

SIEMENS



OpenAir™ GMA..1 actuators with spring return Technical basics

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1 Introduction

1.1 Revision history

Changes	Date	Chapter	Pages
Type summary	22.01.2004	2.2	6
Description of functions		2.3.1	7
Electrical parallel connection of actuators		4.2	16
Technical data (without type GMA19...		8	27/28
Referenced documents (related to GMA)		11.2	35
Self-adaptation (diagram /example)	07.05.2004	3.4	12
Self-adaptation (position indicator GMA16..1)		7.2	26
Operating voltage DC 24...48 V	07.06.2004	whole document	
Accessorie ASC77..		2.2	6
Permissible line length and cross-sectional areas	14.02.2005	6.1	19/20
Environmental compatibility and disposal		10	33
Referenced documents		11.2	34
Auxiliary switch	19.10.2006	8	28
Internal diagrams		9.1	29

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 GMA..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 technical fundamentals on the actuators with spring return of type series GMA..1 for:

- Two-position control
- Three-position control
- 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
- Connection diagrams
- Notes on environmental compatibility and disposal

2 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

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

- For damper areas up to 1.5 m², 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.

GMA...	121.1E	126.1E	321.1E	326.1E	131.1E	132.1E	136.1E	161.1E	163.1E	164.1E	166.1E
Control type	Two-position control				Three-position control			Modulating control			
								<i>Standard version</i>			
Operating voltage AC 24 V DC 24...48 V	X	X			X	X	X	X	X	X	X
Operating voltage AC 230 V			X	X							
Positioning signal Y DC 0...10 V DC 0...35 V with character- istic function U ₀ , ΔU								X	X	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, tandem-mounted)	X	X	X	X	X	X	X				

Accessories, spare parts

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

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
External auxiliary switches	ASC77..E
Data sheet for accessories and spare parts	N4697

2.3 Description of functions

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

Type	GMA12..1 / GMA32..1	GMA13..1	GMA16..1
Control type	Two-position control	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 movement depends on the mounting position of the damper shaft.		
	When operating voltage is supplied, the actuator goes from $0^\circ \Rightarrow 90^\circ$.	When operating voltage is supplied and depending on the control, the actuator goes • from $0^\circ \Rightarrow 90^\circ$ (open) • from $90^\circ \Rightarrow 0^\circ$ (close) When control is interrupted, the actuator remains in the respective position.	
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: Mechanical	Rotary angle position given by the position indicator.		
Position indication: Electrical		Connecting the feedback potentiometer to an external voltage source results in voltage supply proportional to the rotary angle.	• Position indicator: Output voltage $U = DC 0...10$ V is generated proportional to the rotary angle.
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° .		
Powerpack (two actuators, tandem-mounted)	Mounting two of the same actuator types on the same damper shaft may result in a double torque (not permissible for GMA16..1).		
Response on damper blocking	The actuator is equipped with an automatic switch-off mechanism.		
Manual adjustment	<ul style="list-style-type: none"> 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. 		
Rotary angle limitation	The rotary angle range can be limited mechanically by inserting the shaft adapter in 5° increments.		

2.3.1 Function description supplement for GMA16..1

The following information applies to the **standard** and **enhanced versions** of the modulating actuators.

Characteristic function GMA163.1, GMA164.1

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.

Application

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

- Dampers with a rotary angle limitation, for instance in the $0^\circ...45^\circ$ 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 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").

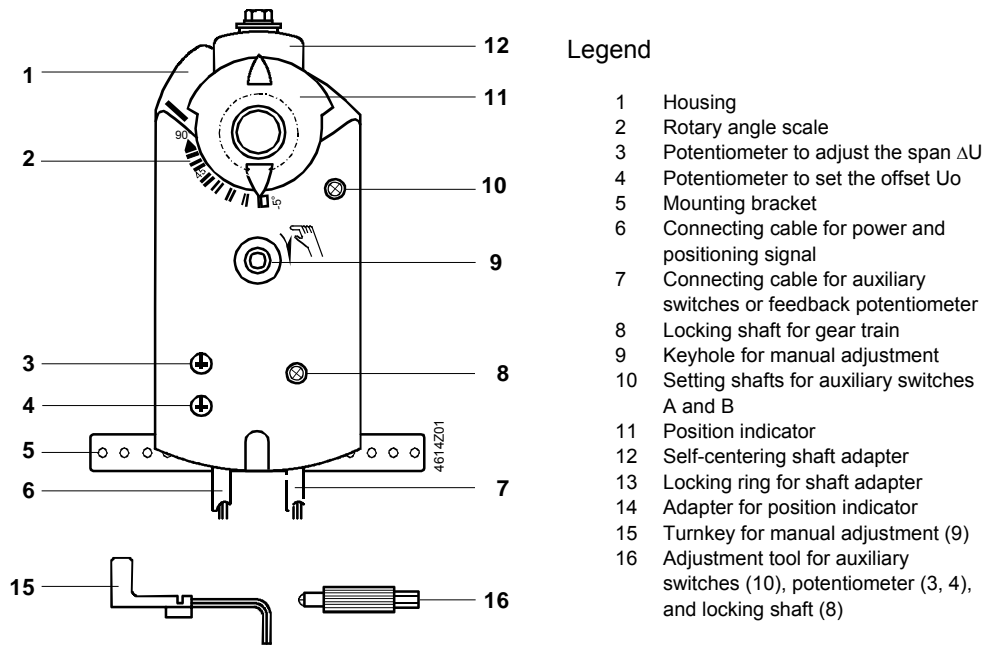
Actuator type	Control type	Controller output
GMA12..1	Two-position	AC 24 V or DC 24...48 V
GMA32..1	Two-position	AC 230 V
GMA13..1	Three-position	AC 24 V or DC 24...48 V
GMA16..1	Modulating	DC 0...10 V / DC 0...35 V

2.5 Structure and design

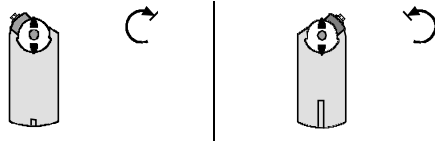
Description	The GMA...1 electrical actuators are available for two-position, three-position, and modulating control with spring return. The nominal torque is 7 Nm. The actuator's connection cables are prewired.
Housing	Robust, light-weight full metal housing from aluminum diecast. The housing guarantees 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.
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 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.
Mounting bracket	A bolted metal strip is used for attaching the actuator.
Electrical connection	All actuators have pre-wired, 0.9 m long (standard length) connection cables.
Type-specific elements	The actuators can be delivered as a type-specific variant having the following elements:
Auxiliary switch	For supplementary functions, the auxiliary switches A and B can be adjusted on either side.
Potentiometer for offset and span	Both potentiometers for the operating functions U_0 and ΔU are accessible on either side.
Feedback potentiometer to position indication	The potentiometer is integrated and can be connected by means of a cable.

2.6 Setting and operator elements

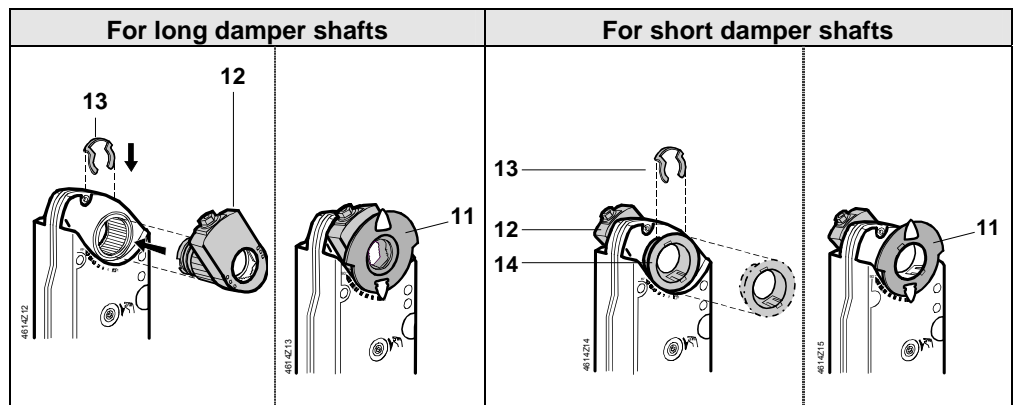
Actuator



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 (positioning signal, DC 0...35 V)
- Control characteristics by including the neutral zone

3.1 Drive motor and spring return

Motor technology

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

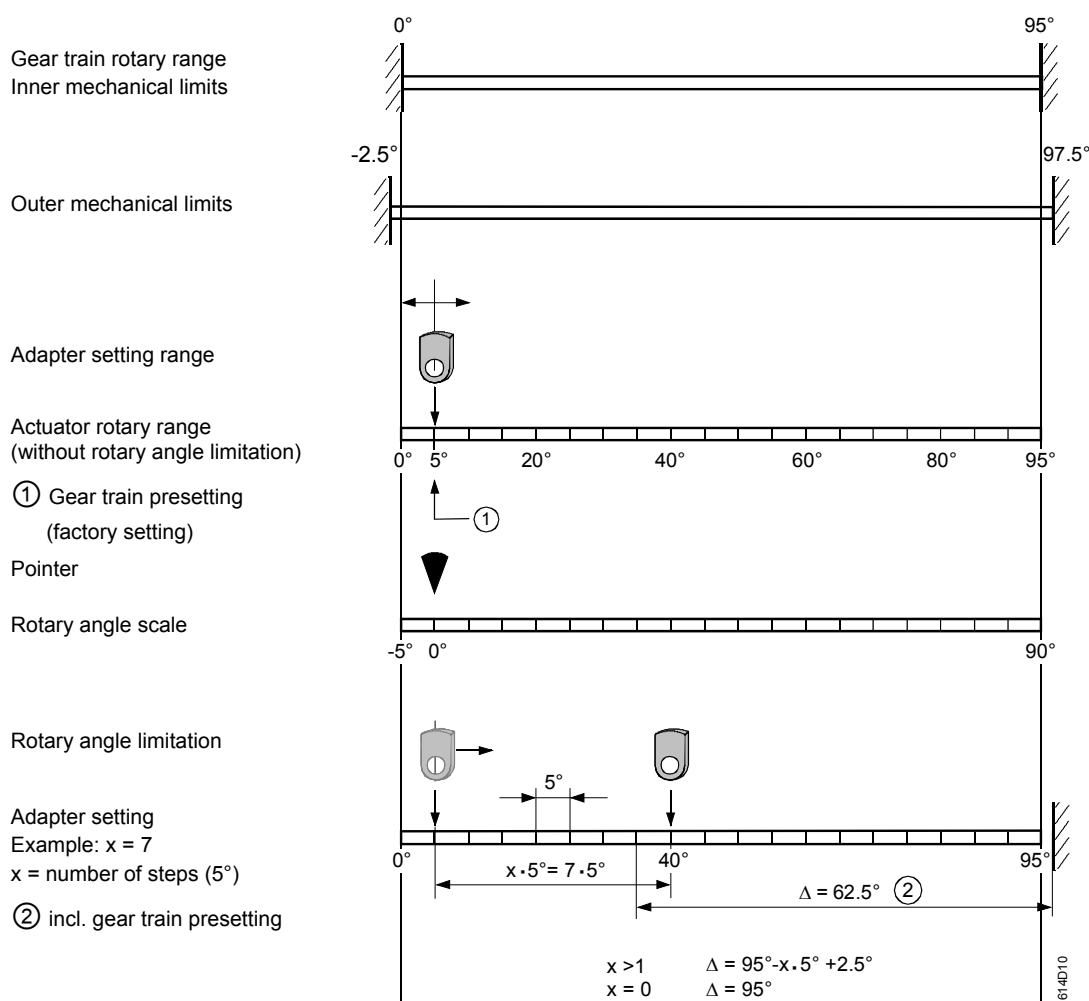
Spring return

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 Rotary range and mechanical limitation

Mechanical functions

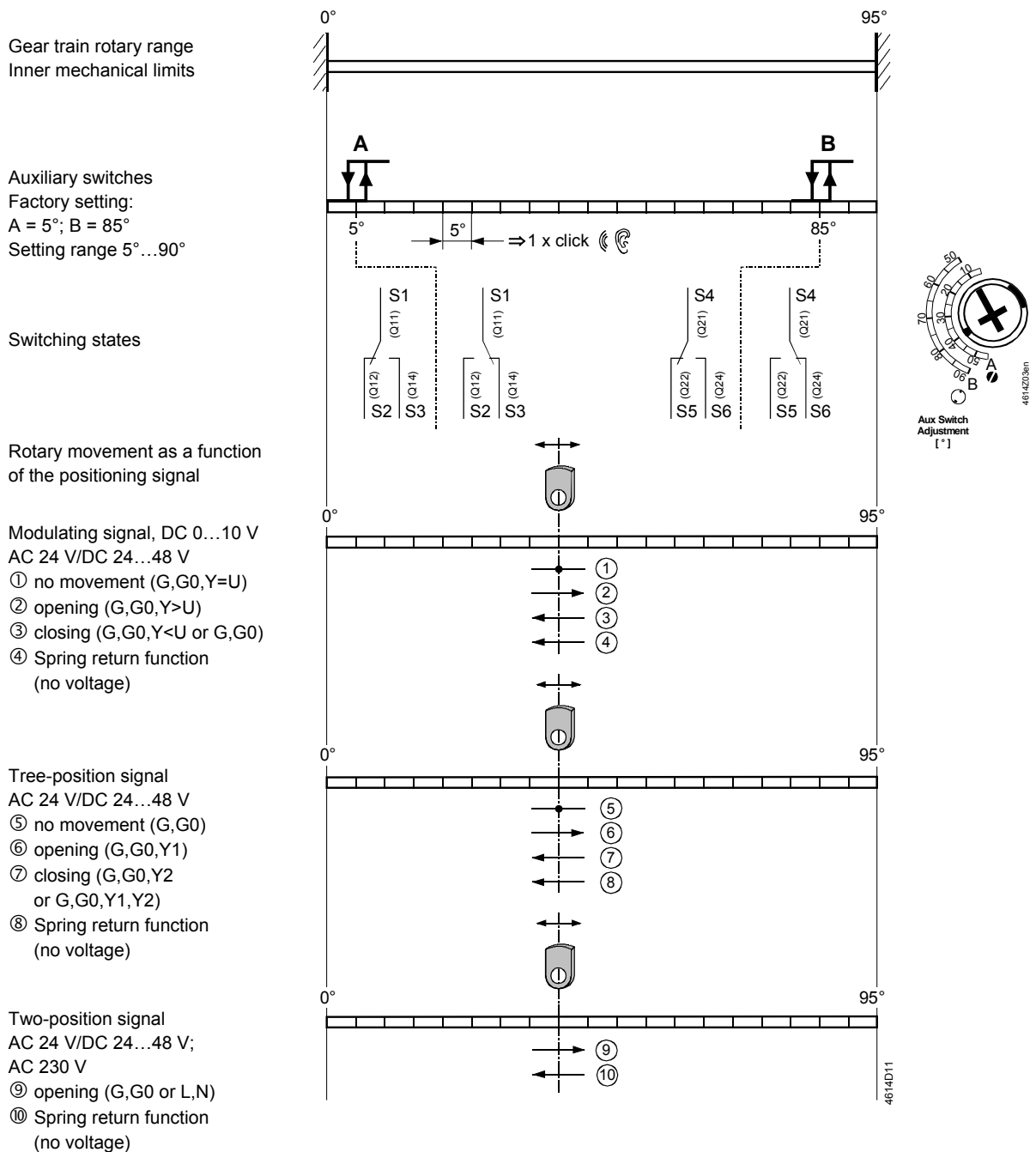
The illustration below shows the relationship between the inner and outer mechanical limitation of the rotary range.



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

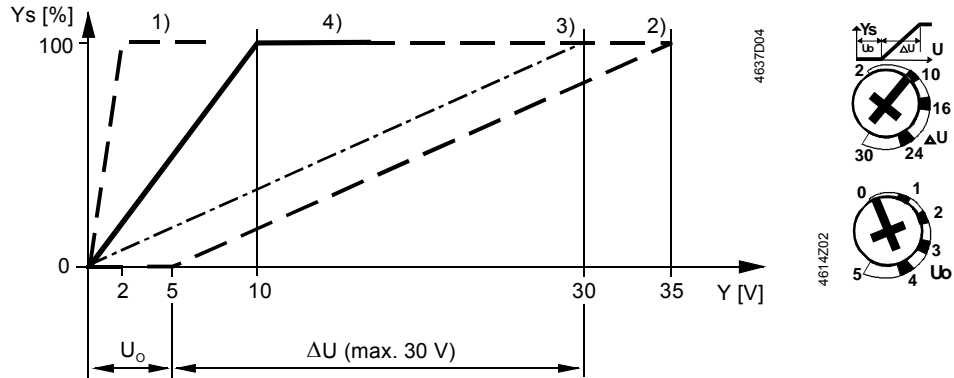
The adjustment tool is used to set the auxiliary switches; it is part of the delivery (type-specific).

3.4 Adjustable characteristic function

Actuators

GMA163.1, GMA164.1,

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 "U_o", you can set the offset for DC 0...5 V, and with potentiometer "ΔU", you can set the span for DC 2...30 V.



Y_s Positioning range: 100 % = Rotary angle 95°
 Y Positioning signal
 U_o Offset
 ΔU Span (for $Y_s = 100\%$)

Examples as per the diagram

Example	Positioning signal Y	Positioning range Y_s	Settings	
			U_o	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 U_o thus amounts to 2 V. The rotary angle is 90°.

Formula

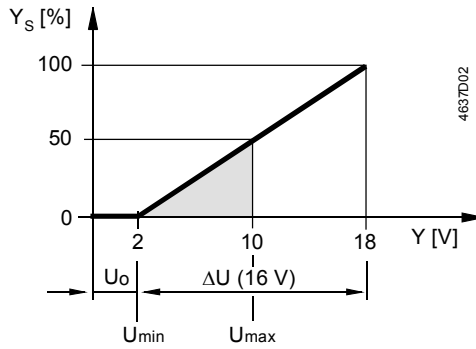
Calculating the setting value for ΔU :

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

Potentiometer settings

$U_o = 2 \text{ V}$, $\Delta U = 16 \text{ V}$

Characteristic function for the above example



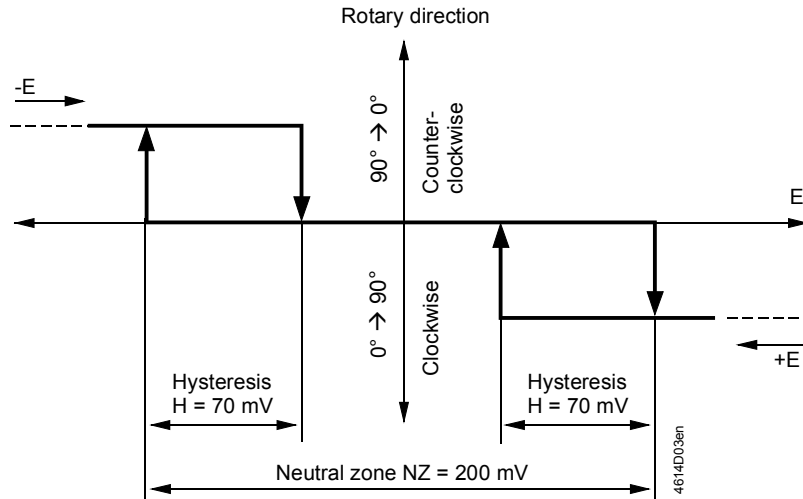
Max. positioning range $Y_{smax} = 100\%$ (95°)
 Span $Y_s = 50\%$ (47.5°)
 Offset $U_o = 2\text{ V}$
 Span $\Delta U = 16\text{ V}$
 Effective span
 $\Delta U_w = U_{max} - U_{min}$
 $= 10\text{ V} - 2\text{ V} = 8\text{ V}$

3.5 Neutral zone

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

Actuators
 GMA161.1, 166.1
 (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**).



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
 GMA163.1, 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: <ul style="list-style-type: none">• 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 business.• 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: <ul style="list-style-type: none">• As a rule, earthing as well as non-earthing of G0 is permissible for AC 24 V/ DC 24...48 V operating voltage. However, observe all local regulations and customary procedures.• For functional reasons, earthing may be required or not permissible.
<i>Recommendation on earthing G0</i>		<ul style="list-style-type: none">• Earth all AC 24 V and 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: <ul style="list-style-type: none"> • Permissible deviation of AC 24 V nominal voltage at the actuators: +/- 20 %. • Permissible deviation of 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 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 %).
Specifications 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: <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/DC 24...48 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

- Two-position and three-position actuators GMA32..1, GMA12..1, and GMA13..1: Mount max. two actuators on the same damper shaft.
- Use the mounting bracket to secure the second actuator also (see accessories in chapter 2.2).
- **Do not mechanically** connect modulating **GMA16..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 **not** permissible.

 Feedback potentiometer for position indication

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

Electrical parallel connection of actuators

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

See chapter 6 "wiring notes" for more information.



Caution
Maintenance

Do not open the actuator!

The device is maintenance-free. Only the manufacturer may conduct any repair work.

4.3 Notes on EMC optimization

Running cables in a duct

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

Cable types

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

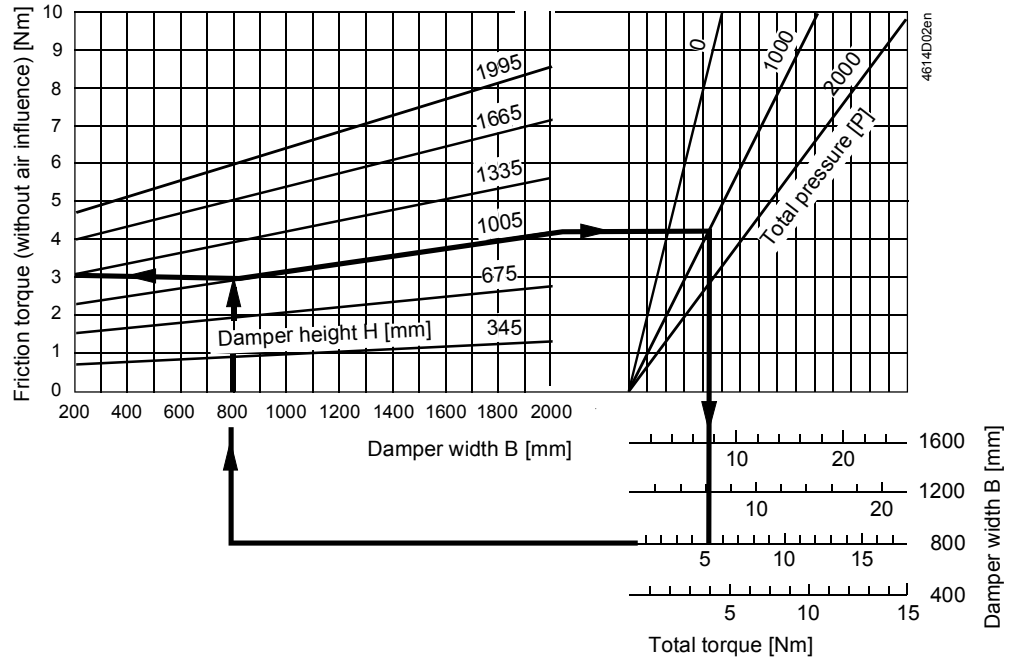
After obtaining the damper torque rating [Nm/m^2] from the manufacturer and determining the damper area, calculate the total torque required to move the damper as follows:

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

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

Sizing diagram

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



Example

Damper for blinds:
 Width = 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 $\frac{\text{Total torque [Nm]}}{\text{SF}^1}$	then use type (with spring return)
$\leq 7 \text{ Nm}$	GMA..1 (7Nm)
$\leq 14 \text{ Nm}$	2 x GMA..1 (2 x 7 Nm) ² or
$\leq 18 \text{ Nm}$	GCA..1 (18 Nm) ³
$\leq 36 \text{ Nm}$	2 x GCA..1 (2 x 18 Nm) ⁴

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 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.

5 Mounting notes

Mounting instructions	All information and steps to properly prepare and mount the actuator are available in the mounting instructions 4 319 0108 0 (M4614) 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 either clockwise or counter-clockwise rotation of the damper shaft and 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".
Mounting position in dependence of rotary direction	<ul style="list-style-type: none">• GMA12..1, 32..1, 13..1, 16..1: For mounting, turn the actuator by 180° depending on the necessary rotary direction. All setting and operator 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: <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.
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 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 GMA12..1, 32..1, 13..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.

Note

- This chapter is written for AC/DC24 V and AC 230 V (Information for AC 24... 48 V on inquiry)

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
GMA12..1 GMA13..1	AC/DC 24 V	G0, G Y1, Y2	4 % each (tot. 8 %) of AC/DC 24 V
GMA16..1	AC 24 V	G0, G	4 % each (tot. 8 %) of AC 24 V
	DC 24 V	G0, G	1 % of DC 10 V
GMA32..1	AC 230 V	L, N	2 % each (tot. 4 %) of AC 230 V

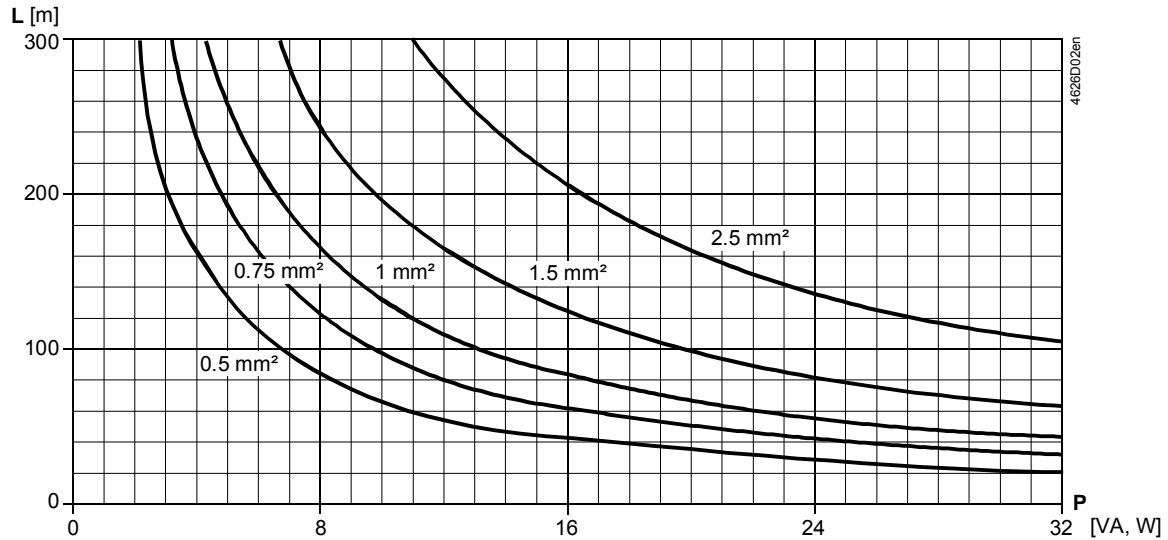
Notes on the G0 line
(GMA16..1)

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% over G0 line).

**Line length/consumption
AC/DC 24 V**

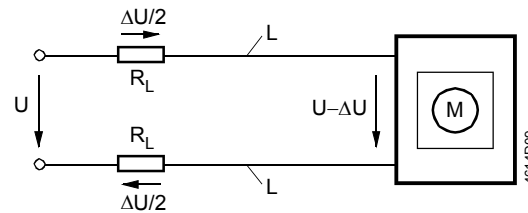
The diagram applies to AC/DC 24 V and shows the permissible line length **L** as a function of consumption **P** and as a parameter of the line cross sections.



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.
- C is the primary power consumption for all actuators connected in parallel.

P&I diagram:
Voltage drop on the supply lines



Formula for line length

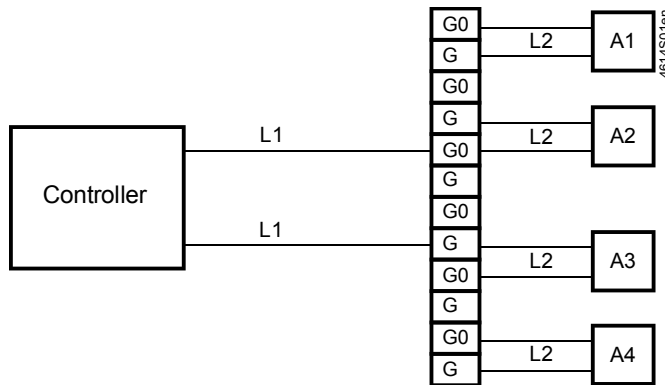
The maximum line length can be calculated using the following formula.

Operating voltage	Perm. voltage drop / line	Formula for line length
AC/DC 24 V	4 % of AC/DC 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 (two-position)

Actuators with two-position control
GMA12..1 and GMA32..1

Type	Operating voltage	Power consumption	Perm. voltage drop for line 1 (G) and 2 (G0)
GMA12..1	AC 24 V DC 24 V	5 VA 3.5 W	$\Delta U/U = \text{max. } 8\%$ (4 % each per line)
GMA32..1	AC 230 V	7 VA	$\Delta U/U = \text{max. } 4\%$ (2 % each per line)

Use the table or the formulas in chapter 6.1 to determine the permissible line lengths and cross sections.

6.3 Actuator wiring (three-position)

Actuators with three-position control
GMA13..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.

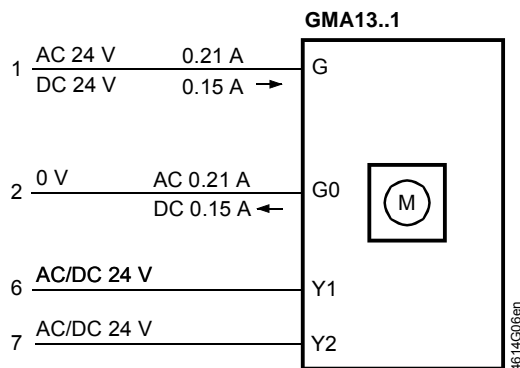
Power consumption and perm. voltage drop with one actuator

The table shows the main 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	5 VA 3.5 W	$\Delta U/U = \text{max. } 8\%$ (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 GMA13..1 and AC/DC 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)
<ul style="list-style-type: none"> Consumption = 2 x 5 VA = 10 VA Line current = 2 x 0.21 A = 0.42 A Max. permissible single line length: 197 m at 1.5 mm² line cross section. 	<ul style="list-style-type: none"> Consumption = 2 x 3.5 W = 7 W Line current = 2 x 0.15 A = 0.3 A Max. permissible single line length: 281 m at 1.5 mm² line cross section.

6.4 Actuator wiring (modulating)

Modulating actuators
GMA16..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

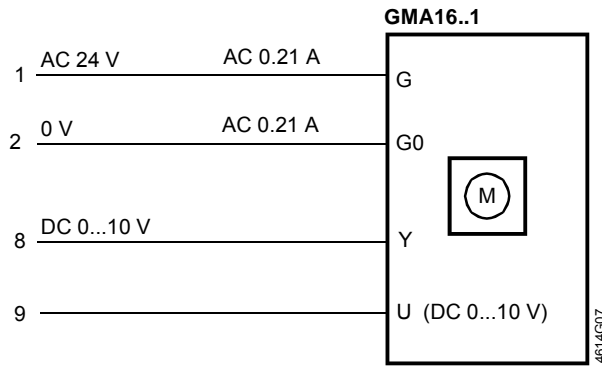
Power consumption and perm. voltage drop with one actuator

With AC supply, the G0 line has a AC 0.21 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	5 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 GMA16..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: $4 \times 5 \text{ VA} = 20 \text{ VA}$
- Line current: $4 \times 0.21 \text{ A} = 0.84 \text{ A}$
- **Permissible single line length for G, G0:**
98 m at 1.5 mm^2 line cross section, or
163 m at 2.5 mm^2 line cross section.

6.4.2 DC 24 V supply

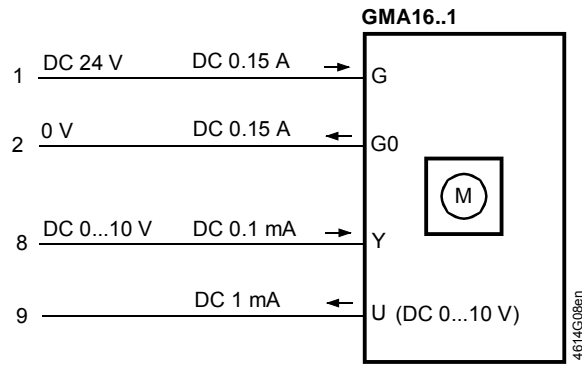
Power consumption and
perm. voltage drop with
one actuator

With DC supply, the G0 line has a DC 0.15 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	3.5 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 GMA16..1, GMA19...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 %)
<ul style="list-style-type: none"> • Consumption: $4 \times 3.5 \text{ W} = 14 \text{ W}$ • Line current: $4 \times 0.15 \text{ A} = 0.6 \text{ A}$ • Permissible single line length: 13 m at 1.5 mm^2 line cross section or 22 m at 2.5 mm^2 line cross section. 	<ul style="list-style-type: none"> • Consumption: $4 \times 3.5 \text{ W} = 14 \text{ W}$ • Line current: $4 \times 0.15 \text{ A} = 0.6 \text{ A}$ • Permissible single line length: 141 m at 1.5 mm^2 line cross section or 235 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" Z4614en)
- Mounting instructions 74 319 0108 0 (M4614)
- 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.
- 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 function check

Rotary movement: Two-position control GMA12..1, GMA32..1

- When operating voltage is supplied, the actuator must turn 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 GMA13..1

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

Core connections		Rotary direction
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 chapter 9.3.

Rotary movement: Modulating control GMA16..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
GMA163.1, 164.1

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
GMA16..1

Check of output voltage: U = DC 0...10 V for **rotary angle 90°**.

Feedback potentiometer
GMA132.1

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 chapter 3.2, "Rotary 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 GMA12..1, GMA13..1,
GMA16..1

Operating voltage	AC 24 V ±20 %
Frequency	50/60 Hz
Operating voltage	DC 24...48 V ±20 %
Safety extra-low voltage (SELV) or Protection by extra-low voltage (PELV) as per	HD 384
Requirements for external safety insulating transformer (100% duty)	as per EN 61 558
Supply line fuse	max. 10 A
Power consumption: GMA1..1 : Running	AC: 5 VA / 3.5 W
GMA1..1 : Running	DC: 3.5 W (with DC 24 V)
GMA12..1, GMA13..1 : Holding	AC/DC: 2 W
GMA16..1 : Holding	AC/DC: 2.5 W

! AC 230 V supply
for GMA32..1

Operating voltage	AC 230 V ± 10 %
Frequency	50/60 Hz
Supply line fuse	max. 10 A
Power consumption: Running	7 VA / 4.5 W
Holding	3.5 W

Function data

Nominal torque	7 Nm
Maximum torque (blocked)	21 Nm
Min. resetting torque (on power failure)	7 Nm
Min. holding torque	7 Nm
Nominal rotary angle (with position indication)	90 °
Maximum rotary angle (mechanic limitation)	95° ± 2°
Runtime for rotary angle 90° (motor operation)	90 s
Closing time with return spring (on power failure)	15 s
Rotary direction defined by: Mounting type (GMA...1)	clockwise/counterclockwise
Mechanical life	10 ⁵ cycles

! Inputs

Positioning signal for GMA12..1
Positioning signal for GMA32..1
Positioning signal for GMA13..1

Operating voltage AC 24 V/DC 24...48 V (wires 1-2)	Open (0° ⇒ 90°)
Operating voltage AC 230 V (wires 3-4)	Open (0° ⇒ 90°)
Operating voltage AC 24 V/DC 24...48 V (wires 1-2)	
Open: Switching current (wires: AC 1-6 / 2-6; DC 2-6)	> AC/DC 8 mA
Close: Switching current (wires: AC 1-7 / 2-7; DC 2-7)	> AC/DC 8 mA

Positioning signal
for GMA16..1

Input voltage Y (wires 8-2)	DC 0...10 V / 2...10 V
Current consumption	0.1 mA
Input resistance	> 100 kΩ
Max. permissible input voltage	DC 35 V
Protected against faulty wiring	max. AC 24 V/DC 24...48 V
Neutral zone for non-adjustable characteristic function	200 mV
for adjustable characteristic function	2 % of ΔU
Hysteresis for non-adjustable characteristic function	70 mV
for adjustable characteristic function	0.7 % of ΔU

Adjustable characteristic function
for GMA163.1, 164.1

Adjustable with 2 potentiometers	
Offset U ₀	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 GMA16..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 V

Feedback potentiometer
for GMA132.1

Change of resistance (wires P1-P2)	0...1000 Ω
Load	< 1 W
Max. sliding contact current	< 10 mA
Permissible voltage at potentiometer (SELV/PELV)	max. AC 24 V/DC 24 V
Insulation resistance between potentiometer and housing	AC 500 V

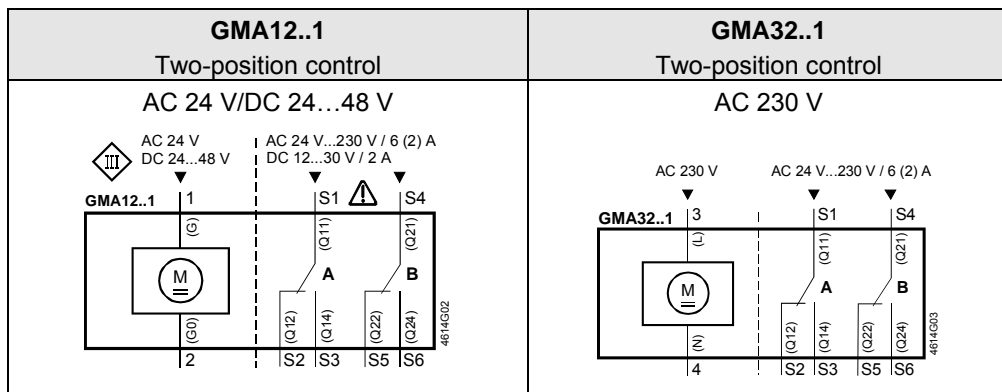
 Auxiliary switch
for GMA..6.1, GMA164.1,

	AC power supply	
	Switching voltage	AC 24...230 V
	Nominal current res./ind.	6 A / 2 A
	Life: 6 A res., 2 A ind. without load	10 ⁴ cycles 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°
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/DC 24 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 (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 (EMC)	
	Immunity for all models, except GMA132.1x	IEC/EN 61 000-6-2
	Immunity for GMA132.1x	IEC/EN 61 000-6-1
	Emissions for all models	IEC/EN 61 000-6-3
	 -conformity	
	Electromagnetic compatibility as per Low voltage directive	89/336/EEC 73/23/EEC
	 -conformity	
	Australian EMC Framework Radio Interference Emission Standard	Radio Communication Act 1992 AS/NZS 3548
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	Weight without packaging	
	GMA1..1	1.2 kg
	GMA321.1, 326.1	1.3 kg

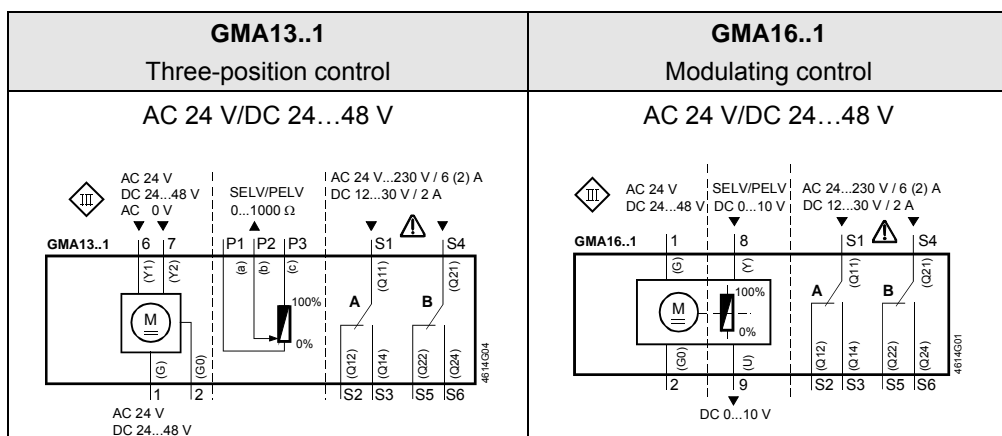
9 Diagrams

9.1 Internal diagrams

Two-position control



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



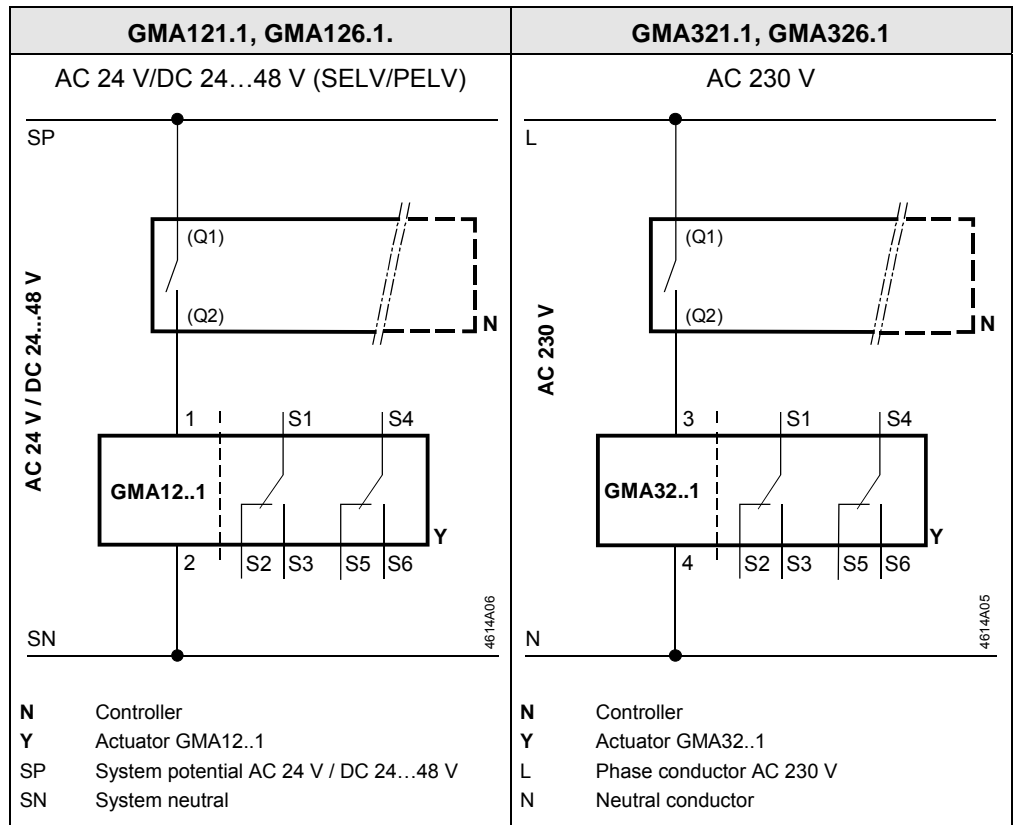
9.2 Cable labeling

All wires are color-coded and labeled.

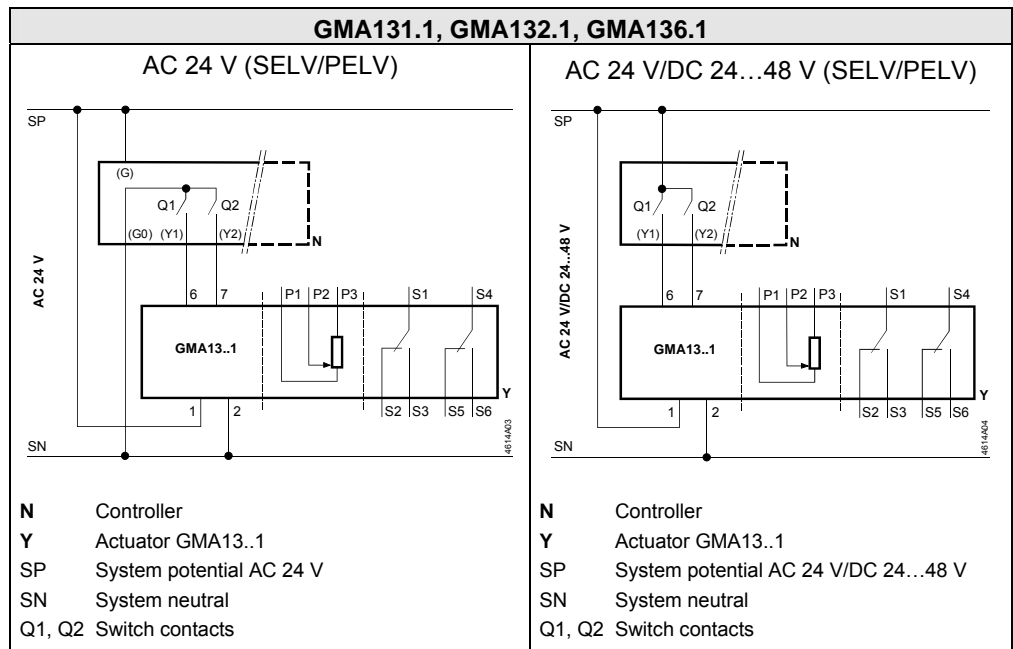
Pin	Cable				Meaning
	Code	No.	Color	Abbreviation	
Actuators AC 24 V DC 24...48 V	G	1	red	RD	System potential AC 24 V/DC 24...48 V
	G0	2	black	BK	System neutral
	Y1	6	purple	VT	Pos. signal AC 0 V, AC 24 V/DC 24...48 V "Open"
	Y2	7	orange	OG	Pos. signal AC 0 V, AC 24 V/DC 24...48 V "Close"
	Y	8	grey	GY	Pos. signal DC 0...10 V, 0...35 V
U	9	pink	PK	Position indication DC 0...10 V	
Actuators 230 V AC	L	3	brown	BN	Phase AC 230 V
	N	4	blue	BU	Neutral conductor
Auxiliary switch	Q11	S1	grey/red	GY RD	Switch A input
	Q12	S2	grey/blue	GY BU	Switch A normally-closed contact
	Q14	S3	grey/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 (two-pos./three-pos.)

Two-position GMA12..1, 32..1



Three-position control GMA13..1



Operating states of GMA13..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		Operating state	Rotary direction	
Q1	Q2			
		Remains in current position		
		Opens		
		Closes		
		Closes		
Mounting position of actuator GMA13..1				

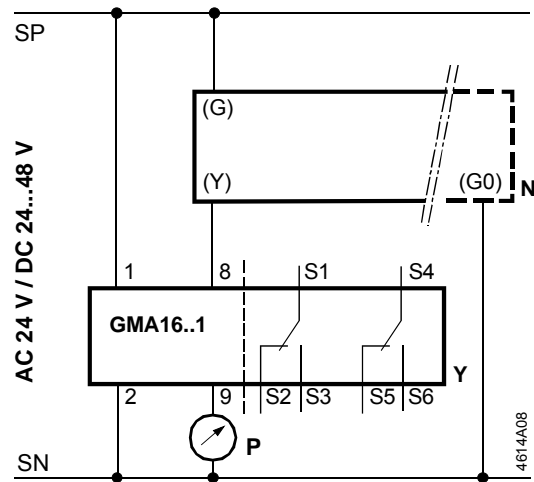
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9.4 Connection diagrams (modulating)

9.4.1 Typical application

The controller output is connected directly to the actuator input.

GMA16..1



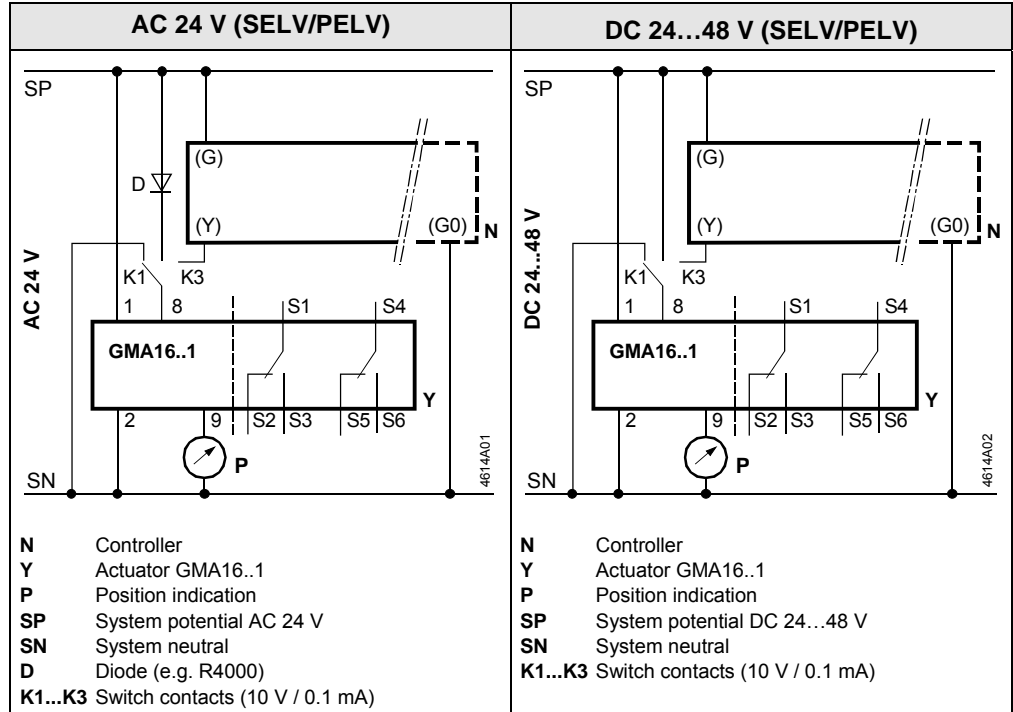
- N** Controller
- Y** Actuator GMA16..1
- P** Position indication
- SP** System potential
- AC 24 V/DC 24...48 V
- SN** System neutral

4614A08

9.4.2 Special switchings for modulating control

The following connections 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 below).

Modulating control,
fully open, fully locked
with
GMA16..1



Operating states of
GMA16..1

Switch contacts	Operating state	Rotary direction	
K3	Control operation		
K2	Fully open *)		
K1	Fully closed		
Mounting position for actuator GMA16..1			

Note
GMA163.1, 164.1

*) Actuators with adjustable characteristic function: Full opening cannot be reached (dependent on U_0 , ΔU) in this position (switch contact K2).

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-castDo not dispose as household garbage. This particularly applies 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. **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.

Product-specific note

Spring return actuators contain pre-tensioned 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 dealership.

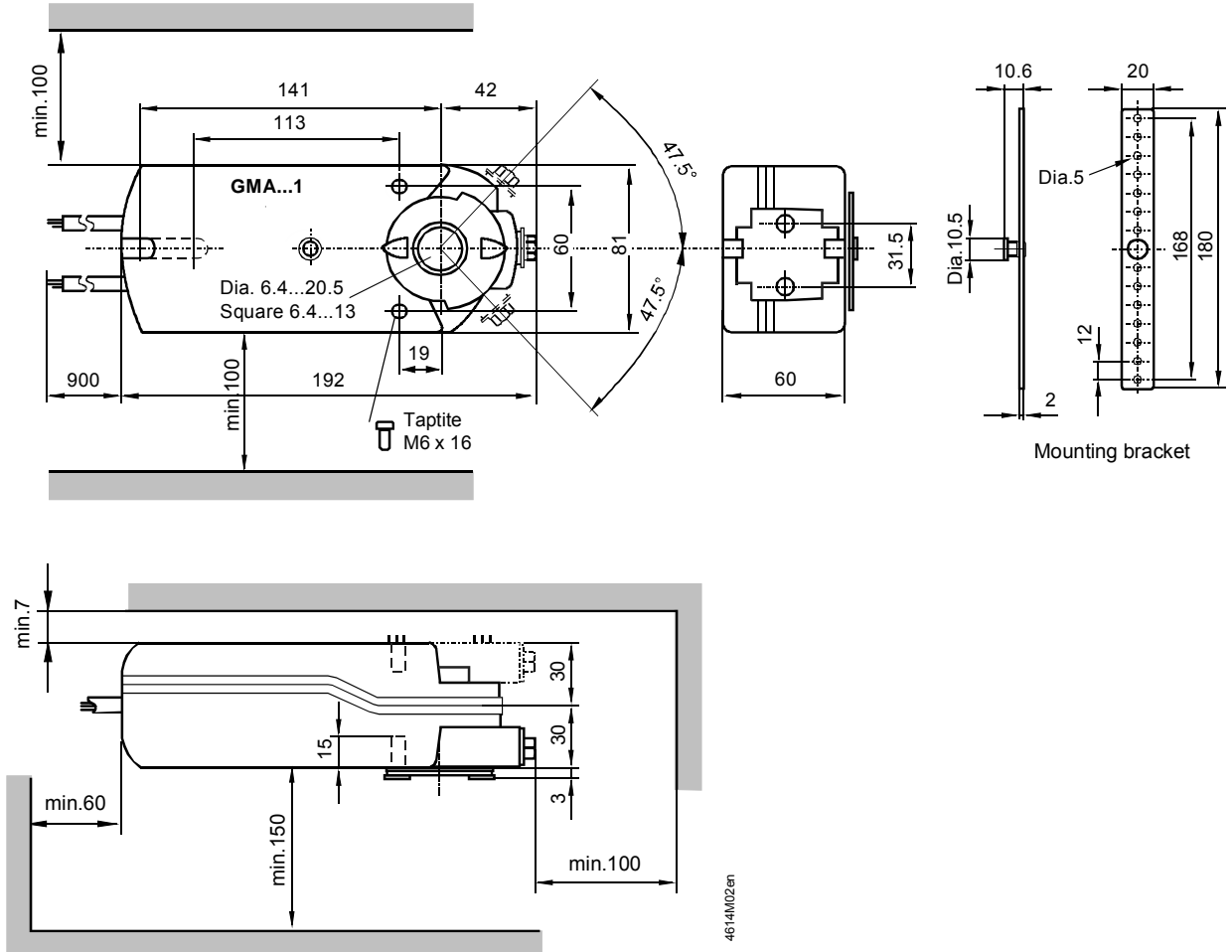
11 Appendix

Chapter contents

This chapter contains:

- Actuator dimensions
- Referenced documents
- Standards and directives

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
- 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.

Technical documentation

Type series GMA...1

Document number (Classification no.)	Title/Description	Contents
N4614en (N4614)	Actuators for air dampers, rotary version with spring return (GMA...1: Two-pos., three-pos., modulating).	Type overview, function and selection criteria.
Z4614en (Z4614)	Technical basics, spring return actuators GMA....1 (this document).	Technical basics for engineering, mounting, wiring, and commissioning.
74 319 0108 0 (M4614)	Mounting instructions on GMA...1.	Instructions on mounting a rotary actuator with spring return.

Accessories for type series GMA...1

N4697en (N4697)	Accessories and spare parts for actuators GMA...1	Overview, allocation to actuator type, and application.
N4615en (N4615)	External auxiliary switches ASC77..	Type overview and function
74 319 0236 0 (M4614.1)	Universal lever ASK71.9	Mounting instructions
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	
74 319 0431 0 (M4615)	External auxiliary switches ASC77..	

Standards and directives

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 61 000-6-1	Electromagnetic compatibility: Immunity
IEC/EN 61 000-6-2	Electromagnetic compatibility: Immunity
IEC/EN 61 000-6-3	Electromagnetic compatibility: Emissions
89/336/EEC	Directives on electromagnetic compatibility
73/23/EEC	Low voltage directive

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