



Multi-turn actuators

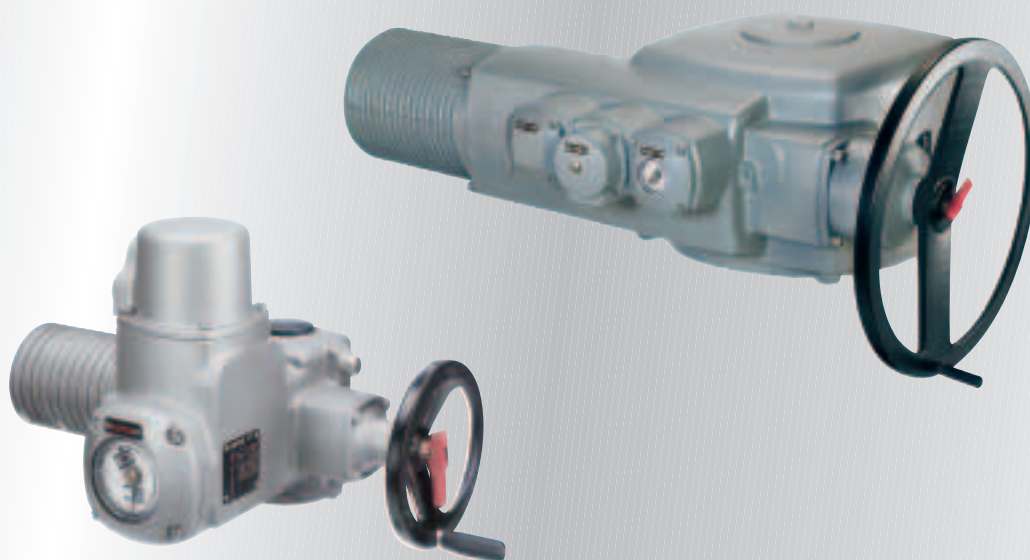
for OPEN - CLOSE and modulating duty

SA 07.1 – SA 48.1

SAR 07.1 – SAR 30.1

SAEx(C) 07.1 – SAEx(C) 40.1

SAREx(C) 07.1 – SAREx(C) 30.1





Applications

AUMA multi-turn actuators are used wherever the automation of a valve requires rotation, e.g. when using gate valves. The actuators can be adapted to suit the requirements of nearly all valve applications. This is achieved by:

- an extremely wide torque range,
- various combination possibilities with AUMA valve gearboxes and controls,
- a large variety of versions.



Energy

- : Power plants
- : Air pollution control
- : District heating
- : Pipelines



Water/Wastewater

- : Water works
- : Sewage treatment plants
- : Pumping stations
- : Dams



Chemical industry

- : Chemical industry
- : Petrochemical industry
- : Pharmaceutical industry



Others

- : Oil and gas industry
- : Air conditioning
- : Ship building industry
- : Steel mills
- : Cement plants
- : Food industry

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Solutions for a world in motion

This brochure will provide both the beginner and the expert with an overview of the functions and applications of AUMA SA/SAR multi-turn actuators. It is used as the basis to determine whether a device is suitable for the chosen application.

For detailed product selection refer to the separate data sheets and price lists. On request, AUMA engineers within field service and within our subsidiaries can help you to find the correct device for the application.

The SA/SAR multi-turn actuator version has been available since 1986. Ever since, the actuators have been continuously improved. They can be combined with the latest generation of AUMA actuator controls – enabled by the modular design principle of the AUMA product range. Both the mechanical interfaces as well as options for integration into a DCS are always up to date.

The latest detailed information on the SA and SAR multi-turn actuators can be found on the Internet under www.auma.com. All documents, including dimensional drawings, wiring diagrams and final inspection records (for supplied multi-turn actuators) are available on the Internet in a digitalised form.

Subject to change without notice.

The product features and technical data provided do not express or imply any warranty.

Applications/duty types

AUMA automates valves; to put it in a nutshell, this is what AUMA actuators do. In other words: AUMA actuators can be used for remote control of valves; either by an operation command manually triggered in the control room or within the framework of an automated process-controlled procedure. AUMA is an actuator specialist.

According to the different valve designs, there are multi-turn, part-turn and linear actuators. This brochure puts the focus on multi-turn actuators. Multi-turn actuators are predominantly used for the automation of gate valves, for example, where more than one rotation of the valve shaft is required.

Shutting off, positioning, controlling

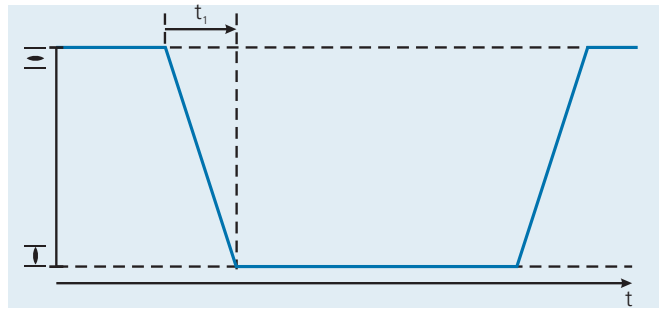
The second important selection criterion after the type of movement is the type of duty. Is the valve to be used as shut-off device (open-close duty), is the valve to be positioned in mid-travel (positioning mode) or is the valve position to be changed at short intervals, i.e. to control the flow through a pipeline (modulating duty)? These are essential factors for sizing the valve and the actuator as the load may vary considerably depending on the operation mode.

Consequently, there are AUMA actuators for open-close and positioning duty as well as actuators which meet the high requirements of modulating duty.

OPEN-CLOSE duty and positioning duty

OPEN-CLOSE duty

The valve is operated relatively seldom, the time intervals can span between a few minutes up to several months.

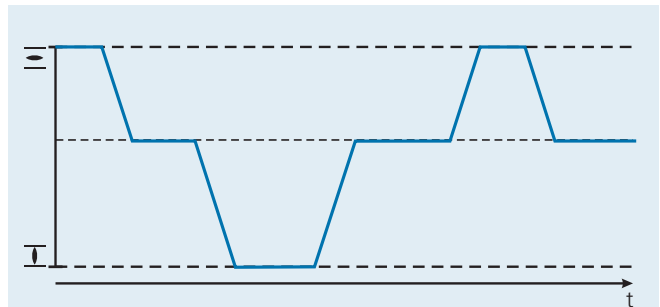


Typical operation in open-close duty

[t_i] Running time. The maximum permissible running time without interruption is usually 15 min, optionally 30 min.

Positioning duty

The valve is operated to a specified intermediate position, e.g. to set a consistent flow rate. The same running time limits as in open-close duty apply.



Typical operation in positioning duty



AUMA multi-turn actuators mounted on gate valves in the kerosene tank farm at Chubu airport in Japan.

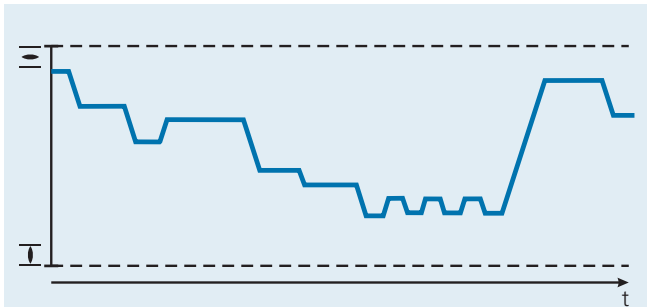


AUMA explosion-proof actuators distribute the crude oil to different tanks in a tank farm in Northern Germany.

Modulating duty

The most distinctive feature of a closed-loop application is that changing conditions require frequent adjustment of the MOV. Sensitive closed-loop applications require adjustments within intervals of a few seconds.

The demands on the actuator are high. Mechanical components and the motor must be designed correctly to withstand a large number of operations over a long time with no decline in the modulating accuracy.



Typical operation in modulating duty

Types of duty for AUMA actuators

The correct AUMA actuator for the duty can be determined by the type designation.

Multi-turn actuators for open-close and positioning duty

AUMA multi-turn actuators for open-close and positioning duty are marked with the type designations SA, SAExC, and SAEx.

Available sizes:

- SA 07.1 – SA 48.1
- SAExC 07.1 – SAExC 16.1
- SAEx 25.1 – SAEx 40.1

As standard, the actuators conform to the types of duty S2 - 15 min or S2 - 30 min as an option.

Multi-turn actuators for modulating duty

AUMA multi-turn actuators for modulating duty are marked with the type designations SAR, SARExC, and SAREx.

Available sizes:

- SAR 07.1 – SAR 30.1
- SARExC 07.1 – SARExC 16.1
- SAREx 25.1 – SAREx 30.1

As standard, the actuators conform to the types of duty S4 - 25 % or S4 - 50 % as an option.



Gate valves with mounted AUMA actuator for a dam project in Australia before installation.



AUMA modulating actuator mounted on a control valve in a desalination plant.

Modular design – versions

Modular design – with or without controls

Each application has its special requirements. For this reason, AUMA only builds actuators on demand – tailor-made to customer requirements. Due to the modular design of the AUMA product range, different features can be combined. For each actuator type, there is a large number of equipment variants.

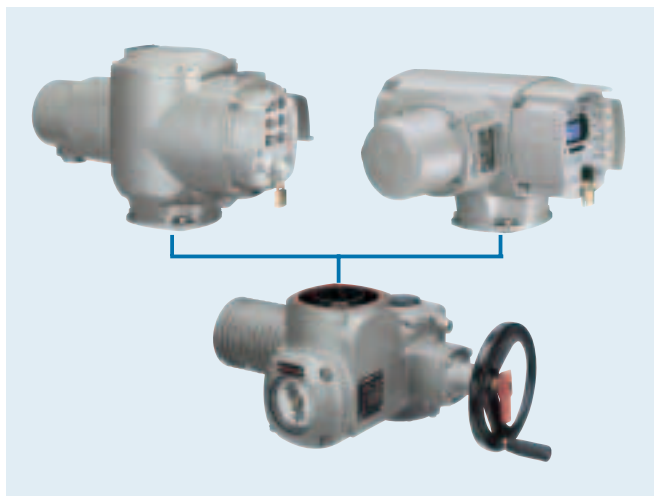
One of the fundamental benefits of AUMA's modular design is the ability to add integral controls to the basic actuator.

Actuators without integral controls

If your plant design requires the control of the actuators from a central point, e.g. from a PLC, AUMA supplies actuators without controls, the so-called AUMA NORM version. NORM actuators supply unprocessed signals; the external controls have to process all signals to and from the actuators according to the operation.

NORM actuators have no switchgear for switching the actuator motor on or off. This switchgear, e.g. reversing contactors, has to be included within the external controls to ensure, for example, that the actuator motor is automatically switched off if the actuator signals that an end position has been reached.

AUMA NORM actuators have no operating elements to operate the actuator electrically in the local mode. If this is required, separate local controls have to be installed and integrated into the control system.



Due to the modular design principle, the multi-turn actuator may be supplied without controls or with AUMA MATIC or AUMATIC integral controls.

Actuators with integral controls

After establishing the power supply, the actuators are ready for operation immediately. The actuator signals are processed locally. The required switching procedures are immediately performed within the integral controls, using the integral reversing contactors or thyristors.

After connecting the power supply, the actuator can be operated immediately in the local mode, using the local controls.

Extensive installation work for external controls is no longer required.

The automatic phase correction ensures the correct direction of rotation even if the phases are crossed over during electrical installation.

The high functionality of the controls relieves the DCS, so data exchange is reduced to a minimum.

Integral controls are a prerequisite when connecting actuators to a fieldbus.

NORM actuators can also be retrofitted or supplemented at a later date.

For further information on the integral controls refer to page 21 and the separate brochures:

- Product description
Actuator controls AUMA MATIC
- Product description
Actuator controls AUMATIC



[1] **Multi-turn actuators**
SA 07.1 – SA 16.1/SAR 07.1 – SAR 16.1
without integral controls
(AUMA NORM)

- Torques from 10 to 1,000 Nm



[2] **Multi-turn actuators**
SA 25.1 – SA 48.1 /SAR 25.1 – SAR 30.1
without integral controls
(AUMA NORM)

- Torques from 630 to 32,000 Nm



[3] **Multi-turn actuators**
with integral controls AUMA MATIC

The AUMA MATIC is ideal for simple OPEN - CLOSE applications (open-close duty) and for conventional control. If equipped accordingly, it may also be used for closed-loop control.

Further information on page 21.



[4] **Multi-turn actuator**
with integral controls AUMATIC

The AUMATIC is the all-rounder among AUMA controls. It is equipped with a micro controller and has a lot more functions than the AUMA MATIC. The AUMATIC is ideal for closed-loop control applications. And it is also the AUMATIC that is used for the implementation of the latest fieldbus system developments.

Further information on page 21.

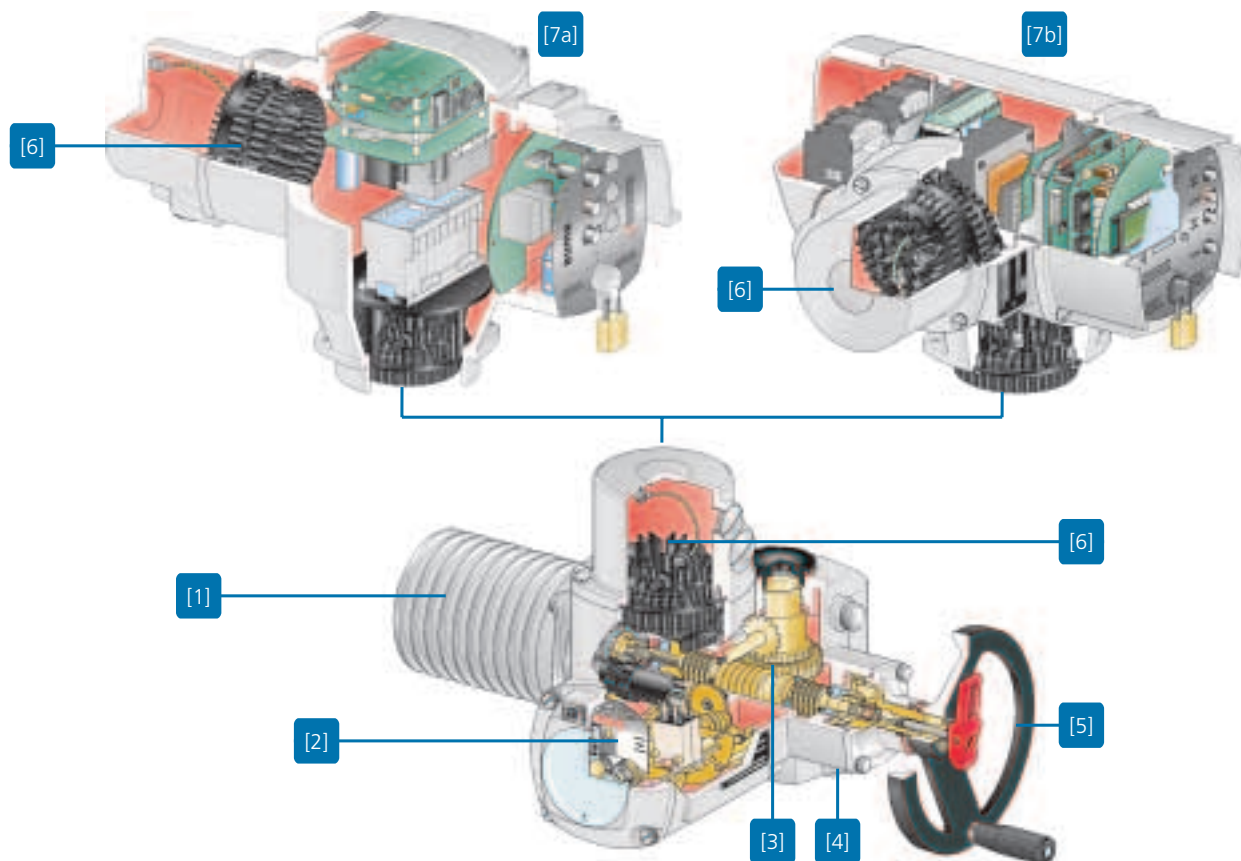


[5] **Multi-turn actuator**
with controls on wall bracket

Controls can also be mounted separately from the actuator on a wall bracket. This is recommended if:

- limited space restricts the access to directly mounted controls
- high ambient temperatures in the surroundings of the actuator could affect the electronics,
- heavy valve vibration could influence the controls.

Design principle



[1] Motor

Most actuators are equipped with robust 3-phase asynchronous motors. 1-phase AC or DC motors are also available up to actuator size 16.1.

The motor is connected via an internal plug/socket connector (up to 16 A nominal current). This enables quick exchange of the motor, e.g. for change of output speed. Further information on page 12.

[2] Control unit

The control unit includes two measuring systems (limit switching and torque switching) which measure the travel or the torque present at the output drive. Further information on page 14.

[3] Gearing

The well proven principle of worm gearing, sometimes combined with a planetary gear, is used to reduce the motor speed to the required actuator output speed. The sliding worm is positioned between two stacks of springs on the worm shaft. The worm will be moved in relation to the torque. This axial displacement, as measure for the torque, is transmitted to the control unit via lever and gear wheels.

[4] Valve attachment

The mounting flange is according to EN ISO 5210 or DIN 3210. Various output drive types are available. Therefore it is possible to adapt to different types of valves. Further information on page 24.

[5] Handwheel with change-over mechanism

For commissioning or in an emergency the multi-turn actuator can be operated with the handwheel. By operating the red change-over lever the motor drive is disconnected and the manual drive engaged. Decoupling is possible with little force, even if the actuator is operated at full rated torque. When starting the motor the manual drive is automatically disengaged. During electric operation the handwheel does not rotate.

[6] Electrical connection

The electrical connection is made via a plug/socket connector, no matter whether the actuator is equipped with or without controls.

For maintenance work, the actuator can be disconnected quickly from the power supply and control cables and easily reconnected.

For multi-turn actuators from size 25.1, the motor cables are connected via terminals. Further information on page 22.

[7] Integral controls (option)

AUMA actuators with AUMA MATIC [7a] or AUMATIC [7b] integral controls are ready for operation as soon as the supply voltage has been connected. The actuator can easily be operated on site via the local controls. Via the installed switchgear, i.e. reversing contactors or thyristors, the integral controls automatically and immediately perform the required motor switching procedures. The electrical connection between integral controls and actuator is made by using a plug/socket connector.

Further information on page 21.

Summary of applications, functions, and equipment

Standard ● Option ■	SA 07.1 – 48.1	SAR 07.1 – 30.1	SAEx(C) 07.1 – 40.1	SAREx(C) 07.1 – 30.1	Page
Applications/duty type					
Open-close duty	●	–	●	–	4
Positioning duty	●	–	●	–	4
Modulating duty	–	●	–	●	5
Service conditions					
Enclosure protection IP 67	●	●	●	●	10
Enclosure protection IP 68	■	■	■	■	10
High temperature version	■	–	–	–	10
Low temperature version	■	■	■	■	10
Corrosion protection KN	●	●	●	●	11
Corrosion protection KS, KX	■	■	■	■	11
Explosion protection	–	–	■	■	11
Functions					
Motor operation	●	●	●	●	12
Manual operation	●	●	●	●	8, 13
Limit seating	●	●	●	●	13
Torque seating	●	●	●	●	13
Overload protection of the valve	●	●	●	●	15
Protection against unauthorised operation	■	■	■	■	15
Protection of the motor against overheating	●	●	●	●	16
Protection against accidental changing of the valve position	● ¹	● ¹	● ¹	● ¹	16
Feedback signals²/indication					
Valve end positions	●	●	●	●	19
Valve position	■	■	■	■	19, 20
Intermediate positions	■	■	■	■	19
Actuator/valve is running	■	■	■	■	19, 20
Fault (excessive temperature)	●	●	●	●	19
Fault (torque fault)	●	●	●	●	19
Integral controls³					
AUMA MATIC	■	■	■	■	21
AUMATIC	■	■	■	■	21
Electrical connection for non-explosion-proof devices					
Electrical connection with plug/socket	●	●	–	–	22
Expanded connection compartments	■	■	–	–	22
Double sealed	■	■	–	–	22
Protection cover	■	■	–	–	22
Parking frame	■	■	–	–	22
Electrical connection for explosion-proof devices					
Plug/socket connector for explosion-proof actuators	–	–	●	●	23
Plug-in terminal connection for explosion-proof actuators	–	–	■	■	23
Double sealed	–	–	●	●	23
Protection cover	–	–	■	■	23
Parking frame	–	–	■	■	23
Valve attachment according to EN ISO 5210/DIN 3210					
Output drive types B, B1	●	●	●	●	24
A, B2, B3, B3D, B4, C, D, DD, E	■	■	■	■	24
Special output drives	■	■	■	■	24

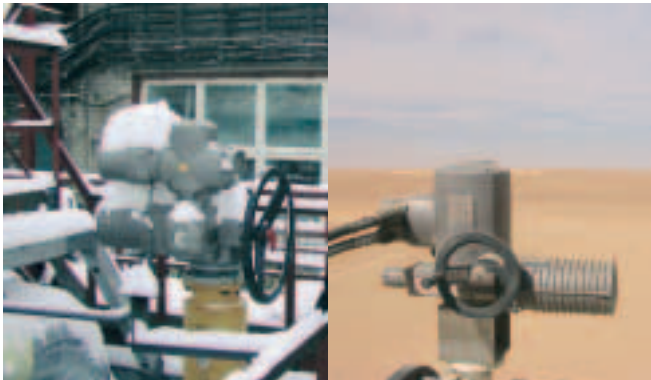
¹ For high output speeds, refer to separate technical data sheet

² For actuators without integral controls, the actuator signals have to be processed accordingly in the higher level control system.

³ up to size 16.1

Service conditions

AUMA actuators are used worldwide; in all climate zones, in industrial plants of all kinds under special local ambient conditions. AUMA actuators have to operate reliably and for a long time under any conditions without requiring major maintenance work. For this very reason, AUMA has focussed on making AUMA actuators resistant to the most unfavourable conditions and on adapting protective measures to state-of-the-art technology right from the beginning.



AUMA actuators at work – in Siberia and in the Sahara

Enclosure protection

IP 67

AUMA actuators conform to enclosure protection IP 67 according to EN 60 529. IP 67 means protection against immersion up to max. 1 m head of water for max. 30 minutes.

IP 68

AUMA actuators are available with improved enclosure protection IP 68 according to EN 60 529. IP 68 means protection against submersion up to 6 m head of water for max. 72 hours. During submersion up to 10 operations are permissible.

In order to guarantee the enclosure protection IP 68, suitable cable glands must be used. They are not part of the standard supply, but can be provided by AUMA on request.

Ambient temperatures

Types	Actuator types	Versions	Temperature range
SA	Multi-turn actuators for open-close duty	Standard Low temperature Extreme low temperature High temperature	– 25 °C ... + 80 °C – 40 °C ... + 60 °C – 60 °C ... + 60 °C 0 °C ... + 120 °C ¹
SAR	Multi-turn actuators for modulating duty	Standard Low temperature Extreme low temperature	– 25 °C ... + 60 °C – 40 °C ... + 60 °C – 60 °C ... + 60 °C
SAExC	Explosion-proof multi-turn actuators for open-close duty	Standard Low temperature Extreme low temperature High temperature	– 20 °C ... + 40 °C/60 °C ² – 40 °C ... + 40 °C/60 °C ² – 50 °C ... + 40 °C/60 °C ² – 20 °C ... + 80 °C ³
SAEx SARExC SAREx	Explosion-proof multi-turn actuators for open-close and modulating duty	Standard Low temperature Extreme low temperature	– 20 °C ... + 40 °C/60 °C ² – 40 °C ... + 40 °C/60 °C ² – 50 °C ... + 40 °C/60 °C ²

If an actuator is equipped with directly mounted AUMA MATIC or AUMATIC integral controls, the maximum permissible ambient temperature is to + 70 °C, unless the actuator requires a lower temperature limit.

¹ Valid for AUMA NORM version without electronic position transmitter RWG, with RWG max. + 80 °C

² For the temperature range + 60 °C, special sizing is required for temperature class T4.

³ In combination with explosion group IIB and temperature class T3

Corrosion protection/colour

Standard (KN)

The standard AUMA corrosion protection KN is a high quality coating. This is suitable for outdoor installation and for slightly aggressive atmospheres with a low level of pollution.

KS

AUMA recommends this corrosion protection class for installation in occasionally or permanently aggressive atmospheres with a moderate pollutant concentration.

KX

AUMA recommends this corrosion protection class for installation in aggressive atmosphere with high humidity and a high pollutant concentration.

Colour

The standard colour of the finish coating is grey (DB 702, similar to RAL 9007). Other colours are possible on request.

Explosion protection

For the installation of actuators in potentially hazardous or explosive areas, special protective measures are required. These are stipulated in the European Standards EN 50 014, 50 018, and 50 019. The PTB (Physikalisch Technische Bundesanstalt, the German national test authority) and the BVS (German Mining Test Facility) as European test authorities have certified the conformity of the equipment with the mentioned standards.

Explosion protection classification of the multi-turn actuators

Types	Classifications
SAExC 07.1 – SAExC 16.1 SARExC 07.1 – SARExC 16.1 with and without integral controls	■ II2G EEx de IIC T4 ■ II2G c IIC T4 ■ II2D Ex tD A21 IP6X T130°C
SAExC 07.1 – SAExC 10.1 SARExC 07.1 – SARExC 10.1 without integral controls	■ I M2 Ex de I
SAEx 25.1 – SAEx 40.1 SAREx 25.1 – SAREx 30.1	■ II2G EEx ed IIB T4 ¹ ■ II2G c IIB T4 ■ II2D Ex tD A21 IP6X T130°C

¹ With electronic position transmitter RWG 5020 Ex, the explosion protection classification corresponds to II2G EEx ed [ib] IIB T4 (intrinsically safe)

Certificates of Conformity from national test authorities in other countries, e.g. USA, Canada, CIS, Brazil, Japan, etc., are also available.

Functions

The function of an actuator is to electrically set a defined valve position, triggered by an operation command, e.g. from a process control system.

This seemingly simple task has to be performed under the most diverse conditions, depending on the application. This includes different switch-off criteria, safety concepts and connection to the control system. These all require special actuator configuration to provide the optimum solution for this task.

Furthermore, different protective equipment is required protecting both actuator and valve against damage or even destruction.

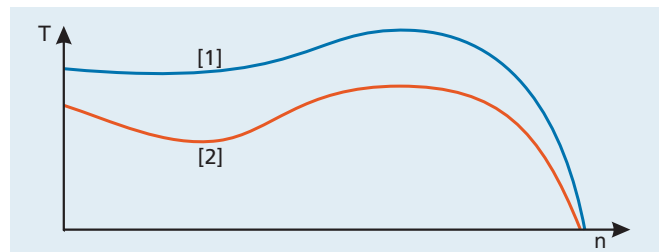
The functions described in the following can be used to find a solution to more than 90 % of the possible tasks.

In all AUMA subsidiaries, engineers will help you in finding the suitable actuator, especially for applications with special requirements.

Motor operation

During normal operation, the actuator is operated via the actuator controls which receive operation commands from the control room. If the actuator is also to be operated locally, additional local controls are required. If the actuator is equipped with optional integral AUMA controls, the local controls and the motor controls are always included.

To meet the special valve automation requirements, AUMA uses specially designed electric motors which have both a compact design and a favourable torque curve. Starting from standstill, they provide a high torque to unseat sticky valves from their end position.



Torque T depending on the output speed n

[1] AUMA 3-ph AC motor

[2] Standard motor with identical power and larger size

Actuators are generally supplied with 3-phase AC motors. These asynchronous motors have a simple design and are robust during operation.

The actuators can also be supplied with 1-phase AC or DC motors.

Manual operation

Electric actuators are always equipped with a handwheel. During commissioning, the actuator is operated manually by the handwheel for the purpose of setting the end positions.

If the power supply fails, the valve can be operated via the handwheel. The manual drive is engaged via a change-over mechanism, the connection to the motor is disconnected at the same time. The handwheel does not rotate during motor operation.

If the electric motor is switched on, the manual drive is automatically disconnected, and the transmission of torque between motor and gearing is restored.



Switching off in the end positions

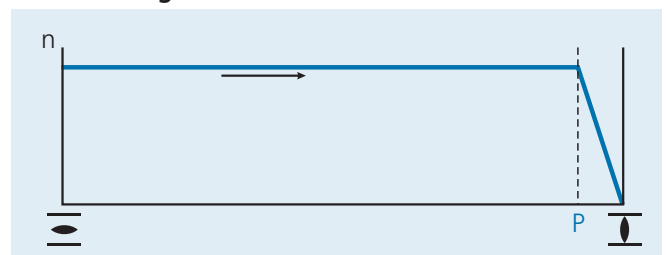
Depending on the design of the valve and/or the application, the actuator is switched off in the end positions according to one of the following procedures stipulated by the valve manufacturer:

- Limit seating, i.e. at one of the set switching positions
- Torque seating. This type of seating is used if the valve has to be moved to end position CLOSED at a defined torque.

AUMA actuators contain two independent measuring systems, limit switching and torque switching (see page 14).

The type of seating has to be considered in the actuator controls.

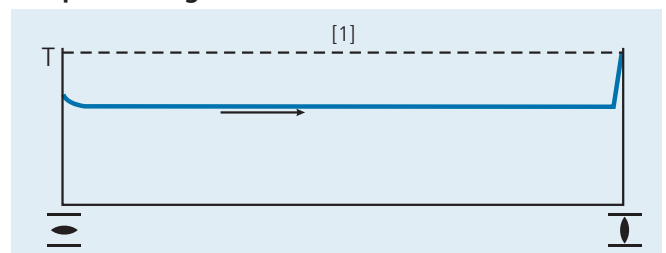
Limit seating



Output speed n depending on the travel

The actuator runs at nominal output speed up to tripping point P. When setting P, you have to account for the overrun of the actuator. The overrun is generated by the inertia of both the actuator and the valve and the delay time of the controls.

Torque seating



Torque T depending on the travel

[1] Set tripping torque

When reaching end position CLOSED the torque increases within the valve seat until the actuator is switched off after reaching the set value.

Functions

Control unit with limit and torque switching

Controls can switch off the actuator via limit and torque seating in the end positions or in case of overload. The control unit (refer to illustration on page 8) includes two independent measuring systems which measure the travel or the torque present at the output drive.

Control unit with micro switches

Travel and incoming torque are recorded via a counter gear mechanism and a lever system within the control unit. When the set switching points are reached, the corresponding micro switches are operated via cams.

The control unit contains:

- one torque switch each for the directions OPEN and CLOSE,
- one limit switch each for the end positions OPEN and CLOSED.

The switch signals trip the actuator according to the type of seating required.

Limit and torque switches are available in several versions:

- Single switch
one NC and one NO contact, not galvanically isolated.
- Tandem switch (option)
for switching two different potentials.
A tandem switch provides the electrical connection with the signal for switching off the actuator and another galvanically isolated signal.
- Triple switches (option)
For applications where three different potentials are to be switched. The switch consists of one single and one tandem switch.
- Intermediate position switch (option)
The so-called DUO limit switching contains an additional switch for setting intermediate switching points outside the end positions for each direction.

In the basic version the switch contacts are made of silver. For voltages between 5 V and 50 V and extremely low currents, switches with gold plated contacts are recommended.

Control unit with magnetic limit and torque transmitter (option)

Position and the available torque are continuously recorded via Hall sensors. The valve position and the torque present within the valve are available as continuous signals.

The magnetic limit and torque transmitter is designed to measure immediately the precise valve position once the power supply has been restored after a power failure. A reference operation is not required. The system does not require auxiliary energy, e.g. battery.

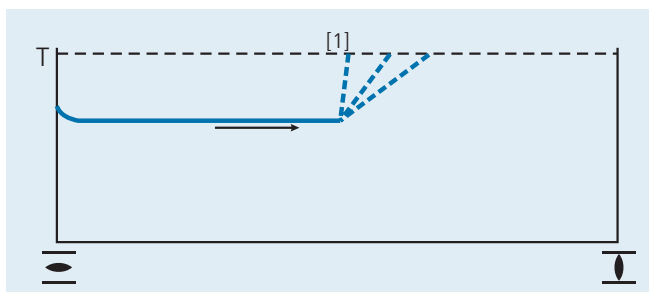
If the control unit is used with an MWG, the actuator has to be equipped with the integral AUMATIC actuator controls. A significant advantage of this combination is that all actuator parameters can be set without opening the housing or the use of any tools.

Overload protection of the valve

The torque switching acts as overload protection for the whole travel. Thereby the valve is protected against damage or destruction due to excessive torques.

If excessive torque builds up at the valve's closing element in an intermediate position, e.g. due to a trapped object, the torque switches will trip as soon as the set tripping torque is exceeded.

Correct processing of the torque signal is the prerequisite for fully functional overload protection. This is automatically ensured for actuators with AUMA integral controls.



Torque T depending on the travel

Protection against unauthorised operation (option)

The position of freely accessible valves, e.g. gate valves on rainwater catchment basins, may not be changed by unauthorised personnel.

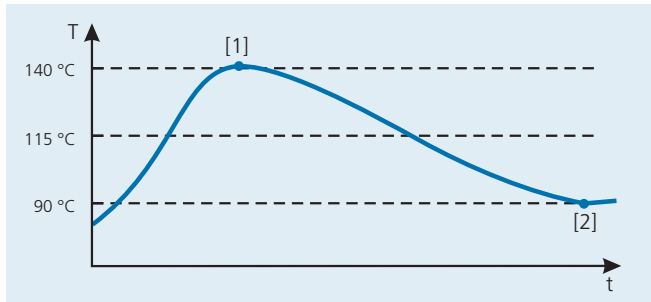
This can be prevented by securing the actuator handwheel by means of a locking device.



Functions

Protection of the motor against overheating

The windings of the 3-phase AC and 1-phase AC motors contain thermoswitches or PTC thermistors which trip as soon as the temperature within the motor exceeds 140 °C. Should this be the case, the controls have to switch off the actuator.



Motor temperature curve against time

[1] Tripping point

[2] Switch-on point

Thermoswitches or PTC thermistors offer far better protection than thermal overload relays, since the temperature rise is directly measured at the motor windings.

Actuator type	Thermoswitch	PTC thermistor
SA 07.1 – SA 48.1	Standard	Option
SAR 07.1 – SAR 30.1	Standard	Option
SAExC 07.1 – SAExC 16.1	Option ¹	Standard
SARExC 07.1 – SARExC 16.1 ²	–	Standard
SAEx 25.1 – SAEx 40.1	Option	Standard ¹
SAREx 25.1 – SAREx 30.1	–	Standard

¹ According to EN 60079-14, a thermal overload relay (e.g. motor protection switch) must be installed for these actuators in addition to the thermoswitches.

² For AUMA NORM actuators, a suitable PTC tripping device has to be included in the external controls. If the actuator is equipped with integral controls, the PTC tripping device is already included.

Protection against accidental changing of the valve position

Gravity, vibration or forces acting upon the medium within a pipeline may lead to accidental changes in the valve position. This has to be prevented.

Self-locking

Due to their design, actuators counteract torques acting upon the output side with a load. If the load prevents the valve position from being changed from standstill, this is called self-locking.

Most AUMA actuators are self-locking as standard. For actuators with high output speeds and certain actuator/gearbox combinations, self-locking can be achieved by mounting an anti-backdrive device.

Self-braking

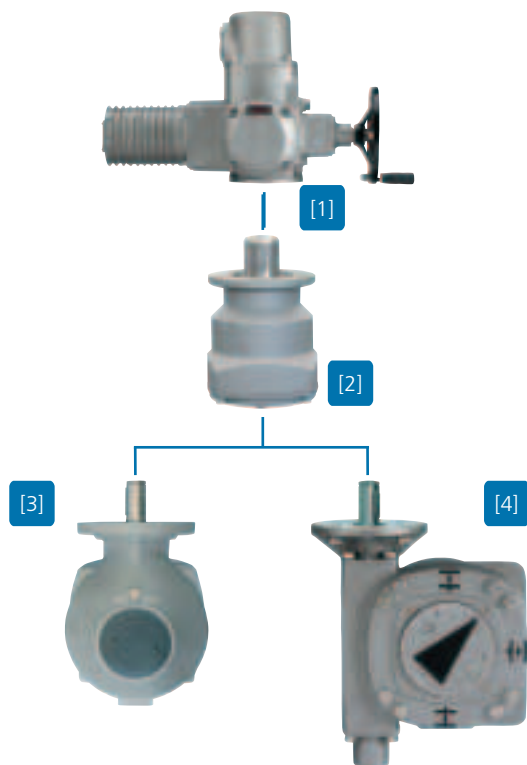
If the valve is effectively brought to a standstill after operation, this is called self-braking. The braking torque of the actuator has to correspond to at least the maximum output torque.

This requirement can also be met by using an anti-backdrive device or a brake motor.

Anti-backdrive device

By using an anti-backdrive device both self-locking and self-braking can be achieved. The retaining or braking torque corresponds to at least the maximum settable tripping torque of the actuator.

With anti-backdrive devices, the use of expensive brake motors is no longer required for many applications. The anti-backdrive device is less expensive, much simpler and safer to use.



[1] The anti-backdrive device is directly mounted to the output drive of the actuator.

[2] The actuator with anti-backdrive device can either be directly mounted to the valve or a valve gearbox, in our example a GK multi-turn gearbox [3] and a GS part-turn gearbox [4]. In this case, particularly high retaining or braking torques are available, since only the comparatively low torques at the gearbox input act upon the anti-backdrive device.

The only exception are small-size gearboxes where the anti-backdrive device is installed at the gearbox output.

Signals/indication

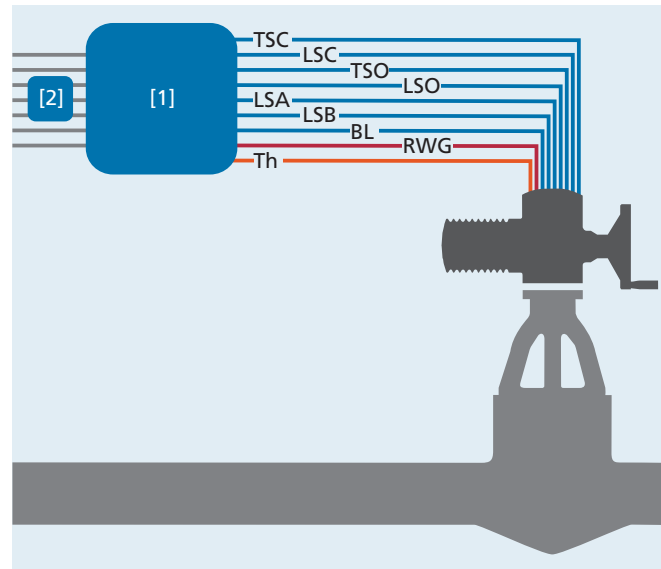
Signals are the foundation for controlling a process flow. For this reason, actuators provide a number of signals which indicate the operational status of the actuator and of the valve.

Many applications require that the actuator or the valve status can be provided locally. Depending on the equipment, the actuator offers various possibilities.

Feedback signals

The actuator signals are sent and evaluated by the actuator controls. For an AUMA NORM actuator, the signals are processed via external actuator controls, e.g. a PLC. For AUMA MATIC or AUMATIC actuators, the actuator signals are processed directly and locally; the higher level controls are provided with evaluated signals.

Actuator signals



AUMA actuator fully equipped

[1] Actuator controls, e.g. PLC

[2] Feedback signals to the DCS

[TSC] Torque switch signal in direction CLOSE

[LSC] Limit switch signal in end position CLOSED

[TSO] Torque switch signal in direction OPEN

[LSO] Limit switch signal in end position OPEN

[LSA] Intermediate position switch signal in direction CLOSE (option)

[LSB] Intermediate position switch signal in direction OPEN (option)

[BL] Blinker transmitter signal, option for actuators for modulating duty

[RWG] Electronic position transmitter 0/4 – 20 mA (option)

[Th] Thermoswitch

Feedback signals

Feedback	Actuators without integral controls (AUMA NORM)
	When using tandem switches instead of the common single switches, the signals can be fed back twice as galvanically isolated signals.
Valve end positions	Limit and torque switch signals have to be evaluated within the external controls. When processing the signals it has to be considered whether the actuator is limit or torque seated in the end positions. For limit seating, the end position signal is generated by evaluating the limit switch signals. For torque seating, the end position feedback signal is generated by combining limit and torque switch signals.
Valve position	An optional position transmitter provides the external controls with the valve position either as a voltage signal or as a 0/4 – 20 mA current signal.
Intermediate positions, e.g. for starting up a pump when reaching a particular valve position	As an option, the actuator contains two additional intermediate position switches, one for each direction (DUO limit switching)
Actuator/valve is operated	Can be provided by a blinker switch which is included in the basic version of open-close actuators and optionally available for modulating actuators.
Fault (excessive temperature)	The higher level controls have to monitor the thermoswitches installed in the actuator motor. Tripping of the thermoswitches has to switch off the actuator immediately to prevent it from being damaged. Consequently, the external controls have to generate a fault signal to be able to detect and eliminate a fault.
Fault (torque fault)	Tripping of a torque switch in mid-travel has to lead to immediate switching off of the actuator. Torque switch tripping in one of the end positions can also be part of normal operation. This is identified by the limit switch tripping at the same time. In all other cases, the tripping of the torque switch is to be interpreted as a fault. To be able to identify and eliminate a fault, the external controls have to provide a fault signal.

Feedback signals for actuators with integral controls

Integral controls have the following advantages:

- For actuators with integral controls, the above mentioned feedback signals are directly made available. This reduces the number of signals to be led to the higher level controls.
- By means of enhanced diagnostic functions, the AUMATIC provides a number of other feedback signals which can be used if required.
- The controls have binary and analogue outputs or alternatively a fieldbus interface which can be used to transmit the signals to the DCS.

Further information on these actuator types is available in the brochures:

- Product description
Actuator controls AUMA MATIC
- Product description
Actuator controls AUMATIC

Signals/indication

Local indication

Actuators without integral controls (AUMA NORM)



On request, the actuator is equipped with a mechanical position indicator which can be used to view the valve position and also as running indication. From a long distance, the mechanical position indicator is still fully legible.

For AUMA NORM actuators, the actuator signals are exclusively processed by the external actuator controls. If signals generated within these controls are required as local indication, additional display elements and signal channels become necessary.

Actuators with integral controls

Actuators with integral controls can also be equipped with the mechanical position indicator. Furthermore, the controls are complete with indication lights, or, in the case of the AUMATIC, a display, which indicate the operation status locally.

For more detailed information on local indication, refer to the following brochures:

- Product description
Actuator controls AUMA MATIC
- Product description
Actuator controls AUMATIC

Integral controls

The integral controls evaluate the actuator signals and operation commands and perform the required switching procedures automatically and without delay, using the installed switchgear, reversing contactors or thyristors. The controls make the evaluated actuator signals available to the higher level controls as feedback signals.

Actuators with integral controls are ready for operation immediately after establishing the power supply and can be operated via the operating elements.

AUMA MATIC

In its basic version, the AUMA MATIC is ideal for simple OPEN - CLOSE applications.

The AUMA MATIC provides end position indication, the selector switch position and a collective fault signal, all as feedback signals.

The behaviour of the AUMA MATIC can be adapted to the application via programming switches, e.g. programming of the type of seating.

Options:

- Three-position controller
- Fieldbus interface (Profibus DP or Modbus RTU)



AUMA MATIC local controls with push buttons, selector switches and indication lights

Further literature

Detailed information can be found in the brochure 'Product description, Actuator controls AUMA MATIC'

AUMATIC

As well as the AUMA MATIC's basic functionality, the AUMATIC offers some other advantages, e.g.

- programmable signal relays
- non-intrusive setting (option)
- adaptive positioner (option)
- fieldbus interfaces for Profibus DP, Modbus RTU, DeviceNet, Foundation Fieldbus (option)
- monitoring and diagnosis
- logging of operating data
- cable-based or wireless programming interface¹ for connecting a programming device



AUMATIC local controls with push buttons for operation and programming, selector switch, display with plain text display, indication lights and programming interface.

Further literature

Detailed information can be found in the brochure 'Product description, Actuator controls AUMATIC'

¹ The AUMATIC with programming interface is not available in both England and Japan.

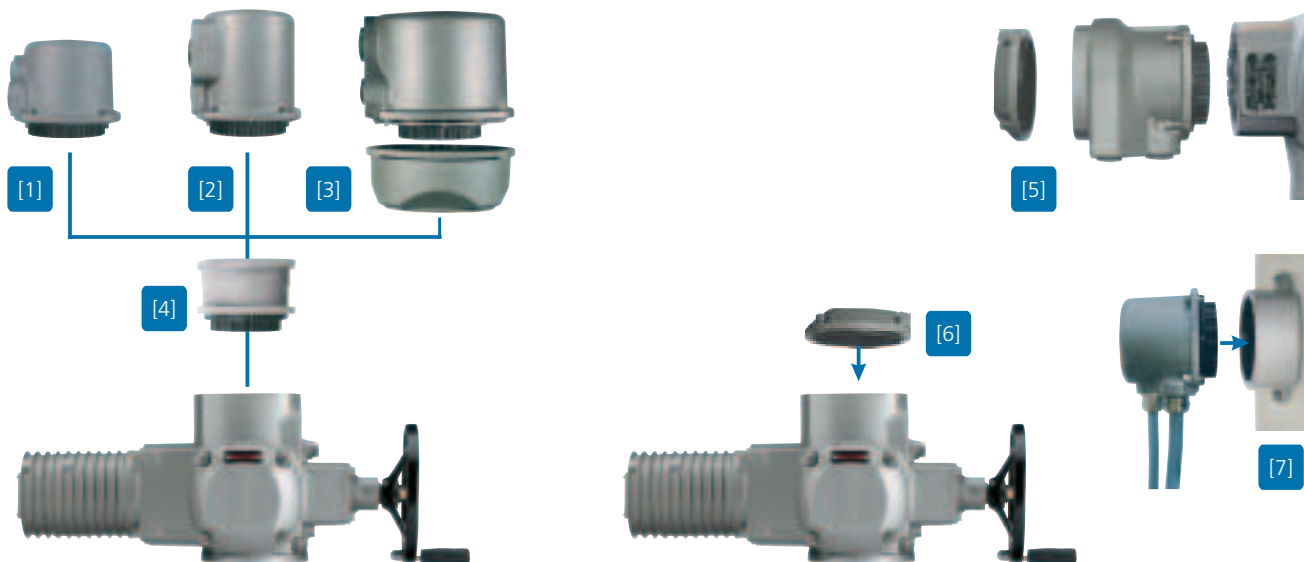
Electrical connection for non-explosion-proof actuators

AUMA non-explosion-proof actuators use a “plug-in” type electrical connection. This applies to both power supply and signal cables¹. The wiring made during installation remains undisturbed, even if the actuator has to be disconnected from the mains or the DCS, e.g. for maintenance purposes. The actuator can be quickly reconnected, wiring errors are avoided.

The electrical connection is available in different sizes. The number of cable entries may vary. The cable entries usually have metric threads, Pg- or NPT-threads are also available.

The electrical connections can be used for actuators with or without controls.

¹ For sizes SA 25.1 and larger the motor is connected to screw type terminals in the actuator terminal compartment. The controls are still wired to the AUMA plug/socket connector.



All electric connections are based on the AUMA plug/socket connector with 50 screw-type terminals for connecting the signal cables and three screw-type connections for connecting the supply voltage.

[1] Standard S

with three cable entries. The diameter is 100 mm.

[2] Enlarged terminal compartment SH (option)

with up to six cable entries

[3] Enlarged terminal compartment SE (option)

with three cable entries. The diameter is 135 mm. An intermediate frame is required for adapting to the actuator housing.

[4] Double sealed intermediate frame (option)

When removing the plug cover or due to leaky cable glands, ingress of dust and water into the housing is possible. This is prevented by inserting the double sealed intermediate frame between the electrical connection and actuator housing. The enclosure protection, IP 67 or IP 68, will not be affected, even if the electrical connection is removed. The double sealed intermediate frame can be combined with any of the illustrated electrical connections.

[5] Fieldbus connection SD

If the actuator is equipped with actuator controls with a fieldbus interface, a special electrical connection is required. The connection of the power supply does not differ from the other electrical connections, a connection board for connecting the fieldbus cables is integrated into the plug.

[6] Protection cover

for protecting the plug compartment when plug is removed.

[7] Parking frame

for safe mounting of a disconnected plug.

Electrical connection for explosion-proof actuators

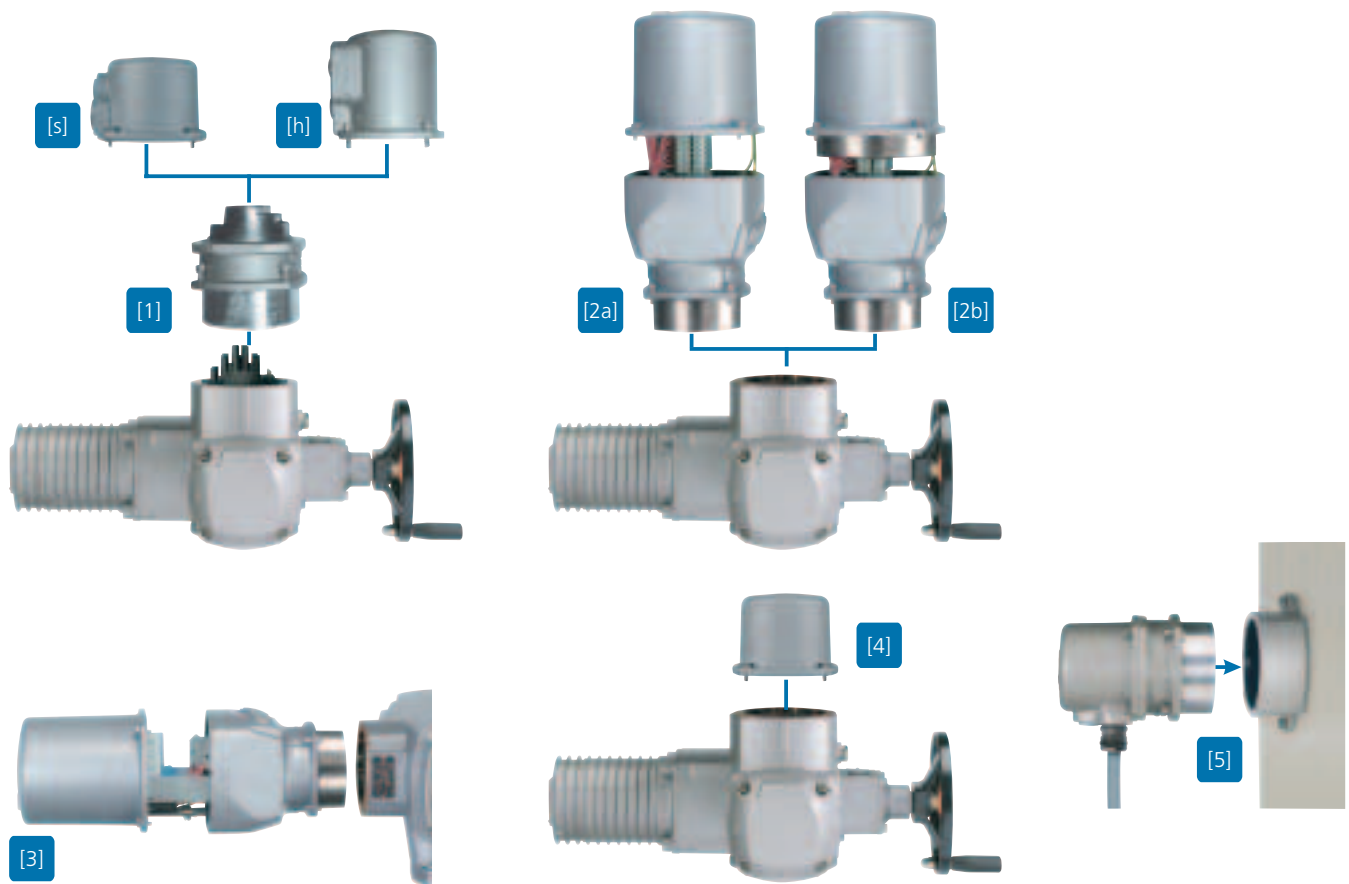
AUMA explosion-proof actuators use a “plug-in” type electrical connection.¹ This applies to both power supply and signal cables. The wiring made during installation remains undisturbed, even if the actuator has to be disconnected from the mains or the DCS, e.g. for maintenance purposes. The actuator can be quickly reconnected and wiring errors are avoided.

Explosion-proof connections are always double sealed: The flameproof enclosure inside the actuator remains intact even after removing the plug cover.

The electrical connection is either designed in the protection type “Increased safety” or “Flameproof enclosure”.

The electrical connections can be used for actuators with or without controls.

¹ For the explosion-proof multi-turn actuators SAEx 25.1 – SAEx 40.1 the terminal connection cannot be plugged in.



[1] Plug/socket connector with screw-type terminals KP

with 38 screw-type connections for the signal cables. This connection type is the standard connection for explosion-proof actuators, even for those with a fieldbus interface. The connection can be supplied with a standard plug cover (s) with three cable entries or with a high (h) plug cover with up to six cable entries. The connection with the high (h) cover is also used for devices with integral controls and fieldbus interface.

[2] Plug/socket connector with spring cage terminal blocks KES

with up to 50 spring-cage terminal blocks for connecting signal cables. Used with operating voltages exceeding 525 V and/or if a large number of terminals are required. The electrical connection has up to 6 cable entries. The connection is available in protection type “Increased safety” [2a] or “Flameproof enclosure” [2b].

[3] Plug/socket connector with FO coupler KES

This connection type is used for actuators with AUMATIC integral controls with a fieldbus interface and signal transmission via fibre optics. The design basically corresponds to the plug/socket connector with spring cage terminals with the addition of an FO coupler.

[4] Protection cover

for protecting the plug compartment when the plug is removed.

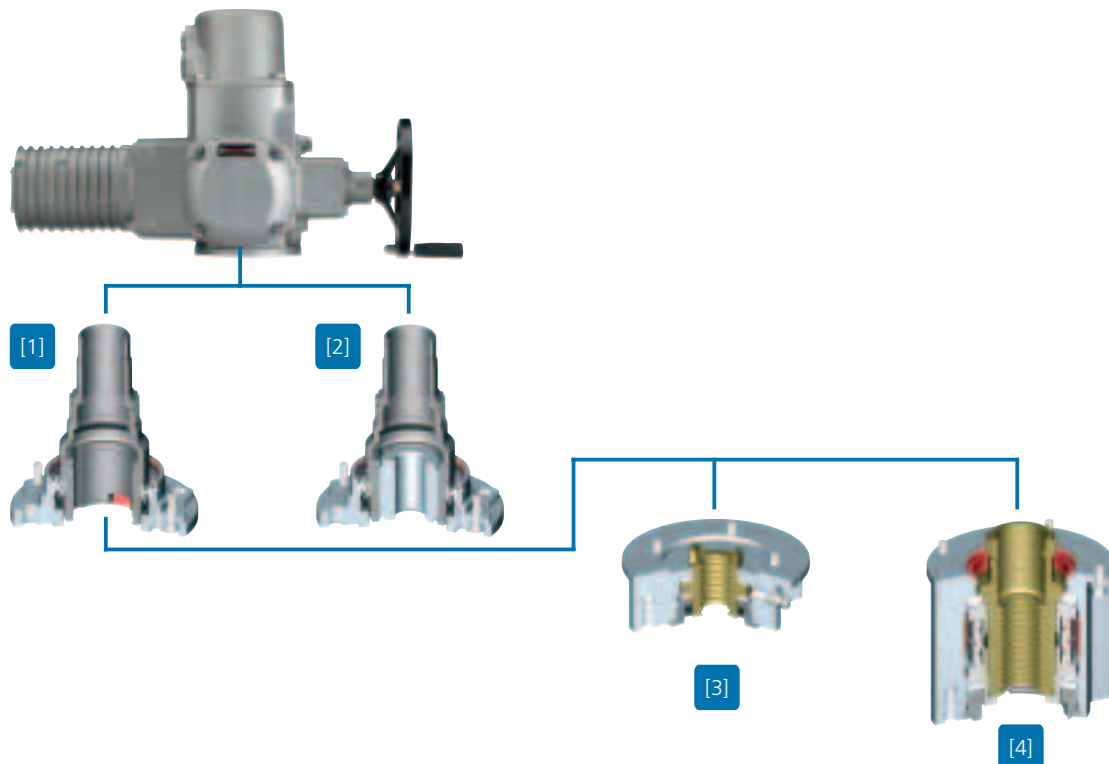
[5] Parking frame

for safe mounting of a disconnected plug. The parking frame with mounted plug is protected against the ingress of both dust and water.

Valve attachment

The actuator is mounted to the valve using a mounting flange standardised according to EN ISO 5210 or DIN 3210.

The output drive types are also manufactured according to these standards. They establish the mechanical connection between the output drive of the actuator and the valve stem or the valve shaft. The torque is transmitted from the actuator to the valve using this connection. There are various output drive types for available different valve types. The most common output drive types are illustrated below.



[1] Output drive types B1, B2 (EN ISO 5210), or B (DIN 3210)

The output drive is integrated in the hollow shaft of the actuator. The torque is transmitted via a parallel key. Low radial loads can be accepted.

[2] Output drive types B3 or B4 (EN ISO 5210), or E (3210)

The torque is transmitted via a parallel key. By using a plug sleeve, output drive type B1 can easily be converted to output drive types B3 or B4.

[3] Output drive type A (EN ISO 5210/DIN 3210)

Stem nut for rising and non-rotating valve stems. The mounting flange together with the stem nut and thrust bearings form an assembly, which is suitable for accepting thrust. The unit is screwed to the actuator whose hollow output shaft is designed as output drive type B1. Output drive type A cannot accept any radial loads.

[4] Output drive type AF (EN ISO 5210/DIN 3210)

Spring-loaded stem nut for rising and non-rotating valve stems. The springs compensate for dynamic thrust at high speeds or even for thermal expansion of the valve stem. This unit is screwed to the actuator which contains a hollow shaft with internal teeth.

[5] Special output drive types (without illustration)

Further output drive types are available besides those described:

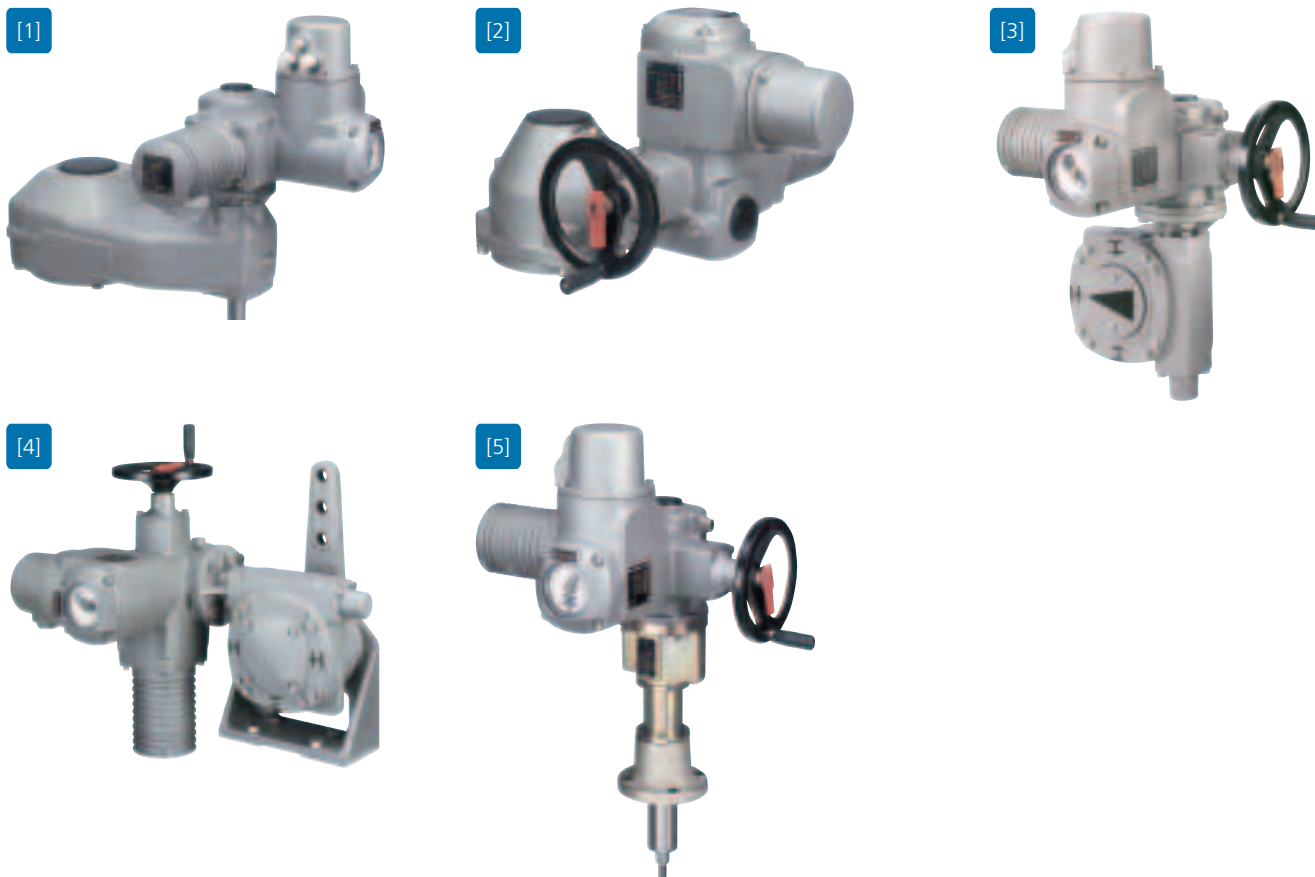
- Pendulum stem nut AK
- Stem nut with plain bearings AG
- Hexagon in hollow shaft
- Insulated output drives IB1 and IB3

For detailed information on special output drive types refer to the separate data sheets and price lists.

Combinations with valve gearboxes

AUMA valve gearboxes are an essential part of the modular product range. They can be combined with virtually any AUMA multi-turn actuator.

Detailed information on gearboxes can be found in separate brochures and on separate technical data sheets.



[1] Multi-turn actuator with spur gearbox GST 10.1 – GST 40.1

- Torques up to 16,000 Nm

The GST meets the following criteria:

- Expansion of the torque range of an actuator size. The combination of a small actuator with gearbox is often more cost-effective than a large actuator.
- Adaptations to special mounting conditions

[2] Multi-turn actuator with bevel gearbox GK 10.2 – GK 40.2

- Torques up to 16,000 Nm

The GK basically has the same functionality as the GST. Furthermore, so-called double-stem solutions can be provided by using two GK gearboxes and an SA actuator.

[3] Multi-turn actuator with worm gearbox GS 50 – GS 500

- Torques up to 360,000 Nm

The GS worm gearboxes convert the multi-turn movement at the output shaft of the multi-turn actuator into a part-turn movement, generally 90°. The combination of a multi-turn actuator and worm gearbox forms a part-turn actuator. Solutions are therefore available for large part-turn valves with high torque requirements.

[4] Multi-turn actuator with lever gearbox GF 50.3 – GF 250.3

- Torques up to 32,000 Nm

These combinations can be used to automate valves which are operated via a lever arrangement.

[5] Multi-turn actuator with linear thrust unit LE 12.1 – LE 200.1

- Thrusts up to 217 kN
- Strokes up to 500 mm

The linear thrust unit converts the rotary movement of the actuator output shaft into a linear movement. The combination of a multi-turn actuator and linear thrust unit forms a linear actuator.

Technical data

Multi-turn actuators for open-close duty

The following data is valid for actuators with 3-phase AC motors with an S2 - 15 min duty type. For detailed information, restrictions for actuators with high output speeds as well as data on other motor types and types of duty refer to separate technical data sheets.

Type	Output speeds at 50 Hz ¹	Setting range for tripping torque	Valve mounting flange	
	[rpm]	[Nm]	Standard (EN ISO 5210)	Option (DIN 3210)
SA/SAExC 07.1	4 – 180	10 – 30	F07 or F10	G0
SA/SAExC 07.5	4 – 180	20 – 60	F07 or F10	G0
SA/SAExC 10.1	4 – 180	40 – 120	F10	G0
SA/SAExC 14.1	4 – 180	100 – 250	F14	G½
SA/SAExC 14.5	4 – 180	200 – 500	F14	G½
SA/SAExC 16.1	4 – 180	400 – 1,000	F16	G3
SA/SAEx 25.1	4 – 90	630 – 2,000	F25	G4
SA/SAEx 30.1	4 – 90	1,250 – 4,000	F30	G5
SA/SAEx 35.1	4 – 45	2,500 – 8,000	F35	G6
SA/SAEx 40.1	4 – 32	5,000 – 16,000	F40	G7
SA 48.1	4 – 16	10,000 – 32,000	F48	–

¹ Fixed output speeds multiplied by 1.4

Multi-turn actuators for modulating duty

The following data is valid for actuators with 3-phase AC motors with an S4 - 25 % duty type. For detailed information and data on other motor types and types of duty refer to separate technical data sheets.

Type	Output speeds at 50 Hz ¹	Setting range for tripping torques	Permissible average torque for modulating duty	Valve mounting flange	
	[rpm]	[Nm]	[Nm]	Standard (EN ISO 5210)	Option (DIN 3210)
SAR/SARExC 07.1	4 – 45	15 – 30	15	F07 or F10	G0
SAR/SARExC 07.5	4 – 45	30 – 60	30	F07 or F10	G0
SAR/SARExC 10.1	4 – 45	60 – 120	60	F10	G0
SAR/SARExC 14.1	4 – 45	120 – 250	120	F14	G½
SAR/SARExC 14.5	4 – 45	250 – 500	200	F14	G½
SAR/SARExC 16.1	4 – 45	500 – 1,000	400	F16	G3
SAR/SAREx 25.1	4 – 11	1,000 – 2,000	800	F25	G4
SAR/SAREx 30.1	4 – 11	2,000 – 4,000	1,600	F30	G5

¹ Fixed output speeds multiplied by 1.4

Supply voltages/mains frequencies

The standard supply voltages are listed below. Not all actuator versions or sizes are available with all motor types or voltages/frequencies. For detailed information refer to the separate electric data sheets.

3-phase AC

Voltages	Frequency
[V]	[Hz]
220; 230; 240; 380; 400; 415; 500	50
440; 460; 480	60

1-phase AC

Voltages	Frequency
[V]	[Hz]
230	50
115	60

DC current

Voltages
[V]
24; 48; 60; 110; 220

Lifetime of multi-turn actuators for open-close duty

An operation cycle is based on an operation from CLOSED to OPEN and back to CLOSED, with a travel of 30 turns per stroke.

Type	Operation cycles
SA/SAExC 07.1 – 10.1	20,000
SA/SAExC 14.1 – 16.1	15,000
SA/SAEx 25.1 – 30.1	10,000
SA/SAEx 35.1 – 48.1	5,000

Lifetime of multi-turn actuators for modulating duty

The lifetime depends on the load and the number of starts. A high starting frequency will rarely improve the modulating accuracy. To reach the longest possible maintenance and fault-free operation time, the number of starts per hour chosen should be as low as possible for the process. This can be achieved by setting the modulating parameters accordingly.

Type	Modulating steps in millions	Number of starts ¹
	min.	max/h
SAR 07.1 – 10.1	5	1,200
SARExC 07.1 – 10.1	5	900
SAR 14.1 – 14.5	3.5	1,200 ²
SARExC 14.1 – 14.5	3.5	900 ²
SAR 16.1	3.5	900 ²
SARExC 16.1	3.5	600 ²
SAR 25.1 – 30.1	2.5	300
SAREx 25.1 – 30.1	2.5	300

¹ Based on the permissible average torque in the modulating duty according to 'Technical data SAR'

² Reduced number of starts for high output speeds

Technical data

Motor duty types (according to IEC 34-1)

Depending on service conditions, open-close or modulating duty and running time, the motors are available with different duty types. The motors are not designed for permanent operation S1, but for short-time duty S2 or intermittent duty S4. Additional cooling of the motors is not required whilst a high enclosure protection is maintained.

The time information for short-time duty S2 indicates the maximum permissible running time without interruption; the motor then has to cool down to ambient temperature. The percentages given for intermittent duty S4 indicate the percentage of the operation time in relation to the pause time.

	3-phase AC	1-phase AC	DC current
SA 07.1 – 48.1	S2 - 15 min S2 - 30 min	S2 - 10 min ¹	S2 - 15 min
SAR 07.1 – 30.1	S4 - 25 % S4 - 50 %	S4 - 25 % ²	–
SAEx(C) 07.1 – 40.1	S2 - 15 min S2 - 30 min	S2 - 15 min ¹ S2 - 30 min ¹	S2 - 15 min ³
SAREx(C) 07.1 – 30.1	S4 - 25 %	S4 - 25 % ²	–

¹ up to size 14.5

² up to size 14.1

³ for size 07.1

Mounting position

AUMA actuators (with or without integral controls), can be operated without restriction in any mounting position.

Noise level

The noise level caused by the multi-turn actuator does not exceed 72 dB (A).

Vibration resistance

according to EN 60068-2-6.

The actuators are resistant to vibrations during start-up or failure of the plant up to 2 g, for a frequency range of 10 to 200 Hz. However, a fatigue strength may not be derived from this.

This data is valid for multi-turn actuators without integral controls with AUMA plug/socket connector or Ex-plug/socket connector (KP), but not in combination with gearboxes.

Certificates

Declaration of Incorporation/certificate of conformity

Declaration of incorporation in accordance with Machinery Directive

According to this EU directive, AUMA actuators, actuator controls and valve gearboxes are not complete machines. This means that a Declaration of conformity in accordance with the Machinery Directive cannot be issued by AUMA. AUMA's Declaration of Incorporation confirms that during the design stage of the devices, the standards mentioned in the Machinery Directive were applied. The Declarations of Incorporation are included in the operation instructions of the devices.

Only by mounting the actuator to other components (valves, pipelines etc.) a 'machine' within the meaning of the directive is formed. Before commissioning this machine a Certificate of Conformity must be issued.

Certificate of conformity in accordance with Low Voltage, EMC, and ATEX directive

AUMA actuators fulfil the requirements of these EU directives, which has been proved in extensive tests. Therefore AUMA offers a Declaration of Conformity.

The Declarations of Conformity are included in the operation instructions of the devices.

Compulsory marking with CE mark

AUMA products meet the requirements of the mentioned EU directives. The name plate is therefore marked with the CE mark.



Final inspection record

After assembly, all actuators are thoroughly tested according to AUMA's inspection specification and the torque switches are calibrated. The procedure is recorded on the final inspection record.

Certificates

To prove the suitability of the devices for special applications, notified bodies perform type tests on the devices. One example are the tests to which explosion-proof devices are subjected. If a device has passed the test, this is recorded in a certificate. For all explosion-proof devices mentioned in this brochure, the relevant certificates can be provided.

Where can I get the certificates?

All certificates and records are provided by AUMA on request either digitally or as hardcopy.

The documents can be downloaded from the AUMA website 7/24; some of them are password protected.



Quality is not just a matter of trust

Actuators must be reliable and dependable. They determine the cycle of accurately defined work processes.

But reliability does not begin in production. It begins with a well thought out design and careful selection of materials. This continues with conscientious production.

At AUMA, quality management is monitored on a daily basis. Numerous customer and independent audits, backed by ISO 9001 and ISO 14001 certification confirm these high standards.



The actuator specialist

At AUMA, everything revolves around the electric actuator. In a world where industrial processes have become increasingly complex, concentration is an asset - while still being able to see the bigger picture.

AUMA has to cope with a multitude of requirements from the most different applications and from every corner of the world - this is our daily business. We rise to this challenge by pursuing a clear but flexible product policy - supplying the ideal actuator to every customer.

For this purpose, you have to know your markets. Thinking globally means acting regionally. A comprehensive worldwide sales and service network ensures that there is a competent local contact for every customer.

Since 1964, AUMA has established an excellent brand name in the world of actuators. Reliability and innovation are concepts which are closely linked with AUMA. This is above all to be credited to AUMA's dedicated employees who work enthusiastically on the future of the actuator.



Further literature

Brochures

- Information
Electric actuators and valve gearboxes according to ATEX directive 94/9/EC for the use in potentially explosive atmospheres
- Information
Electric part-turn actuators SA/GS combinations
- Product description
Actuator controls AUMA MATIC
- Product description
Actuator controls AUMATIC

Technical data

- Multi-turn actuators for open-close duty with 3-phase AC motors
SA 07.1 – SA 48.1
- Multi-turn actuators for open-close duty with 1-phase AC motors
SA 07.1 – SA 14.5
- Multi-turn actuators for open-close duty with DC motors
SA 07.1 – SA 16.1
- Multi-turn actuators for open-close duty with 3-phase AC motors
SAExC 07.1 – SAExC 16.1
- Multi-turn actuators for open-close duty with 3-phase AC motors
SAEx 25.1 – SAEx 40.1
- Multi-turn actuators for modulating duty with 3-phase AC motors
SAR 07.1 – SAR 30.1
- Multi-turn actuators for modulating duty with 1-phase AC motors
SAR 07.1 – SAR 14.1
- Multi-turn actuators for modulating duty with 3-phase AC motors
SAREx 07.1 – SAREx 16.1

- Multi-turn actuators for modulating duty with 3-phase AC motors
SAREx 25.1 – SAREx 30.1

Furthermore, there are electrical data sheets, dimension sheets, proposed wiring diagrams and wiring diagrams available.



The latest issues of the entire documentation can be downloaded as PDF files from www.auma.com.

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[1] Multi-turn actuators
SA 07.1 – SA 48.1
Torques from 10 to 32,000 Nm
Output speeds from 4 to 180 rpm

[2] Multi-turn actuators SA/SAR
with controls AUMATIC
Torques from 10 to 1,000 Nm
Output speeds from 4 to 180 rpm

[3] Linear actuators SA/LE
Combination of multi-turn actuator SA
with linear thrust unit LE
Thrusts from
4 kN to 217 kN
Strokes up to 500 mm
Linear speeds
from 20 to 360 mm/min

[4] Part-turn actuators
SG 05.1 – SG 12.1
Torques from 100 to 1,200 Nm
Operating times for 90° from 4 to 180 s

[5] Part-turn actuators SA/GS
Combination of multi-turn actuator SA with
part-turn gearbox GS
Torques up to 360,000 Nm

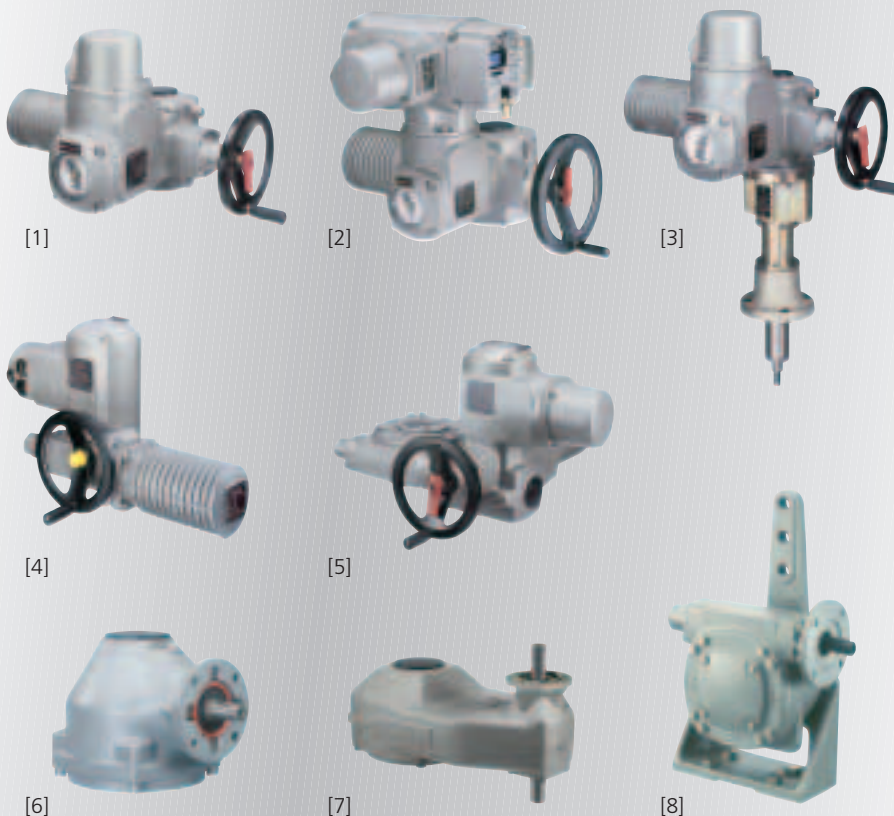
[6] Bevel gearboxes
GK 10.2 – GK 40.2
Torques up to 16,000 Nm

[7] Spur gearboxes
GST 10.1 – GST 40.1
Torques up to 16,000 Nm

[8] Worm gearboxes with base and lever
GF 50.3 – GF 250.3
Torques up to 32,000 Nm

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