators featuring this function can be used for the following applications:</p> <ul style="list-style-type: none"> <li>• Dampers with rotational angle limitation can, for instance, be controlled in the range of 0...45° on a control signal of max. DC 10 V (offset <math>U_0</math> and effective span <math>\Delta U_w</math>, with or without self-adaptation).</li> <li>• As a sequencing actuator in control circuits that can only apply a DC 0...10 V control signal to control more than one sequence.</li> </ul>
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- In control systems with a control signal deviating from DC 0...10 V such as DC 2...10 V.

Adjustable auxiliary switches

Auxiliary switches provide supplementary functions. The switching points for switches A and B (one changeover switch each) can be set independently in increments of 5° within the 0°...90° rotational angle range.  
Refer to "Technical design", "Commissioning notes", and "Internal diagram".

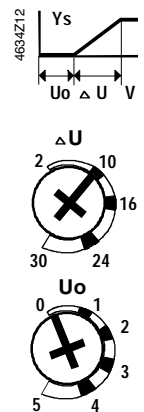
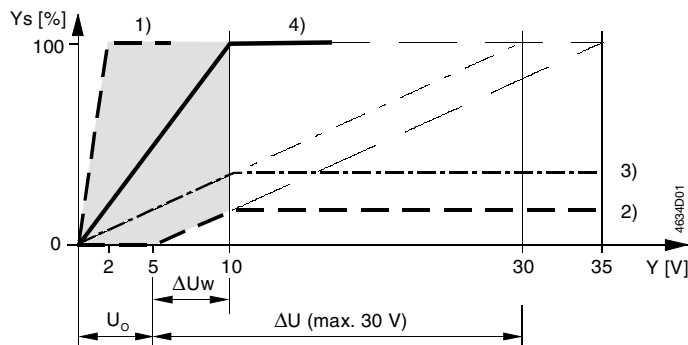
## Technical design

### Motor technology

A reversible synchronous motor enables accurate speed control. Electronic runtime monitoring and magnetic coupling for torque limitation represent a protective measure for both actuator and dampers.

Adjustable operating function (type-specific)

A modulating DC 0..10 V control signal from the controller operates the actuator. The rotational angle is proportional to the control signal. Using the "U<sub>o</sub>" potentiometer, you can set the offset for DC 0...5 V, and with the "ΔU" potentiometer, you can set the span for DC 2...30 V.



- Ys Control range (100 % = angle of rotation 90°)
- Y Control signal
- U<sub>o</sub> Offset range
- ΔU Span (for Ys = 100 %), (virtual span if Y > 10 V)
- ΔU<sub>w</sub> Effective span = 10 V - U<sub>o</sub>

Examples as per diagram	Set offset U <sub>o</sub>	Span ΔU		Control range Ys
		Set	Effective	
1) min. span	DC 0 V	DC 2 V	DC 2 V	100 % / 90°
2) min. rotational angle	DC 5 V	DC 30 V	DC 5 V	16.7 % / 15°
3) min. rotational angle	DC 0 V	DC 30 V	DC 10 V	33.3 % / 30°
4) factory setting	DC 0 V	DC 10 V	DC 10 V	100 % / 90°

Note

- The Y input is limited to a max. of DC 10 V, i.e., voltages > DC 10 V are limited.
- The virtual adjustable span ΔU is max. 30 V.
- The effective span ΔU<sub>w</sub> = 10 V - U<sub>o</sub> is between 5 V and 10 V.

Example

Define the adjustable span ΔU for an actuator that is to open from 0...50 % (0...45°). The offset U<sub>o</sub> is 2 V.

Formula

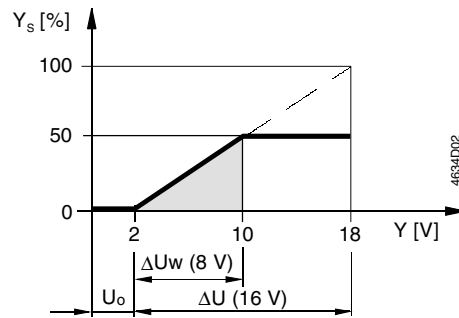
Calculating the value for ΔU:

$$\Delta U = \frac{\text{max. control range } Ys \text{ max } [\%]}{\text{span control range } Ys [\%]} \cdot (10 [\text{V}] - U_o [\text{V}]) = \frac{100 \%}{50 \%} \cdot (10 \text{ V} - 2 \text{ V}) = 16 \text{ V}$$

Potentiometer settings

**U<sub>o</sub> = 2 V, ΔU = 16 V**

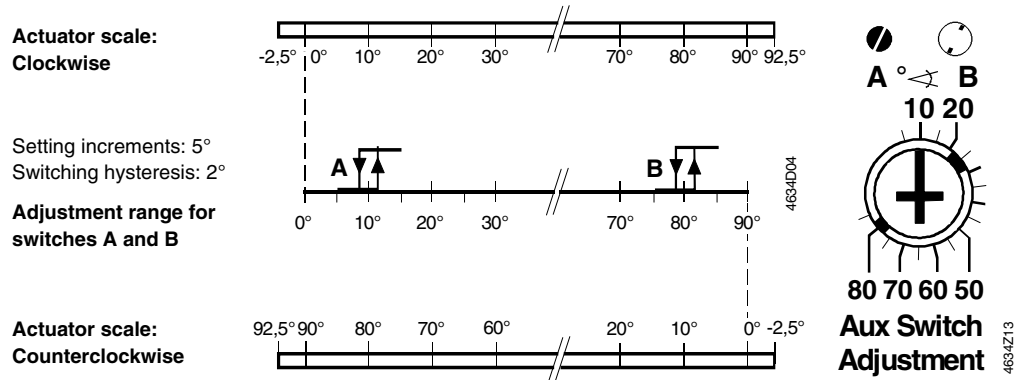
Operating function for the above example



Max. control range	$Y_{smax} = 100\% (90^\circ)$
Span control range	$Y_s = 50\% (45^\circ)$
Virtual span	$\Delta U = 16\text{ V}$
Effective span	$\Delta U_w = 8\text{ V}$

### Adjustable auxiliary switches (type-specific)

The illustration below shows the adjustable switching values for auxiliary switches A and B in relation to the rotational angle.



Note

The setting shafts for the auxiliary switches turn together with the actuator. The scales are valid only for the **zero position of the actuator on clockwise** movement.

## Mechanical design

### Basic components

Housing

A robust, light-weight plastic housing and a gear train plate made from steel guarantee an extended actuator life even under severe environmental conditions.

Gear train

Maintenance-free and noise-free gear train with stall and overload protection for the life of the actuator.

Slider for manual adjustment

The red slider on the side serves for manually releasing and adjusting the gear train.

Coupling bushing

The coupling bushing is made from hardened sintered steel to attach the actuator on the damper shaft for differing shaft diameters and cross sections (square, round).

Centering element GLB...1 (10 Nm)

This element is also made from hardened sintered steel and serves the following purposes:

- ensuring a friction-locked connection between a damper shaft with a small diameter (8...10 mm) and the coupling bushing.
- reducing the vertical movement of the actuator by applying eccentric movement.

DIL switches

The three DIL switches serve to:

- select self-adaptation of the rotational angle range
- set the rotational movement direction
- select the line of action between an inverted and non-inverted operating function of the output voltage for the position indication.

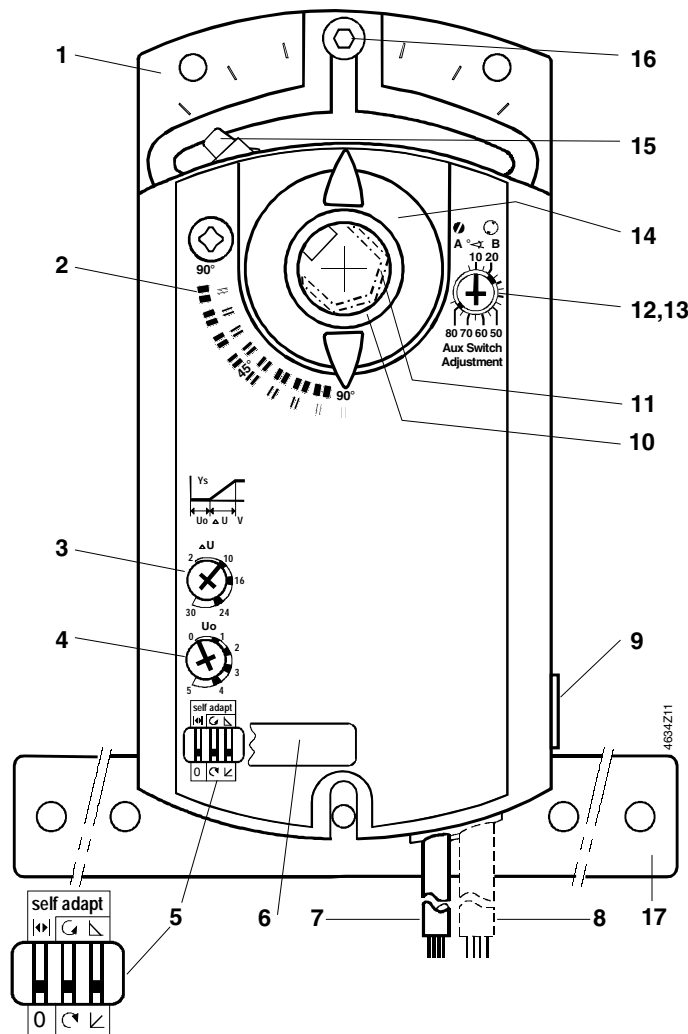
Mounting bracket	A metal strip with bolt serves to prevent the actuator from twisting.
Electrical connection	All actuators are equipped with pre-wired 0.9 m long connecting cables.

### Type-specific elements

Auxiliary switch	For supplementary functions, the auxiliary switches A and B can be adjusted on the actuator front (top right).
Potentiometer for offset and span	Both potentiometers for the operating functions $U_0$ and $\Delta U$ are accessible on the actuator front.

### Setting and operating elements

Refer to "Technical design" and "Commissioning notes" in this data sheet.



- 1 Base plate and housing
- 2 Rotational angle scales 0°...90° / 90°...0°
- 3 Potentiometer to adjust the span  $\Delta U$
- 4 Potentiometer to set the offset span  $U_0$
- 5 DIL switches for
  - self-adaptation
  - rotational movement direction
  - inverted or non-inverted output voltage operating function
- 6 Cover for DIL switches
- 7 Connecting cable for power, control signal and position indication
- 8 Connecting cable for auxiliary switches
- 9 Slider to disengage the gear train
- 10 Coupling bushing
- 11 Centering element for GLB...1E (shaft diameter 8...10 mm)
- 12,13 Setting shafts for auxiliary switches A and B
- 14 Position indicator
- 15 Adjustment lever with shaft fastening screw
- 16 Adjusting screw for rotational angle limitation
- 17 Mounting bracket

## Engineering notes



The basic system data for the control systems in use contain all engineering information; refer to this data prior to mounting, wiring, and commissioning the actuator and carefully read all safety information. Pay special attention to all safety notes and explanations relating to control signals DC 0...10 V.

### Intended use

Use these actuators in a system only for applications as described in the basic system documentation of the applied control systems. Additionally, include all actuator-specific features and conditions as described in the brief description on the title page of this data sheet (bold print) and in the chapters "Use", "Engineering notes", and "Technical data".



The sections flagged with a warning symbol as illustrated in the left margin contain safety-related requirements and restrictions; it is important that you adhere to them to prevent physical injuries or equipment damages.

### AC 24 V supply

Operate the actuators only on **safety extra-low voltage (SELV)** or **protection by extra-low voltage (PELV)** as per HD 384.

### Auxiliary switches A, B

Apply **only mains voltage** or **only safety extra-low voltage** to the switching outputs of auxiliary switches A and B. Mixed operation is not permissible. However, operation using various phases is permissible.



### Caution, maintenance

#### **Do not open the actuator!**

The unit is maintenance-free. Any repair work must be conducted by the manufacturer only.

### Electric parallel connection of actuators

Electric connection in parallel of the GDB...1 actuators with GLB...1 is permissible only if the operating voltage is within the required tolerance. Remember to include voltage drops at the feed lines. With the L&G DC 0...10 V controller output, you can connect a maximum of 10 actuators (LG terminal codes G, G0, Y).

### Note

Do not mechanically couple the actuators.

### Required actuator type

Selection of the actuator depends on several torque factors. After obtaining the damper torque rating (Nm/m<sup>2</sup>) from the manufacturer and determining the damper area, calculate the total torque required to move the damper as follows:

$$\text{Total Torque} = \text{Torque Rating} \times \text{Damper Area}$$

Determine your type of actuator from the below table:

If $\frac{\text{Total torque [Nm]}}{\text{SF}^1}$	then use type
$\leq 5 \text{ Nm}$	GDB16...1 (5 Nm)
$\leq 10 \text{ Nm}$	GLB16...1 (10 Nm)
$\leq 20 \text{ Nm}$	GBB16...1 (20 Nm)
$\leq 35 \text{ Nm}$	GIB16...1 (35 Nm)

<sup>1</sup> Safety factor SF: When calculating the number of actuators, non-definable variables such as slight misalignment, damper age, etc. must be included as a safety factor. We recommend a safety factor of 0.80 (or 80% of the torque characteristic).

### Sizing transformers for AC 24 V (SELV)

- Use safety insulating transformers with double insulation as per EN 60 742; the transformers must be made for 100% runtime.
- Observe all local safety rules and regulations pertaining to sizing and protection of transformers.
- Determine the transformer's power consumption by adding up the power consumption in VA for all actuators used.

Wiring and commissioning	Refer to "Commissioning notes" and "Diagrams" in this data sheet as well as to the HVAC job drawings.
Settings	The values for the offset ( $\Delta U$ ) and span ( $U_o$ ) must be entered in the respective plant documentation.

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## Mounting notes

Mounting instructions	All information and steps to properly prepare and mount the actuator are listed in the Mounting Instruction guide supplied with the actuator. Both position indicator and mounting bracket are delivered separately.
Mounting position	Choose the actuator's mounting position so that you can easily access the cables as well as the setting shafts on the actuator front. Refer to "Dimensions".
Mounting bracket	When you mount the actuator directly on the damper shaft, use the mounting bracket. The pivot must have sufficient working depth in the base plate and sufficient play toward the shaft center, especially for smaller shaft diameters that cause greater eccentric movement.
Centering element GLB...1 (10 Nm)	To ensure a friction-locked connection at a shaft diameter of 8...10 mm, install the supplied centering element between the damper shaft and the coupling bushing as per the mounting instructions.
Damper shafts	Information on minimum length and diameter for the damper shaft is available in "Technical data".
Manual adjustment	Disconnect the voltage supply before manually adjusting the actuator via the red slider.
Mechanical limitation of rotational angle	Where required, you can set the rotational angle range by positioning the adjusting screw accordingly.
Using the linear mounting set	The mounting set as described in "Type summary" for changing the rotational movement to a linear stroke is mounted separately.

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## Commissioning notes

References	For commissioning, the following reference documentation must exist: <ul style="list-style-type: none"> <li>• This data sheet: N4634</li> <li>• Mounting instructions M4634</li> <li>• Job diagram</li> </ul>
Ambient conditions	Check to ensure that all permissible values as contained in the "Technical data" have been observed.
Mechanical check	<ul style="list-style-type: none"> <li>• Check for proper mounting and to ensure that all mechanical settings correspond to the plant-specific requirements. Additionally, ensure that the dampers are shut tight when in the closed position.</li> <li>• Check the direction of rotation</li> <li>• Use the red slider (while no voltage is supplied) to manually adjust the dampers or the actuator.</li> <li>• Fasten the actuator securely to avoid twisting and blocking of the actuator.</li> </ul>

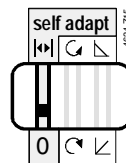
## Electrical check

- Check to ensure that the cables are connected in accordance with the plant wiring diagram (see "Diagrams").
- The operating voltage AC 24 V (SELV/PELV) must be within the tolerance values.
- Functional check:
  - As per the DIL switch settings 1, 2 or 3
  - When applying a DC 10 V control signal, the actuator must turn from 0° to 90° or to the end position of the rotational angle limitation (clockwise or counterclockwise).
  - After disconnecting the AC 24 V operating voltage, the actuator stops.
  - After interrupting the control signal Y, but while operating voltage is still supplied, the actuator returns to the "0" position.
- Output voltage DC 0...10 V (inverted or non-inverted operating function) for the position indication while the actuator moves from 0...90° or from 90°...0.
- Change the auxiliary switch contacts "A" and "B" while the actuator reaches the respective switching positions.

## DIL switch settings

The following functions can be set and thus require checking.

### DIL switch 1: Self-adaptation



Self-adaptation can either be ON or OFF. See "Functions" for a functional description.

Factory setting: self-adaptation OFF (0)

### DIL switch 2: Rotational movement direction



The rotational movement direction must match the desired damper movement direction (clockwise or counterclockwise).

Factory setting: clockwise direction (↻).

### DIL switch 3: Output voltage operating function for position indication

The line of action for output voltage U of the electrical position indication can be selected independent of the rotational movement direction. The following variants are possible:

Rot. movement direction 0...90°	DIL switch position	Output voltage U
↻	↙ non-inverted	DC 0...10 V
↻	↘ inverted	DC 10...0 V
↺	↙ non-inverted	DC 0...10 V
↺	↘ inverted	DC 10...0 V

### Factory setting



**Non-inverted operating function (↙)**

$Y_S = 0...100\%$  (0°...90°)

$U = DC\ 0...10\ V$

### Control signal operating function, factory setting

The potentiometers which are used to set the offset and span have the following factory setting: offset  $U_0 = 0\ V$ ; span  $\Delta U = 10\ V$

The desired value can be adjusted using a flat blade screwdriver in accordance with the information supplied in "Technical design".

### Switches A and B: Factory setting

The auxiliary switches have the following factory settings:

Switch A: switching point at 5°

Switch B: switching point at 85°

The settings for A and B can be set to the desired values using the setting shafts; refer to "Technical design".

### Note

- In order to ensure an exact switching position for switches A and B, refer to "Adjustable auxiliary switches" under the "Technical design" heading.
- The angle values are valid only for the "0" actuator position (clockwise direction).



Function check on damper blocking

- Allow the actuator to turn by applying a control signal until the damper blocks at an integrated stop (only for functional checks).
- Increase the control signal
- If the difference between the control signal Y and the output signal U exceeds 0.2 V, the actuator must
  - turn off after 6 s
  - restart after 7 s for 6 s
  - restart for 6 s after 24 h

Note

If the difference between control signal Y and output signal U is negative (control signal Y smaller than output signal U), the actuator turns back.

## Technical data

### Power supply AC24 V

Operating voltage	AC 24 V $\pm$ 20 %
Safety extra-low voltage (SELV) or Protection by extra-low voltage (PELV) as per Requirements of external safety insulating transformer (100% ED)	HD 384 as per EN 60742
Supply line fuse	max. 10 A
Frequency	50/60 Hz
Power supply (with control signal)	125 mA
Power consumption: with control signal holding	3 VA/2 W 1 VA/1 W

### Mechanical data

Torque GDB16..1E	
Nominal torque	5 Nm
Minimum holding torque (with/without operating voltage)	> 5 Nm
Maximum torque	< 7 Nm
Torque GLB16..1E	
Nominal torque	10 Nm
Minimum holding torque (with/without operating voltage)	> 10 Nm
Maximum torque	< 14 Nm
Nominal rotational angle (with position indication)	90°
Maximum rotational angle (mechanic limitation)	95° $\pm$ 2°
Runtime for nominal rotational angle 90°, motor operation at 50/60 Hz	150 s / 125 s
Periodic switch-on time of the motor on damper blocking	6 s after 24 h each
Rotational movement direction (defined by DIL switch setting)	clockwise / counterclockwise
Mechanical life	10 <sup>5</sup> cycles

### Input

Control signal Y	Input voltage (wires 8-2)	DC 0...10 V
	Max. permissible input voltage	DC 35 V
	Limited to	DC 10 V
	Input resistance	> 100 k $\Omega$
	Neutral zone NZ (for non-adjustable operating function)	200 mV

Adjustable operating function for GDB / GLB163.1E GDB / GLB164.1E	Offset U <sub>0</sub> (adjustable with potentiometer)	DC 0...5 V
	Span $\Delta$ U for Y <sub>s</sub> = 100 %	
	Function range, limited	DC 2...10 V
	Adjustable with potentiometer (virtual)	DC 2...30 V
	Neutral zone NZ (for adjustable operating function)	2 % of $\Delta$ U

Self-adaption of the set rotational angle range	Control signal Y for	
	GDB / GLB161.1E and 166.1E	DC 0...10 V
	GDB / GLB163.1E and 164.1E	set values for U <sub>0</sub> and $\Delta$ U
	Calibration on active self-adaptation	ever 24 hours and after operating voltage failure

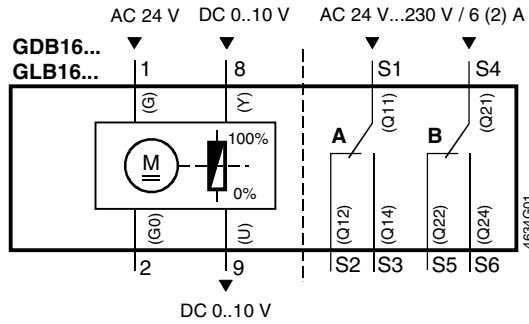
## Outputs

⚠ Auxiliary switches for GDB / GLB164.1E GDB / GLB166.1	Number of changeover switches	2
	Life: 6 A resistive, 2 A inductive 5 A resistive, 1 A inductive without load	10 <sup>4</sup> switchings 5 x 10 <sup>4</sup> switchings 10 <sup>6</sup> switchings
	Switching voltage	AC 24...230 V
	Nominal current resistive/inductive	6 A / 2 A
	Insulation resistance between auxiliary switches and housing	AC 4 kV
	Switching range of the auxiliary switches	5°...85°
	Setting increments	5°
	Switching hysteresis	3°
	Factory changeover settings	
	Switch A	5°
	Switch B	85°
Output signal for position indication	Output signal (wires 9-2) Output voltage (for Ys = 0...100%) Max. output current Protected against false connections	DC 0...10 V or DC 10...0 V DC ± 1 mA max. AC 24 V
<b>Wire connections</b>	Cable lengths	0.9 m
	Supply AC 24 V (wires 1, 2)	2 x 0.75 mm <sup>2</sup>
	Output signal (wires 8, 9)	2 x 0.75 mm <sup>2</sup>
	Auxiliary switches A and B (wires S1...S6)	6 x 0.75 mm <sup>2</sup>
<b>Housing protection</b>	Degree of protection as per EN 60 529	IP 40
<b>Protection class</b>	Insulation class	
	AC 24 V	III
	Auxiliary switch	II
<b>Environmental conditions</b>	Operation	IEC 721-3-3
	Climatic conditions	Class 3K5
	Mounting location	Interior, weather-protected
	Temperature	-30...55 °C
	Humidity (non-condensing)	< 95% r.h.
	Transport	IEC 721-3-2
	Climatic conditions	Class 2K2
	Temperature	-30...60 °C
	Humidity (non-condensing)	< 95% r.h.
	Mechanical conditions	Class 2M3
<b>Standards</b>	Product safety	
	Automatic electrical controls for household and similar use (type 1)	EN 60 730-2-14
	Electromagnetic compatibility	
	Immunity	EN 50 082-2
	Emissions	EN 50 081-1
	CE Conformity	
	Electromagnetic compatibility as per Low voltage directive	89/336/EEC 73/23/EEC
<b>Dimensions</b>	Actuator	
	W x H x D see Dimensions	68 x 137 x 59.5 mm
	Damper shaft	
	Round	8...16 mm
	Square	6...12 mm
	Min. length	20 mm
	Max. shaft hardness	< 300 HV
	Centering element	
	Used with GLB...1E for shaft diameter	8...10 mm
<b>Weight</b>	Without packaging	0.48 kg

## Diagrams

### Internal diagram

GDB/ GLB161.1E  
 GDB/ GLB166.1E  
 GDB/ GLB163.1E  
 GDB/ GLB164.1E



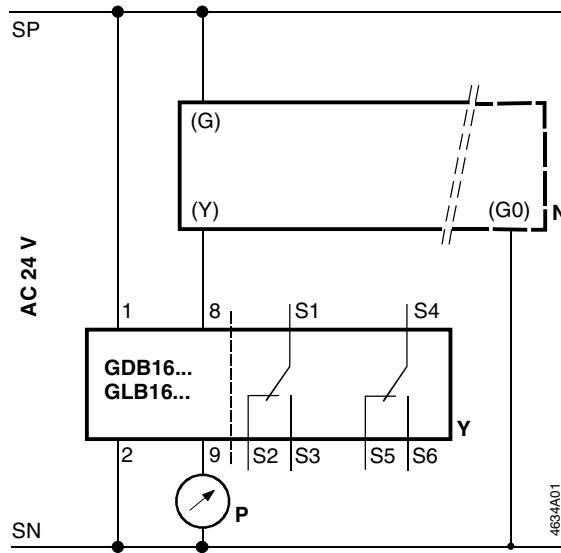
### Cable labeling

All wires are color-coded and labeled.

Cable	Wire labeling	Designation	Color	L&G terminal code
Actuator AC 24 V	1	System potential AC 24 V	red	G
	2	System neutral	black	G0
	8	Control signal DC 0 ... 10 V	gray	Y
	9	Position indication DC 0 ... 10 V	pink	U
Auxiliary switch	S1	Switch A Input	gray/red	Q11
	S2	Switch A Normally closed contact	gray/blue	Q12
	S3	Switch A Normally open contact	gray/pink	Q14
	S4	Switch B Input	black/red	Q21
	S5	Switch B Normally closed contact	black/blue	Q22
	S6	Switch B Normally open contact	black/pink	Q24

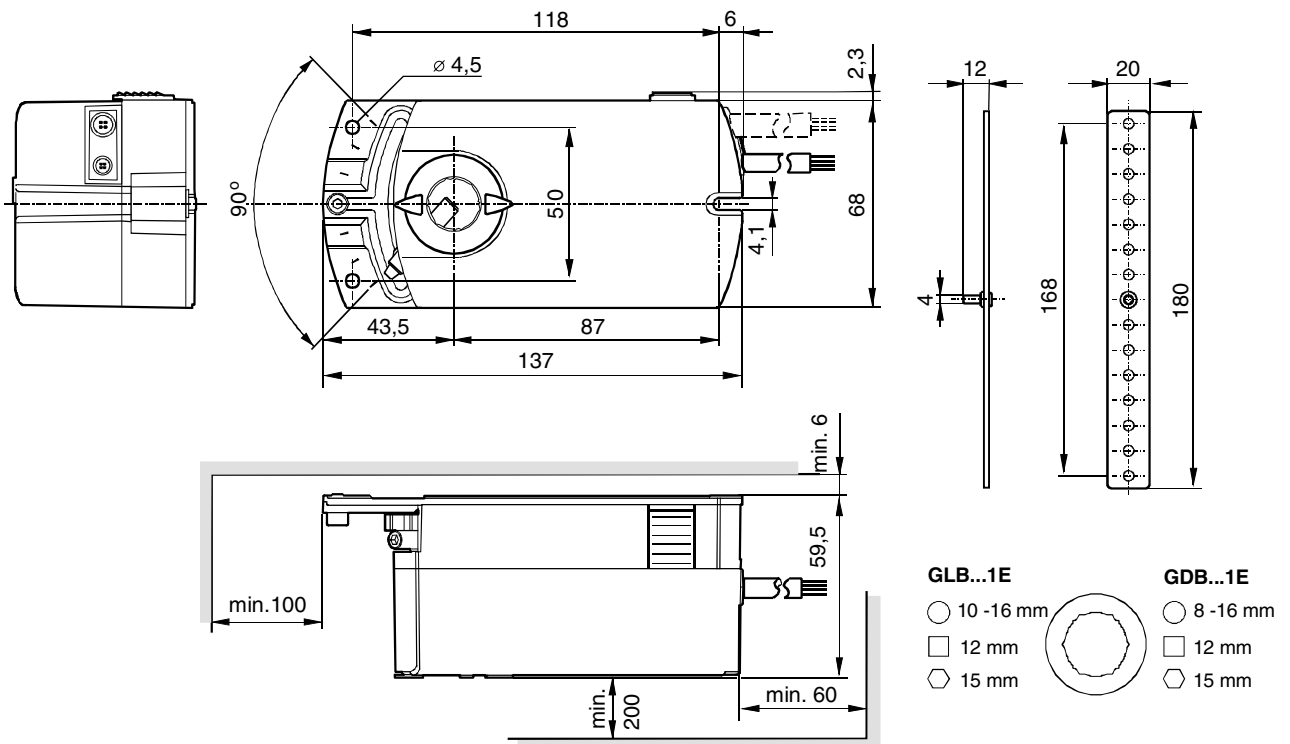
### Connection diagram

GDB/ GLB161.1E  
 GDB/ GLB166.1E  
 GDB/ GLB163.1E  
 GDB/ GLB164.1E



**N** Controller or I/O unit  
**Y** Actuator GDB / GLB16...1  
**P** Position indication  
**SP** System potential  
**SN** System neutral

## Dimensions



4634M01