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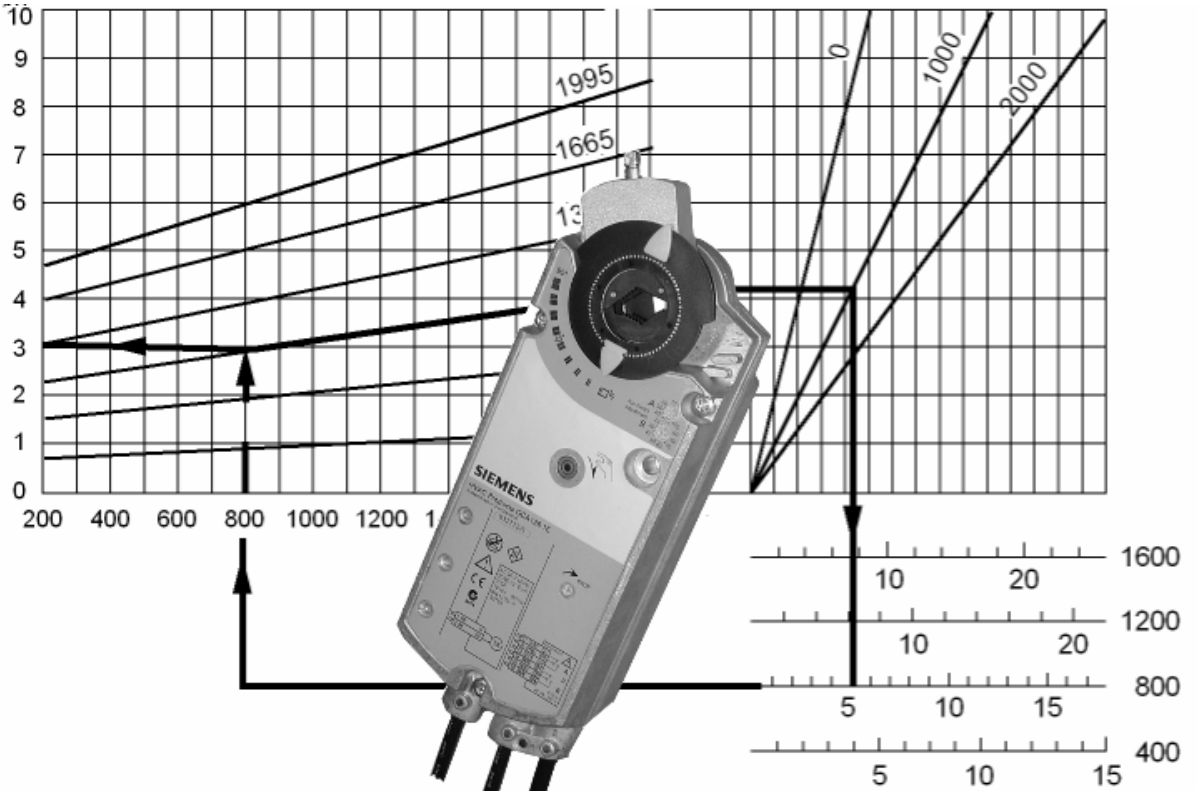

OpenAir™
Rotary actuators with spring return GCA…1
Technical basics

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Building Technologies
HVAC Products

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1 Introduction

1.1 Revision history

Changes	Date	Chapter	Pages
Powerpack (two actuators)	04.12.2003	2.2, 2.3.1	6, 7
Setting and operating elements		2.6	9
Technical data (Dimensions)		8	27
Dimensions		11.1	33
External Auxiliary Switch ASC77…	05.01.2005	2.2, 11.2	6, 34
Electrical parallel connection of actuators	28.01.2005	4.2	15
Permissible line lengths and cross-sectional areas		6.1	19
Environmental compatibility and disposal		10	32
Dimensions (2 x 33.75)		11.1	33
Referenced documents (Note STEP)		11.2	34
Wiring notes	08.08.2006	6	19…23
Operating voltage DC 24…48 V		whole document	
Technical Data 8 (Power consumption, torque and auxiliary switch)		8	27, 28

1.2 About this document

Main audience

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

Purpose

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

Referenced documents

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

1.3 Document contents

This document contains technical fundamentals on the rotary actuators with spring return of type series GCA...1 for:

- Two-position control
- Three-position control
- Modulating control

The following topics are discussed:

- Type summary and description of the available options
- Applications and functions
- Actuator design including setting and operating 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
- Notes on environmental compatibility and disposal

2 Spring return actuators

Introduction

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

2.1 Application

Spring-return actuators are used in ventilation and air conditioning plants to operate air dampers and air throttles:

- For damper areas up to 3 m^2, friction-dependent
- In ventilation sections where the actuator must move to the zero position (emergency position) during power failure
- For connection to two-position, three-position, or modulating controllers
- 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.

GCA...	**121.1E**	**126.1E**	**321.1E**	**326.1E**	**131.1E**	**135.1E**	**161.1E**	**163.1E**	**164.1E**	**166.1E**
Mode of control	Two-position				Three-position		Modulating			
Operating voltage AC 24 V DC 24…48 V	X	X			X	X	X	X	X	X
Operating voltage AC 230 V			X	X						
Positioning signal Y DC 0...10 V							X			X
DC 0...35 V with characteristic function Uo, ΔU								X	X	
Position indicator U = DC 0...10 V							X	X	X	X
Feedback potentiometer 1kΩ						X				
Auxiliary switches (two)		X		X		X			X	X
Powerpack (two actuators)	X	X	X	X	X	X	X	X	X	X

Accessories, spare parts

For functional enhancements of the actuators, the following accessories are available:

External Auxiliary Switch (1 Switch)	**ASC77.1**
External Auxiliary Switch (2 Switches)	**ASC77.2**
Rotary/linear set for duct mounting	**ASK71.1**
Rotary/linear set for frame mounting	**ASK71.2**
Rotary/linear set with lever	**ASK71.3**
Rotary/linear set with lever and mounting plate	**ASK71.4**
Universal lever	**ASK71.9**
Bracket for powerpack	**ASK73.1**
Self-aligning bracket for powerpack	**ASK73.2**
Special shaft adapter	**ASK74.1**
Weather shield for rotary actuator	**ASK75.1**
Data sheet for accessories and spare parts	**N4699**

2.3 Description of functions

2.3.1 Description of functions for GCA...1

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

Type	GCA12..1 / GCA32..1	GMA13..1	GCA16..1
Mode of control	Two-position	Three-position	Modulating
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, direction of rotation	Clockwise or counter-clockwise movement depends on the mounting position of the damper shaft.		
	When operating voltage is supplied, the actuator travels from 0° ⇒ 90°.	When operating voltage is supplied and depending on the control, the actuator travels • from 0°⇒ 90° (open) • from 90°⇒ 0° (close) When control is interrupted, the actuator remains in the respective position.	• When operating voltage and a positioning signal are supplied, the actuator travels to the requested position. • After interrupting the positioning signal, the actuator travels to position Y = DC 0 V.
Spring return	On power failure or when the operating voltage is switched off, the spring return moves the actuator to its mechanical zero position.		
Position indication: Mechanically	Angular position given by the position indicator.		
Position indication: Electrically		Connecting the feedback potentiometer to an external voltage source results in voltage supply proportional to angular rotation.	• Position indicator: Output voltage U = DC 0...10 V is generated proportional to the angular rotation.
Auxiliary switches	The switching points for auxiliary switches A and B can be set independent of each other in increments of 5° within 5° to 90°.		
Powerpack (two actuators, tandem-mounted)	Mounting two of the same actuator types on the same damper shaft results in a double torque (with accessories ASK73.1).		Mounting two of the same actuator types on the same damper shaft results in a double torque (with accessories ASK73.2).
Response on damper blocking	The actuator is equipped with an automatic switch-off mechanism.		
Manual adjustment	• When no voltage is applied, you can turn the actuator to any rotary angle position (using a hex wrench) and lock by using a screwdriver, or the adjustment tool. • The actuator returns to the zero position on mechanical unlocking by means of a hex wrench (turn in "90°" – open" direction) or by shortly supplying operating voltage.		
Limitation of angular rotation	The angular rotation range can be limited mechanically by inserting the shaft adapter in 5° increments.		

2.3.2 Function description supplement for GCA16..1

The following information applies to modulating actuators.

Characteristic function
(GCA163.1, GCA164.1

Offset Uo and span ΔU can be adjusted using two potentiometers (see section 3.4 "Adjustable characteristic function"). The maximum permissible input voltage (Uo + ΔU) is DC 35 V.

Application

Actuators featuring this function can be used for the following applications:

- 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.
- 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.

2.4 Controllers

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

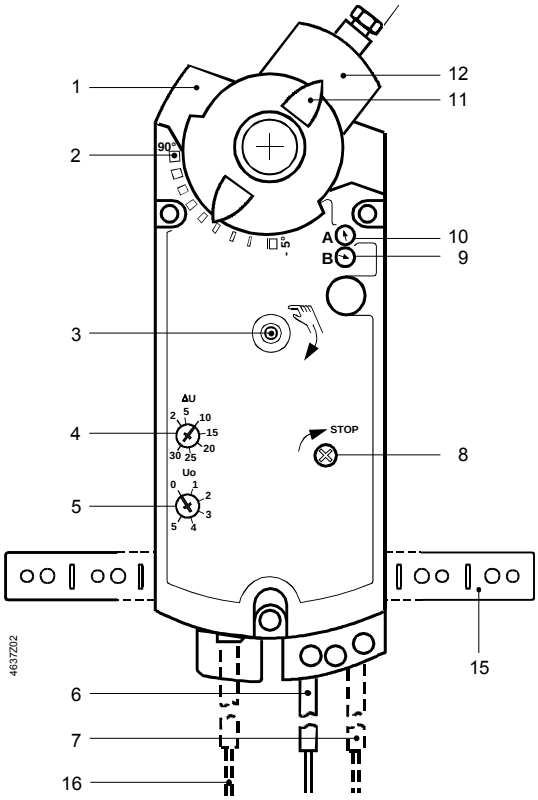
Actuator type	Mode of control	Controller output
GCA12..1	Two-position	AC 24 V or DC 24…48 V
GCA32..1	Two-position	AC 230 V
GCA13..1	Three-position	AC 24 V or DC 24…48 V
GCA16..1	Modulating	DC 0...10 V / DC 0...35 V

2.5 Mechanical design

Brief description	The electromotoric GCA...1 actuators are available for two-position, three-position, and modulating control with spring return. The nominal torque is 18 Nm. The actuator's connecting cables are prewired.
Housing	Robust, light-weight full metal housing made of die-cast aluminum. 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.
Spring preload	The spring preload of 5° ensures safe closure of the air dampers following correct mounting.
Manual adjustment	You can manually adjust the actuator using a hex wrench and lock it using a screwdriver.
Self-centering shaft adapter	This mounting type allows for securing 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 air duct side. The shaft adapter coupling and the adapter holding are coupled by means of double-sided gearing.
Mounting bracket	A bolted perforated metal strip is used for attaching the actuator.
Electrical connection	All actuators have prewired, 0.9 m long (standard length) connecting cables.
Type-specific elements	The actuators can be delivered as a type-specific variant having the following elements:
Auxiliary switches	For auxiliary functions, the auxiliary switches A and B can be adjusted on either side.
Potentiometer for offset and span	Both potentiometers for the operating functions Uo and ∆U are accessible on either side.
Feedback potentiometer for position indication	The potentiometer is integrated and can be connected by means of a cable.

2.6 Setting and operating elements

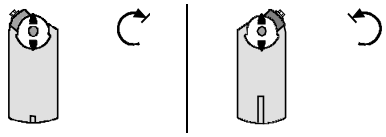
Actuator



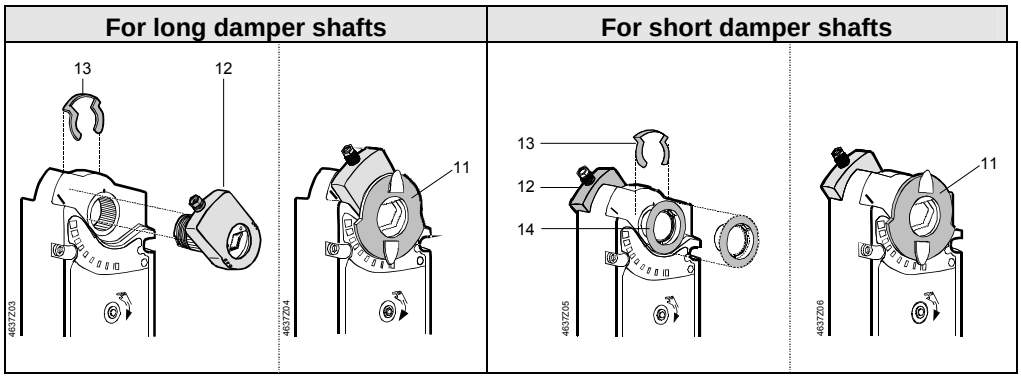
Legend

1 Housing
2 Rotary angle scale
3 Hex wrench hole for manual adjustment
4 Potentiometer to adjust the span ΔU
5 Potentiometer to set the offset Uo
6 Connecting cable for power supply and positioning signal
7 Connecting cable for auxiliary switches
8 Locking shaft for gear train
9 Setting shaft for auxiliary switch B
10 Setting shaft for auxiliary switch A
11 Position indicator
12 Self-centering shaft adapter
13 Locking ring for shaft adapter
14 Adapter for position indicator
15 Mounting bracket
16 Connecting cable for feedback potentiometer

Rotary direction, dependent on mounting position



Arrangement of shaft adapter



3 Technical design

Introduction

This chapter discusses the following topics:

- Drive motor and spring return
- Adjustable auxiliary switches
- Adjustable characteristic function (setpoint signal, DC 0...35 V)
- Control characteristics by including the neutral zone

3.1 Drive motor and spring return

Drive motor

The brushless DC motor allows for accurate speed control, torque supervision to protect the actuator and dampers, and provides a reliable spring return function.

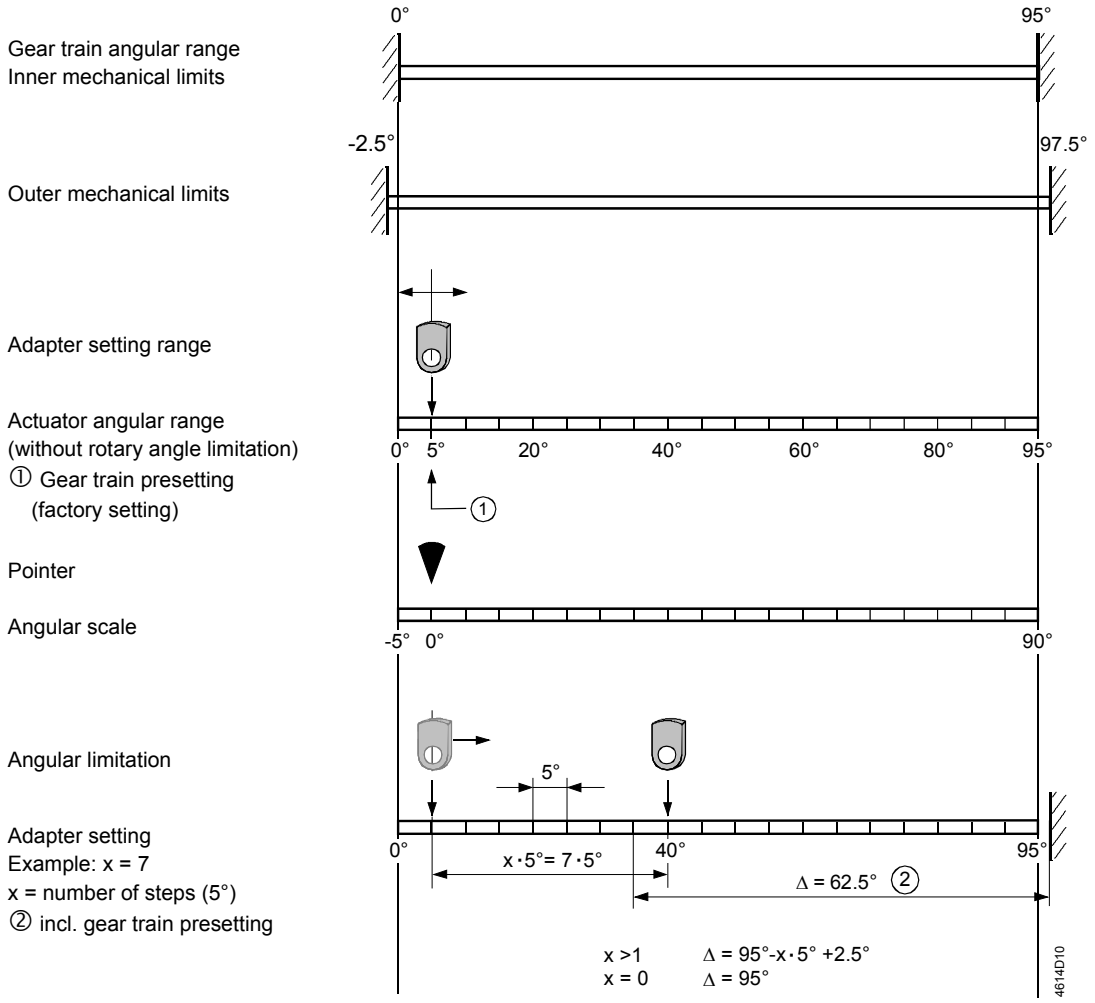
Spring return

The spring return force is stored in a spring which returns the actuator to the zero position in the case of power failure.

3.2 Angular range and mechanical limitation

Mechanical functions

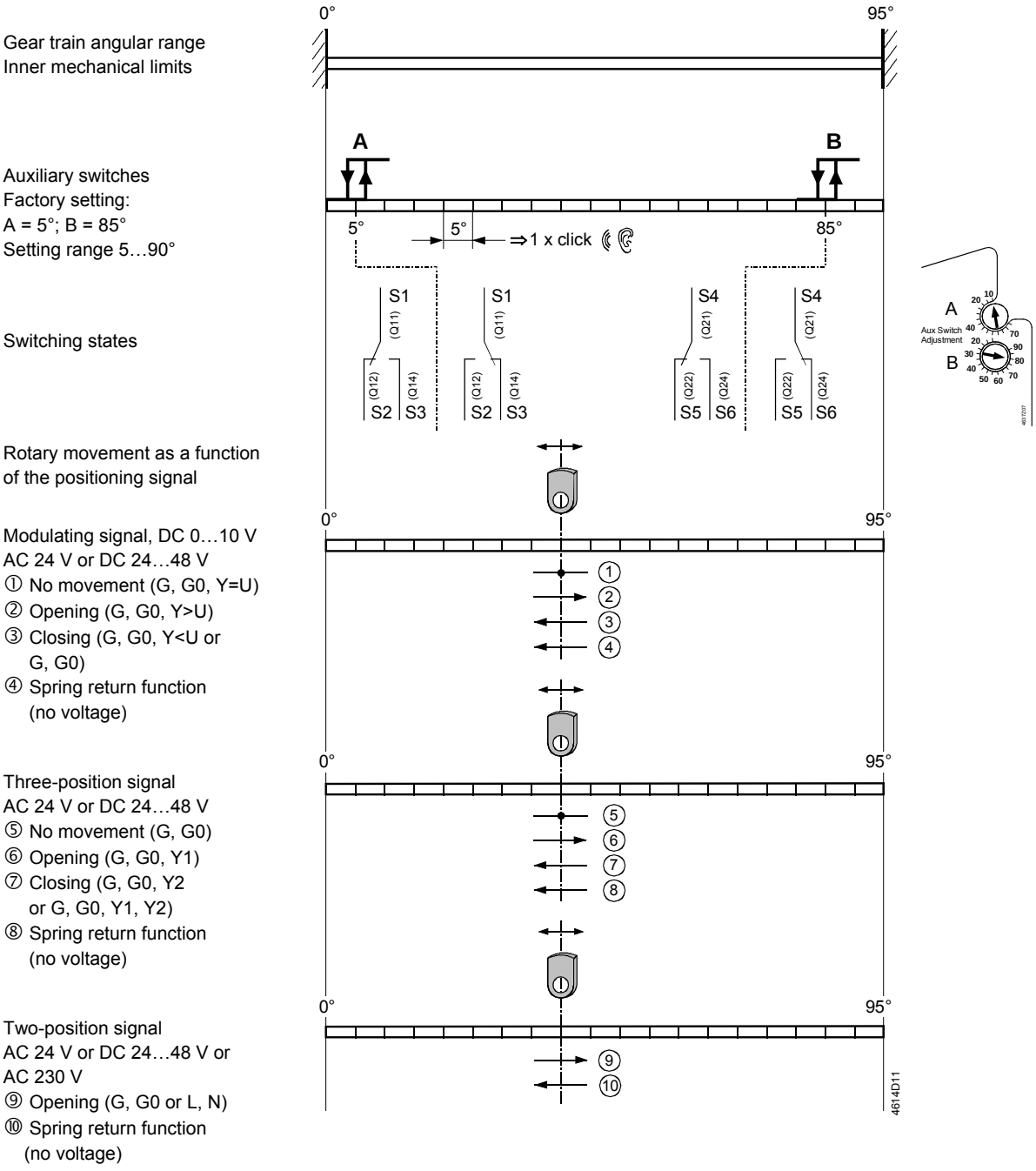
The illustration below shows the relationship between the inner and outer mechanical limitation of the angular range.



3.3 Auxiliary switches and positioning signals

Electrical functions

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



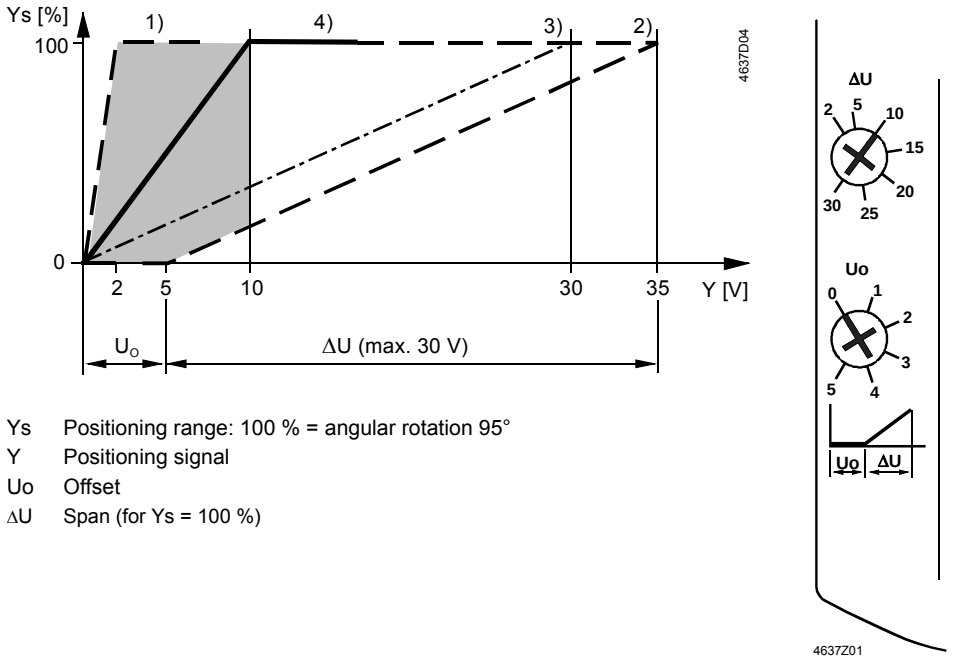
Note

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

3.4 Adjustable characteristic function

Actuators
GCA163.1, GCA164.1

A modulating positioning signal DC 0..35 V from a controller drives the actuator. The angular rotation 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: 100 % = angular rotation 95°
Y Positioning signal
Uo Offset
ΔU Span (for Ys = 100 %)

Examples as per the diagram

Example	Positioning signal Y	Positioning range Ys	Settings Uo	Settings ΔU
1)	DC 0...2 V	0...100 %	DC 0 V	DC 2 V
2)	DC 5...10 V DC 5...35 V	0...17 % 0...100 %	DC 5 V	DC 30 V
3)	DC 0...10 V DC 0...30 V	0...33 % 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 angular rotation is 90°. Self-adaption is inactive.

Formula

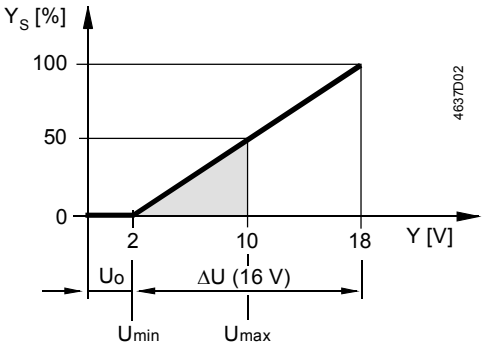
Calculating the setting value for ΔU:

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

Potentiometer settings

Uo = 2 V, ΔU = 16 V

Characteristic for the above example



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

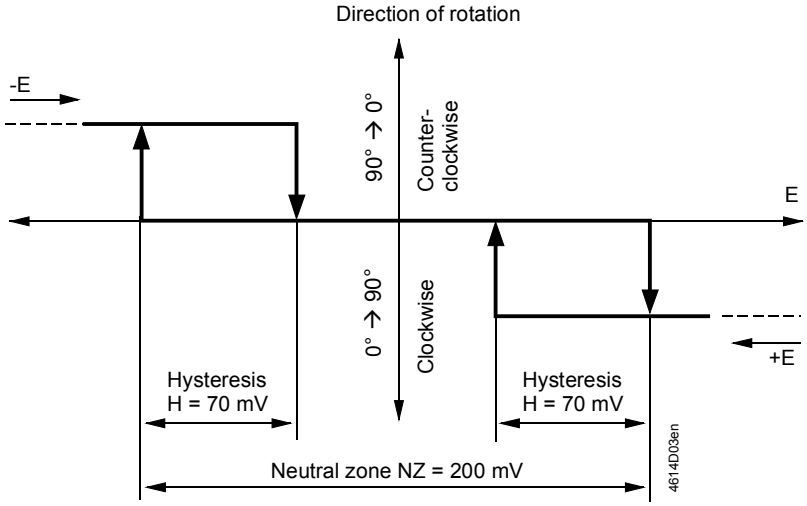
Effective span
ΔUw = Umax – Umin
= 10 V - 2 V = 8 V

3.5 Neutral zone

For modulating actuators, note the control characteristic for the selected switch-on point of the setpoint.

Actuators
GCA161.1, GCA166.1
(DC 0...10 V)

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**) and if the direction of rotation is set to **"clockwise"**.



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

Actuators
GCA163.1, GCA164.1
(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".

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-voltage 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 business
- Third-party regulations from, e.g., the general contractors or building contractors

Safety

Electrical safety in Siemens building management 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 = **S**afety **E**xtra-**L**ow **V**oltage **SELV**
Grounded = **P**rotective **E**xtra-**L**ow **V**oltage **PELV**

⚠ Earthing of G0 (system neutral)

Observe the following for grounding G0:

- As a rule, earthing as well as nonearthing of G0 is permissible for AC 24 V or DC 24…48 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

- **Earth all AC 24 V or DC 24…48 V systems** unless otherwise specified by the respective manufacturers.
- 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
DC 24…48 V
, AC 230 V

The following regulations apply to these operating voltages:

	Regulation
Operating voltage AC 24 V DC 24…48 V	The operating voltage must comply with the requirements for SELV or PELV: • Permissible deviation of AC 24 V / DC 24…48 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 isolating transformers as per EN 61 558, with double insulation, designed for 100 % duty 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 %).
Specification for DC 24…48 V supply	• Determine the supply by adding up the power consumption in W for all actuators used.
Fuse of AC 24 V DC 24…48 V operating voltage	Transformers, secondary side or DC supply: • According to the effective load of all connected devices • Line G (system potential) must always be fused • Where required, line G0 also (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 / DC 24…48 V extra-low voltage as per **SELV** or **PELV**
- Double insulation between AC 230 V mains voltage and SELV/PELV circuits

Mechanical parallel connection of actuators

- Mount max. two actuators on the same damper shaft.
  Use the mounting bracket to secure the second actuator also
  (see accessories in section 2.2).

⚠ 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. Operation using various phases is not permissible.

⚠ Feedback potentiometer for position indication

Consider the potentiometer's electric data to indicate the damper position via the external circuit.

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 actuator 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 cables
- Cables susceptible to interference: Control cables, extra-low voltage cables, interface cables, LAN cables, digital and analogue signal cables

Cable segregation

- Both cable types can be routed 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

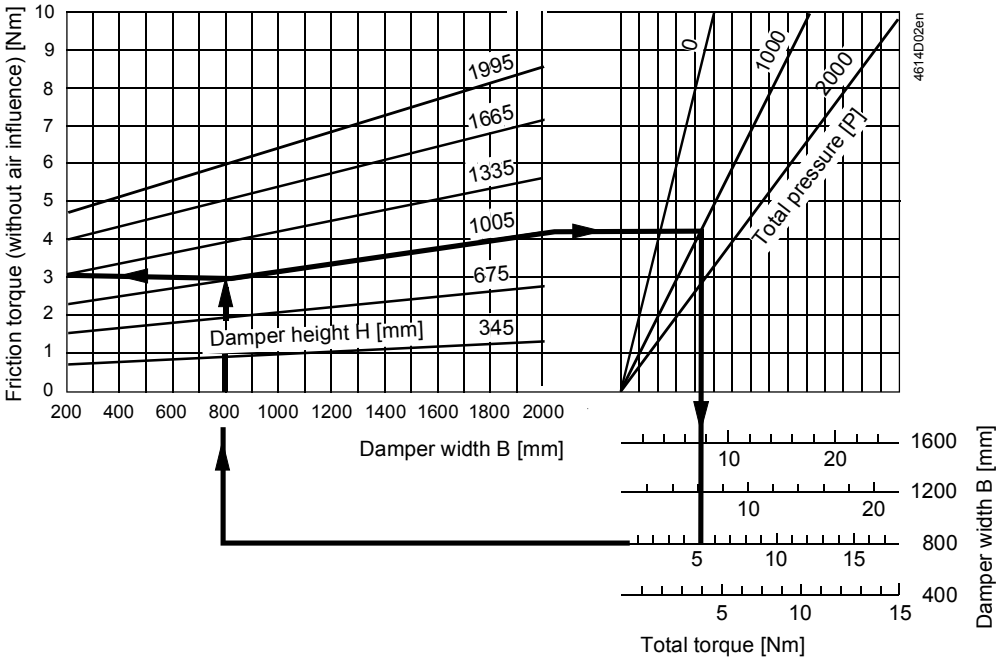
After obtaining the damper torque rating [Nm/m^2] from the manufacturer and determining the damper area, calculate the total torque required to move the damper as follows:

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 charts.

Sizing chart

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



Example

Damper for blinds:

Width	= 800 mm
Height	= 1005 mm
Total pressure	= 1000 Pa

The total torque of about **5 Nm** results from the diagram.

Determining the actuator type

Determine your type of actuator from the table below:

If $\frac{\text{Total torque [Nm]}}{SF^{1}}$	**Then use type** (with spring return)
≤ 7 Nm	GMA...1 (7Nm)
≤ 14 Nm	2 x GMA...1 (2 x 7 Nm) [2] or
≤ 18 Nm	GCA...1 (18 Nm) [3]
≤ 36 Nm	2 x GCA...1 (2 x 18 Nm) [4]

Notes

[1] Safety Factor SF:
When calculating the number of actuators, remember to include nondefinable 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 7 Nm, the following can be used:

[2] Two actuators (tandem-mounted "powerpack") of type series GMA12..1, GMA32..1, GMA13..1

[3] one actuator of type series GCA...1.

[4] If the actuator torque is greater than 18 Nm, two actuators of type series GCA...1 can mechanically be connected and mounted on the damper shaft.
(refer to chapter 5 “Mounting notes“, powerpack mounting)

5 Mounting notes

Mounting instructions	All information and steps to properly prepare and mount the actuator are available in the mounting instructions 4 319 2615 0 (M4613) delivered with the actuator. The shaft adapter as well as all other individual parts are not premounted, as the actuator components are put together differently depending on either clockwise or counter-clockwise rotation of the damper shaft and damper shaft length. Refer to section 2.5 "Mechanical design".
Mounting position	Choose the actuator's mounting position so that you can easily access the cables as well as the setting elements on the front of the actuator. Refer to section 11.1 "Dimensions".
Mounting position in dependence of rotary direction	For mounting, turn the actuator by 180° depending on the necessary rotary direction. All setting and operating elements are available on both sides of the actuator, depending on clockwise or counter-clockwise rotation.
Device protection	To satisfy the IP54 protection class requirements, the following conditions must be fulfilled: • 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 shield ASK75.1 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.
Spring preload	The actuator comes with a factory-set spring preload of 5° which ensures a tight close-off for the air dampers.
Manual adjustment	Manual adjustment of the shaft adapter via hex wrench and gear train locking as per the mounting instructions. To ensure a tight close-off function for the dampers and the exact switching position for switches A and B, the actuator can only be adjusted with a **mounted shaft adapter and position indicator** in accordance with the mounting instructions.
Mechanical limitation of angular rotation	If necessary, you can limit the angular rotation 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 (section 2.2 "Type summary") as per the separate mounting instructions.
Tandem (powerpack) mounting	When mounting two actuators on the same damper shaft (for GCA12..1, 32..1, 13..1), use the ASK73.1 bracket. When mounting two actuators type GCA16..1 on the same damper shaft, use the self-aligning bracket ASK73.2.

6 Wiring notes

Introduction

Prior to wiring, study all information in the following sections:

- "Safety notes" in section 4.1
- "Device-specific regulations" in section 4.2
- "Notes on EMC optimization" in section 4.3
- "Connection Diagrams" in chapter 9, and the
- HVAC plant diagram.
- This chapter is written for AC/DC 24 V and AC 230 V
  (Information for AC 24…48 V on inquiry)

6.1 Permissible line lengths 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 controller. Determine the necessary line length from the following diagram and the formulas.

Note

To determine the line length and cross-sectional area, 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
GCA12..1 GCA13..1	AC/DC 24 V	G0, G Y1, Y2	4 % each (tot. 8 %) of AC/DC 24 V
GCA16..1	AC 24 V	G0, G	4 % each (tot. 8 %) of AC 24 V
	DC 24 V	G0	1 % of DC 10 V
GCA32..1	AC 230 V	L, N	2 % each (tot. 4 %) of AC 230 V

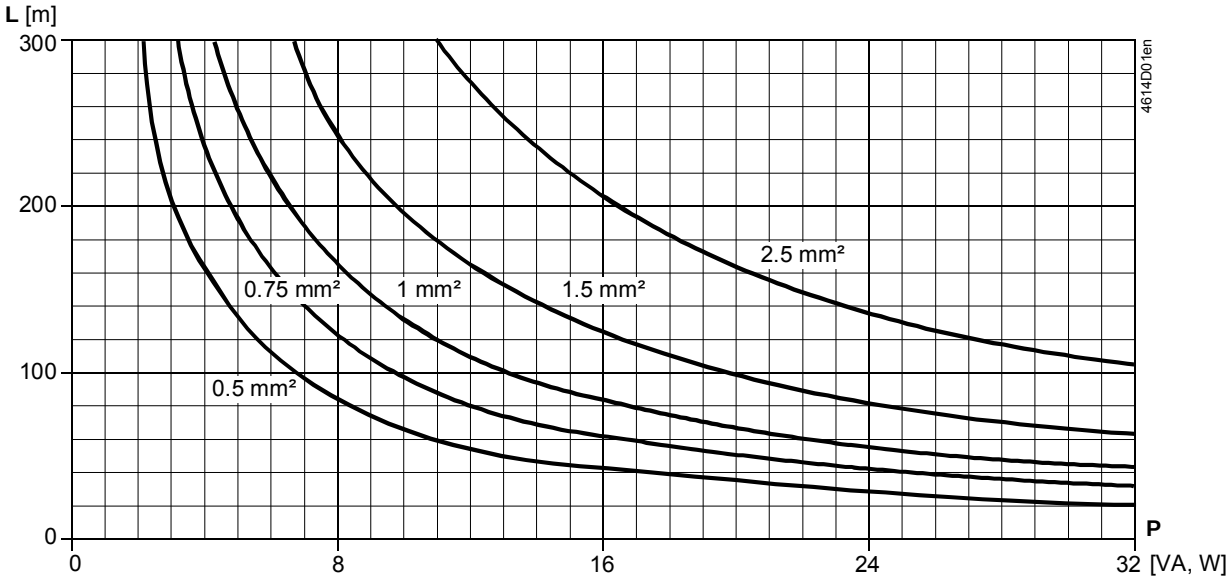
Notes on the G0 line (GCA16..1)

Consider the following criteria:

- For modulating control and DC 24 V operating voltage:
  The permissible positioning signal error caused by a voltage drop in the line current (direct voltage mean value) 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 % across G0 line).

Line length/consumption AC/DC 24 V

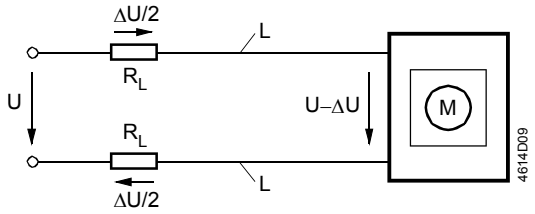
The diagram applies to AC/DC 24 V and shows the permissible line length **L** as a function of consumption **P** and as a parameter of the line cross-sectional area.



Notes on diagram

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

Diagram: Voltage drop on the supply lines



Formula for line length

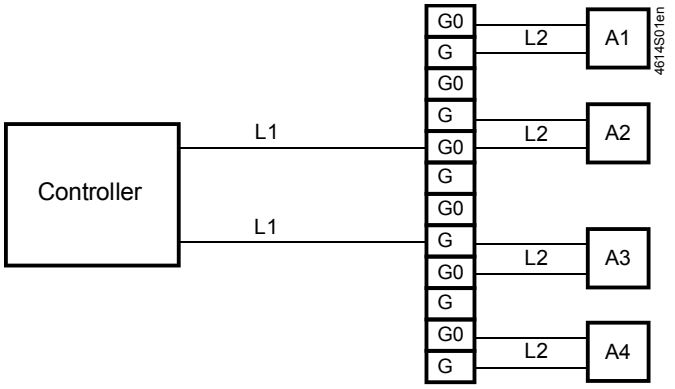
The maximum line length can be calculated using the following formula.

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

A Cross-sectional area 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 field.
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-sectional areas 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 (two-position)

Actuators with two-position control
GCA12..1 and GCA32..1

Type	Operating voltage	Power consumption	Perm. voltage drop for line 1 (G) and 2 (G0)
GCA12..1	AC 24 V DC 24 V	7 VA 4 W	ΔU/U = max. 8 % (4 % each per line)
GCA32..1	AC 230 V	8 VA	ΔU/U = max. 4 % (2 % each per line)

Use the table or the formulas in section 6.1 to determine the permissible line lengths and cross-sectional areas.

6.3 Actuator wiring (three-position)

Actuators with three-position control
GCA13..1

Three-position actuators are supplied AC/DC 24 V via the supply lines 1 (G) and 2 (G0). The positioning signal current of about 8 mA is supplied via lines 6 and 7.

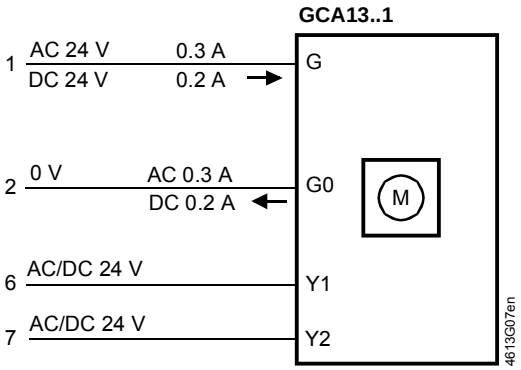
Power consumption and perm. voltage drop with one actuator

The table shows the power consumption used to size the actuator lines as well as the permissible voltage drop.

Operating voltage	Power consumption	Perm. voltage drop for line 1 (G), 2 (G0), 6 (Y1), 7 (Y2)
AC 24 V DC 24 V	7 VA 4 W	ΔU/U = max. 8 % (4 % each per line)

P&I diagram:
Conduction currents

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 GCA13..1 and AC 24 V supply.
Only the currents in line 1 (G) and 2 (G0) determine the line sizing.

Max. permissible voltage drop = **4 % per line** (total 8 %).

AC 24 V: Line 1 (G), 2 (G0)	**DC 24 V: Line 1 (G), 2 (G0)**
• Consumption = 2 x 7 VA = 14 VA • Line current = 2 x 0.3 A = 0.6 A • Max. permissible single line length: 141 m at 1.5 mm^2 line cross-section	• Consumption = 2 x 4 W = 8 W • Line current = 2 x 0.2 A = 0.4 A • Max. permissible single line length: 246 m at 1.5 mm^2 line cross-section

6.4 Actuator wiring (modulating)

Modulating actuators
GCA16..1

Differentiate between AC 24 V and DC 24 V to determine the permissible line lengths between the positioning module and the actuator. The section below discusses the effect of G0 line sizing.

6.4.1 AC 24 V supply

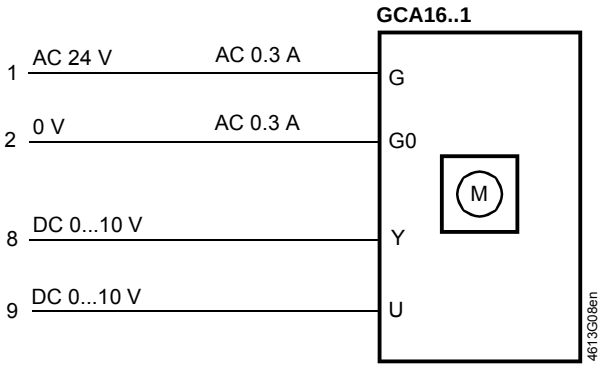
Power consumption and perm. voltage drop with one actuator

With AC supply, the G0 line has a AC 0.3 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.

Operating voltage	**Power consumption**	**Perm. voltage drop for line 1 (G), 2 (G0)**
AC 24 V	7 VA	4 % of AC 24 V

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 four actuators

Determining the line lengths for four actuators GCA16..1 at **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 7 VA = 28 VA
- Line current: 4 x 0.3 A = 1.2 A
- Permissible single line length for G, G0:
  70 m at 1.5 mm^2 cross-sectional area, or
  117 m at 2.5 mm^2 cross-sectional area

6.4.2 DC 24 V supply

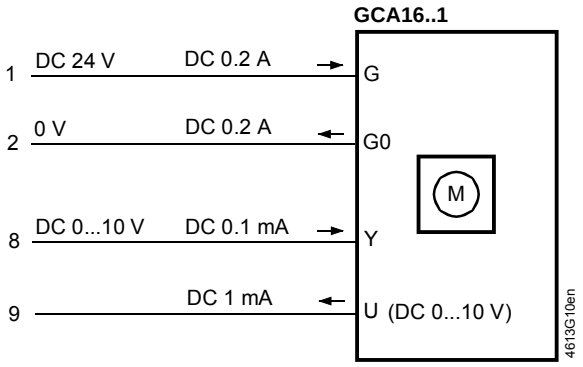
Power consumption and perm. voltage drop with one actuator

With DC supply, the G0 line has a DC 0.2 A supply current and a DC 0.1 mA positioning signal current (from Y = DC 0...10 V). The entire DC voltage drop on the G0 line directly impacts positioning signal Y.
Max. permissible voltage drop on **G0 line = 1 %.**

	Power consumption	**Perm. voltage drop for line**			
		1 (G)	**2 (G0)**	**8 (Y)**	**9 (U)**
Operating voltage: DC 24 V	4 W	4 % of DC 24 V	1 % of DC 24 V		
Positioning signal: Y = DC 0...10 V	0.001 W			1 % of DC 10 V	
Position indicator: U = DC 0...10 V	0.01 W				1 % of DC 10 V

P&I diagram:
Conduction currents at DC 24 V

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 GCA16..1 at **DC 24 V** supply. Only the DC currents in line 1 (G) and 2 (G0) determine the line sizing.

Line 2 (G0): (max. voltage drop **1 %**)	**Line 1 (G):** (max. voltage drop **4 %**)
• Consumption: 4 x 4 W = 16 W • Line current: 4 x 0.2 A = 0.8 A • Permissible single line length: 10 m at 1.5 mm^2 line cross section or 17 m at 2.5 mm^2 line cross section.	• Consumption: 4 x 4 W = 16 W • Line current: 4 x 0.2 A = 0.8 A • Permissible single line length: 123 m at 1.5 mm^2 line cross section or 205 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" Z4613en)
- Mounting instructions 4 319 2615 0 (M4613)
- 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 fully closed position.
- Fasten the actuator securely to avoid side load.
- Check the rotary movement: Manually set the damper by turning the adapter using a hex wrench, and lock the gear train as per the mounting instructions (only if no voltage is applied).
- Check the unlocking mechanism of the gear train by turning the hex wrench in the direction of 90°.

Electrical check

- Check to ensure that the cables are connected in accordance with the plant wiring diagram.
- The operating voltage AC 24 V / DC 24…48 V (SELV/PELV) or AC 230 V must be within the tolerance values.

7.2 Electrical functional check

Rotary movement: Two-position control
GCA12..1, GCA32..1

- When operating voltage is supplied, the actuator must travel from 0° to 90° (or to end position for rotary angle limitation).
- After interrupting the operating voltage, the actuator must return to the zero position.

Rotary movement: Three-position control
GCA13..1

Check the actuator operating states as follows (see also section 9.3 "Connection diagrams (two-pos./three-pos.)").

Wire connections		Direction of rotation
AC 24 V	**DC 24…48 V**	
1 – 6 (SN) / 2 – 6 (SP)	2 – 6 (SP)	from 0° ⇒ 90°
1 – 7 (SN) / 2 – 7 (SP)	2 – 7 (SP)	from 90° ⇒ 0°
1 – 6 / 1 – 7 or 2 – 6 / 2 – 7 open	2 – 6 / 2 – 7 open	Actuator stays in position reached
After interrupting the operating voltage, the actuator must return to the zero position.		

Note

Check the actuator operating states as per the truth table in section 9.3.

Rotary movement: Modulating control
GCA16..1

- When applying a DC 10 V input signal, the actuator must turn from 0° ⇒ 90° / 90° ⇒ 0° (or to the end position of the rotary angle limitation).
- After interrupting the operating voltage, the actuator must return to the mechanical zero position (spring return function).
- After interrupting positioning signal Y, but while operating voltage is still supplied, the actuator returns to the zero position.
- When the actuator moves from 0...90°, output voltage U = DC 0...10 V is generated as a position indication.

Characteristic function
GCA163.1, GCA164.1

Factory setting: The potentiometers for setting the offset Uo and span ∆U are set to the following values: Uo = 0 V, ∆U = 10 V.

Note

Specify the values set for Uo and ∆U in the plant papers.

Position indicator
GCA16..1

Check of output voltage U:

- U = DC 0...10 V for **angular rotation 90°**.

Feedback potentiometer
GCA132.1

Measures resistance changes while the actuator turns.

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 section 3.2, "Angular range and mechanical limitation").

Important

The angle values are valid only for the **zero position** of the actuator and when no current is applied.

Factory setting

The auxiliary switches have the following settings:

- Switch A: Switchover point at 5°
- Switch B: Switchover point at 85°

8 Technical data

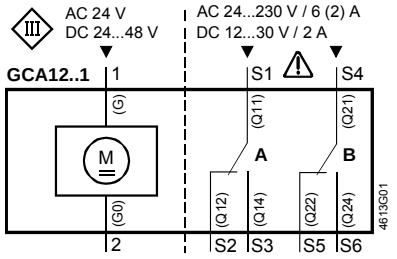
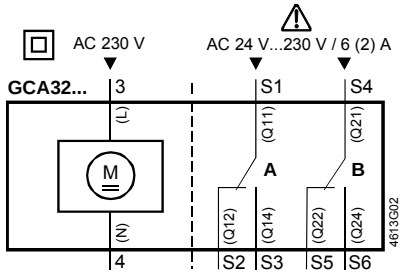
⚠ Supply, AC 24 V / DC 24…48 V (SELV/PELV) for GCA12..1, GCA13..1, GCA16..1	Operating voltage AC		AC 24 V ±20 %
	Frequency		50/60 Hz
	Operating voltage DC		DC 24…48 V ±20 %
	Safety extra-low voltage (SELV) or		
	Protective extra-low voltage (PELV) as per		HD 384
	Requirements for external safety isolating transformer (100% duty)		as per EN 61 558
	Supply line fuse		max. 10 A
	Power consumption:	Running	AC: 7 VA / 5 W
		Running	DC: 4 W
		Holding	AC: 5 VA / 3 W
		Holding	DC: 3 W
⚠ AC 230 V supply for GCA32..1	Operating voltage		AC 230 V ± 10 %
	Frequency		50/60 Hz
	Supply line fuse		max. 10 A
	Power consumption:	Running	8 VA / 6 W
		Holding	6 VA / 4 W
Functional data	Nominal torque		18 Nm
	Maximum torque (blocked)		50 Nm
	Min. resetting torque (on power failure)		18 Nm
	Min. holding torque		18 Nm
	Nominal rotary angle (with position indication)		90 °
	Maximum angular rotation angle (mechanically limited)		95° ± 2°
	Runtime for rotary angle 90° (motor operation)		90 s
	Closing time with return spring (on power failure)		15 s
	Direction of rotation defined by:		
	Mounting type (GCA...1)		clockwise/counter-clockwise
	Mechanical life		10^5 cycles
⚠ Inputs			
Positioning signal for GCA12..1	Operating voltage AC 24 V / DC 24…48 V (wires 1-2)		open (0° ⇒ 90°)
Positioning signal for GCA32..1	Operating voltage AC 230 V (wires 3-4)		open (0° ⇒ 90°)
Positioning signal for GCA13..1	Operating voltage AC 24 V / DC24…48 V (wires 1-2)		
	Open: Switching current (wires: AC 1-6)		> AC/DC 8 mA
	Close: Switching current (wires: AC 1-7)		> AC/DC 8 mA
Positioning signal for GCA16..1	Input voltage Y (wires 8-2)		DC 0...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 / DC 24…48 V
	Neutral zone	for nonadjustable characteristic function	200 mV
		for adjustable characteristic function	2 % of ΔU
	Hysteresis	for nonadjustable characteristic function	70 mV
		for adjustable characteristic function	0.7 % of ΔU
Adjustable characteristic function for GCA163.1, GCA164.1	Adjustable with 2 potentiometers		
	Offset Uo		DC 0...5 V
	Span ΔU		DC 2...30 V
	Max. permissible input voltage		DC 35 V
	Protected against faulty wiring		max. AC 24 V / DC 24…48 V
⚠ Outputs			
Position indicator for GCA16..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 / DC 24…48 V
Feedback potentiometer for GCA135.1	Change of resistance (wires P1-P2)		0...1000 Ω
	Load		< 1 W
	Max. sliding contact current		< 10 mA
	Permissible voltage at potentiometer (SELV/PELV)		AC 24 V / DC 24…48 V
	Insulation resistance between potentiometer and housing		AC 500 V

⚠ Auxiliary switch for GCA..6.1, GCA164.1	AC power supply	
	Switching voltage	AC 24...230 V
	Nominal current res./ind.	6 A / 2 A
	Life: 6 A res., 2 A ind.	10^4 cycles
	without load	10^6 cycles
	DC power supply	
	Switching voltage	DC 12..30 V
	Nominal current	DC 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°
Connecting cables	Cross-sectional area of prewired connecting 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 / DC 24…48 V	III
	AC 230 V	II
	Feedback potentiometer	III
	Auxiliary switch	II
Environmental conditions	Operation	IEC 721-3-3
	Climatic conditions	class 3K5
	Mounting location	interior, weather-protected
	Temperature	–32....+55 °C
	Humidity (noncondensing)	< 95 % r.h.
	Transport	IEC 721-3-2
	Climatic conditions	class 2K2
	Temperature	–32...+70 °C
	Humidity (noncondensing)	< 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 (EMC)	
	Immunity for all models, except GCA135.1x	IEC/EN 61 000-6-2
	Immunity for GCA135.1x	IEC/EN 61 000-6-1
	Emissions for all models	IEC/EN 61 000-6-3
	CE conformity	
	Electromagnetic compatibility as per	89/336/EEC
	Low- voltage directive	73/23/EEC
	-conformity	
	Australian EMC Framework	Radio Communication Act 1992
	Radio Interference Emission Standard	AS/NZS 3548
Dimensions	Actuator W x H x D (see "Dimensions")	100 x 300 x 67.5 mm
	Damper shaft	
	Round	8...25.6 mm
	Square	6...18 mm
	Min. length	20 mm
	Max. shaft hardness	< 400 HV
Weight	Weight without packaging	
	GCA1..1	2.0 kg
	GCA32..1	2.1 kg

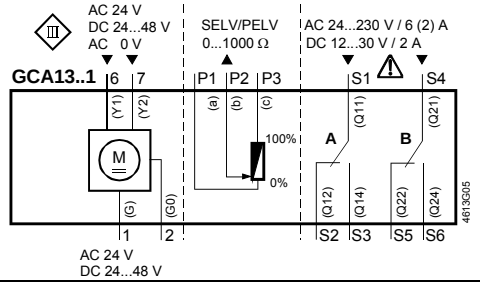
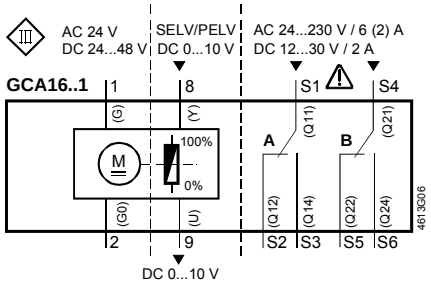
9 Diagrams

9.1 Internal diagrams

Two-position control

GCA12..1	GCA32..1
AC 24 V / DC 24…48 V	AC 230 V
	

Three-position control
Modulating control
Y = DC 0...10 V, 0...35 V

GCA13..1 Three-position control	GCA16..1 Modulating control
AC 24 V / DC 24…48 V	AC 24 V / DC 24…48 V
	

9.2 Cable labeling

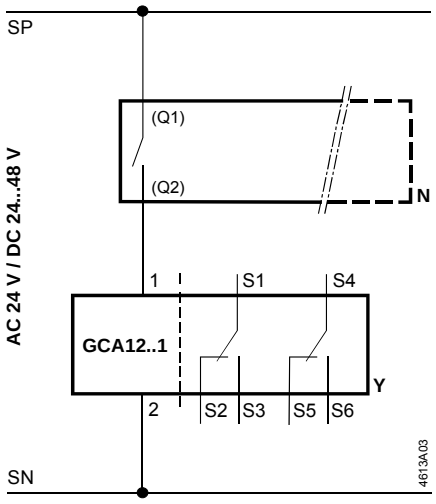
All wires are color-coded and labeled.

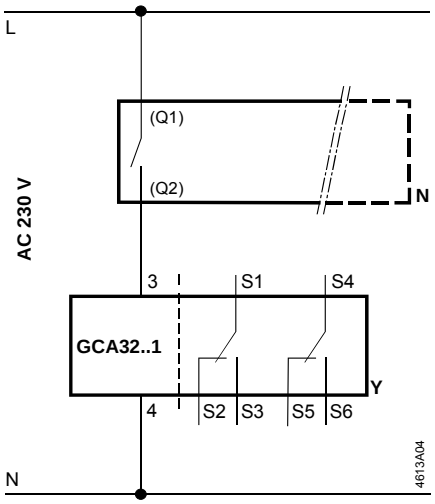
Pin	Cable				Meaning
	Code	No.	Color Abbreviation		
Actuators AC 24 V DC 24…48 V	G G0 Y1 Y2 Y U	1 2 6 7 8 9	red black purple orange grey pink	RD BK VT OG GY PK	System potential AC 24 V/DC 24…48 V System neutral Pos. signal AC 0 V/AC 24 V/DC 24…48 V "Open“ Pos. signal AC 0 V/AC 24 V/DC 24…48 V "Close“ Pos. signal DC 0...10 V, 0...35 V Position indication DC 0...10 V
Actuators AC 230 V	L N	3 4	brown blue	BN BU	Phase AC 230 V Neutral conductor
Auxiliary switch	Q11 Q12 Q14 Q21 Q22 Q24	S1 S2 S3 S4 S5 S6	grey/red grey/blue grey/pink black/red black/blue black/pink	GY RD GY BU GY PK BK RD BK BU BK PK	Switch A input Switch A normally-closed contact Switch A normally-open contact Switch B input Switch B normally-closed contact Switch B normally-open contact
Feedback potentiometer	a b c	P1 P2 P3	white/red white/blue white/pink	WH RD WH BU WH PK	Potentiometer 0...100 % (P1-P2) Potentiometer pick-off Potentiometer 100...0 % (P3-P2)

9.3 Connection diagrams (two-pos./three-pos.)

Two-position
GCA12..1, GCA32..1

GCA121.1, GCA126.1.	GCA321.1, GCA326.1
AC 24 V / DC 24…48 V (SELV/PELV)	AC 230 V



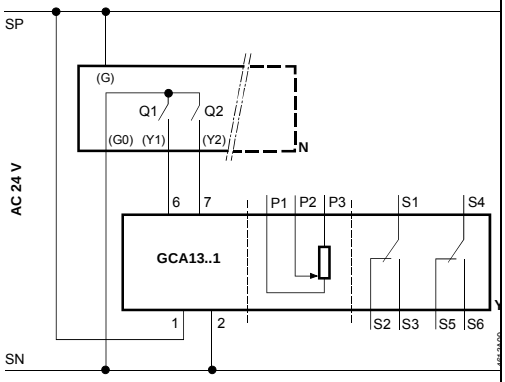


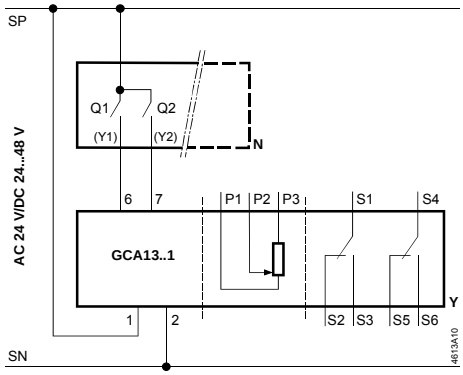
N	Controller
Y	Actuator GCA12..1
SP	System potential AC 24 V / DC 24…48 V
SN	System neutral

N	Controller
Y	Actuator GCA32..1
L	Live conductor AC 230 V
N	Neutral conductor

Three-position control
GCA13..1

GCA131.1, GCA135.1	
AC 24 V (SELV/PELV)	AC 24 V / DC 24…48 V (SELV/PELV)





N	Controller
Y	Actuator GCA13..1
SP	System potential AC 24 V
SN	System neutral
Q1, Q2	Switch contacts

N	Controller
Y	Actuator GCA13..1
SP	System potential AC 24 V / DC 24…48 V
SN	System neutral
Q1, Q2	Switch contacts

Operating states of GCA13..1

The table below shows the actuator's operating states for three-position control in dependence of mounting position and setting of switch contacts Q1 and Q2.

Controller contacts Q1	Q2	Operating state	Rotary direction	
		Remains in current position		
		Opens		
		Closes		
		Closes		
Mounting position of actuator GCA13..1				

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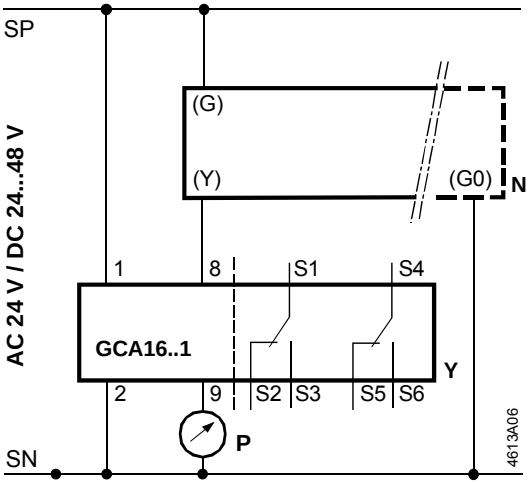
9.4 Connection diagrams (modulating)

9.4.1 Typical application

The controller output is connected directly to the actuator input.

GCA16..1



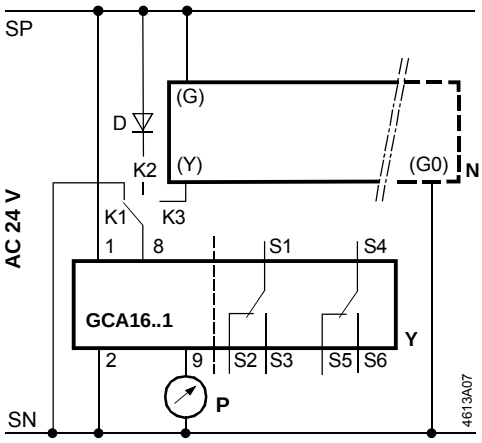
N	Controller
Y	Actuator GCA16..1
P	Position indication
SP	System potential AC 24 V / DC 24…48 V
SN	System neutral

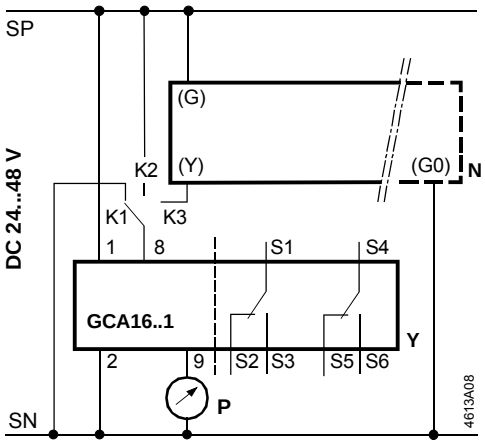
9.4.2 Special diagram for modulating control

The following diagram enables different operating states of the actuator depending on the position of the changeover switch with switch contacts K1, K2, K3 (see table of operating states below).

Modulating control, fully open, fully shut with GCA16..1

AC 24 V (SELV/PELV)	DC 24…48 V (SELV/PELV)





N	Controller	**N**	Controller
Y	Actuator GCA16..1	**Y**	Actuator GCA16..1
P	Position indication	**P**	Position indication
SP	System potential AC 24 V	SP	System potential DC 24…48 V
SN	System neutral	SN	System neutral
D	Diode (e.g. R4000)		
K1...K3	Switch contacts (10 V / 0.1 mA)	K1...K3	Switch contacts (10 V / 0.1 mA)

Operating states of GCA16..1

Switch contacts	Operating state	Direction of rotary	
K3	Control operation		
K2	Fully open *)		
K1	Fully closed		
Mounting position for actuators GCA16..1			

4613T02en

Note
GCA163.1, GCA164.1

*) Actuators with adjustable characteristic function: Full opening cannot be reached (depending on Uo, ΔU) in this position (switch contact K2).

10 Environmental compatibility and disposal

General notes

These actuators were 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, die-cast aluminum and die-cast zinc
  Do not dispose of as household garbage. This applies particularly to the circuit board.
- As a rule, dispose of all waste in an environmentally compatible manner and in accordance with environmental, recycling, and disposal techniques. **Ad-here 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.

Product-specific note

Spring return actuators contain pretensioned springs. Only trained personnel may open (by means of special tools) and dispose of such actuators.

Environmental declaration

The environmental declarations for these actuators contain detailed information on the materials and volumes used. Request a declaration at your local Siemens sales office.

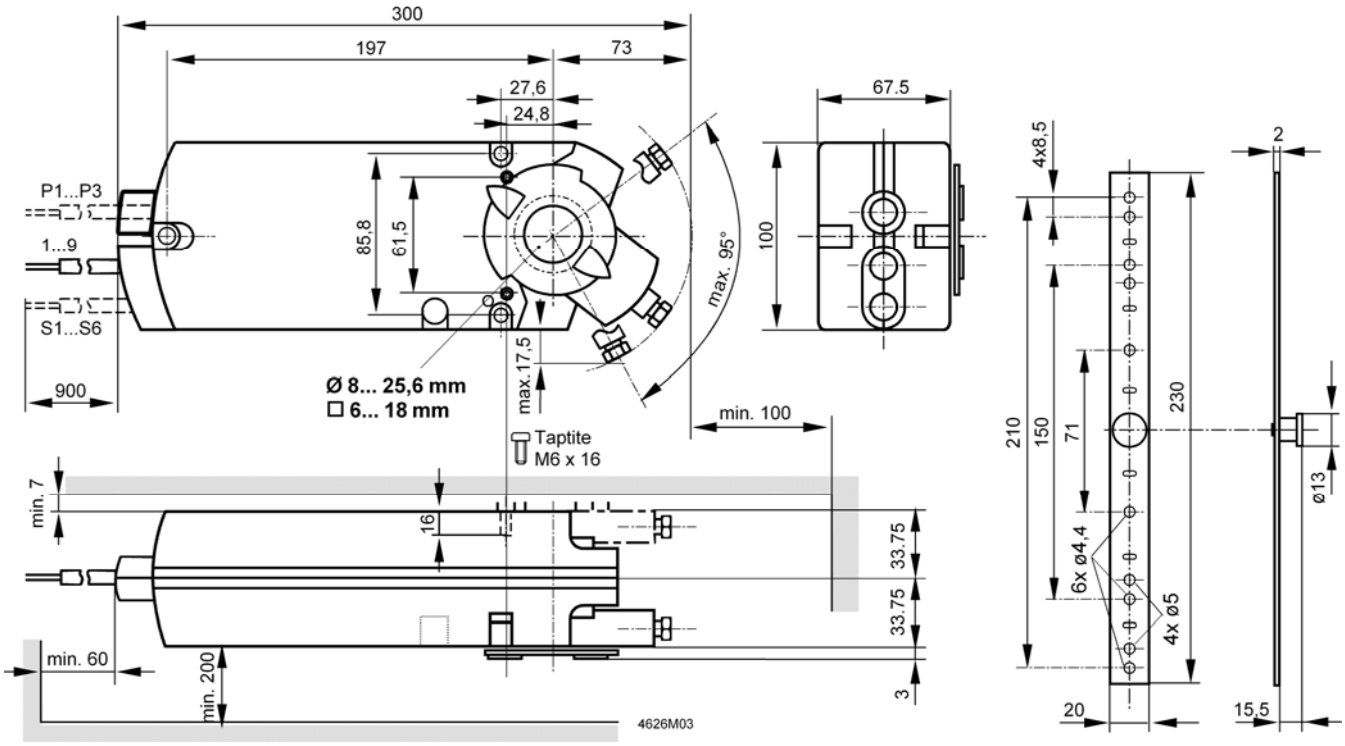
11 Appendix

Chapter contents

This chapter contains:

- Actuator dimensions
- Referenced documents

11.1 Dimensions



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
- 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

Document number (classification no.)	Title/description	Contents
Type series GCA...1		
N4613en (N4613)	Actuators for air dampers, rotary version with spring return (GCA...1: Two-pos., three-pos., modulating).	Type overview, function and selection criteria
74 319 2615 0 (M4613)	Mounting instructions on GCA...1.	Instructions on mounting a rotary actuator with spring return
Type series GCA...1		
N4699en (N4699)	Accessories and spare parts	Overview, allocation to actuator type and application
N4615en (N4615)	External Auxiliary Switches ASC77…	Detailed specifications
74 319 0413 0 (M4615)	External Auxiliary Switches ASC77…	Mounting instructions
4 319 2659 0 (M4626.1)	Rotary/linear set for duct mounting ASK71.1	
4 319 2708 0 (M4626.2)	Rotary/linear set for wall mounting ASK71.2	
4 319 2725 0 (M4626.3)	Rotary/linear set with lever ASK71.3	
4 319 2846 0 (M4626.4)	Rotary/linear set with lever and mounting bracket ASK71.4	
4 319 0236 0 (M4614.1)	Universal lever ASK71.9	
4 319 2849 0 (M4613.1)	Bracket for powerpack ASK73.1	
4 319 2950 0 (M4613.2)	Self-aligning bracket for powerpack ASK73.2	
4 718 1406 0	Special shaft adapter ASK74.1	
74 319 2946 0 (M4626.11)	Weather shield ASK75.1	

Standards and directives

HD 384	Electrical installations in buildings
EN 61 558	Safety of transformers, mains-powered units and similar equipment
IEC/EN 61 000-6-1	Electromagnetic compatibility: Immunity for GCA135.1x
IEC/EN 61 000-6-2	Electromagnetic compatibility: Immunity for all models, except GCA135.1x
IEC/EN 61 000-6-3	Electromagnetic compatibility: Emissions
89/336/EEC	Directives for electromagnetic compatibility
73/23/EEC	Low- voltage directive

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