

ELECTRIC ACTUATORS LAST POSITION

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1. Application

Electric actuators provide the actuation force/torque in one of several ways. Electromechanical actuators may be used to power a motor that converts electrical energy into mechanical torque.

Electrical energy is used to actuate equipment such as control valves type on-off or modulated. The electric actuators can operate many types of valves like, butterfly, plug, ball, gate, globe, knife, etc. Available with three electric drive system: quarter-turn, multi-turn and linear.

The advantage of an electrical actuator against pneumatic or hydraulic ones is that they do not need air or oil supply, and normally electrical power is easier to install and often available at the site. The disadvantage is that the operation time is normally longer than with other type of actuators.



2. Principle of operation

Electric actuators are equipped with an electric motor in combination with a gearbox, particularly developed for valve automation, providing the torque required for operating the moving elements of the valves (rotation or linear). For the manual valve operation, if required, it is possible to use a handwheel. Some of the models incorporate this option as standard.

Typically, controls are integrated within the actuator and are equipped with a local control unit apart from the electrical interface to the control system. The control unit is responsible for switching the actuator motor on and off and records travel and torque data from the valve.

3. Compact electric actuators

The desire for actuators with integrated controls, especially for installations with limited space, has been expressed repeatedly by our customers and was thus the basis for the development of this product series. By employing innovative gearing and motor technology, it was developed as compact multi-turn actuator with integrated controls. By using new materials, it was also possible to cut down on the weight considerably.



3.1 Key Features

- Actuator for on-off (S2) and modulating control (S4) (See details in page xx)
- ATEX compliant, with explosion-proof housings
- Power supply voltages from 24 V up to 220 V DC or up to 400 V AC 3ph
- As rotary actuators: up to 62Nm, with gearboxes: up to 500Nm
- As semi-rotary (quarter turn 90°) actuators: up to 15.000 Nm
- As linear actuators: up to 25kN and 200mm stroke
- Adjustable speed/positioning time

This is an electric multi-turn actuator with integral control unit & frequency inverter technology for installation on valves, worm gear boxes, linear units and multi turn gearboxes.



Motor	PM-motor (permanent magnet motor) controlled via frequency inverter
Isolation Class	F
Operation mode	version for short operation duty (on-off) S2-15 min version for modulating duty S4-1200 cycles/hour with 40% duty cycle (see details in page 13)
Power supply	AC 1 x 90 – 240 V / 50/60 Hz AC 3 x 380 – 400 V / 50/60 Hz DC 100 – 220 V DC 24 V
Local control	Selector LOCAL-OFF-REMOTE, lockable Control switch OPEN-STOP-CLOSE LCD display for visualization and status information, in different languages 5 LED's for status indication and control information Cover lid in 90° steps rotatable Infrared interface for data exchange Bluetooth interface for data exchange
Remote control	5 binary inputs 24/48 V DC free programmable
Status signals	8 binary outputs 24/48 V DC free programmable
Handwheel	for manual operation
Valve connection	to ISO 5210 (for direct connection of the actuator to the valve)
Ambient temperature	-25°C up to +60°C
Enclosure protection	IP 67 according EN 60 529 and IEC529
Options	-Bus interface (see detailed description below) -Analog position feedback with 0/4...20 mA signal (2-wire) -Positioner with input of 0/4...20 mA signal -Special paintings -Explosion protection II 2 G Ex de IIC T4 or T6 Gb (up to 60 Nm) -Other options on request

3.2 Versions

3.2.1 Direct multi-turn actuators for on-off service up to 64 Nm

With power supply 1phase & 3phase AC

For on-off duty: maximum torque 32Nm, 64Nm

For modulating duty: not available

With power supply 24V DC

For on-off duty and up to 5rpm: maximum torque 32Nm

For on-off duty and up to 20rpm: maximum torque 10Nm

For modulating duty: not available

3.2.2 Multiturn actuators with gearboxes for on-off, modulating and linear service

Multi turn compact actuators with spur or bevel gearboxes for torque from 40 Nm up to 10.000 Nm and linear force from 20 kN up to 1100 kN

Power supply	1phase & 3phase AC or 24V DC
Rotation	clockwise rotation of drive sleeve by clockwise rotation of input shaft
Connection to valve	according to ISO 5211 (through the gearbox)
Ambient temperature	-40°C up to 120°C
Enclosure protection	IP 67 according EN 60 529 and IEC529
Corrosion protection	for installation in aggressive atmosphere
Gear input	input shaft with key for handwheel or with input shaft from the actuator according to ISO 5210
Gear output	output sleeve blank or special version upon request
Options	-low temperature design -60°C up to +100°C -high temperature design -20°C up to 150°C -special color



3.2.3 Quarter turn (90°) compact actuator with gearbox from 250 Nm up to 32.000 Nm

Power supply	1phase & 3phase AC or 24VDC (with reduced torque)
Rotation	clockwise rotation
Connection to valve	according to ISO 5211
Ambient temperature	-40°C up to 120°C
Enclosure protection	IP 67 according EN 60 529 and IEC529
Corrosion protection	for installation in aggressive atmosphere
Gear output	basic plate with flange size according ISO 5210 without center ring E-worm gearbox: plug insert 45° turnable. For large gearbox size an output blank drive sleeve is available.
Position indicator	mechanical position indicator on gearbox
Options	-low temperature design -60°C up to +100°C -high temperature design -20°C up to 150°C -enclosure protection IP68 EN 60 529 and IEC529 -marine design

3.2.4 Direct linear compact actuator with force up to 26 KN

Power supply	1phase & 3phase AC or 24VDC
Rotation	spindle of linear unit moves out of the housing with clockwise movement of the actuator and closes the valve
Flange to actuator	according to ISO 5210
Ambient temperature	-25°C up to +80°C
Enclosure protection	IP 66 or IP67 according to EN 60 529 and IEC529 (must be specified)
Corrosion protection	for installation in aggressive atmosphere
Connection to the valve	norm flange according EN ISO 5210
Maximum stroke	up to 500 mm
Maximum force	20 kN force in S4-duty (for details please see page 13)



All compact actuators are available for installation in explosive atmospheres. Explosion protection II 2 G Ex de IIC T4 or T6 Gb according to ATEX Directive 2014/34/EU.

4. High performance robust electric actuators



4.1 Key Features

- Actuators for on-off (S2) and modulating (S4) control (for details please see page 13)
- ATEX compliant and explosion-proof actuators (If required)
- Power supply voltages from 24 V DC to 690 V AC 3-phase
- As multiturn actuators with torque up to 5,000 Nm, with gearboxes up to 43,000 Nm
- As quarter-turn (90°) actuators with torque up to 300,000 Nm
- As linear actuators with force up to 400 kN and 500 mm stroke
- Positioning times from 3 seconds or 40 mm/sec.

4.2 Versions available

4.2.1 Direct multiturn actuators for on-off and modulating service

General specifications:

Control unit	1 limit switch each for end position Open/Close 1 torque switch each for closing and opening flashing switch for running indication (Only applicable for On-Off version) heater 230 V >AC, 5 W
Handwheel	for manual operation
Connection to valve	according to ISO 5210 and/or DIN 3210
Ambient temperature	-25°C to +80°C in on-off duty and -25°C to +80°C in modulating duty
Enclosure protection	IP66 according to EN 60 529 and IEC529 (IP54 with DC motor)
Corrosion protection	for installation in aggressive atmosphere
Options	-Intelligent control unit (see description below) -Protection enclosure IP68 waterproof according EN 60 529 and IEC 529 -Extreme temperatures -60°C to + 100°C -Bus interface (see detailed description below) -Analog position feedback with 0/4...20 mA signal (2-wire) -Positioner with input of 0/4...20 mA signal

Note: Multiturn actuators with gearboxes are available for torque till 43.000 Nm.

Direct multiturn actuator for on-off duty with torque from 7 Nm up to 5.000 Nm, 3 phase motor

Motor	3 phase AC motor, insulation class F
Mode of operation	S2 – 20 min

Direct multiturn actuator for modulating duty with torque from 7 Nm up to 5.000 Nm with 3 phase motor

Motor	3 phase AC motor, insulation class F
Mode of operation	Modulating duty S4-1200 cycles per hour with 40% duty cycle (for details please see page 13)

Direct multiturn actuator for on-off duty with torque from 7 Nm up to 500 Nm with 1 phase motor

Motor	1 phase motor, insulation class F
Mode of operation	S2 – 15min (for details please see page 13)

Direct multiturn actuator for modulating duty with torque from 7 Nm up to 500 Nm with 1 phase motor

Motor	1 phase motor, insulation class F
Mode of operation	with AC or DC-motor: Modulating duty S4-1200 cycles per hour with 40% duty cycle (for details please see page 13)

4.2.2 Quarter turn actuators with gearbox for on-off and modulating service

General specifications (Basic design):

Rotation	Clockwise rotation of insert by clockwise rotation of input shaft
Position indicator	Mechanical position indicator on gearbox
End stops	End stop with screw for an easily stroke adjustment between 0° and 90° (+/- 5° adjustable)
Self-locking	Self-locking gearbox with single worm
Gear output	plug insert 45° turnable, drive sleeve with screws in 45° steps turnable or drive sleeve blank
Handwheel	for manual operation
Actuator connection	according to ISO 5210
Valve connection	according to ISO 5211
Ambient temperature	-20/-40°C to +120°C
Enclosure protection	IP67 according to EN 60 529 and IEC529
Corrosion protection	for installation in aggressive atmosphere
Options	-Intelligent control unit (see description below) -Protection enclosure IP68 waterproof according EN 60 529 and IEC 529 -Low temperature: -60°C to + 100°C -High temperature: -20°C to + 150°C -Marine design -Bus interface (see detailed description below)

Quarter turn actuator with gearbox (90° or 120°) for on-off duty, torque up to 300.000 Nm

Motor	3 phase AC motor, insulation class F
Mode of operation	S2 – 20 min (for details please see page 13)

Quarter turn actuator with gearbox (90° or 120°) for modulating duty, torque up to 300.000 Nm

Motor	3 phase AC motor, insulation class F
Mode of operation	Modulating duty S4-1200 cycles per hour with 40% duty cycle (for details please see page 13)

Quarter turn actuator with gearbox (90° or 120°) for on-off duty, torque up to 300.000 Nm

Motor	1 phase motor, insulation class F
Mode of operation	S2 – 15min (for details please see page 13)

Quarter turn actuator with gearbox (90° or 120°) for modulating duty, torque up to 300.000 Nm

Motor	1 phase motor, insulation class F
Mode of operation	with AC or DC-motor: Modulating duty S4-1200 cycles per hour with 40% duty cycle (for details please see page 13)



4.2.3 Direct multiturn actuators for linear service

General specifications (Basic design):

Movement	The spindle of the linear-Unit moves out of the housing with clockwise rotation of the actuator and closes the valve
Handwheel	for manual operation
Valve connection	according to ISO 5210
Ambient temperature	-25°C to +80°C
Enclosure protection	IP66 according to EN 60 529 and IEC529
Corrosion protection	for installation in aggressive atmosphere
Options	<ul style="list-style-type: none"> -Intelligent control unit (see description below) -Protection enclosure according EN 60 529 and IEC 529 IP68 waterproof -Low temperature: -60°C to +100°C -High temperature: -20°C to +150°C -Marine design -Bus interface (see detailed description below) - Analogue 4-20mA signals in additional logic circuit board for position transmission or positioner control with 4-20mA from PLC

Direct multi-turn actuator with linear function with force up to 350 kN



All high-performance versions are available for installation in explosive atmospheres. Explosion protection II 2 G Ex de IIC T4 or T6 Gb according to Directive 2014/34/EU (ATEX).

5. Control unit for high performance actuators



Power switching	reversing contactors (mechanically & electrically interlocked) for motor power up to 5,5 kW, for motor power from 5,5W up 22kW or thyristor unit for modulating duty as option
Local control	<ul style="list-style-type: none"> -Selector LOCAL-OFF-REMOTE, lockable -Control switch OPEN-STOP-CLOSE -Large LCD display for detail visualization, status information & adjustment of parameters in different languages. -White display backlight for normal operation, red display backlight for alarms -5 LED's for status indication and control information -Cover lid with display in 90° steps rotatable -Infrared interface or Bluetooth interface for data exchange and actuator control with android App or windows PC
Remote control	<ul style="list-style-type: none"> -5 binary inputs 24/48 V DC free programmable Open-Stop-Close-Emergency Open-Emergency Close, free programmable, 24 V DC rated voltage with common ground potential, inputs configurable with jumpers in groups with separated commons
Status signals	<p>8 binary outputs:</p> <p>Ready-Open-Closed-Opening-Closing-Torque-Local-Remote, free programmable, 24 V DC supply, max. load 0,5A/channel</p>
Motor protection	Monitoring of motor temperature (with thermo switches in the motor), phase sequence monitoring or automatic correction with 3-phase motor for safe installation.
Features	<ul style="list-style-type: none"> -Free adjustable step mode control for open and close, -4 intermediate positions definable, -actuator torque adjustable between 40-100% from max. torque, -password protection for reading and writing parameters, -alternative menu structure adjustable, -different user levels adjustable, -counter values: power on hours, count of over torque switch off, -preventive maintenance notification

Electrical connectors

<i>For motor connection</i>	6pole plug for motors up to 5,5kW: Han6E 4pole + PE for motors >5,5kW: Han K4/0
<i>For control connection</i>	14 pole plug HAN24E with screw contacts
Cable entries	metric cables entries for cable glands, closed with blind glands
Ambient temperature	-25°C up to +70°C
Enclosure protection	IP 67 according to EN 60 529 and IEC529
Corrosion protection	for installation in aggressive atmosphere
Heater	24VDC heater in switching device of multi-turn actuators
Options	-Bus interface (see detailed description below) - Analog position feedback with 0/4...20 mA signal (2-wire) - Positioner with input of 0/4...20 mA signal - Separate control panel for wall mounting with max 40 m cable - Explosion protection II 2 G Ex de IIC T4 Gb - Other options on request

Control unit can be installed separate of the actuator



5.1 Digital protocols / Bus communication

The advantages of a digital bus system are:

- High degree of reliability
- Self-diagnostic by the system
- Better availability
- Lower amount of cabling

Our electric actuators can be supplied with following systems

PROFIBUS

PROFIBUS DP-V0 and DP-V1, based on RS485 interface and on the standards EC 61158 and IEC 61784.

With up to 126 nodes / max. of 32 nodes per segment / max. of 4 segments

Explosion proof design

1-channel or 2-channel design (redundant)

MODBUS

MODBUS RTU based on RS485 interface and on the standards IEC 61158 and IEC 61784.

Speed up to 1.5 MBaud

Up to 247 nodes / max of 32 nodes per segment / max. of 8 segments

1-channel or 2-channel design (redundant)

DEVICENET

DEVICENET based on the CAN bus protocol and on the IEC 62026 standard.

The connection cable is used for data communication and power supply simultaneously

Up to 64 nodes

Explosion proof design

Automatic detection of speed

HART

HART-Protocol

Digital protocol transmitted over the 4...20 mA signals

Provided with the actuator with this type of digital communication is a DTM file (Device Type Manager File) and DD files (Device Description). With this information the most common software (e.g. PACTWARE) is supported.

MODBUS

MODBUS TCP is based on the IEC 61158 standard

2-port interface (hub already included in the actuator)

Connection with a M-12 connector with protection IP 67

It can be integrated into existing TCP systems.

POWERLINK

Powerlink is an in-house development made by Bernecker & Rainer as real-time bus for critical applications.

2-port interface (hub already included in the actuator)

Connection with a M-12 connector with protection IP 67

It can be integrated into existing TCP systems.

6. General technical information

6.1 Duty cycles according to IEC 34 Standard

<p>S1</p>	<p>Continuous running duty The duty type S1 can be defined as operation at a constant load maintained for sufficient time to allow the machine to reach thermal equilibrium. ΔT – Time sufficient to allow the machine to reach thermal equilibrium</p>	
<p>S2</p>	<p>Short-time duty The duty type S2 can be defined as operation at constant load for a given time, less than that required to reach thermal equilibrium, followed by a time de-energized and at rest of sufficient duration to re-establish the equilibrium between the machine temperature and that of the coolant temperature. A complete designation provides the abbreviation of the duty type followed by an indication of the duration of the duty (S2 40 minutes). ΔT_c – Operation time at constant load ΔT_0 – Time de-energized</p>	
<p>S3</p>	<p>Periodic duty The duty type S3 is defined as a sequence of identical duty cycles, each including a time of operation at constant load and a time de-energized and at rest. The contribution to the temperature-rise given by the starting phase is negligible. A complete designation provides the abbreviation of the duty type followed by the indication of the cyclic duration factor (S3 30%). ΔT_c – Operation time at constant load ΔT_0 – Time de-energized and at rest Cyclic duration factor = $\Delta T_c / T$</p>	

<p>S4</p>	<p>Intermittent periodic duty with starting</p> <p>The duty type S4 is defined as a sequence of identical duty cycles, each cycle including a significant starting time, a time of operation at constant load and a time de-energized and at a rest.</p> <p>A complete designation provides the abbreviation of the duty type followed by the indication of the cyclic duration factor, by the moment of inertia of the motor JM and by the moment of inertia of the load JL, both referred to the motor shaft (S4 20% JM = 0.15 kg m² JL = 0.7 kg m²).</p> <p>ΔT^* – Starting/accelerating time ΔT_c – Operation time at constant load ΔT_0 – Time de-energized and at rest Cyclic duration factor = $(\Delta T^* + \Delta T_c) / T$</p>	
<p>S5</p>	<p>Intermittent periodic duty with electric braking</p> <p>The duty type S5 is defined as a sequence of identical duty cycles, each cycle consisting of a starting time, a time of operation at constant load, a time of electric braking and a time de-energized and at a rest.</p> <p>A complete designation refers to the duty type and gives the same type of indication of the previous case.</p> <p>ΔT^* – Starting/accelerating time ΔT_c – Operation time at constant load ΔT_f – Time of electric braking ΔT_0 – Time de-energized and at rest Cyclic duration factor = $(\Delta T^* + \Delta T_c + \Delta T_f) / T$</p>	

<p>S6</p>	<p>Continuous-operation periodic duty The duty type S6 is defined as a sequence of identical duty cycles, each cycle consisting of a time of operation at constant load and a time of operation at no-load. There is no time de-energized and at rest. A complete designation provides the abbreviation of the duty type followed by the indication of the cyclic duration factor (S6 30%). ΔT_c – Operation time at constant load ΔT_0 – Operation time at no load Cyclic duration factor = $\Delta T_c / \Delta T_0$</p>	
<p>S7</p>	<p>Continuous-operation periodic duty with electric braking The duty type S7 is defined as a sequence of identical duty cycles, each cycle consisting of a starting time, time of operation at constant load and a time of electric braking. There is no time de-energized and at rest. A complete designation provides the abbreviation of the duty type followed by the indication of both the moment of inertia of the motor JM and the moment of inertia of the load JL (S7 JM = 0.4 kg m² JL = 7.5 kg m²). ΔT^* – Starting/accelerating time ΔT_c – Operation time at constant load ΔT_f – Time of electric braking Cyclic duration factor = 1</p>	
<p>S8</p>	<p>Continuous-operation periodic duty with related load / speed The duty type S8 is defined as a sequence of identical duty cycles, each consisting of a time of operation at constant load corresponding to a predetermined speed of rotation, followed by one or more times of operation at other constant loads corresponding to different speeds of rotation. There is no time de-energized and at rest. A complete designation provides the abbreviation of the duty type followed by the indication of the moment of inertia of the motor JM and by the</p>	

	<p>moment of inertia of the load JL, together with the load, speed and cyclic duration factor, for each speed condition (S8 JM = 0.7 kg m² JL = 8kgm² 25kW 800rpm 25% 40kW 1250rpm 20% 25 kW 1000 rpm 55%).</p> <p>ΔT^* – Starting/accelerating time $\Delta Tc1$; $\Delta Tc2$; $\Delta Tc3$ – Operation time at constant load $\Delta Tf1$; $\Delta Tf2$ – Time of electric braking Cyclic duration factor = $(\Delta T^* + \Delta Tc1)/T$; $(\Delta Tf1 + \Delta Tc2)/T$; $(\Delta Tf2 + \Delta Tc3)/T$</p>	
S9	<p>Duty with non-periodic load and speed variations</p> <p>The duty type S9 is defined as a duty in which generally load and speed vary non-periodically within the permissible operating range. This duty includes frequently applied overloads which may greatly exceed the reference load.</p> <p>ΔT^* – Starting / accelerating time ΔTs – Time under overload ΔTc – Operation time at constant load ΔTf – Time of electric braking $\Delta T0$ – Time de-energized and at rest</p>	
S10	<p>Duty with discrete constant loads and speeds</p> <p>The duty type S10 is defined as the operation characterized by a specific number of discrete values of load maintained for a sufficient time to allow the machine to reach thermal equilibrium. The minimum load during a duty cycle may have value zero and be relevant to a no-load or rest condition. A complete designation provides the abbreviation of the duty type followed by the indication of the per unit quantities p/Δt for the partial load and its duration, and by the indication of the per unit quantity TL which represents the thermal life expectancy of the insulation system related to the thermal life expectancy in case of duty type S1 with rated output, and by the quantity r which indicates the load for a time de-energized and at rest (S10 p/Δt = 1.1/0.4; 1/0.3; 0.9/0.2; r/0.1 TL = 0.6).</p>	

	<p>$\Delta\theta_1$; $\Delta\theta_2$; $\Delta\theta_3$ – Difference between the temperature rise of the winding at each of the various loads within one cycle and the temperature rise based on duty cycle S1 with reference load</p> <p>$\Delta\theta_{ref}$ – Temperature at reference load based on duty type S1</p> <p>t_1; t_2; t_3; t_4: time of a constant load within a cycle</p> <p>P_1; P_2; P_3; P_4: time of one load cycle</p> <p>(Pref: reference load based on duty type S1)</p>	
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