

SIEMENS



OpenAir™ Actuators without spring return GEB...1 Technical basics

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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

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 and
- Modulating control.

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 m², 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
	Three-position control						Modulating control.			
Operating voltage AC 24 V	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	
Position indicator U = DC 0...10 V							X	X	X	X
Feedback potentiometer 1kΩ		X			X					
Self-adaptation of rotary angle range							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
Control type	Three-position control	Modulating control.
Positioning signal with adjustable characteristic function		Y = DC 0...35 V with offset $U_0 = 0...5$ V and span $\Delta U = 2...30$ 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.	<ul style="list-style-type: none"> On the direction of the DIL rotary direction switch. On the positioning signal. The actuator stays in the position reached: <ul style="list-style-type: none"> If the positioning signal is maintained at a constant value. If the operating voltage is interrupted.
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.	<ul style="list-style-type: none"> Position indicator: Output voltage $U = DC$ 0...10 V is generated proportional to the rotary angle. Only for <i>GEB16..1</i>: The direction of action (inverted or not inverted) of output voltage U depends on the rotary direction of the DIL switch.
Self-adaptation of rotary angle range		<ul style="list-style-type: none"> The actuator automatically determines the mechanical end of range for the rotational angle. The characteristic function ($U_0, \Delta U$) is mapped to the determined 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 of the same actuator types on the same damper shaft may result in a double 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 U_0 and span ΔU can be adjusted using two potentiometers (see 3.4 "Adjustable characteristic function"). The maximum permissible input voltage ($U_0 + \Delta U$) is DC 35 V. Actuators featuring this function can be used for the following applications:

- Dampers with a rotary angle limitation, for instance in the $0^\circ \dots 45^\circ$ range, can be controlled using the full positioning signal range DC 0...10 V.
- As a sequencing actuator in control loops that can only apply a DC 0...10 V positioning signal to control more than one sequence.
- 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:

- Activated self-adaptation and switching-on of operating voltage.
- Switch-on and switch-off for self-adaptation when operating voltage is supplied.

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
<ul style="list-style-type: none"> • The actuator maps the characteristic function ($U_0, \Delta U$) to the positioning range $Y_s = 100\%$ for rotary angle 90°. • The actuator calibrates the position indication with $U = \text{DC } 0 \dots 10 \text{ V}$ for rotary angle 90°. 	<ul style="list-style-type: none"> • The actuator maps the characteristic function ($U_0, \Delta U$) to the positioning range $Y_s = 100\%$ for the determined rotary angle range. • The actuator calibrates the position indication with $U = \text{DC } 0 \dots 10 \text{ V}$ for the determined rotary angle range.

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").

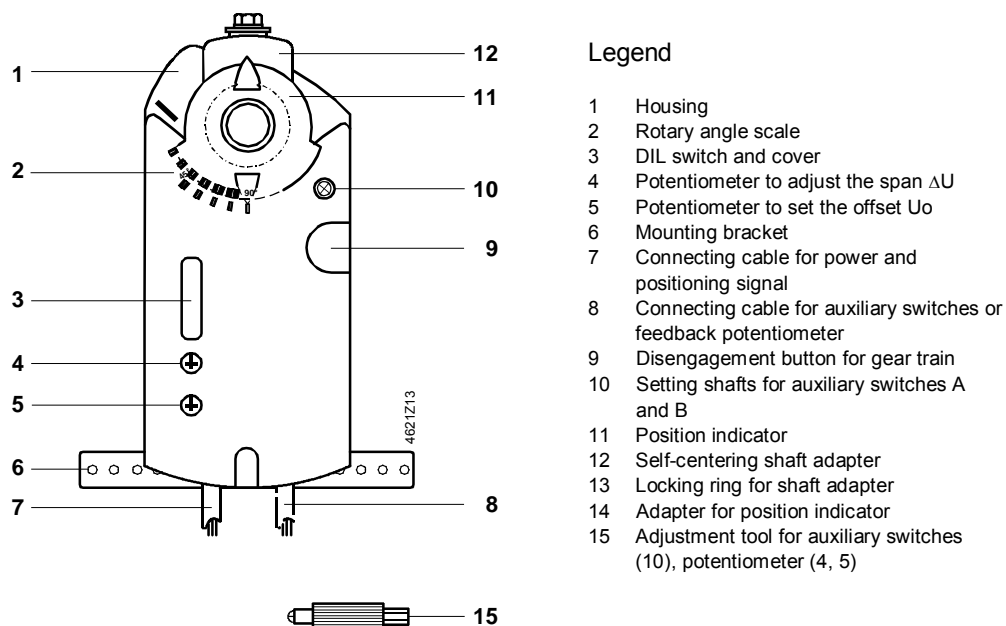
Actuator type	Control type	Controller output
GEB13..1	Three-position	AC 24 V
GEB33..1	Three-position	AC 230 V
GEB16..1	Modulating	DC 0...10 V / DC 2...10 V / DC 0...35 V

2.5 Structure and design

Description	The electronic motor-driven GEB..1 actuators are available for three-position and modulating 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 U_0 and ΔU 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.

2.6 Setting and operator elements

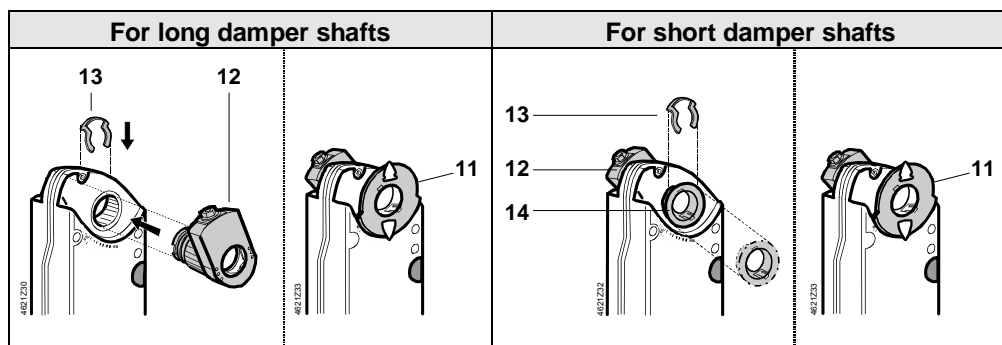
Actuator



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 U_o
- 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



DIL switch (Legend pos. 3) GEB16..1

Meaning	DIL switch label		Meaning	Function
Counter-clockwise arrow			Clockwise arrow	Rotary angle direction
Active			0	Off
DC 2...10 V	2...		0...	DC 0...10 V
DC 0...35 V (Comfort)	C		0	DC 0...10 V

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

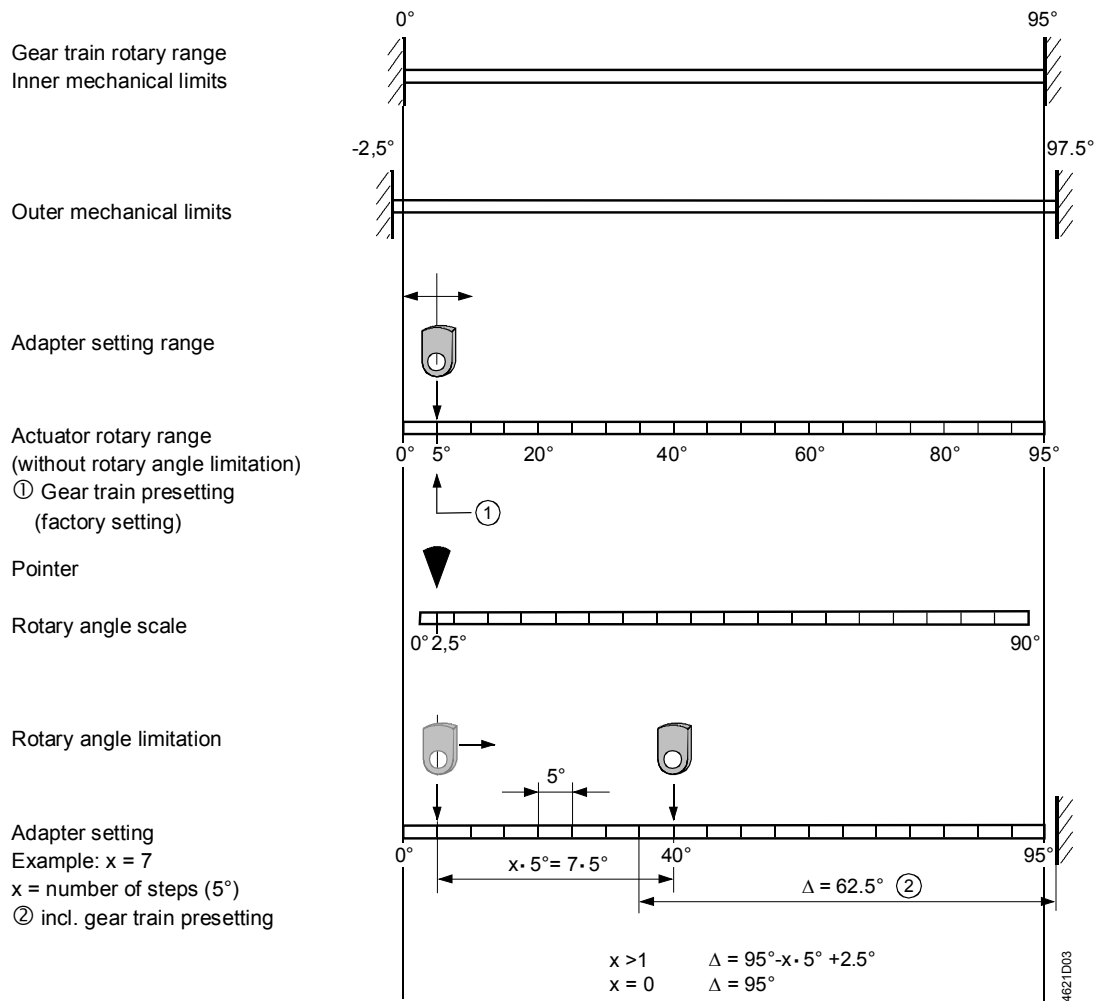
Motor technology

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

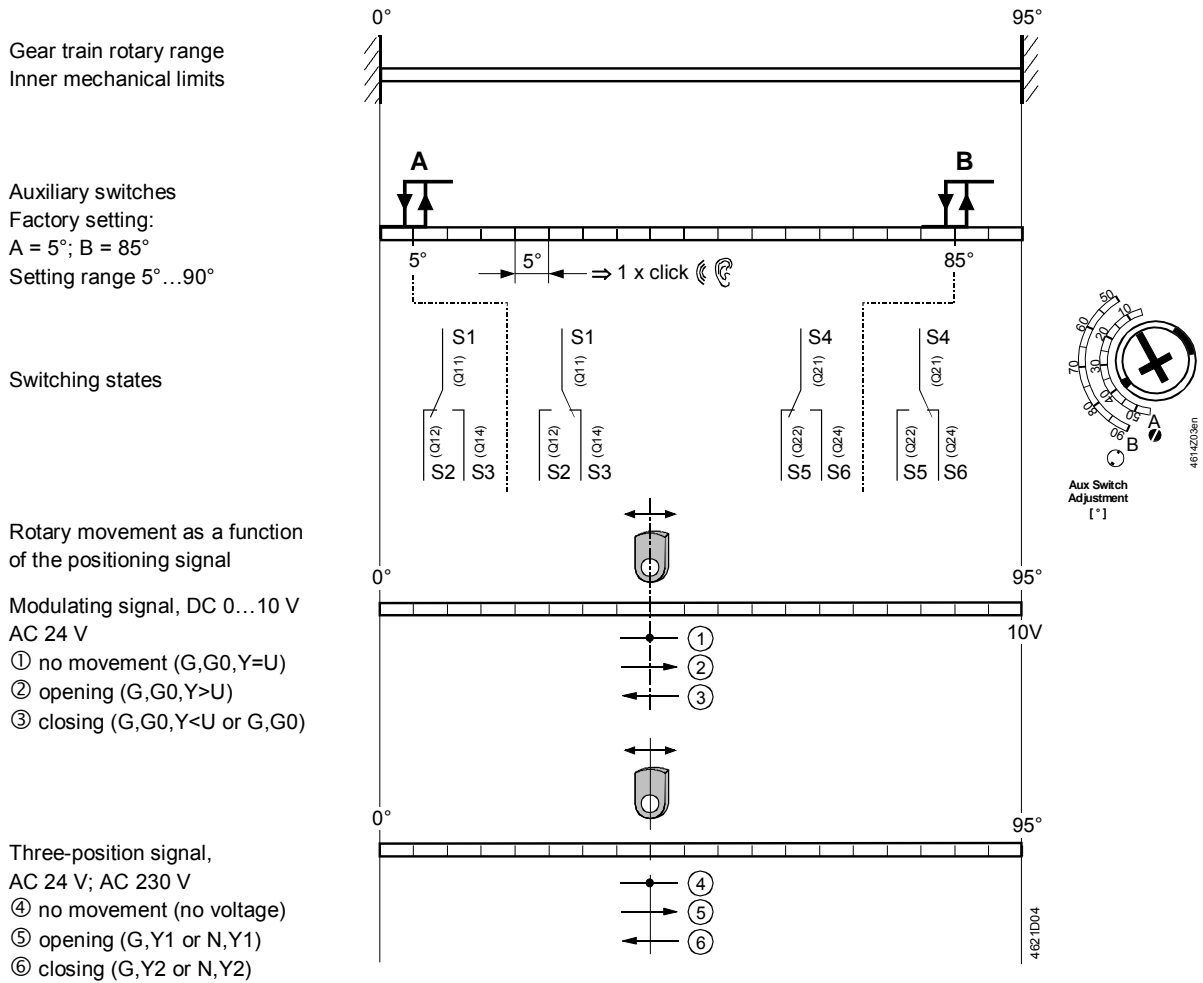
The illustration below shows the relationship between the inner and outer mechanical limitation of the rotary range.



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.



Note

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

Adjustment tool

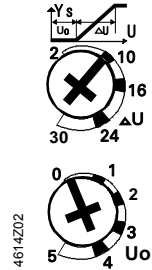
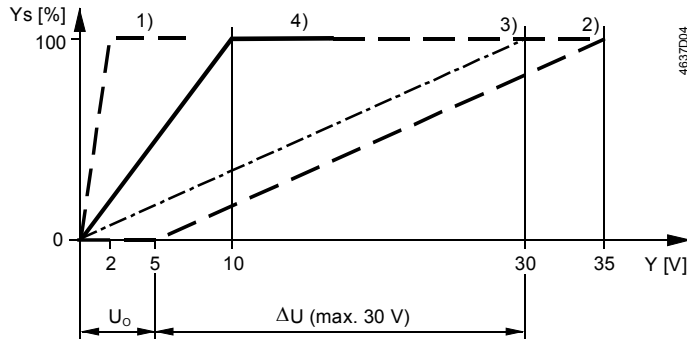
The adjustment tool is used to set the auxiliary switches; it is part of the delivery (type-specific).

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	0...17 %	DC 5 V	DC 30 V
	DC 5...35 V	0...100 %		
3)	DC 0...10 V	0...33 %	DC 0 V	DC 30 V
	DC 0...30 V	0...100 %		
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

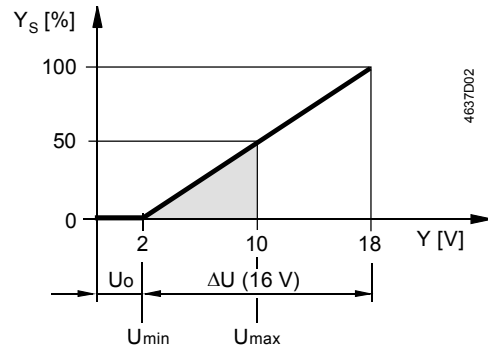
Calculating the setting value for ΔU:

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

Potentiometer settings

Uo = 2 V, ΔU = 16 V

Characteristic function for the example



Max. positioning range $Y_{smax} = 100\%$ (95°)
 Span $Y_s = 50\%$ (47.5°)
 Offset $U_o = 2\text{ V}$
 Span $\Delta U = 16\text{ V}$

Effective span
 $\Delta U_w = U_{max} - U_{min}$
 $= 10\text{ V} - 2\text{ V} = 8\text{ V}$

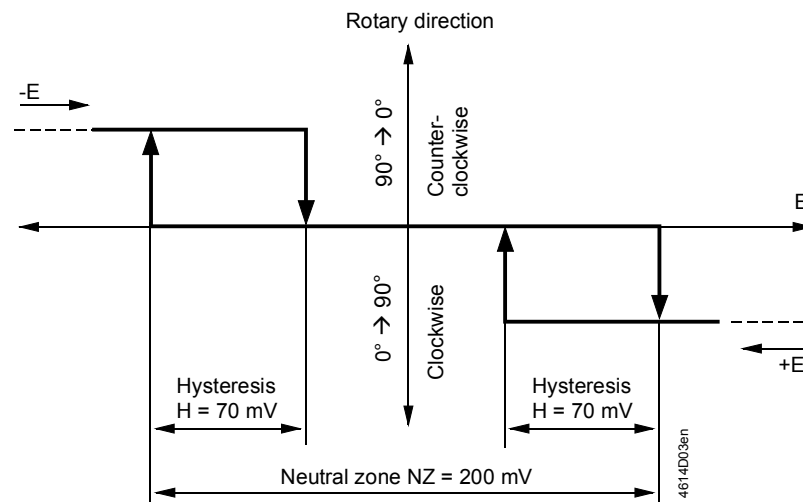
3.5 Neutral zone

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**).



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




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.

If ignored, injuries and equipment damages may result.

 General regulations

Observe the following general regulations during engineering and project execution:

- Electric and high-power regulations of the respective country.
- Other mandatory country regulations.
- House installation regulations of the respective country.
- Regulations by the energy supplier.
- Diagrams, cable lists, dispositions, specifications, and instructions as per the customer or the engineering company.
- 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:

Unearthed = Safety Extra-Low Voltage **SELV**

Grounded = Protection by Extra-Low Voltage **PELV**


 Earthing of
G0 (system neutral)

Observe the following for grounding G0:

- 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.
- 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.
- 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: <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Safety transformers as per EN 61558, with double isolation, designed for 100 % runtime to supply SELV or PELV circuits. • Determine the transformer's power consumption by adding up the power consumption in VA for all actuators used. • The capacity used from the transformer should amount to at least 50 % of the nominal load for efficiency reasons (power efficiency). • 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: <ul style="list-style-type: none"> • According to the effective load of all connected devices. • Line G (system potential) must always be fused. • 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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

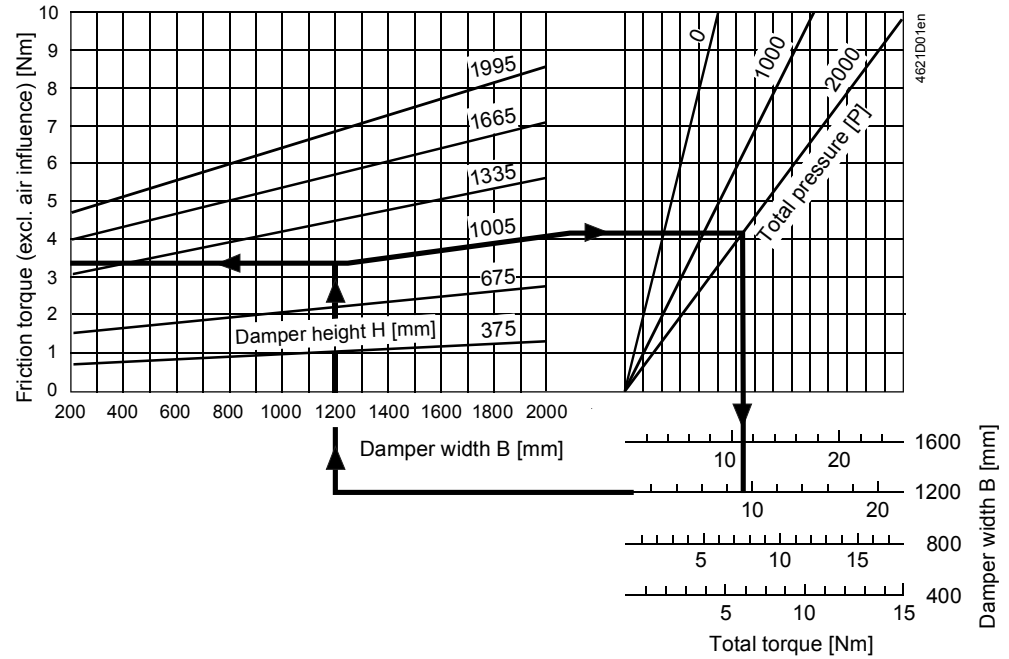
Selection of the actuator depends on several torque factors. After obtaining the damper torque rating [Nm/m²] from the manufacturer and determining the damper area, calculate the total torque required to move the damper as follows:

$$\text{Total torque [Nm]} = \text{Torque rating [Nm/m}^2\text{]} \times \text{damper area [m}^2\text{]}.$$

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 $\frac{\text{total torque [Nm]}}{\text{SF}^1}$	then use type
$\leq 15 \text{ Nm}$	GEB...1 (15 Nm)
$\leq 25 \text{ Nm}$	GBB...1 (25 Nm) ²
$\leq 30 \text{ Nm}$	2 x GEB...1 (2 x 15 Nm) ³
$\leq 35 \text{ Nm}$	GIB...1 (35 Nm) ⁴
$\leq 70 \text{ Nm}$	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: <ul style="list-style-type: none">• The actuators are equipped only for vertical mounting (cable entries at bottom) with air dampers having a horizontal shaft.• The actuator mounted on the damper shaft may be mounted by max. +/- 45° to the vertical line:• 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. 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 G0, Y, U	4 % each (tot. 8 %) of AC 24 V 1 % of DC 10 V
GEB33..1	AC 230 V	L, N	2 % each (tot. 4 %) of AC 230V

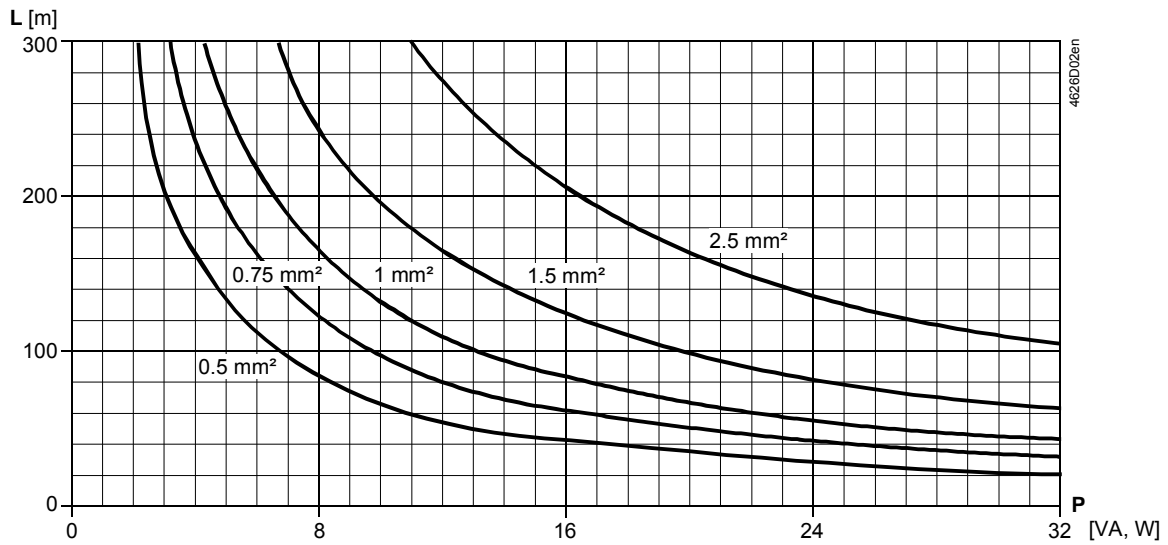
Notes on the G0 line (GEB16..1)

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**

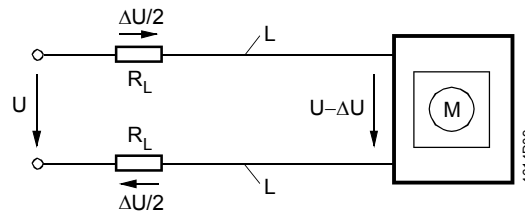
The diagram applies to AC 24 V and shows the permissible line length **L** as a function of consumption **P** and as a parameter of the line cross sections.



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

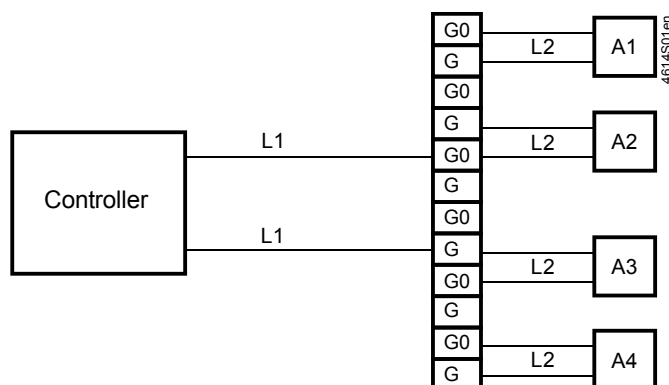
The maximum line length can be calculated using the following formula.

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

- A Line cross section in [mm²]
- 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).

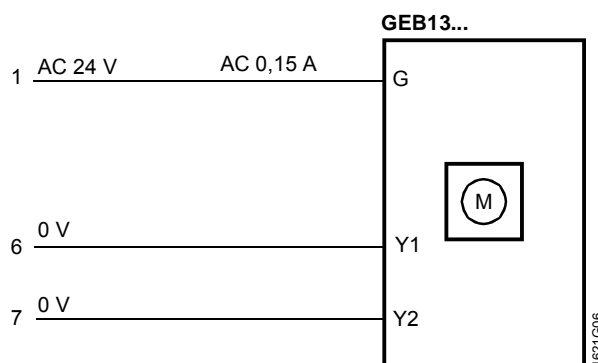
Power consumption and perm. voltage drop with one actuator

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	$\Delta U/U = \text{max. } 8\% \text{ (4\% each per line)}$

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 = $2 \times 3.5 \text{ VA} = 7 \text{ VA}$.
- Line current = $2 \times 0.15 \text{ A} = 0.3 \text{ A}$.

Max. permissible single line length: 280 m at 1.5 mm^2 line cross section.

6.3 Actuator wiring (modulating)

Modulating actuators GEB16..1

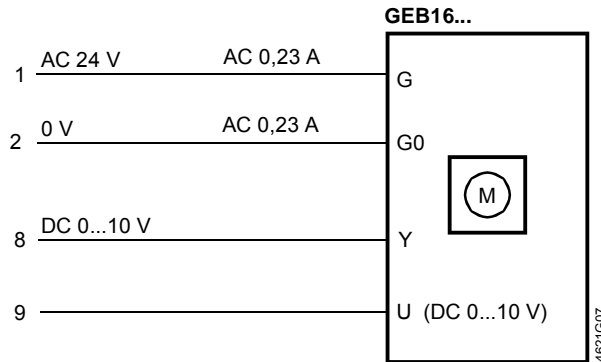
With AC supply, the G0 line has a AC 0.23 A supply current and a DC 0.1 mA positioning signal current (from Y = DC 0...10 V). The AC voltage drop on the G0 line does not impact the positioning signal Y.

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 = $4 \times 5.5 \text{ VA} = 22 \text{ VA}$.
- Line current = $4 \times 0.23 \text{ A} = 0.92 \text{ A}$.
- **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.

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 counterclockwise 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_0 and span ΔU are set to the following values: $U_0 = 0 \text{ V}$, $\Delta U = 10 \text{ V}$.

Note

Specify the values set for U_0 and ΔU 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



- Alternative switch-on/switch-off of self-adaptation.
|<>|: ON
0: OFF
- Factory setting: 0.

Positioning signal without characteristic function: (GEB161.1, GEB166.1)



- Alternate setting:
2...: DC 2...10 V
0...: DC 0...10 V
- Factory setting: 0...

Positioning signal with/without characteristic function: (GEB163.1, GEB164.1)



- Alternate setting:
C: DC 0...35 V (Comfort, with characteristic function)
0: DC 0...10 V (without characteristic function)
- Factory setting: 0.



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 5 A resistive, 1 A inductive without load
	Switching voltage	6 A resistive, 2 A inductive 10 ⁴ switchings 5 x 10 ⁴ switchings 10 ⁶ switchings
	Nominal current resistive/inductive	AC 24...230 V
	Electric strength auxiliary switch against housing	6 A / 2 A
	Switching range for auxiliary switches	AC 4 kV
	Setting increments	5°...90°
	Switching hysteresis	5°
	Factory switch setting	2°
	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	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 for household and similar use	EN 60 730-2-14 (type 1)
	Electromagnetic compatibility (Application)	For residential, commercial and industrial environments
	EU Conformity (CE)	A5W00004376 ¹⁾
	RCM Conformity	A5W00004377 ¹⁾
	Product environmental declaration ²⁾	CE1E4621en 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

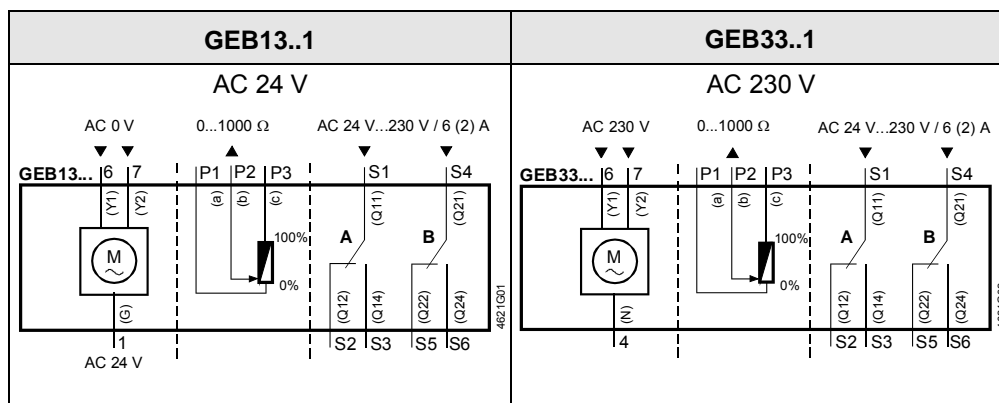
¹⁾ The documents can be downloaded from <http://siemens.com/bt/download>

²⁾ The product environmental declaration contains data on environmentally compatible product design and assessments (RoHS compliance, materials composition, packaging, environmental benefit, disposal).

9 Diagrams

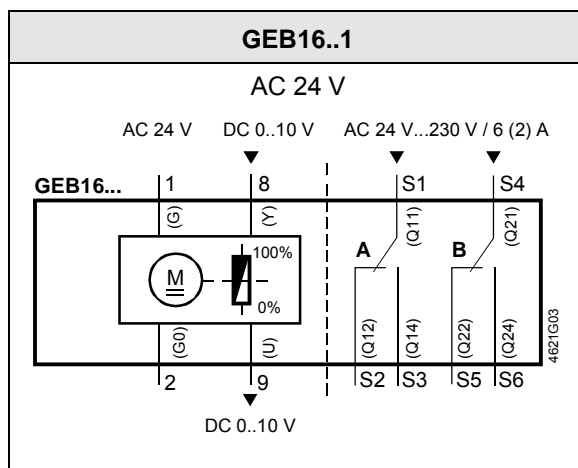
9.1 Internal diagrams

Three-position control



Modulating control

Y = DC 0...10 V, 2...10 V, 0...35 V



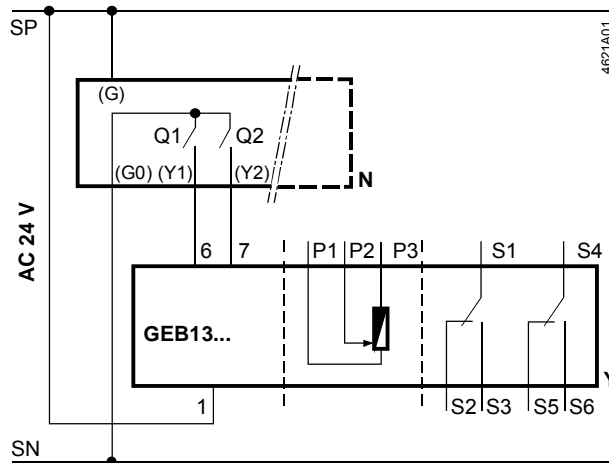
9.2 Cable labeling

All wires are color-coded and labeled.

Pin	Cable				Meaning
	Code	No.	Color	Abbreviation	
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
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)

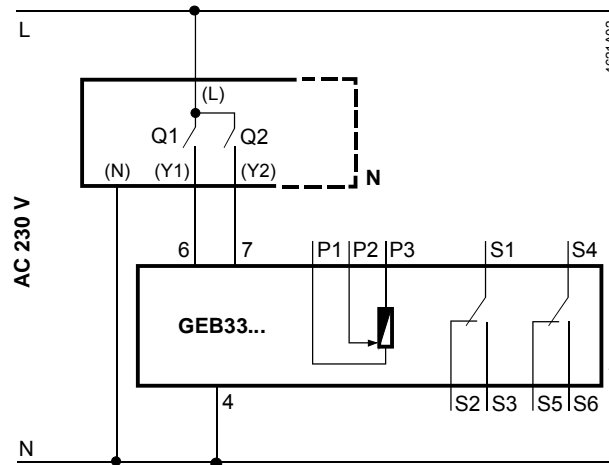
9.3 Connection diagrams (three-position control)

GEB13..1
AC 24 V



N Controller
Y Actuator GEB13..1
SP System potential AC 24 V
SN System neutral
Q1, Q2 Controller contacts

GEB33..1
AC 230 V



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	
		Remains in current position
		Not permissible

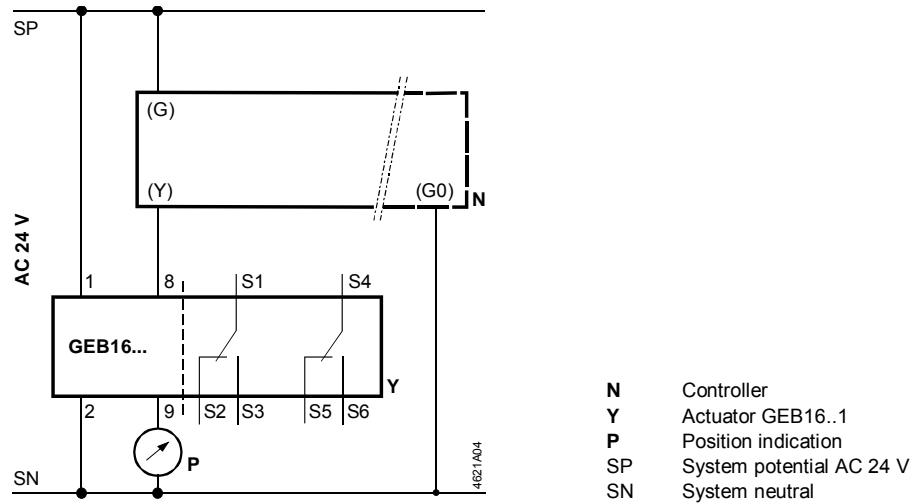
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9.4 Connection diagrams (modulating)

9.4.1 Typical application

The controller output is connected directly to the actuator input.

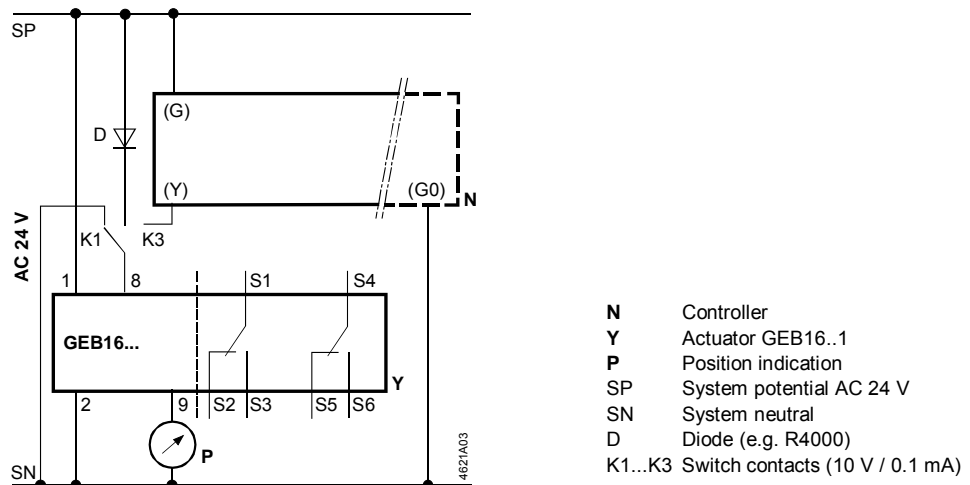
GEB16..1



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



Operating states with GEB16..1

Switch contacts	Operating state	Rotary direction	
K3	Modulating control	↺	↻
K2	Fully open	↺	↻
K1	Fully closed	↺	↻
DIL switch position		↺	↻

4621T01en

Note

*) Full opening for actuator types with adjustable characteristic function depends on the set voltage values (U_0 , ΔU) and the supply voltage tolerance.

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.

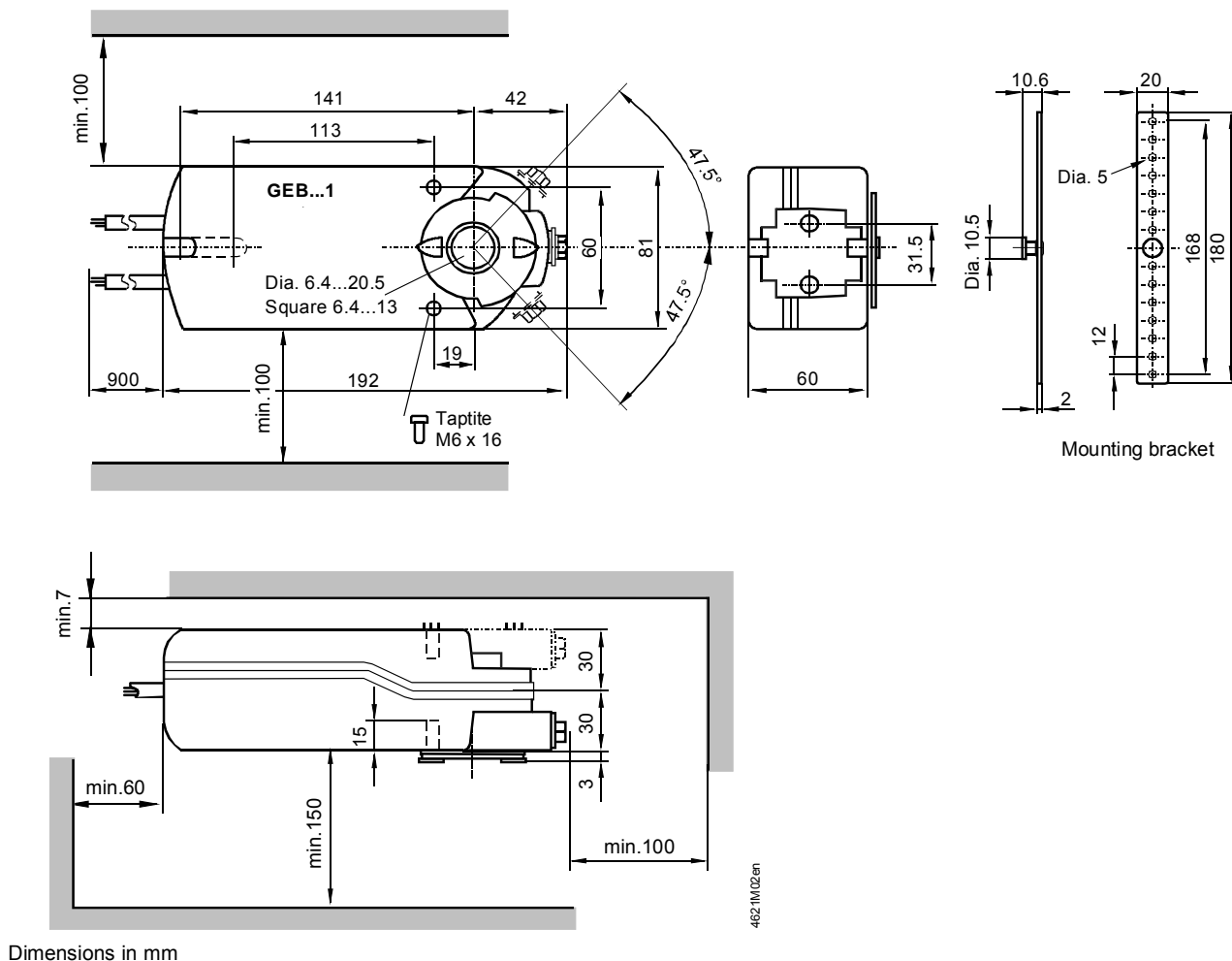
11 Appendix

Chapter contents

This chapter contains:

- Actuator dimensions
- Referenced documents
- Feedback form

11.1 Dimensions



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.
CM2Z4621en (Z4621)	Technical basics, actuators without spring return GEB...1.	Technical basics for engineering, mounting, wiring, and commissioning.
74 319 0109 0 (M4621)	Mounting instructions on GEB...1.	Instructions on mounting a rotary actuator without spring return.

Accessories for type series GEB...1

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..	Mounting instructions and application examples.
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.	
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

Issued by
Siemens Switzerland Ltd
Building Technologies Division
International Headquarters
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Switzerland
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www.siemens.com/buildingtechnologies

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