# SIEMENS

**OpenAir™**
**Actuators without spring return GEB…1**
Technical basics

Actuators without spring return GEB…1

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# 1 Introduction

## 1.1 Revision history

| Changes | Date | Chapter | Pages |
|---|---|---|---|
| Accessories (Ext. auxiliary switches ASC77..) | 10.01.2005 | 2.2 | 6 |
| Referenced documents (ASC77..) | | 11.2 | 33 |
| Electrical parallel connection of actuators | 07.02.2005 | 4.2 | 16 |
| Determining the actuator type | | 4.4 | 18 |
| Permissible line length and cross-sectional areas | | 6.1 | 20/21 |
| Environmental compatibility and disposal | | 10 | 31 |
| Referenced documents | | 11.2 | 32/33 |
| EU and RCM Conformity | 26.02.2016 | 8 | 27 |
| European Directive 2012/19/EU | | 10 | 31 |
| Added type GEB161.1E/MO | 26.05.2017 | whole document | |

## 1.2 About this document

Main audience

This document targets engineering, product management, and commissioning staff in the market areas.

Purpose

This document provides basic knowledge. In addition to background information, it contains general technical fundamentals on the GEB…1 actuator series.
It offers all information on engineering, correct mounting and wiring, commissioning, and service.

Referenced documents

Chapter 11.2 Referenced documents contains a list of documents on rotary and linear actuators with accessories.

## 1.3 Document contents

This document contains basic technical information on type series GEB...1 for:
- Three-position control
- Modulating control, and
- Modbus communication

The following topics are discussed:
- Type overview and description of the available options
- Applications and functions
- Actuator design including setting and operator elements
- Adjustable auxiliary switches and characteristic function
- Notes on engineering and safety-specific guidelines and regulations
- Notes on mounting, wiring, and commissioning
- Technical data
- Diagrams
- Environmental compatibility and disposal

# 2 Non spring-return actuators

Introduction

This chapter provides information on application, functions, and device combinations. Furthermore, it contains a type overview and explains the actuator design including setting and operator elements for this family of actuators.

## 2.1 Application

The actuators are used in ventilating and air conditioning plants to operate air dampers and air throttles:

- For damper areas up to 3 m$^2$, friction-dependent.
- Suitable for modulating controllers (DC 0...10 V) or three-position controllers (e.g. for outside air dampers).
- For dampers having two actuators on the same damper shaft (tandem-mounted actuators or Powerpack).

## 2.2   Type summary

The following table shows the options for the actuator types.

| GEB.... | 131.1E | 132.1E | 136.1E | 331.1E | 332.1E | 336.1E | 161.1E | 163.1E | 164.1E | 166.1E | 161.1E/MO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Three-position control | | | | | | Modulating control | | | | Modbus RTU |
| Operating voltage AC 24 V | X | X | X | | | | X | X | X | X | X |
| Operating voltage AC 230 V | | | | X | X | X | | | | | |
| Positioning signal input Y | | | | | | | | | | | |
|   DC 0...10 V | | | | | | | X | X | X | X | |
|   DC 2...10 V | | | | | | | X | | | X | |
|   DC 0...35 V with characteristic function | | | | | | | | X | X | | |
|   Modbus RTU | | | | | | | | | | | X |
| Position indicator U = DC 0...10 V | | | | | | | X | X | X | X | |
|   Modbus RTU | | | | | | | | | | | X |
| Feedback potentiometer 1kΩ | | X | | | X | | | | | | |
| Self-adaptation of rotary angle range | | | | | | | X | X | X | X | X |
| Auxiliary switches (two) | | | X | | | X | | | X | X | |
| Rotary direction switch | | | | | | | X | X | X | X | |
| Powerpack (two actuators, tandem-mounted) | X | X | X | X | X | X | | | | | |

**Accessories, spare parts**   For functional enhancements of the actuators, the following accessories are available:

Accessories

| | |
|---|---|
| External auxiliary switches (1 switch) | **ASC77.1** |
| External auxiliary switches (2 switches) | **ASC77.2** |
| Universal lever | **ASK71.9** |
| Rotary/linear set for duct and wall mounting | **ASK71.11** |
| Rotary/linear set with lever | **ASK71.13** |
| Rotary/linear set with lever and mounting plate | **ASK71.14** |
| Weather protection cover | **ASK75.3** |
| Mounting bracket for tandem-mounted actuators or Powerpack | **ASK73.3** |
| Data sheet for accessories and spare parts | **N4697** |

# 2.3 Description of functions

## 2.3.1 Description of functions for GEB...1

The functions are listed in a table and are assigned to the respective control types.

| Type | GEB13..1 / GEB33..1 | GEB16..1 | GEB161.1E/MO |
|---|---|---|---|
| Control type | Three-position control | Modulating control. | Modbus RTU |
| Positioning signal with adjustable characteristic function | - | Y = DC 0...35 V with offset  Uo = 0...5 V and span  ΔU = 2...30 V | - |
| Rotary movement, rotary direction | Clockwise or counter-clockwise direction depends: | | |
| | On the type of control. With no power applied, the actuator remains in the respective position. | • On the direction of the DIL rotary direction switch. <br> • On the positioning signal. The actuator stays in the position reached: <br> • If the positioning signal is maintained at a constant value. <br> • If the operating voltage is interrupted. | On the setting of the respective parameter |
| Position indication: Mechanical | Rotary angle position indication by using a position indicator. | | |
| Position indication: Electrical | Connecting the feedback potentiometer to an external voltage source results in voltage supply proportional to the rotary angle. | • Position indicator: Output voltage U = DC 0...10 V is generated proportional to the rotary angle. <br> • Only for *GEB16..1*: The direction of action (inverted or not inverted) of output voltage U depends on the rotary direction of the DIL switch. | By Modbus register value |
| Self-adaptation of rotary angle range | - | • The actuator automatically determines the mechanical end of range for the rotational angle. <br> • The characteristic function (Uo, ΔU) is mapped to the determined rotary angle range. | When self-adaption is active, the actuator automatically detects mechanical end of the rotary angle range. |
| Auxiliary switch | The switching points for auxiliary switches A and B can be set independent of each other in increments of 5° within 5° to 90°. | | |
| Response on damper blocking | .- | The actuator is equipped with an automatic switch-off mechanism. | |
| Powerpack (two actuators, tandem-mounted) | Mounting two actuators of the same type on the same damper shaft doubles the torque. | Not permitted. | |
| Manual adjustment | The actuator can be manually adjusted by pushing the gear train disengagement button. | | |
| Rotary angle limitation | The rotary angle for the shaft adapter can be limited mechanically by inserting the shaft adapter in 5° increments. | | |

## 2.3.2 Supplementary information on the description of functions for GEB16..1

| | |
|---|---|
| Supplement | The following information applies to **modulating** actuators. |
| **Characteristic function** (GEB163.1, GEB164.1) Application | Offset Uo and span ∆U can be adjusted using two potentiometers (see 3.4 "Adjustable characteristic function"). The maximum permissible input voltage (Uo + ∆U) is DC 35 V. Actuators featuring this function can be used for the following applications:<br>• Dampers with a rotary angle limitation, for instance in the 0°...45° range, can be controlled using the full positioning signal range DC 0...10 V.<br>• As a sequencing actuator in control loops that can only apply a DC 0...10 V positioning signal to control more than one sequence.<br>• In control systems with a positioning signal deviating from DC 0...10 V such as DC 2...10 V or DC 0…35 V. |
| **Self-adaptation of the rotary angle range** (GEB16..1) | The actuator automatically determines the mechanical end of range for the rotary angle on:<br>• Activated self-adaptation and switching-on of operating voltage.<br>• Switch-on and switch-off for self-adaptation when operating voltage is supplied.<br><br>The table shows the different effects of the characteristic function's mapping to the rotary angle range for "inactive self-adaptation" and "active self-adaptation" (see also chapter 3.4 "Adjustable characteristic function"). |

| Inactive self-adaptation | Active self-adaptation |
|---|---|
| • The actuator maps the characteristic function (Uo, ∆U) to the positioning range Ys = 100 % for **rotary angle 90°**.<br>• The actuator calibrates the position indication with U = DC 0...10 V for **rotary angle 90°**. | • The actuator maps the characteristic function (Uo, ∆U) to the positioning range Ys = 100 % for **the determined rotary angle range**.<br>• The actuator calibrates the position indication with U = DC 0...10 V for **the determined rotary angle range**. |

| | |
|---|---|
| **Process values and parameters** GEB161.1E/MO | All process values (setpoints and actual values) and all parameters are implemented as Modbus RTU registers. |
| **Self-adaption of the rotary angle range** GEB161.1E/MO | The actuator automatically determines the effective rotary angle range when the respective parameter is set to "on". In that case the actuator performs a calibration run at first startup to determine its actual opening range and adjusts the 0..100% feedback signal to this opening range.<br>The table shows the different effects of the characteristic function's mapping to the rotary angle range for "inactive self-adaptation" and "active self-adaption": |

| Inactive self-adaption | Active self-adaption |
|---|---|
| • The actuator calibrates the position indication with Actual Position = 0..100% for **rotary angle = 90°** | • The actuator calibrates the position indication with Actual Position = 0..100% for **rotary angle < 90°** |

## 2.4 Controllers

The actuators can be connected to all controllers having the following outputs.
All safety-related requirements must be met (see chapter 4 "Engineering notes").

| Actuator type | Control type | Controller output |
|---|---|---|
| GEB13..1 | Three-position | AC 24 V |
| GEB33..1 | Three-position | AC 230 V |
| GEB16..1 | Modulating | DC 0...10 V / DC 2...10 V / DC 0...35 V |
| GEB161.1E/MO | Modbus RTU | Modbus RTU |

## 2.5 Structure and design

| | |
|---|---|
| Description | The electronic motor-driven GEB..1 electronic actuators are available for three-position, modulating and networked control. The maximum torque is 15 Nm. The actuator's connection cables are prewired. |
| Housing | Robust, light-weight full metal housing from aluminum diecast. The housing guarantees a long actuator life even under harsh environmental conditions. |
| Gear train | Maintenance-free and noise-free gear train with stall and overload protection for the life of the actuator. |
| Self-centering shaft adapter | This mounting type allows for fastening the actuator to shafts with various diameters and in various shapes (square, round) using just one screw. Insert the shaft adapter from either side into the opening for the shaft adapter. For short shafts, the shaft adapter is on the duct side. The shaft adapter coupling and the adapter holding are coupled by means of double-sided gearing. |
| Manual adjustment | When no voltage is supplied, you can manually adjust the actuator or the air damper by pressing the gear train disengagement button. |
| Mounting bracket | A bolted metal strip is used to attach the actuator. |
| Electrical connection | All actuators have pre-wired 0.9 m long connection cables. |

| | |
|---|---|
| **Type-specific elements** | The actuators can be delivered as a type-specific variant having the following elements: |
| Auxiliary switch | For supplementary functions, you can adjust auxiliary switches A and B on the actuator front. |
| Potentiometer for offset and span | Both potentiometers for the characteristic functions Uo and $\Delta$U are accessible on the front. |
| DIL switch (only for GEB16..1) | The DIL switches exist only in modulating actuators and are accessible from the front (see chapter 2.6 "Setting and operator elements"). |
| Feedback potentiometer to position indication | The potentiometer is integrated and can be connected by means of a cable. |

Cover for DIL switch
(only for GEB16..1)

This cover protects the DIL switch against dust and water spray.

Push button and LED
at external Interface

The HMI of networked types consists of a push button and an LED to allow certain interactions with the actuator or to provide visible feedback from the actuator.

## 2.6    Setting and operator elements

**Actuator**
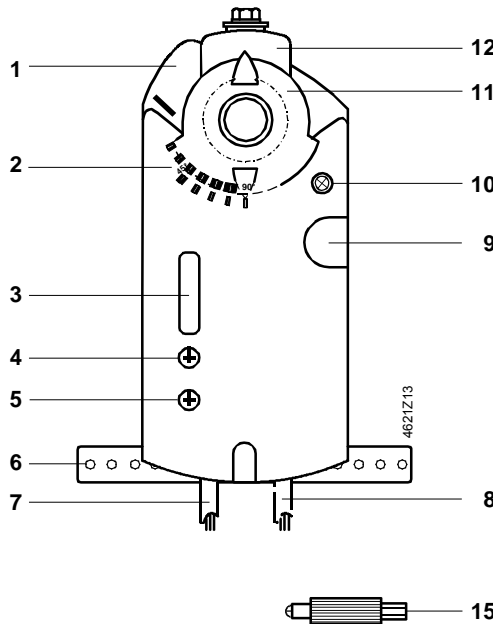


Legend

1    Housing
2    Rotary angle scale
3    DIL switch and cover
4    Potentiometer to adjust the span ΔU
5    Potentiometer to set the offset Uo
6    Mounting bracket
7    Connecting cable for power and positioning signal
8    Connecting cable for auxiliary switches or feedback potentiometer
9    Disengagement button for gear train
10   Setting shafts for auxiliary switches A and B
11   Position indicator
12   Self-centering shaft adapter
13   Locking ring for shaft adapter
14   Adapter for position indicator
15   Adjustment tool for auxiliary switches (10), potentiometer (4, 5)

**Arrangement of shaft adapter**



| For long damper shafts | For short damper shafts |
| --- | --- |
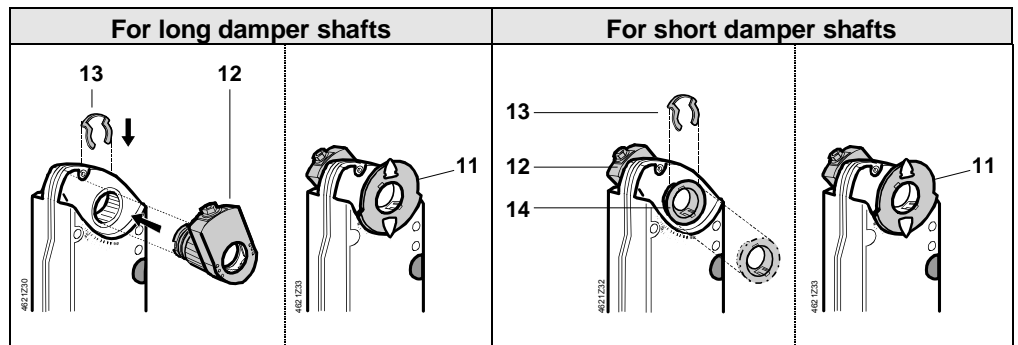
**DIL switch**
(Legend pos. 3)
GEB16..1

| Meaning | DIL switch label | | | Meaning | Function |
| --- | --- | --- | --- | --- | --- |
| Counter-clockwise arrow | ↶ | ▭◼ | ↷ | Clockwise arrow | Rotary angle direction |
| Active | \|◆\| | ▭◼ | 0 | Off | Self-adaptation |
| DC 2...10 V | 2... | | 0... | DC 0...10 V | Positioning signal **GEB161.1, GEB166.1** |
| DC 0...35 V (**C**omfort) | C | ◼▭ | 0 | DC 0...10 V | Positioning signal **GEB163.1, GEB164.1** |

*Note*

▭◼  Factory setting for DIL switch.

# 3 Technical design

Introduction

This chapter discusses the following topics:
- Motor technology.
- Adjustable auxiliary switches.
- Adjustable characteristic function (positioning signal, DC 0...35 V).
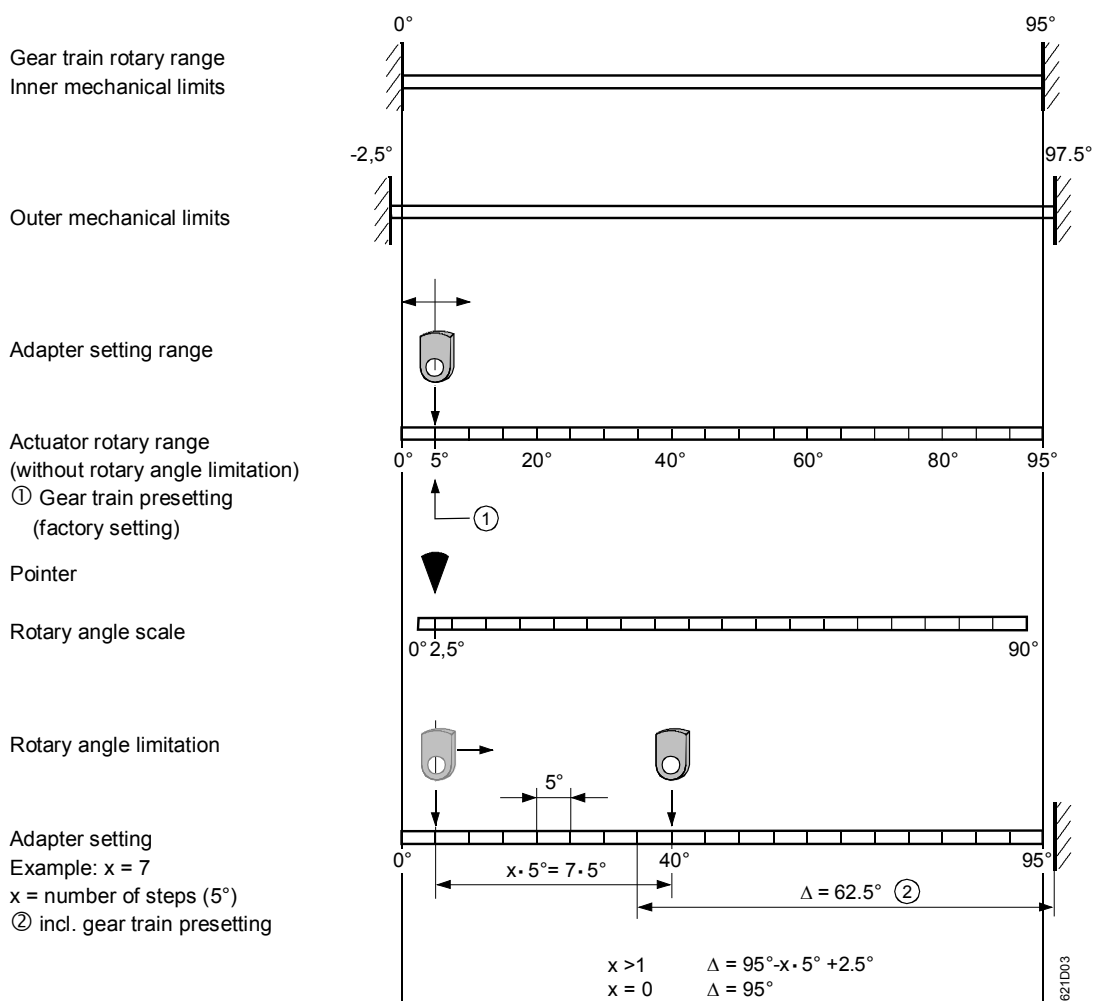- Control characteristics by including the neutral zone

## 3.1 Motor technology

Motor technology

A synchronous motor enables accurate speed control. The magnetic coupling serves as a torque supervision to protect both actuator and dampers.

## 3.2 Rotary range and mechanical limitation

Mechanical functions

The illustration below shows the relationship between the inner and outer mechanical limitation of the rotary range.

Gear train rotary range
Inner mechanical limits

Outer mechanical limits

Adapter setting range

Actuator rotary range
(without rotary angle limitation)
① Gear train presetting
  (factory setting)

Pointer

Rotary angle scale

Rotary angle limitation

Adapter setting
Example: x = 7
x = number of steps (5°)
② incl. gear train presetting

$x \cdot 5° = 7 \cdot 5°$

$\Delta = 62.5°$ ②

$x > 1 \qquad \Delta = 95° - x \cdot 5° + 2.5°$
$x = 0 \qquad \Delta = 95°$

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# 3.3 Auxiliary switches and positioning signals

Electrical functions

The illustration below shows the relationship between the rotary angle, the adjustable switching points for auxiliary switches A and B, and the positioning signal.

Gear train rotary range
Inner mechanical limits

Auxiliary switches
Factory setting:
A = 5°; B = 85°
Setting range 5°...90°

Switching states

Rotary movement as a function of the positioning signal

Modulating signal, DC 0...10 V
AC 24 V
① no movement (G,G0,Y=U)
② opening (G,G0,Y>U)
③ closing (G,G0,Y<U or G,G0)

Three-position signal,
AC 24 V; AC 230 V
④ no movement (no voltage)
⑤ opening (G,Y1 or N,Y1)
⑥ closing (G,Y2 or N,Y2)

*Note*

The setting shafts for the auxiliary switches turn together with the adapter. The scales thus only refer to the **inner mechnical 0° limit**.

Adjustment tool

The adjustment tool is used to set the auxiliary switches; it is part of the delivery (type-specific).

# 3.4 Adjustable characteristic function

**Actuators**
GEB163.1, GEB164.1

A modulating positioning signal DC 0..35 V from a controller controls the actuator. The rotary angle is proportional to the positioning signal. Using potentiometer "Uo", you can set the offset for DC 0...5 V, and with potentiometer "ΔU", you can set the span for DC 2...30 V.
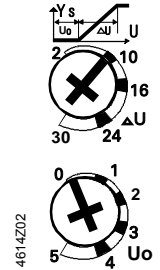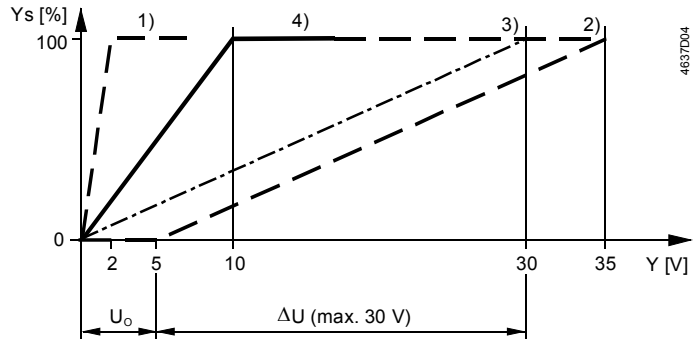


Ys  Positioning range
    For inactive self-adaptation:  100 % = Rotary angle 95°
    For active self-adaptation:  100 % = Determined rotary angle
Y   Positioning signal
Uo  Offset
ΔU  Span (for Ys = 100 %)

Examples as per the diagram

| Example | Positioning signal Y | Positioning range Ys | Settings | |
|---|---|---|---|---|
| | | | Uo | ΔU |
| 1) | DC 0...2 V | 0...100 % | DC 0 V | DC 2 V |
| 2) | DC 5...10 V<br>DC 5...35 V | 0...17 %<br>0...100 % | DC 5 V | DC 30 V |
| 3) | DC 0...10 V<br>DC 0...30 V | 0...33 %<br>0...100 % | DC 0 V | DC 30 V |
| 4)* | DC 0...10 V | 0...100 % | DC 0 V | DC 10 V |

4)* Characteristic curve for factory setting

*Note*

- The Y input is limited to max. DC 35 V.
- The adjustable span ΔU is max. 30 V.

**Example**

Define the adjustable span ΔU if the actuator is to open from 0...50 % at a positioning signal of Y = DC 2…10 V. The offset Uo thus amounts to 2 V. The rotary angle is 90°. Self-adaptation is inactive.
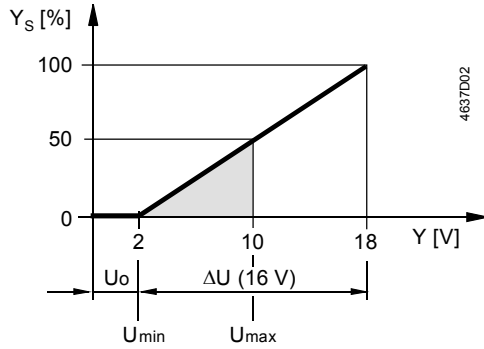
Formula

Calculating the setting value for ΔU:

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

Potentiometer settings

**Uo = 2 V, ΔU = 16 V**

Characteristic function for the example

Y_S [%]

$$Y_S \text{ [\%]}$$

100

50

0

2    10    18    Y [V]

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U_o

ΔU (16 V)

U_min    U_max

Max. positioning range Ysmax = 100 % (95°)
Span Ys = 50 % (47.5°)
Offset Uo = **2 V**
Span ΔU = **16 V**

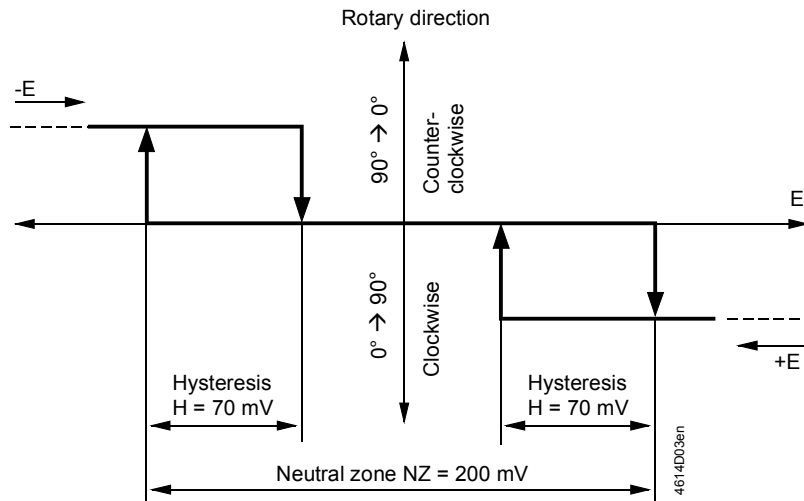Effective span
ΔUw = Umax – Umin
= 10 V - 2 V = 8 V

# 3.5    Neutral zone

**Actuators**
GEB16...1 (DC 0...10 V)

For modulating control actuators, note the control characteristic for the selected switch-on point of the setpoint. The diagram shows the setting characteristics by including the neutral zone for range DC 0...10 V.

*Note*

The diagram shows the setting characteristics by including the neutral zone. The values for the neutral zone listed in the diagram apply to DC 0...10 V (**without characteristic function**).

Rotary direction

-E

$90° \rightarrow 0°$    Counter-clockwise

E

$0° \rightarrow 90°$    Clockwise

+E

Hysteresis
H = 70 mV

Hysteresis
H = 70 mV

Neutral zone NZ = 200 mV

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The diagram shows the relationship between the differential voltage E = Y – U (difference between setpoint Y and actual value U) and the rotary direction, including hysteresis and neutral zone.

**Actuators**
GEB163.1, 164.1
(DC 0...35 V)

For DC 0...35 V (**with characteristic function**) the following values apply:
Neutral zone    NZ = 2 % of span ΔU.
Hysteresis    H = 0.7 % of span ΔU.

# 4 Engineering notes

| | |
|---|---|
| Introduction | Carefully study the basics of the control systems used before proceeding to the sections below, and pay special attention to all safety-related information. |
| Intended use | Use these actuators in a system only for applications as described in the basic system documentation of the control systems used. Additionally, note the actuator-specific properties and conditions as described in this chapter and in chapter 8 "Technical data" in this document. |

## 4.1 Safety notes

| | |
|---|---|
| **[STOP]** Please observe the following notes | This chapter explains general and system-specific regulations for mains and operating voltages. It also contains important information regarding your own safety and that of your plant. |
| ⚠ Safety note | The warning triangle to the left means that you must observe all respectively listed regulations and notes.<br>If ignored, injuries and equipment damages may result. |
| ⚠ General regulations | Observe the following general regulations during engineering and project execution:<br>• Electric and high-power regulations of the respective country.<br>• Other mandatory country regulations.<br>• House installation regulations of the respective country.<br>• Regulations by the energy supplier.<br>• Diagrams, cable lists, dispositions, specifications, and instructions as per the customer or the engineering company.<br>• Third-party regulations from, e.g., the general contractors or building contractors. |
| Safety | Electrical safety in Landis & Staefa building automation and control systems primarily depends on **extra-low voltage with safe isolation from mains voltage**. |
| SELV, PELV | Depending on the earthing of extra-low voltage, SELV or PELV applications as per HD384 "Electrical plants in buildings" result:<br>**Unearthed = S**afety **E**xtra-**L**ow **V**oltage **SELV**<br>**Grounded = P**rotection by **E**xtra-**L**ow **V**oltage **PELV** |
| ⚠ Earthing of G0 (system neutral) | Observe the following for grounding G0:<br>• As a rule, earthing as well as non-earthing of G0 is permissible for AC 24 V operating voltage. However, observe all local regulations and customary procedures.<br>• For functional reasons, earthing may be required or not permissible. |
| *Recommendation on earthing G0* | • **As a rule, ground AC 24 V systems** if not otherwise indicated by the manufacturer.<br>• To avoid earth loops, connect systems with **PELV** to the earth at **only one end** in the system, normally at the transformer, unless otherwise specified. |

**⚠ Operating voltage AC 24 V, AC 230 V**

The following regulations apply to these operating voltages:

| | Regulation |
|---|---|
| Operating voltage AC 24 V | The operating voltage must comply with the requirements for SELV or PELV:<br>• Permissible deviation of AC 24 V nominal voltage at the actuators: +/-20 %. |
| Operating voltage AC 230 V | Permissible deviation of AC 230 V nominal voltage at the actuators: +/-10 %. |
| Specification on AC 24 V transformers | • Safety transformers as per EN 61558, with double isolation, designed for 100 % runtime to supply SELV or PELV circuits.<br>• Determine the transformer's power consumption by adding up the power consumption in VA for all actuators used.<br>• The capacity used from the transformer should amount to at least 50 % of the nominal load for efficiency reasons (power efficiency).<br>• The nominal capacity of the transformer must be at least 25 VA. For smaller transformers, the ratio between voltage at idle time to voltage at full load is unsatisfactory (> + 20 %). |
| Fuse of AC 24 V operating voltage | Transformers, secondary side:<br>• According to the effective load of all connected devices.<br>• Line G (system potential) must always be fused.<br>• Where required, additional line G0 (system neutral). |
| Fuse of AC 230 V mains voltage | Transformers, primary side, as per the applicable installation regulations of the respective country. |

## 4.2 Device-specific regulations

**⚠ Device safety**

Safety for the devices is ensured by (among other aspects):
• Supply of AC 24 V extra-low voltage as per **SELV** or **PELV**.
• Double isolation between AC 230 V mains voltage and SELV/PELV circuits.

**Mechanical parallel connection of actuators**

• Three-position actuators GEB13..1 and GEB33..1:
Mount max. two actuators on the same damper shaft. Use the mounting bracket to also secure the second actuator (see accessories in chapter 2.2).
• **Do not mechanically** connect modulating GEB16..1 actuators.

**⚠ 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.

**⚠ Feedback potentiometer for position indication**

Include the potentiometer's electric data to indicate the damper position via external switching.

**Electrical parallel connection of actuators**

Up to 10 actuators of the same device type can be electrical parallel wired. Cable length and cable cross section have to be respected.

See chapter 6 "wiring notes" for more information.

**Caution, maintenance**

**Do not open the actuator.**
The device is maintenance-free. Only the manufacturer may conduct any repair work.

# 4.3 Notes on EMC optimization

**Running cables in a duct**

Make sure to separate high-interference cables from equipment susceptible to interference.

**Cable types**

- Cables emitting interference:      Motor cables, particularly motors supplied by variable speed drives, energy cable.
- Cables susceptible to interference:      Control cables, extra-low voltage cables, interface cables, LAN cables, digital and analog signal cables.

**Cable segregation**

- You can run both cable types in the same cable ducting, but in different compartments.
- If ducting with three closed sides and a partition is not available, separate the interference-emitting cables from other cables by a minimum of 150 mm or route in separate ducting.
- Cross high-interference cables with equipment susceptible to interference only at right angles.
- When, as an exception, signal and interference-emitting supply cables are run in parallel, the risk of interference is very high. In this case, limit the cable length of the positioning signal line DC 0...10 V for modulating actuators.

**Unshielded cables**

We recommend to use unshielded cables. When selecting unshielded cables, follow the manufacturer's installation recommendations. In general, **unshielded twisted-pair** cables have sufficient EMC characteristics for building services (incl. data applications) as well as the advantage that no provision is required for coupling to the surrounding earth.

# 4.4 Determining the actuator

**Required actuator torque**

Selection of the actuator depends on several torque factors. After obtaining the damper torque rating [Nm/m$^2$] from the manufacturer and determining the damper area, calculate the total torque required to move the damper as follows:

**Total torque** [Nm] = Torque rating [Nm/m$^2$] × damper area [m$^2$].

Instead of the torque rating, the total torque can also be determined from the manufacturer's sizing diagrams.

Sizing diagram | The following diagram (example EMCO) allows for determining the total torque for this air damper type.
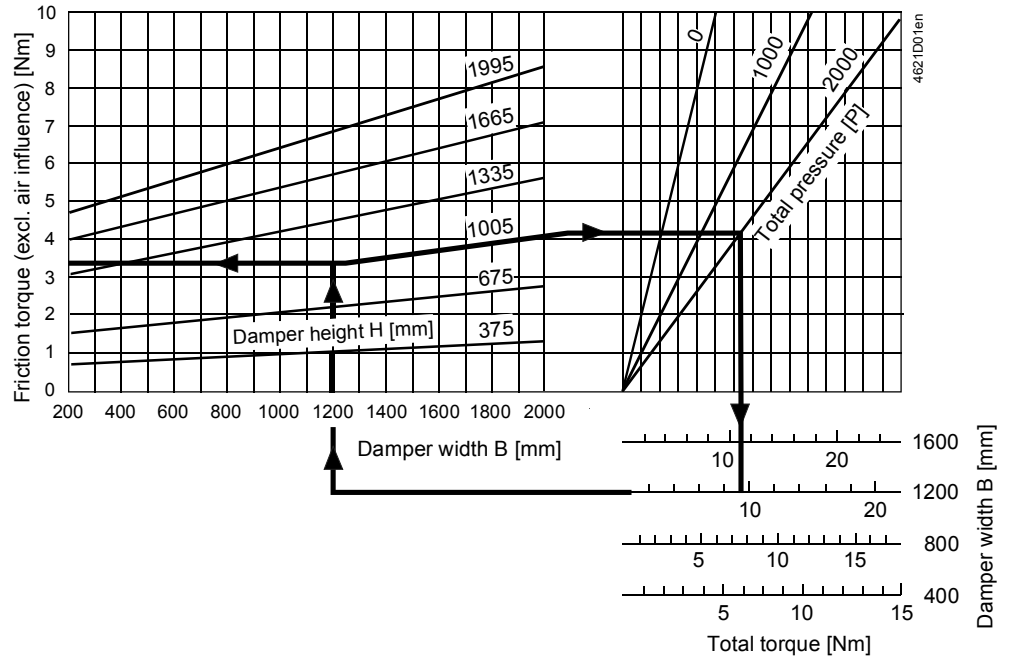


Example

Damper for blinds:
Width = 1200 mm
Height = 1005 mm
Total pressure = 2000 Pa

The total torque of about **10 Nm** results from the diagram.

**Determining the actuator type**

Determine your type of actuator from the table below:

| If $\dfrac{\text{total torque [Nm]}}{\text{SF}^{1}}$ | then use type |
|---|---|
| ≤ 15 Nm | GEB...1 (15 Nm) |
| ≤ 25 Nm | GBB...1 (25 Nm) [2] |
| ≤ 30 Nm | 2 x GEB...1 (2 x 15 Nm) [3] |
| ≤ 35 Nm | GIB...1 (35 Nm) [4] |
| ≤ 70 Nm | 2 x GIB...1 (2 x 35 Nm) [5] |

*Notes*

[1] Safety Factor SF:
When calculating the number of actuators, remember to include non-definable variables such as slight misalignment, damper age, etc. as a safety factor. We recommend a total safety factor of 0.8.
Apply the same factor when calculating the actuator torque by the torque rating.

If the required actuator torque is greater than 15 Nm, you can use the following:
[2] One actuator of type series GBB...1 or
[3] Two actuators (tandem-mounted "Powerpack") of type series GEB13..1, Geb33..1, or
[4] One actuator of type series GIB...1 .
[5] If the actuator torque is greater than 30 Nm, two actuators of type series GIB...1 can mechanically be connected and mounted on the damper shaft.
(See data sheets N4625, N4635, and N4699).

# 5 Mounting notes

| | |
|---|---|
| Mounting instructions | All information and steps to properly prepare and mount the actuator are available in the mounting instructions 4 319 0109 0 (M4621) delivered with the actuator. The shaft adapter as well as all other individual parts are not pre-mounted, as the actuator components are put together differently depending on damper shaft length. Refer to "2.5 "Structure and design" in this chapter. |
| Mounting position | Choose the actuator's mounting position so that you can easily access the cables as well as the setting dials on the front of the actuator. Refer to 11.1 "Dimensions". |
| Device protection | To satisfy the IP54 protection class requirements, the following conditions must be fulfilled:<br>• The actuators are equipped only for vertical mounting (cable entries at bottom) with air dampers having a horizontal shaft.<br>• The actuator mounted on the damper shaft may be mounted by max. +/- 45° to the vertical line:<br>• Use the weather protection cover ASK75.3 for any mounting position. |
| Mounting bracket | The mounting bracket (see dimensions) is required for mounting on the damper shaft. The insertion depth for the bolt into the housing must be sufficient and guaranteed. |
| Factory setting | The actuator comes with a factory setting of +2.5° which ensures a tight close-off for the air dampers. |
| Manual adjustment | The actuator can be manually adjusted by pushing the gear train disengagement button.<br>To ensure a tight close-off function for the dampers and the exact switching position for switches A and B, adjust the actuator only if the **shaft adapter and the position indicator are mounted** in accordance with the mounting instructions. |
| Mechanical limitation of rotary angle | If necessary, you can limit the rotary angle at increments of 5° for the entire span by positioning the shaft adapter in the respective position. |
| Damper shafts | Refer to chapter 8 "Technical data" for information on minimum length and diameter of the damper shafts. |
| Use of rotary/linear sets | Mount the mounting sets for converting a rotary movement to linear movement (chapter 2.2 Type summary) as per the separate mounting instructions. |
| Tandem (Powerpack) mounting | When mounting two actuators on the same damper shaft (for GEB13..1 and GEB33..1), use the ASK73.3 mounting bracket. |

# 6 Wiring notes

Introduction

Prior to wiring, study all information in the following sections:
- "Safety notes" in chapter 4.1
- "Device-specific regulations" in chapter 4.2
- "Notes on EMC optimization" in chapter 4.3
- "Diagrams" in chapter 9, and the
- HVAC plant diagram.

## 6.1 Permissible line length and cross-sectional areas

The line lengths and cross-sectional areas depend on the actuators power consumption and the permissible voltage drop of the connection lines to the actuators. Determine the necessary line length from the following diagram and the formulas.

*Note*

To determine the line length and cross section, adhere to the permissible operating voltage tolerance at the actuator (see chapter 8, "Technical data") in addition to the permissible voltage drop between the signal and supply lines (see table below).

Permissible voltage drop

The line sizing between the controller and the actuators depends on the actuator type used and is determined on the following basis.

| Type | Operating voltage | Line | Max. permissible voltage drop |
|------|-------------------|------|-------------------------------|
| GEB13..1 | AC 24 V | G, Y1, Y2 | 4 % each (tot. 8 %) of AC 24 V |
| GEB16..1.. | AC 24 V | G0, G<br>G0, Y, U | 4 % each (tot. 8 %) of AC 24 V<br>1 % of DC 10 V |
| GEB33..1 | AC 230 V | L, N | 2 % each (tot. 4 %) of AC 230V |

*Notes on the G0 line (GEB16..1)*

Consider the following criteria:
- For modulating control:
  The permissible positioning signal error caused by a voltage drop in the line current on the G0 line must not exceed 1%.
- The G0 line's voltage drop caused by surges in the DC circuit in the actuator may not exceed 2 Vpp.
- In the case of improper sizing of the G0 line, actuator load changes may cause natural oscillation due to a change in the DC voltage drop.
- The supply voltage loss at AC 24 V may not exceed 8% (4% over G0 line).
- **DC voltage drop over the G0 line** is caused as follows:
  - Asymmetrically in the internal actuator supply (ca. DC 8 mA).
  - Positioning signal current DC 0.1 mA (from Y = DC 10...10 V).
  - Positioning signal current DC 1 mA (from U = DC 0...10 V).
- **It can be ignored for the following aspects.**

**Line length/consumption AC 24 V**

The diagram applies to AC 24 V and shows the permissible line length **L** as a function of consumption **P** and as a parameter of the line cross sections.
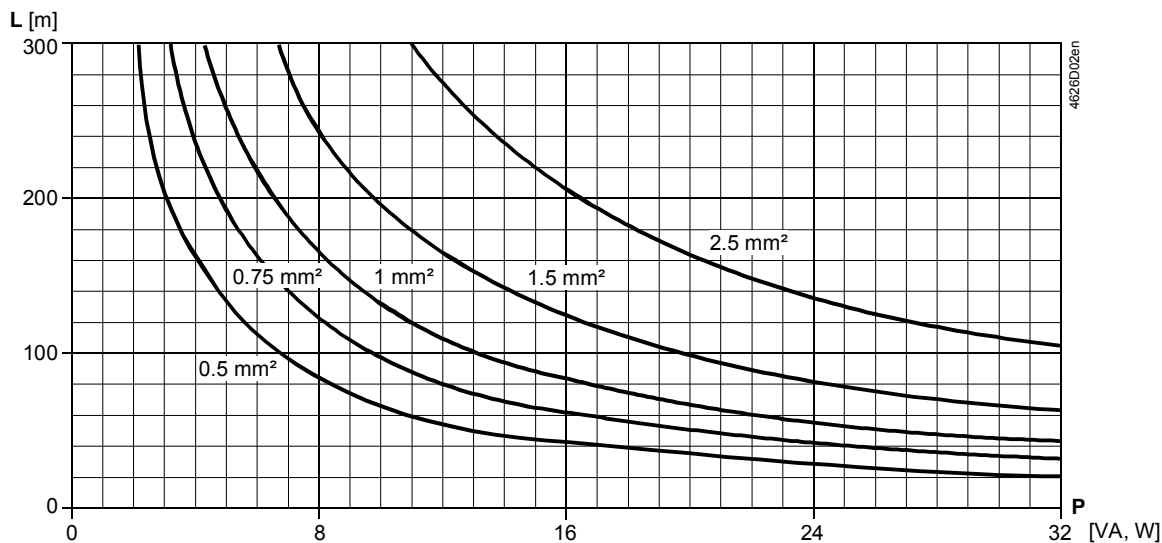


*Notes on diagram*

- The values in [VA, W] on the P-axis are allocated to the permissible voltage drops ($\Delta U/2U = 4$ %) on line L as per the above table and to the P&I diagram.
- P is the primary power consumption for all actuators connected in parallel.

P&I diagram:
Voltage drop on the supply lines
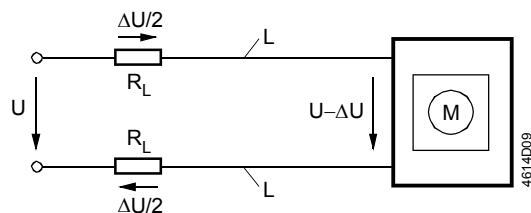


**Formula for line length**

The maximum line length can be calculated using the following formula.

| Operating voltage | Perm. voltage drop / line | Formula for line length |
|---|---|---|
| AC 24 V | 4 % of AC 24 V | $L = \dfrac{1313 \bullet A}{P}$ [m] |
| | 1 % of DC 10 V | $L = \dfrac{5.47 \bullet A}{I\,(DC)}$ [m] |
| AC 230 V | 2 % of AC 230 V | $L = 46 \bullet \dfrac{1313 \bullet A}{P}$ [m] |

A     Line cross section in [mm$^2$]
L     Permissible line length in [m]
P     Power consumption in [VA] or [W];
        The value is printed on the actuator's type plate.
I(DC)    DC current portion in line G0 in [A]

**Line length for actuators connected in parallel**

The following sections show how to determine the permissible line length and cross sections for the various actuators based on examples.

The examples for actuators connected in parallel apply to the following arrangement:
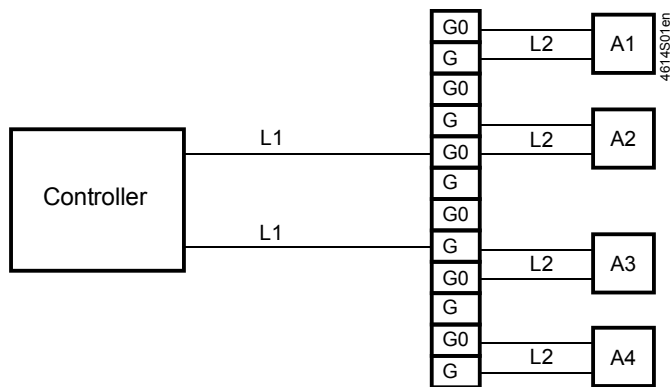


Assumption

The line resistances of L2 are equal and can be ignored for L1. Separately calculate the permissible line lengths L2 for other connections (ring, star-like).

## 6.2 Actuator wiring (three-position)

**Actuators with three-position control**
GEB13..1

In three-position actuators, only the situation as presented under **AC 24 V** is important. Sizing occurs via lines 1 (G), 6 (Y1), and 7 (Y2).

Power consumption and perm. voltage drop with one actuator

The table shows the main power consumption of an actuator as well as the permissible voltage drop.

| Operating voltage/pos. signal | Power consumption | Perm. voltage drop for line 1 (G), 6 (Y1), 7 (Y2) |
|---|---|---|
| AC 24 V | 3.5 VA | $\Delta U/U$ = max. 8 % (4 % each per line) |

P&I diagram: Conduction currents at AC 24 V

The diagram shows the currents in the connecting lines for **one actuator**.
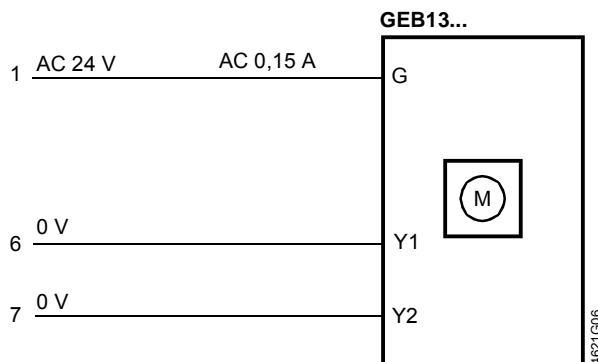


**Example:**
Parallel connection of two actuators

Determining the line lengths for two actuators GEB13..1 and AC 24 V supply.
Only the currents in line 1 (G) and 6 (Y1) or 7 (Y2) determine the line sizing.
Max. permissible voltage drop = **4% per line** (total 8 %).
- Consumption = 2 x 3.5 VA = 7 VA.
- Line current = 2 x 0.15 A = 0.3 A.
Max. permissible single line length: 280 m at 1.5 mm$^2$ line cross section.

# 6.3    Actuator wiring (modulating)

**Modulating actuators**
GEB16..1

With AC supply, the G0 line has a AC 0.23 A supply current and a DC 0.1 mA positioning signal current (from Y = DC 0...10 V). The AC voltage drop on the G0 line does not impact the positioning signal Y.

Power consumption and perm. voltage drop with one actuator

| Operating voltage | Power consumption | Perm. voltage drop for line 1 (G)2 (G0) |
|---|---|---|
| AC 24 V | 5.5 VA | 4 % of AC 24 V |

P&I diagram:
Conduction currents

The diagram shows the currents in the connecting lines for **one actuator**.
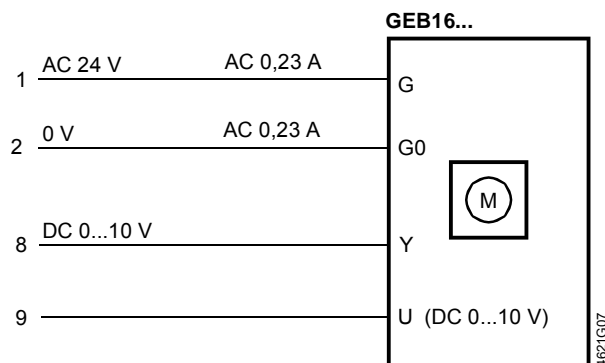
**Example:**
Parallel connection of four actuators

Determining the line lengths for four actuators GEB16..1 and AC 24 V supply. Only the AC currents in line 1 (G) and 2 (G0) determine the line sizing.
Max. permissible voltage drop = **4% per line**.

- Consumption = 4 x 5.5 VA = 22 VA.
- Line current = 4 x 0.23 A = 0.92 A.
- **Permissible single line length for G, G0:**
  90 m at 1.5 mm$^2$ line cross section, or
  149 m at 2.5 mm$^2$ line cross section.

Actuators without spring return GEB…1

## 6.4 Actuator wiring (Modbus RTU)

The damper actuators are supplied with a prewired connecting and communication cable. All interconnected devices must be connected to the same G0.

```
    1        6      8      9
  ┌──┼────────┼──────┼──────┼──┐
  │  (G)    (REF)   (+)    (-)  │
  │                             │
  │  (G0)                       │
  └──┼──────────────────────────┘
     2
```
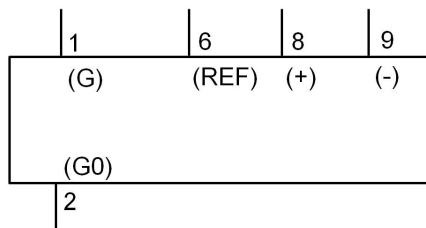
| Strand code | Strand color | Terminal code | Description |
|---|---|---|---|
| 1 | red (RD) | G | System potential AC 24 V |
| 2 | black (BK) | G0 | System neutral AC 24 V |
| 6 | violet (VT) | REF | Reference (Modbus RTU) |
| 8 | grey (GY) | + | Bus + (Modbus RTU) |
| 9 | pink (PK) | - | Bus - (Modbus RTU) |

**Note**

The operating voltage at terminals G and G0 must comply with the requirements under SELV or PELV.

Safety transformers with twofold insulation as per EN 61558 required; they must be designed to be on 100 % of the time.

# 7 Commissioning notes

References

All information necessary for commissioning is contained in the following:
- This document ("Technical basics" Z4621en).
- Mounting instructions 74 319 0109 0  (M4621).
- HVAC plant diagram.

## 7.1 General checks

Environmental conditions

Check to ensure that all permissible values as contained in chapter 8 "Technical data" are observed.

Mechanical check

- 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.
- Fasten the actuator securely to avoid side load.
- Rotary movement check: Manually change the damper setting by pressing the gear train disengagement button and turn the adapter (only if not voltage is applied).

Electrical check

- Check to ensure that the cables are connected in accordance with the plant wiring diagram.
- The operating voltage AC 24 V (SELV/PELV) or AC 230 V must be within the tolerance values.

## 7.2    Electrical function check

**Rotary movement:**
**Three-position control**
GEB13..1, GEB33..1

Check the actuator operating states as follows (see also chapter 9.3 Connection diagrams (three-position control)).

| Wire connections | | Rotary direction |
| AC 24 V | AC 230 V | |
|---|---|---|
| 1 – 6 | 4 – 6 | Clockwise |
| 1 – 7 | 4 – 7 | Counterclockwise |
| 1 – 6 / 1 – 7 open | 4 – 6 / 4 – 7 open | Actuator stays in position reached. |

**Rotary movement:**
**Modulating control**
GEB16..1

Check the actuator operating states as follows (see also chapter 9.4 "Connection diagrams (modulating)"):
- When applying input signal Y = DC 10 V, the actuator turns (clockwise or counter-clockwise as per the DIL switch setting).
- The rotary direction set at the DIL switch must match the desired damper movement direction.
- After interrupting the AC 24 V operating voltage, the actuator stops.
- After interrupting positioning signal Y, but while operating voltage is still supplied, the actuator returns to the zero position.

**Characteristic function for**
**the positioning signal**
GEB163.1, GEB164.1

Factory setting: The potentiometers for setting the offset $U_o$ and span $\Delta U$ are set to the following values: $U_o$ = 0 V, $\Delta U$ = 10 V.

*Note*

Specify the values set for $U_o$ and $\Delta U$ in the plant papers.

Position indicator

Check of output voltage U:
- For inactive self-adaptation: U = DC 0...10 V for **rotary angle 90°**.
- For active self-adaptation: U = DC 0...10 V for **determined rotary range**.

**Feedback potentiometer**

Measures resistance changes while the actuator turns from 0 to 90°.

**Auxiliary switches**
**A and B**

- Switchover of the auxiliary switch contacts "A" and "B" as soon as the actuator reaches the respective switching positions.
- Set the setting shafts (part of the delivery) to the desired value by means of the adjustment tool. (See chapter 3.2, "Rotary range and mechanical limitation".)

*Important*

The angle values are valid only for the **zero** position of the actuator (clockwise direction).

Factory setting

The auxiliary switches have the following factory settings:
- Switch A: Switchover point at 5°.
- Switch B: Switchover point at 85°.

**DIL switch**
for GEB16..1

Use the three DIL switches to check the functions of these actuators.

Rotary direction
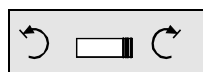


- The set linear travel direction must match the desired damper rotary direction.
- Factory setting: ↻
- Also check the operating states for special switchings as per chapter 9.4.2.
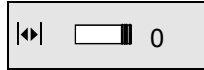
| Self-adaptation | ⟨↔⟩ ▭▮ 0 | • Alternative switch-on/switch-off of self-adaptation.<br>⟨↔⟩: ON<br>0: OFF<br>• Factory setting: 0. |
| --- | --- | --- |
| Positioning signal without characteristic function:<br>(GEB161.1, GEB166.1) | 2... ▭▮ 0... | • Alternate setting:<br>2..: DC 2...10 V<br>0..: DC 0...10 V<br>• Factory setting: 0… |
| Positioning signal with/without characteristic function:<br>(GEB163.1, GEB164.1) | C ▭▮ 0 | • Alternate setting:<br>C: DC 0...35 V (Comfort, with characteristic function)<br>0: DC 0...10 V (without characteristic function)<br>• Factory setting: 0. |
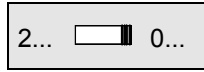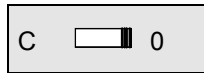
## 7.3 Modbus

### 7.3.1 HMI – Human-machine interface



Push Button    LED

**Push button operation**

| Activity | Push-button operation | Confirmation |
|---|---|---|
| Display current address (starting with lowest address digit) | Press button < 1s | 1-digits: red |
| | | 10-digits: green |
| | | 100-digits: orange |
| | | If termination is switched on, LED flashes 1x blue after address display |
| | | Example: |
| | | 124 = 4x red, 2x green, 1x orange |
| Turn bus termination on / off | | |
| turn on | 1.press 3x | LED flashing and flickering stops (termination mode) |
| | 2.press 1x shortly | LED flashes 1x blue |
| | 3.press button until LED shines red | LED shines red (confirmation) |
| | 4.release button | LED off |
| | | Address display |
| | | LED flashes 1x blue after address display |
| | | Normal operation |
| turn off | 1.press 3x | LED flashing and flickering stops (termination mode) |
| | 2.press button until LED shines red | LED shines red (confirmation) |
| | 3.release button | Normal operation |
| Enter Modbus address with push-button | Press button > 1s and < 5s | See chapter 'Push button addressing' below |
| Enter push-button addressing mode (for use with Climatix™ controllers) | 1. Press button > 5s and < 10s | LED shines red and gets dark after 5s |
| | 2. Release button | LED shines orange |
| Reset to factory settings | Press button > 10s | LED flashes orange |

**LED colors and patterns**

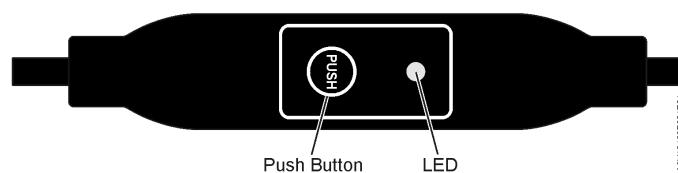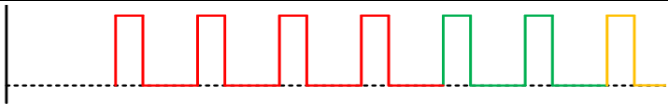| Color | Pattern | Description |
|---|---|---|
| Green | 1s on / 5s off | Normal operation ("life pulse") without bus traffic |
| | flashing | Normal operation ("life pulse") with bus traffic |
| Orange / green | 1s orange / 1s green | Device is in override control |
| Orange | 1s on / 1s off | Bus parameters not yet configured |
| | 1s on / 5s off | Backup mode entered |
| Red | Steady | Mechanical fault, device jammed or manual override |
| | 1s on / 5s off | Internal error |
| | 0.1s on / 1s off | Invalid configuration, e.g. Min = Max |
| Blue | Flashes 1x after address display | Bus termination is set active. |

| **Resetting the device by push button** | 1. Press button for >10s → LED starts flashing **orange**.<br>2. Release button while LED still flashes → LED keeps flashing for 3s.<br>3. If the button is pressed within these 3s, the reset is cancelled.<br>4. After those 3s → LED shines **red** (reset), then the device restarts. |
|---|---|

## 7.3.2 Push button addressing

The Modbus address can be set without a separate tool by using push-button and LED.
To display the current address, press button <1s.

**Display current address (starting with lowest address digit)**

| Colors | | |
|---|---|---|
| 1-digits: red | 10-digits: green | 100-digits: orange |

| Example for address 124: | |
|---|---|
| LED |  |
| **NOTE** | The address is entered and shown starting with lowest address digit, see figure above.<br>(124 in the example is starting with 4x red) |

| **Set new address (starting with lowest address digit)** | 1. **Enter addressing mode**: press button > 1s until LED shines **red**, then release button (before LED gets dark).<br>2. **Enter digits**: press button n-times → LED flashes per button press (feedback). Colors: 1-digits: **red** / 10-digits: **green** / 100-digits: **orange**<br>3. **Store digits**: press button until LED shines in color of next digits → release button,<br>4. **Save address**: press button until LED shines **red** (confirmation) → release button. An address can be stored at any time, i.e. after setting the 1-digits, or after setting the 1- and the 10-digits.<br>5. Entered address is repeated one times for confirmation. |
|---|---|

| **Note** | If button is released before LED shines red, the address is discarded. |
|---|---|

| **Examples** | Set address "124":<br>1. Enter addressing mode<br>2. Set 1-digits: Press button 4-times → LED flashes **red** per button press<br>3. Store 1-digits: press button until LED shines **green** – release button<br>4. Set 10-digits: Press button 2-times → LED flashes **green** per button press<br>5. Store 10-digits: press button until LED shines **orange** – release button<br>6. Set 100-digits: Press button 1-times → LED flashes **orange** per button press<br>7. Store address: press button until LED shines **red** – release button<br>    → address is stored and displayed 1x for confirmation<br><br><br>Set address "50":<br>1. Enter addressing mode<br>2. Skip 1-digits: Hold button pressed until LED shines **green** – release button<br>3. Set 10-digits: Press button 5-times → LED flashes **green** per button press<br>4. Store address (skip 100-digits): hold button pressed until LED shines **red** – release button<br>    → address is stored and displayed 1x for confirmation |
|---|---|

Set address "5":

1.  Enter addressing mode
2.  Set 1- digit: Press button 5-times → LED flashes **green** per button press
    Store address: press button until LED shines **red**
    → address is stored and displayed 1x for confirmation

### 7.3.3 Commissioning

**Workflow 1**

The devices are especially designed for using the Climatix push-button configuration as described in document A3975 [1]. The bus configuration can alternatively be parameterized by the local HMI, cf. page 28.

During commissioning check/set the following:

*   Bus configuration (address, baudrate, transmission mode, and optionally termination). The default address 255 allows to mount and power multiple actuators at the same time without interfering with each other.

*   Damper actuator parameters (opening direction, position limits, position adaptation etc.) can be checked via the Modbus register.

[1] The documents can be downloaded from http://siemens.com/bt/download

**Workflow 2**

The devices can be configured over bus if the pre-commissioning settings allow for a connection between the Modbus master / programming tool and peripheral devices (i.e. non-conflicting addresses and matching baudrate / transmission format).

*   Full configuration over bus: If the address is unique per segment when powered up, the device can be accessed by the Modbus master (or programming tool) and the address and other parameters can then be set to the definitive values.

*   Partial configuration over bus: If the address is not unique per segment when powered up, each device must get a non-conflicting address before connecting it to the bus, either by using the address input with push button (cf. page 29 ) or by setting the address to 246 with push button press > 5s und < 10s (cf. page 28).  After addressing all devices, the remaining configuration can be done over the bus using the default settings for baudrate (auto-baud) and transmission mode for the Modbus master.

*   Overwriting the bus configuration over bus uses a timeout. If „1 = Load" is not written into Reg 768 within 30 seconds, all values are discarded.

Example: Table shows bus configuration registers before and after changing them over bus.

| Reg. | Name | Pre-commissioning | New value (ex.) |
|------|------|-------------------|-----------------|
| 764 | Modbus Address | 246 | 12 |
| 765 | Baudrate | 0 = auto | 1 = 9600 |
| 766 | Transmission Format | 0 = 1-8-E-1 | 3 = 1-8-N-2 |
| 767 | Termination | 0 = Off | 0 = Off |
| 768 | Bus Conf. Command | 0 = Ready | 1 = Load |

## 7.3.4 Modbus registers

| Reg. | Name | R/W | Unit | Scaling | Range / enumeration |
|------|------|-----|------|---------|---------------------|
| **Process Values** | | | | | |
| 1 | Setpoint | RW | % | 0.01 | 0..100 |
| 2 | Override control | RW | -- | -- | 0 = Off / 1 = Open / 2 = Close |
| | | | | | 3 = Stop / 4 = GoToMin / 5 = GoToMax |
| 3 | Actual position | R | % | 0.01 | 0..100 |
| 256 | Command | RW | -- | | 0 = Ready / 1 = Adaption / 2 = Selftest |
| | | | | | 3 = ReInitDevice / 4 = RemoteFactory Reset |

| Reg. | Name | R/W | Unit | Scaling | Range / enumeration |
|------|------|-----|------|---------|---------------------|
| **Parameters** | | | | | |
| 257 | Opening direction | RW | -- | -- | 0 = CW / 1 = CCW |
| 258 | Adaptive Mode | RW | -- | -- | 0 = Off / 1 = On |
| 259 | Operating Mode | RW | -- | -- | 1 = POS |
| 260 | MinPosition | RW | % | 0.01 | 0..100 |
| 261 | MaxPosition | RW | % | 0.01 | 0..100 |
| 262 | Actuator Running Time | R | s | 1 | 150 |
| 513 | Backup Mode | RW | -- | -- | 0 = Go to BackupPosition |
| | | | | | 1 = Keep last position |
| | | | | | 2 = Disabled |
| 514 | Backup Position | RW | % | 0.01 | 0..100 |
| 515 | Backup Timeout | RW | s | 1 | 0..65535 |
| 516 | Startup Setpoint | RW | % | 0.01 | 0..100 |
| 764 | Modbus Address | RW | -- | -- | 1..247 / 255 = "unassigned" |
| 765 | Baudrate | RW | -- | -- | 0 = auto / 1 = 9600 / 2 = 19200 |
| | | | | | 3 = 38400 / 4 = 57600 / 5 = 76800 |
| | | | | | 6 = 115200 |
| 766 | Transmission Format | RW | -- | -- | 0 = 1-8-E-1 / 1 = 1-8-O-1 |
| | | | | | 2 = 1-8-N-1 / 3 = 1-8-N-2 |
| 767 | Bus Termination | RW | -- | -- | 0 = Off / 1 = On |
| 768 | Bus Conf. Command | RW | -- | -- | 0 = Ready / 1 = Load / 2 = Discard |
| 769 | Status | R | -- | -- | See below, Register 769 "Status" |

| Reg. | Name | R/W | Value | Example |
|---|---|---|---|---|
| **Device information** | | | | |
| 1281 | Factory Index | R | Two bytes, each coding an ASCII char. | 00 5A → 00 "Z" <br> Device is of Series "Z" |
| 1282 | Factory Date HWord | R | Two bytes, the lower coding the Year (hex) | Read 1282 → 000F |
| 1283 | Factory Date LWord | R | High byte: coding the month (hex) <br><br> Low byte: coding the day (hex) | Read 1283 → 0418 |

| | HWord | | LWord | |
|---|---|---|---|---|
| | -- | YY | MM | DD |
| Hex | 00 | 0F | 04 | 18 |
| Dec | 00 | 15 | 04 | 24 |

→ Device was manufactured 24 April, 2015

| Reg. | Name | R/W | Value | Example |
|---|---|---|---|---|
| 1284 | Factory SeqNo HWord | R | Hword + LWord = HEX-representation of Sequence number: | Read 1284 → 000A |
| 1285 | Factory SeqNo LWord | R | | Read 1285 → A206 <br> AA206(hex) → 696838 (dec) <br>  → Device has sequence number 696838 |
| 1409 | ASN [Char_16..15] | R | Each register: Two bytes, each coding an ASCII char. <br> ASN is coded beginning with reg. 1409 | Example: <br> 0x47 44 = GD |
| 1410 | ASN [Char_14..13] | R | | 0x42 31 = B1 |
| 1411 | ASN [Char_12..11] | R | | 0x38 31 = 81 |
| 1412 | ASN [Char_10..9] | R | | 0x2E 31 = .1 |
| 1413 | ASN [Char_8..7] | R | | 0x45 2F = E/ |
| 1414 | ASN [Char_6..5] | R | | 0x4D 4F= MO <br>  → ASN is GDB181.1E/MO |
| 1415 | ASN [Char_4..3] | R | | |
| 1416 | ASN [Char_2..1] | R | | Reserve |

**Register 769 "Status"**

| Status | | | |
|---|---|---|---|
| Bit 00 | 1 = reserved | Bit 06 | 1 = Adaption done |
| Bit 01 | 1 = Backup mode active | Bit 07 | 1 = Adaption in progress |
| Bit 02 | 1 = reserved | Bit 08 | 1 = Adaption error |
| Bit 03 | 1 = reserved | Bit 09 | 1 = Selftest failed |
| Bit 04 | 1 = Mechanical fault, device jammed or manual override | Bit 10 | 1 = Selftest passed |
| Bit 05 | 1 = Nom. lifetime exceeded | Bit 11 | 1 = Invalid configuration |

**Supported function codes**

| Function codes | |
|---|---|
| 03 (0x03) | Read Holding Registers |
| 04 (0x04) | Read Input Registers |
| 06 (0x06) | Write Single Register |
| 16 (0x10) | Write Multiple Registers (Limitation: Max. 120 registers within one message) |

## 7.3.5 Parameter and function description

| Function | Reg. | Description |
|---|---|---|
| Override control | 2 | The actuator can be operated in override control for commissioning / maintenance purposes or system-wide functions (e.g. night-cooling).<br>• Manual override: When the gear disengagement is used to freely adjust the damper position, a mechanical jam will be detected if a mismatch between setpoint and actual position persists for more than 10s.<br>• Remote override: The actuator enters this state when an override command is sent over the bus.<br>• Available commands:<br> o Open / Close (depends on opening direction)<br> o Min / Max (depends on Min/Max settings)<br> o Stop |
| Adaptive positioning | 258 | • For air dampers where the opening range is smaller than the nominal opening range 0...90°, the feedback signal can be adapted to have the actual opening range represented as 0...100%.<br>• Using adaptive positioning makes the actuator driving to its end positions at the first startup after activating the adaptive positioning.<br>• To trigger the adaptation again after the first startup, either the command "CalibrateAdaption" (Write "1" into register no. 256 ), or the adaptive positioning can be turned off and on again. |
| Backup mode | 513, 514, 515 | • In case the communication to the controller is lost, the device can be configured to go into a defined state.<br>• Default setting mode is "keep last setpoint", i.e. in case of communication loss, the device controls to the last received setpoint.<br>• If the backup mode is enabled, it can be configured as follows:<br> o go to a predefined backup position<br> o keep current position |
| Restarting the device | 256 | Restarting is possible by:<br>• Power-reset (turning operating voltage off and on) or<br>• by "ReInitDevice" command.<br>→ Device re-initializes and sets all process values to defaults. |
| Reset | | The actuator supports the following re-initialization / reset behaviour:<br>• Local reset by push-button<br>• Remote reset: Using "RemoteFactoryReset" command.<br>Effect of reset:<br>Process values: set to ex-works default values.<br>• Parameters:<br> o Application and actuator parameters are set to factory defaults,<br> o Network parameters are reset only in case of local reset, not by remote reset (otherwise loss of communication).<br>• Not reset are: Counters, status flags, device info, and factory data. |
| Self test | 256 | When triggered, the self test drives the actuator to the detected limits and sets the flags in register 769 according to the result (bit 09 = 1→"failed" or bit 10 = 1 → "passed").<br>The self test is not passed when the limits were not reached from the lower end (results in jam). If the Min/Max limits can be exceeded, the self test is not evaluated as failed. |

# 8 Technical data

| | | |
|---|---|---|
| ⚠ AC 24 V supply (SELV/PELV) for GEB13..1, GEB16..1.. | Operating voltage | AC 24 V ± 20 % (SELV) or AC 24 V class 2 (US) |
| | Frequency | 50/60 Hz |
| | Safety extra-low voltage (SELV) or | |
| | Protection by extra-low voltage (PELV) as per | HD 384 |
| | Requirements for external safety insulating transformer (100 % duty) | as per EN 61 558 |
| | Supply line fuse | max. 10 A |
| | Power consumption    GEB13..1:  Running | 3.5 VA / 3.5 W |
| |                                    GEB16..1:  Running | 5.5 VA / 5.5 W |
| |                                    GEB161.1E/MO: Running | 6 VA / 5.5 W |
| |                                                      Holding | 1.5 W |

| | | |
|---|---|---|
| ⚠ AC 230 V power supply for GEB33..1 | Operating voltage | AC 230 V ± 10 % |
| | Frequency | 50/60 Hz |
| | Supply line fuse | max. 10 A |
| | Power consumption:                    Running | 3 VA / 3 W |

| | | |
|---|---|---|
| Function data | Nominal torque | 15 Nm |
| | Maximum torque (blocked) | 30 Nm |
| | Minimum holding torque | 15 Nm |
| | Nominal rotary angle (with position indication) | 90 ° |
| | Maximum rotary angle (mechanic limitation) | 95° ± 2° |
| | Runtime for 90° rotary angle | 150 s |
| | Mechanical life | $10^5$ cycles |

## ⚠ Inputs

| | | |
|---|---|---|
| Positioning signal for GEB13..1 | Operating voltage AC 24 V    (wires 1-6) | clockwise |
| |                                            (wires 1-7) | counterclockwise |
| Positioning signal for GEB33..1 | Operating voltage AC 230 V   (wires 4-6) | clockwise |
| |                                            (wires 4-7) | counterclockwise |
| Positioning signal for GEB16..1.. | Input voltage (wires 8-2) | DC 0...10 V / 2...10 V |
| |     Current consumption | 0.1 mA |
| |     Input resistance | > 100 kΩ |
| | Max. permissible input voltage | DC 35 V |
| |     Protected against faulty wiring | max. AC 24 V |
| | Neutral zone  for non-adjustable characteristic function | 200 mV |
| |                     for adjustable characteristic function | 2 % of ∆U |
| | Hysteresis    for non-adjustable characteristic function | 70 mV |
| |                     for adjustable characteristic function | 0.7 % of ∆U |

| | | |
|---|---|---|
| | **Communication** | |
| | Modbus RTU | RS-485, not galvanically separated |
| | Number of nodes | Max. 32 |
| | Address range | 1...247 / 255 |
| | | Default: 255 |
| | Transmission formats | 1-8-E-1 / 1-8-O-1 / 1-8-N-1 / 1-8-N-2 |
| | | Default: 1-8-E-1 |
| | Baudrates (kBaud) | Auto / 9.6 / 19.2 / 38.4 / 57.6 / 76.8 / 115.2 |
| | | Default: Auto |
| | Termination | 120 Ω el. Switchable |
| | | Default: Off |

| | | |
|---|---|---|
| Adjustable characteristic function for GEB163.1, 164.1 | Adjustable with 2 potentiometers: | |
| |     Offset Uo | DC 0...5 V |
| |     Span ∆U | DC 2...30 V |
| | Max. input voltage | DC 35 V |
| |     Protected against faulty wiring | max. AC 24 V |

## ⚠ Outputs

| | | |
|---|---|---|
| Position indicator for GEB16...1 | Output signal (wires 9-2) | |
| |     Output voltage U | DC 0...10 V |
| |     Max. output current | DC ± 1 mA |
| |     Protected against faulty wiring | max. AC 24 V |

| | | |
|---|---|---|
| Feedback potentiometer for GEB132.1 / GEB332.1 | Change of resistance (wires P1-P2) | $0...1000 \ \Omega$ |
| | Load | < 1 W |
| | Max. sliding contact current | < 10 mA |
| | Permissible voltage at potentiometer (SELV/PELV) | AC 24 V |
| | Insulation resistance between potentiometer and housing | AC 500 V |

⚠ Auxiliary switches for GEB136.1, GEB336.1 GEB164.1, GEB166.1

| | | | |
|---|---|---|---|
| Contact rating | | | 6 A resistive, 2 A inductive |
| Life: | 6 A resistive, 2 A inductive | | $10^4$ switchings |
| | 5 A resistive, 1 A inductive | | $5 \times 10^4$ switchings |
| | without load | | $10^6$ switchings |
| Switching voltage | | | AC 24...230 V |
| Nominal current resistive/inductive | | | 6 A / 2 A |
| Electric strength auxiliary switch against housing | | | AC 4 kV |
| Switching range for auxiliary switches | | | 5°...90° |
| Setting increments | | | 5° |
| Switching hysteresis | | | 2° |
| Factory switch setting | | | |
| | Switch A | | 5° |
| | Switch B | | 85° |

| | | |
|---|---|---|
| Connection cables | Cross section of prewired connection cables | 0.75 mm$^2$ |
| | Standard cable length | 0.9 m |
| | Permissible length for signal lines (non-communicative types) | 300 m (see chapter 6) |
| Degree of protection of housing | Degree of protection as per EN 60 529 | IP 54 |
| Protection class | Insulation class | as per EN 60 730 |
| | AC 24 V | III |
| | AC 230 V | Landis & Staefa |
| | Feedback potentiometer | III |
| | Auxiliary switches | Landis & Staefa |
| Environmental conditions | Operation | IEC 721-3-3 |
| | Climatic conditions | class 3K5 |
| | Mounting location | interior, weather-protected |
| | Temperature | −32....+55 °C |
| | Humidity (non-condensing) | < 95% r. h. |
| | Transport | IEC 721-3-2 |
| | Climatic conditions | class 2K2 |
| | Temperature | −32...+70 °C |
| | Humidity (non-condensing) | < 95% r. h. |
| | Mechanical conditions | class 2M3 |
| Standards and directives | Product safety | |
| | Automatic electrical controls | EN 60 730-2-14 |
| | for household and similar use | (type 1) |
| | Electromagnetic compatibility (Application) | For residential, commercial and industrial environments |
| | EU Conformity (CE) | A5W00004376 [1] |
| | RCM Conformity | A5W00004377 [1] |
| | EAC Conformity | Eurasia conformity for all GEB.. variants |
| | UL, cUL | UL 873 http://ul.com/database |
| | Product environmental declaration [2] | CE1E4621en [1] and A6V101083254en [1] |
| Dimensions | Actuator W x H x D (see "Dimensions") | 81 x 192 x 63 mm |
| | Damper shaft | |
| | Round | 6.4...20.5 mm |
| | Square | 6.4...13 mm |
| | Min. length | 20 mm |
| | Max. shaft hardness | < 400 HV |
| Weight | Without packaging | |
| | GEB13..1, 16..1 | 1 kg |
| | GEB33..1 | 1.1 kg |
| | GEB161.1E/MO | 1.2 kg |

[1] The documents can be downloaded from http://siemens.com/bt/download
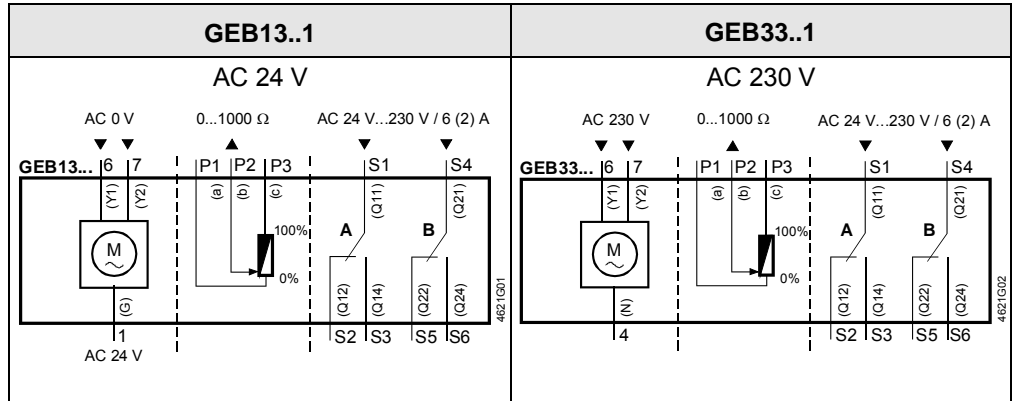[2] The product environmental declaration contains data on environmentally compatible product design and assessments (RoHS compliance, materials composition, packaging, environmental benefit, disposal).
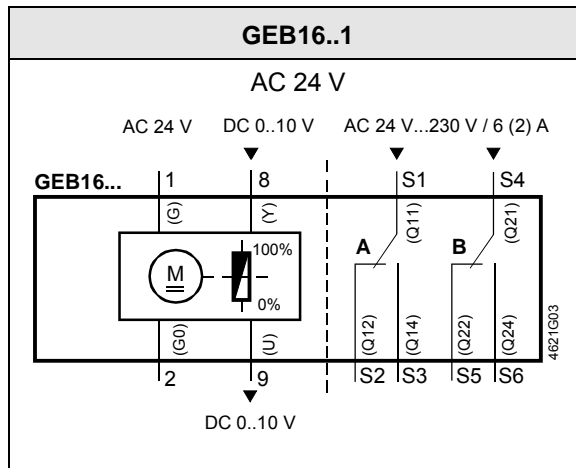
# 9 Diagrams

## 9.1 Internal diagrams

**Three-position control**



| GEB13..1 | GEB33..1 |

AC 24 V / AC 230 V

**Modulating control**
Y = DC 0...10 V, 2...10 V, 0...35 V



GEB16..1

AC 24 V

## 9.2 Cable labeling

All wires are color-coded and labeled.

| Pin | Code | No. | Color Abbreviation | | Meaning |
|-----|------|-----|-------|-----|---------|
| | | | **Cable** | | |
| **Pin** | **Code** | **No.** | **Color Abbreviation** | | **Meaning** |
| Actuators AC 24V | G | 1 | red | RD | System potential AC 24 V |
| | G0 | 2 | black | BK | System neutral |
| | Y1 | 6 | purple | VT | Positioning signal AC 0 V, "clockwise" |
| | Y2 | 7 | orange | OG | Positioning signal AC 0 V, "counterclockwise" |
| | Y | 8 | gray | GY | Pos. signal DC 0...10 V, 2...10 V, 0...35 V |
| | U | 9 | pink | PK | Position indication DC 0...10 V |
| Modbus types | REF | 6 | violet | VT | Reference (Modbus RTU) |
| | + | 8 | gray | GY | Bus + (Modbus RTU) |
| | - | 9 | pink | PK | Bus - (Modbus RTU) |
| Actuators AC 230V | N | 4 | blue | BU | Neutral conductor |
| | Y1 | 6 | black | BK | Positioning signal AC 230 V, "clockwise" |
| | Y2 | 7 | white | WH | Pos. signal AC 230 V, "counterclockwise" |
| Auxiliary switches | Q11 | S1 | gray/red | GY RD | Switch A  Input |
| | Q12 | S2 | gray/blue | GY BU | Switch A  Normally closed contact |
| | Q14 | S3 | gray/pink | GY PK | Switch A  Normally open contact |
| | Q21 | S4 | black/red | BK RD | Switch B  Input |
| | Q22 | S5 | black/blue | BK BU | Switch B  Normally closed contact |
| | Q24 | S6 | black/pink | BK PK | Switch B  Normally open contact |
| Feedback potentiometer | a | P1 | white/red | WH RD | Potentiometer 0...100 % (P1-P2) |
| | b | P2 | white/blue | WH BU | Potentiometer pick-off |
| | c | P3 | white/pink | WH PK | Potentiometer 100...0 % (P3-P2) |

## 9.3   Connection diagrams (three-position control)

**GEB13..1**
AC 24 V



```
4621A01
```
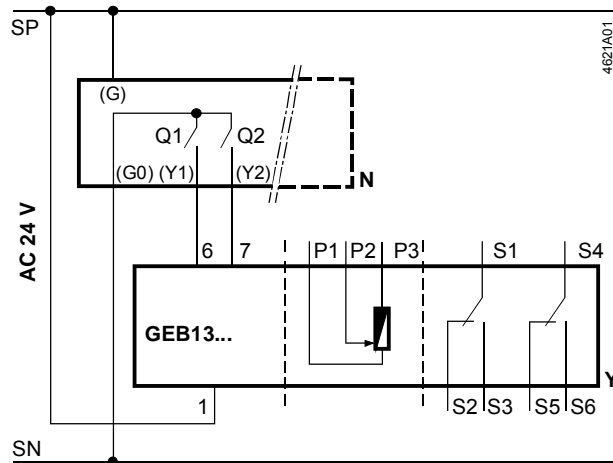
| | Legend |
|---|---|
| **N** | Controller |
| **Y** | Actuator GEB13..1 |
| **SP** | System potential AC 24 V |
| **SN** | System neutral |
| **Q1, Q2** | Controller contacts |

**GEB33..1**
AC 230 V



```
4621A02
```
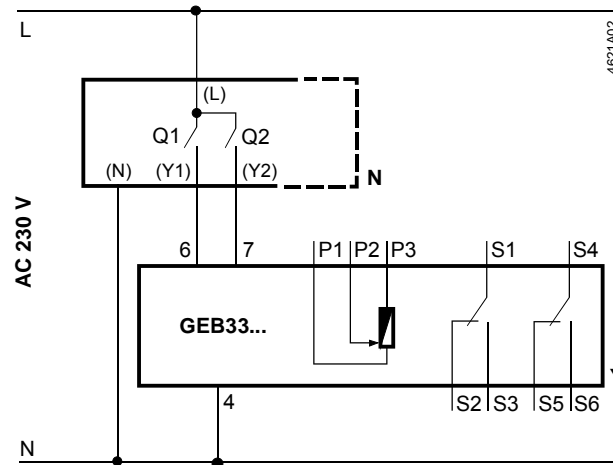
| | Legend |
|---|---|
| **N** | Controller |
| **Y** | Actuator GEB33..1 |
| **L** | System potential AC 230 V |
| **N** | System neutral |
| **Q1, Q2** | Controller contacts |

Operating states for actuators GEB13..1, GEB33..1

The table shows the actuator's operating state for both rotary directions regardless of the position of the controller contacts Q1 and Q2.

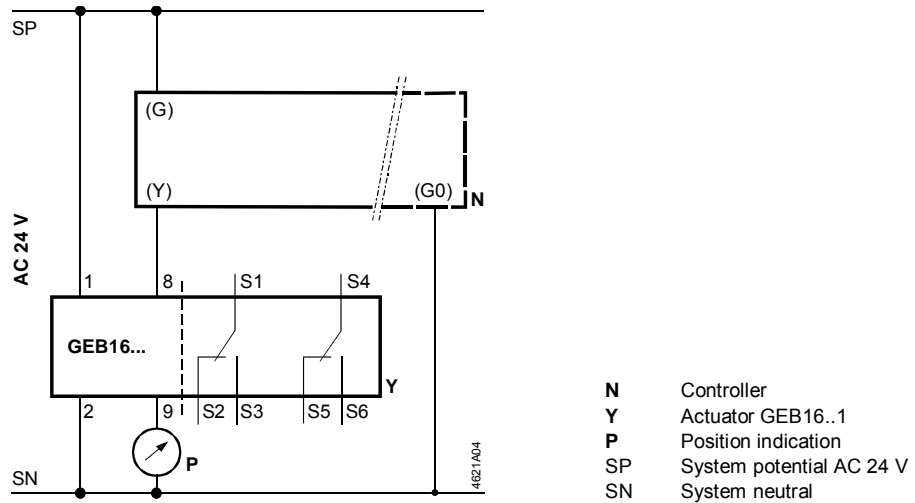| Controller contacts | | Operating state |
|---|---|---|
| **Q1** | **Q2** | |
| open | open | Remains in current position |
| closed | open | ↻ |
| open | closed | ↺ |
| closed | closed | **Not permissible** |

```
4621T02en
```

# 9.4 Connection diagrams (modulating)

## 9.4.1 Typical application

The controller output is connected directly to the actuator input.

**GEB16..1**



| | |
|---|---|
| **N** | Controller |
| **Y** | Actuator GEB16..1 |
| **P** | Position indication |
| **SP** | System potential AC 24 V |
| **SN** | System neutral |

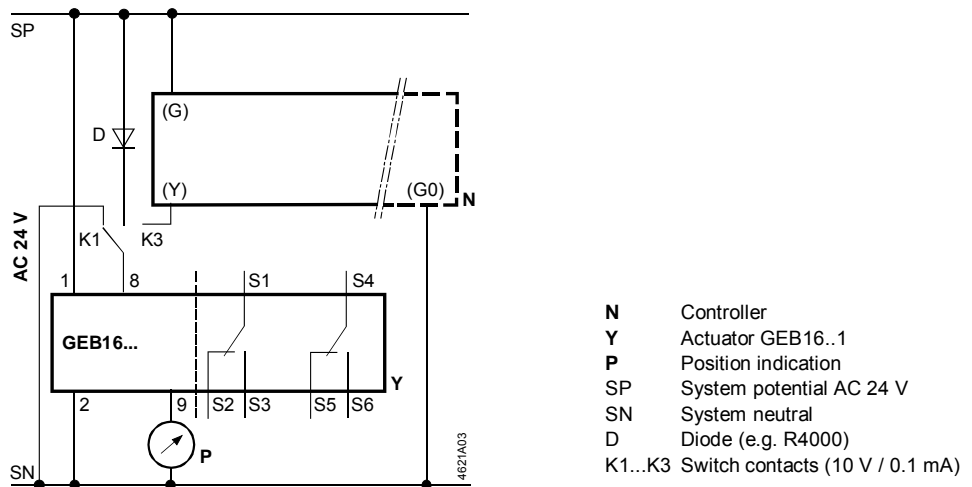## 9.4.2 Special switchings for modulating control

The following connection enable different operating states of the actuator depending on the position of the changeover switch featuring switch contacts K1, K2, K3 (see table of operating states).

**Modulating control, fully open, fully locked with** GEB16..1



| | |
|---|---|
| **N** | Controller |
| **Y** | Actuator GEB16..1 |
| **P** | Position indication |
| **SP** | System potential AC 24 V |
| **SN** | System neutral |
| **D** | Diode (e.g. R4000) |
| **K1...K3** | Switch contacts (10 V / 0.1 mA) |

**Operating states with** GEB16..1

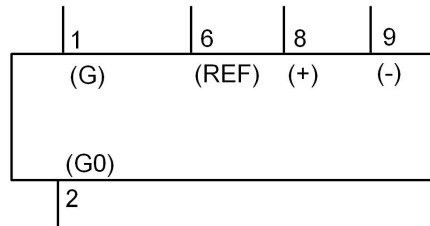| Switch contacts | Operating state | Rotary direction | |
|---|---|---|---|
| **K3** | Modulating control | ↶ | ↶ |
| **K2** | Fully open | ↺ | ↻ |
| **K1** | Fully closed | ↻ | ↺ |
| **DIL switch position** | | ↺ ▮▭ ⟳ | ⟲ ▭▮ ↻ |

*Note*

*) Full opening for actuator types with adjustable characteristic function depends on the set voltage values (Uo, ΔU) and the supply voltage tolerance.

## 9.5 Connection diagrams (networked)
### 9.5.1 Typical application

The application controller is connected to the actuator by the bus cable.

```
     1           6      8        9
   ┌─┼───────────┼──────┼────────┼──┐
   │ (G)        (REF)  (+)      (-)  │
   │                                 │
   │                                 │
   │ (G0)                            │
   └─┼───────────────────────────────┘
     2
```

# 10 Environmental compatibility and disposal

General notes

This actuator was developed and manufactured by using environmentally-compatible materials and by complying with our environmental standards.

For disposal, please remember the following at the end of product life or on defects:
- The device consists of
    – Materials such as steel, aluminum die-cast, and zinc die-cast.

Do not dispose as household garbage. This particularly applies to the circuit board. See also European Directive 2012/19/EU

- As a rule, dispose of all waste in an environmentally compatible manner and in accordance with environmental, recycling, and disposal techniques.
  **Adhere to all local and applicable laws.**

- The aim is to achieve maximum recyclability at the lowest possible pollution. To do this, note the various material and disposal notes printed on specific parts.

Environmental declaration

The environmental declarations for these actuators contain detailed information on the materials and volumes used. Request a declaration at your local dealership.
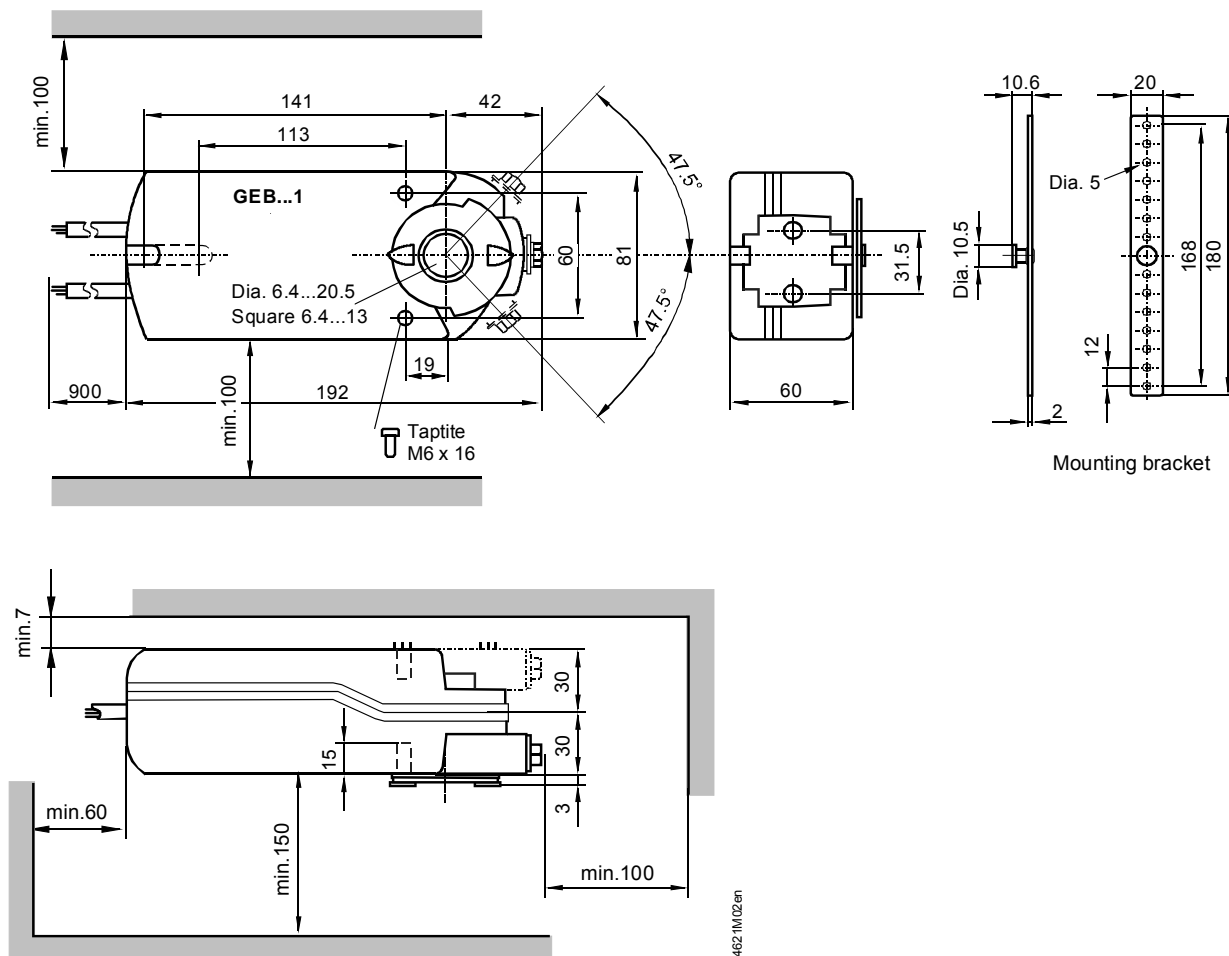
# 11 Appendix

Chapter contents

This chapter contains:
- Actuator dimensions
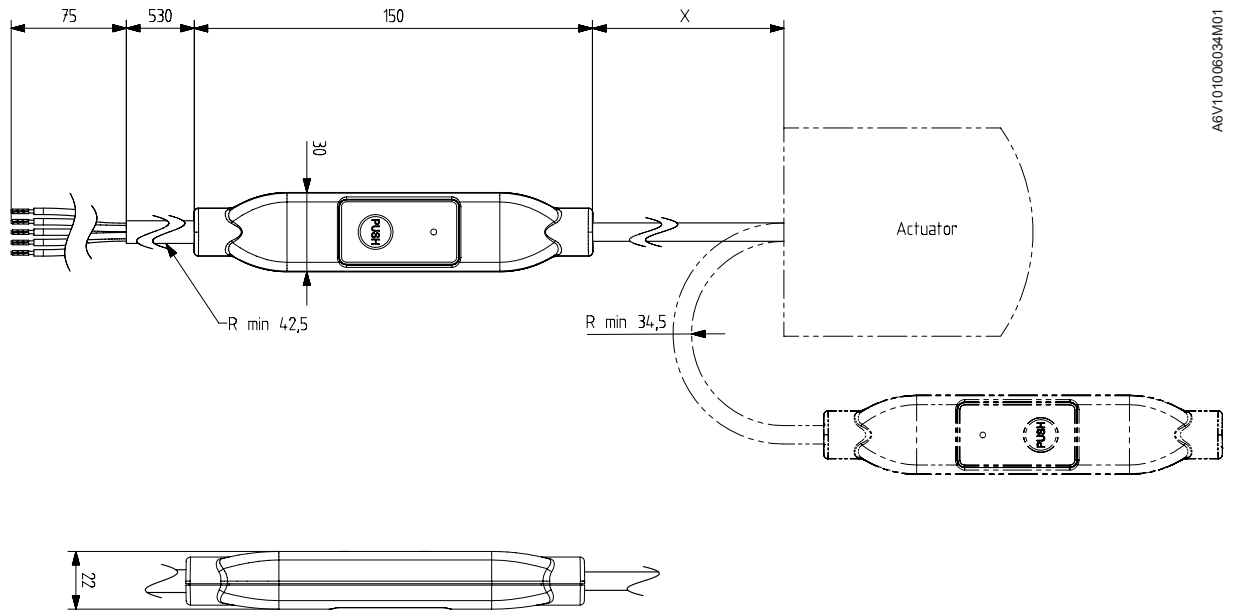- Referenced documents
- Feedback form

## 11.1 Dimensions



Mounting bracket

Dimensions in mm

**External Modbus Interface**



75 530 150 X

30

R min 42,5

R min 34,5

Actuator

A6V101006034M01

22

X = 220 mm

Dimensions in mm

# 11.2 Referenced documents

Purpose of this listing

The previous chapters contain all information relevant to safety and project-specific requirements, mounting, wiring, and commissioning of actuators.

Documents and standards

The following list contains all documents referenced by this document on basics:

- Data sheets (N....) with detailed specifications
- Basic documentation (Z....) with basics on air damper actuators
- Mounting instructions (M….), documents supplied with product

*Note*

The document and classification numbers listed in the table below match those of the Database "STEP" on the company-internal Intranet.

**Standards**

All standards and directives relevant to engineering are also listed.

**Technical documentation**
Type series GEB...1

| Document number (Classification no.) | Title/Description | Contents |
|---|---|---|
| CM2N4621en (N4621) | Actuators for air dampers, rotary version (GEB...1: Three-pos., modulating). | Type overview, function and selection criteria. |
| A6V101037253 | Data sheet: Air Damper Actuators Modbus RTU, GEB.., GIB.. non-spring return types | Type overview, function and selection criteria. |
| CM2Z4621en (Z4621) | Basic documentation: Technical basics, actuators without spring return GEB...1. | Technical basics for engineering, mounting, wiring, and commissioning. |
| 74 319 0109 0 (M4621) | Mounting instructions: GEB...1. | Instructions on mounting a rotary actuator without spring return. |
| A6V101006034 | Installation Instruction: G..161../MO S..6../MO | Installation of types with external Modbus interface. |

Accessories for type series GEB...1

| Document number (Classification no.) | Title/Description | Contents |
|---|---|---|
| CM2N4697en (M4697) | Accessories and spare parts for actuators GMA...1, GEB…. | Overview, allocation to actuator type, and application. |
| CE1N4615en (M4615) | External auxiliary switches ASC77.. | Detailed specifications |
| 74 319 0413 0 (M4615) | External auxiliary switches ASC77.. | |
| 74 319 0236 0 (M4614.1) | Universal lever ASK71.9 | |
| 74 319 0237 0 (M4614.2) | Rotary/linear set for duct and wall mounting ASK71.11. | |
| 74 319 0238 0 (M4614.3) | Rotary/linear set with lever ASK71.13. | |
| 74 319 0239 0 (M4614.4) | Rotary/linear set with lever and mounting plate ASK71.14. | Mounting instructions and application examples. |
| 74 319 0240 0 (M4614.5) | Weather protection cover ASK75.3 | |
| 74 319 0241 0 (M4614.6) | Mounting bracket for tandem-mounted actuators or Powerpack ASK73.3. | |

| Standards | HD 384 | Electrical installations in buildings |
|---|---|---|
| | EN 61 558 | Safety of transformers, power supply units and similar equipment |
| | EN 60 730 | Automatic electrical controls for household and similar use |
| | IEC/EN 61 000-6-3 | Electromagnetic compatibility: Emissions |
| | IEC/EN 61 000-6-1 | Electromagnetic compatibility: Immunity |
| | IEC/EN 61 000-6-2 | Electromagnetic compatibility: Immunity |
| | 89/336/EWG | Directive on electromagnetic compatibility |
| | 73/23/EWG | Low voltage directive |