

**Electric rotary (90°) actuators
for ball valves and flaps
- outside containment of nuclear
power plants**

MODACT MOKA

Type numbers 52 325 - 52 329

CERTIFICATE **TUV NORD**

Management system as per
EN ISO 9001 : 2008

In accordance with TÜV NORD CERT procedures, it is hereby certified that

ZPA Pečky, a.s.
Třída 5. května 166
289 11 Pečky
Czech Republic



applies a management system in line with the above standard for the following scope

**Development and production of electric actuators,
switch boards and sheet metal working.**

Certificate Registration No. 04 100 950161
Audit Report No. 624 362/300

Valid until 2012-09-24
Initial certification 1995-03-01

Certification Body
at TÜV NORD CERT GmbH

Praha, 2009-09-25

This certification was conducted in accordance with the TÜV NORD CERT auditing and certification procedures and is subject to regular surveillance audits.

TÜV NORD CERT GmbH

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USING

Actuators **MODACT MOKA** manufactured in compliance with technical conditions 32-03/07 are intended for controlling shut-off and regulating valves, including valves of protective systems installed in the non-sealed part of nuclear power plants with reactors of type VVER and in attended rooms of nuclear power plants with reactors of type RBMK. The actuators are used to control the valves by turning its control element to the angle of 90°. The actuators meet requirements of the Russian Technical Inspection (Rostechnadzor) NP-068-05 and NP-071-06.

The valves of safety classes 2, 3, 4 according to PNAEG-1-011-97 (OPB 88/97) can be fitted with the mentioned actuators.

Climatic conditions: climatic version of actuators UChL, category of placement 3, type of atmosphere II according to GOST 15150-69, unless otherwise stated in the order.

Working position of actuators – arbitrary.

Protective enclosure min. IP 65.

The actuators fitted with the position transmitter of unified signal 4 – 20 mA can also be used in circuits of automatic regulation of regime S4.

OPERATING CONDITIONS

The actuators in version **MODACT MOKA** must operate reliably with the following parameters of environment:

Temperature	-20 °C to +60 °C (up to 90 °C for 5 h, once in 6 months, 5 cycles for the period of the actuator operation*)
Pressure	from under-pressure 50 Pa to over-pressure 0.1 MPa
Relative humidity	up to 90 % (at 60 °C)

*) *The actuator remains operational in this regime even after its termination. In case of the actuators, revision after termination of the mentioned regime is not required.*

Resistance against seismic effects. Resistance against vibrations

The actuators correspond to the I. category of seismic resistance according to NP-031-01 and maintain their operating ability during as well as after the seismic effects of intensity up to MP3.

The actuators are resistant against vibrations and seismic shocks of acceleration 8 g in different directions within the range of excitation frequency 20 to 50 Hz for the period of action 20 s. In addition, operation ability is confirmed by seismic resonance test in the frequency range 5 to 20 Hz.

The actuators are resistant to shocks in the frequency range 5 to 100 Hz under the action of vibrational load in two directions with acceleration up to 1 g and amplitude of oscillations up to 50 µm.

Resistance against action of deactivating solutions

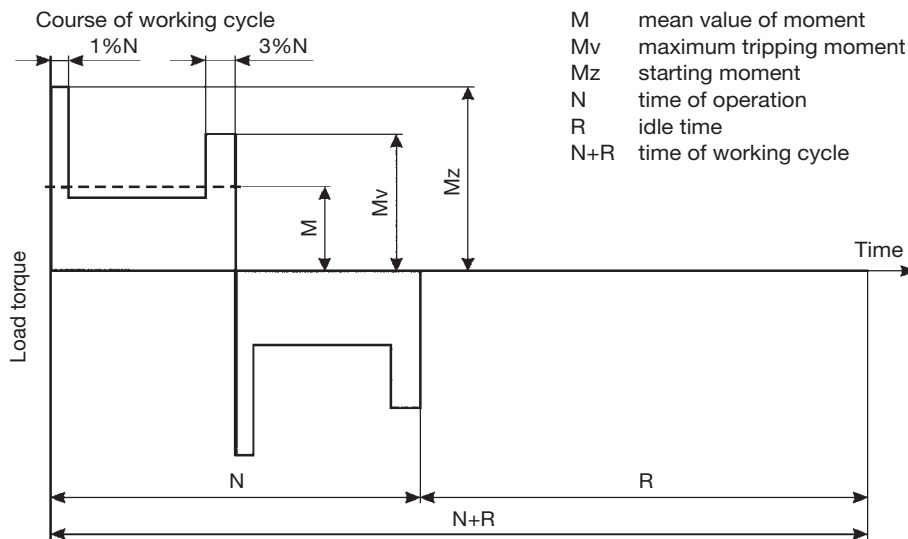
The actuators must be resistant against the action of deactivation solutions. Composition of the solutions is stated in the technical conditions. Composition of deactivation solutions in respective halls can be arbitrary in compliance with NP-068-05.

Dipping of the actuators in a vat with the deactivation solution is unacceptable.

OPERATING REGIME

Maximum duration of the working cycle (closed – open – closed) is 10 min at surrounding temperature +50 °C and with ratio of time in the state of operation to idle time 1:3 (repeated short-time regime with the period of switching-off PV = 25 %). Mean value of loading moment during the period of switching-on is 60 % of the maximum tripping moment.

The actuators can also operate in a discontinuous regime (e.g. in controlling the regulating valve) with frequency of switching-on up to 1200 h⁻¹ with the ratio of time of operation to idle time 1:3. Mean value of loading moment during operation is 40 % of the maximum tripping moment.



BASIC TECHNICAL DATA

Service life of actuators. Reliability

Service life of the actuators is min. 40 years.

The actuators belong to the category of restoring products of standardized reliability. During operation, preventative inspections are carried out with period of min. 15,000 hours. The interval between repairs is min. 4 years.

The specified service life in the interval between two repairs is 1500 cycles (open – closed), wherein probability of faultless operation is min. 0.98. Probability of faultless operation with 25 working cycles per 4 years is 0.998. Confidence probability for calculation of the lower confidence limit of faultless operation is 0.95.

Criteria of the actuators failure are as follows:

- discrepancy in output parameters of the actuators with parameters described in these technical conditions;
- failure to meet acceptable deviations of output parameters;
- failure to meet regulating range of output parameters;
- failure to meet insulation resistance;
- leakage of lubricants from the actuators.

Criteria of limit states of the actuators are as follows:

- rupture of integrity of the body parts that prevents normal function;
- changed shape and dimensions of parts (power kinematic circuits and control units);
- as a result of wear or deformation preventing normal function;
- elapsed specified period of service life.

Supply voltage of actuators

Supply voltage – alternating, three-phase 380/220 (415/240) V. Frequency of supply voltage 50 Hz. Possible emergency deviations of frequency of mains voltage:

Name of regime	Number of load cycles of device per 30 years
Emergency deviation of frequency in the network:	
51.5 to 52.5 Hz – for up to 5 min one-time, but max. 750 min during operation period;	10 cycles per year
50.5 to 51.5 Hz – for up to 5 min one-time, but max. 750 min during operation period;	10 cycles per year
49 to 47.5 Hz – for up to 5 min one-time, but max. 750 min during operation period;	10 cycles per year
47.5 to 46 Hz – for up to 30 s one-time, but max. 300 min during operation period;	40 cycles per year
Note:	
1. With the mentioned emergency deviations of frequency, network voltage must stay at 380/220 (415/240) V.	
2. With frequency in the range 51.5 to 52.5 Hz, starting and rated moment can decrease by max. 10 %.	

The actuators of protective systems must be operational under the following conditions:

- Voltage decreased to 80 % of its rated value with simultaneously decreased frequency by 6 % of its rated value for 15 s;
- Voltage increased to 110 % of its rated value with simultaneously increased frequency by 3 % of its rated value during 15 s.

Herewith, the actuator must not stop and possibility of the valve functioning must be secured.

Self-locking

The actuators are self-locking. The self-locking of the actuator is ensured by the mechanical brake.

Manual control

The actuators must be fitted with a substitute manual control. When the electric motor turns, torque is not transferred to the manual control device; in operation with the manual control device, its torque is not transferred to the electric motor. The actuator design ensures safety of the operator during control by means of the manual control device. When the hand wheel is turned in the clock-wise direction, the valve closes.

Force on the manual control device does not exceed 735 N at the maximum moment on the output shaft and does not exceed 295 N at 0.4 of the maximum moment value.

Anti-condensation heater

The actuators are fitted with the anti-condensation heater preventing condensation of water vapour. Its resistance in actuators MOKA 63 is 12 kohm and in actuators of other types 6.8 kohm. The element is connected to the supply source (to one phase) of voltage 230 V.

Switches

The actuators are fitted with two end-limit, two position, and two moment micro-switches. The micro-switches must have one opening and one closing contact. Each contact of the micro-switch has its outlet at the terminal board. On agreement with the client, the end-limit and position micro-switches can have a single change-over contact, and the moment switches – a single opening contact.

The end-limit, position, and moment switches must be functional under the following conditions:

In the circuits of alternating voltage up to 250 V of frequency 50 and 60 Hz. Current through the closed contacts up to 500 mA, wherein the loss of voltage on the closed contacts must not exceed 0.25 V.

In the circuits of direct voltage 24 and 48 V with current through the closed contacts 1 to 400 mA, wherein the loss of voltage on the closed contacts must not exceed 0.25 V.

The functional diagram of the position switches and the signalling circuits is shown on the page 14.

Position transmitters

In compliance with requirements of the client, the actuator can be fitted with the passive or active, current or resistance position transmitters.

Passive current position transmitter CPT1AA

Rated output signal	4 – 20 mA or 20 – 4 mA
Rated working run	from 0 – 40° to 0 – 120°, regulated
Loading resistance	0 – 500 ohm
Supply voltage	18 – 28 V DC
Dimensions	Ø 40 x 25 mm
Waviness of supply voltage	±5 %
Transmitter power input	max. 560 mW
Insulation resistance	20 Mohm at 50 V DC
Electric strength of insulation	50 V DC
Temperature of operating environment	-25 to + 80 °C, for short time up to +110 °C (max. 2 hours)

The limit value of supply voltage (at surrounding temperature -25 to +60 °C) is 30 V. Voltage between the transmitter box and the signalling wire must not exceed 50 V.

The user must provide for connecting the two-wire circuit of the current transmitter to electric earthing of particular regulator, computer, etc. The connection must be realized in a single point at any place of the circuit outside the actuator. In the version with the current transmitter, the local indicator need not be supplied.

Active current position transmitter DCPT

Rated output signal	4 – 20 mA or 20 – 4 mA
Rated working run	from 60° to 0 – 340°, regulated
Loading resistance	0 – 500 ohm
Non-linearity	max. 1 %
Supply voltage	18 – 28 V DC
Dimensions	Ø 40 x 25 mm
Waviness of supply voltage	±5 %
Max. current consumption of transmitter	max. 42 mA
Insulation resistance	20 Mohm at 50 V DC
Electric strength of insulation	50 V DC
Temperature of operating environment	-25 to + 70 °C

Voltage between the transmitter box and the signalling wire must not exceed 50 V. The current loop is supplied from the source DCPZ located inside the actuator.

Resistance position indicator

The resistance position indicator is formed of a double-wire resistor of variable resistance, each part of which having resistance 100 ohm.

Total resistance	2 x 100 ohm with deviation +12 ohm
Maximum loading current	100 mA
Maximum direct voltage	(against frame) 50 V
Working run	0° to 160°
Non-linearity	max. 1 %

Local position indicator

The removable mechanically connected indicator of position of the actuator output shaft is fixed to the cam shaft of the position unit. The local position indicator serves for orientational determination of position of the actuator output shaft.

Actuator terminal board

The actuators are fitted with a common terminal board for connecting external electric circuits. The terminal board is located under the actuator cover. All contacts of the micro-switches, circuits of the electric motor, and the earthing terminal are connected to it. The terminal board enables connection of one wire of cross-section 2.5 mm² or two wires of cross-section up to 1 mm². The actuators are fitted with two cable bushings providing for connection of:

- in actuators MOKA 63: one cable of outer diameter 10 – 14 mm for control circuits and one cable of outer diameter 13 – 18 mm for circuits of the electric motor;
- in actuators MOKA 125, 250: two cables of outer diameter 13 – 18 mm for control circuits and circuits of the electric motor;
- in actuators MOKA 500, 1000: one cable of outer diameter 13 – 18 mm for control circuits and one cable of outer diameter 13 – 20 mm for circuits of the electric motor.

The cross-sections and diameters of cables must be specified in the order.

The actuators are fitted with the earthing terminals including a device against spontaneous releasing. The design prevents the control circuits from being influenced by the power circuits.

The actuators are supplied with blinded bushings.

Insulation resistance

At temperature 20 ±5 °C and humidity 30 to 80 %, the insulation resistance is min. 20 Mohm. Under the most severe working conditions, resistance of the insulation of electric circuits against each other and against the frame is min. 0.3 Mohm.

Electric strength of insulation

Insulation of electric circuits against frame as well as against each other at temperature 20 ±5 °C and humidity 30 to 80 % must withstand testing alternating voltage of sinus shape of frequency 50 Hz for 1 minute:

Electric circuits of actuator of rated voltage max. 250 V	Testing voltage 1500 V, 50 Hz
Remote transmitter of rated voltage max. 50 V	500 V, 50 Hz
Electric motor of rated three-phase voltage 400 V (380 V)	1800 V, 50 Hz
	According to GOST 183-74
Circuit of current transmitter CPT1AA	50 V DC

Noise

According to GOST P 51402-99, the value of mean level of acoustic pressure at a distance of 2 m (in no-load operation of actuators) does not exceed 80 dB.

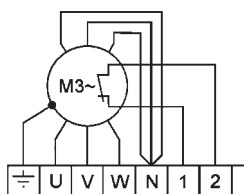
Run-out of output shaft

Motors of type no. 52 325, 52 326, 52 328 max. 1.5°
Motors of type no. 52 327, 52 329 max. 2.5°

Thermal protection of electric motor

Actuators MODACT MOKA 500, type no. 52 328.xx2x and MODACT MOKA 1000, type no. 52 329.xx3x are fitted with the three-phase electric motor (400 V) of power 120 W without a thermal protection. Automatic fuses are built-in in electric motors of other actuators listed in Table 1; they switch off power supply to the electric motor in case of over-heating (after cooling down, the power supply is automatically switched on). Their circuits are not connected to the terminal board of the electric motor. The built-in thermal fuses disconnect the electric motor from power supply in case the temperature of the electric motor winding exceeds +155 °C.

Electric motor FT2B52D is fitted with an automatic fuse the circuit of which is connected to the terminal board of the actuator (see the wiring diagram below). Switched-over load: current 2.5 A at voltage 250 V.



Deviations of basic parameters

Rated values of torques of the output shaft (with acceptable deviations) are given for rated supply voltage with deviation from -15 % to +10 % and for rated frequency of supply voltage in the range ± 2 %, wherein the deviations of voltage and frequency must not have opposite signs.

Acceptable deviations of respective parameters:

Tripping moment	± 15 % of maximum value
Time of turning by 90°	+10 % to - 15 % of rated value (idle run)
For NPP „Kudankulam“ Time of turning	± 10 % at rated supply voltage
Hysteresis of end-limit and position switches	max. 4°
Setting of working run	± 1 °
Non-linearity of position transmitter	± 2.5 % of rated value of transmitter output signal
Hysteresis of position transmitter does not exceed	2.5 % of rated value of transmitter output signal

ORDERING INFORMATION

When ordering, please specify the following:

- Number of actuators required
- Actuator designation
- Complete Type Number, according to Tab.1 (10 - digit)
- Adjustment of tripping torque (If no tripping torque adjustment has been specified the maximum tripping torque will be adjusted by the manufacturer).

The position-limit switches, the signalling switches and the position transmitter are not adjusted at the factory. Right is reserved to change the dimensions and design without notice.

Example of specification in the order

The rotary single-revolution actuator in the version for nuclear power plants MODACT MOKA, type no. 52 326, with tripping torque ranging between 63 and 125 Nms (Nm), resetting speed of the output shaft 20 s / 90°, connecting dimensions F07, square 19 mm in basic position, fitted with resistance position transmitter 2 x 100 ohm, with supply voltage 3 x 230 / 400 V, 50 Hz, should be specified in the order as follows:

Actuator MOKA 125 type no. 52 326.6068A, supply voltage of electric motor 3 x 400 V, 50 Hz.

Meaning of numerical characters of the type number is explained in Tables no. 1 and 2.

Table 1 – Basic technical parameters and characteristics of actuators, type MODACT MOKA for valves, installed in attended areas of nuclear power plants with reactors VVER or RBMK

ELECTRIC ACTUATOR																				
Type	basic complim.		Tripping torque [Nm]	Shifting time [s/90°]	Gear ratio		Max. force on hand wheel ¹ [N]	Way of connection	Weight [kg]	Type	Nominal power [kW]	Voltage [V]	Current [A]	Motor speed [1/min]	Efficiency [%]	Weight coefficient	Start-up to nominal current ratio	Start-up to nominal moment ratio	Places of installation	Start-up torque [Nm]
	12 345	6789A			from output shaft to motor	from output shaft to hand wheel														
MOKA 63	52 325	xx5xA	16 – 32	10	1850	73	10	Bushings	7,4	FT2B62D	0,015	3x380	0,10	2680	40	0,58	2,2			41
		xx6xA	25 – 80	20	3713															
		xx7xA		40	7224															
MOKA 125	52 326	xx5xA	63 – 125	10	1907	65	10	Bushings	12,7	FT4C52NA	0,090	3x380	0,34	2770	62	0,63	2,9			162
		xx6xA		20	3623															
		xx7xA		40	7332															
		xx8xA		80	14963															
MOKA 250	52 327	xx6xA	125 – 250	20	3890	132	10	Bushings	21,0	FT4C52NA	0,090	3x380	0,34	2770	62	0,63	2,9			325
		xx7xA		40	7394															
		xx8xA		80	14963															
		xx9xA		160	14963															
MOKA 500	52 328	xx2xA	250 – 500	20	1875	72	32	Bushings	27,0	EAMR66N04A	0,120	3x380	0,42	1350	54	0,75	2,8			650
		xx3xA		40	3506															
		xx4xA		80	7640															
		xx3xA		40	3630															
MOKA 1000	52 329	xx4xA	500 – 1000	80	6787	139	32	Bushings	43,0	1 PK 7060-4AB	0,120	3x380	0,42	1350	54	0,75	2,8			1300
		xx4xA		80	6787															
		xx5xA		160	14790															

Note:

1) The table shows one force from pair of forces acting at the hand wheel diameter.

Complementary type number:

6th position – output shaft position transmitters:

6xxxA – design with potentiometer 2 x 100 ohm;

7xxxA – design with current transmitter - 4 – 20 mA;

8xxxA – design without position transmitter;


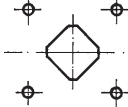
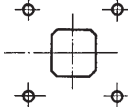
9xxxA – design with current transmitter - 4 – 20 mA with built-in power source.

7th position – reserve: x0xxA - for all design variants;

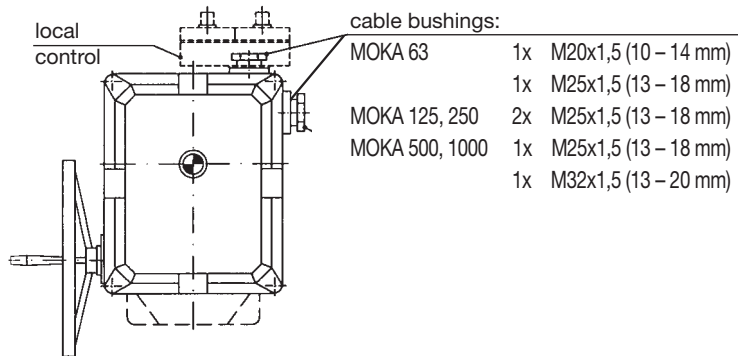
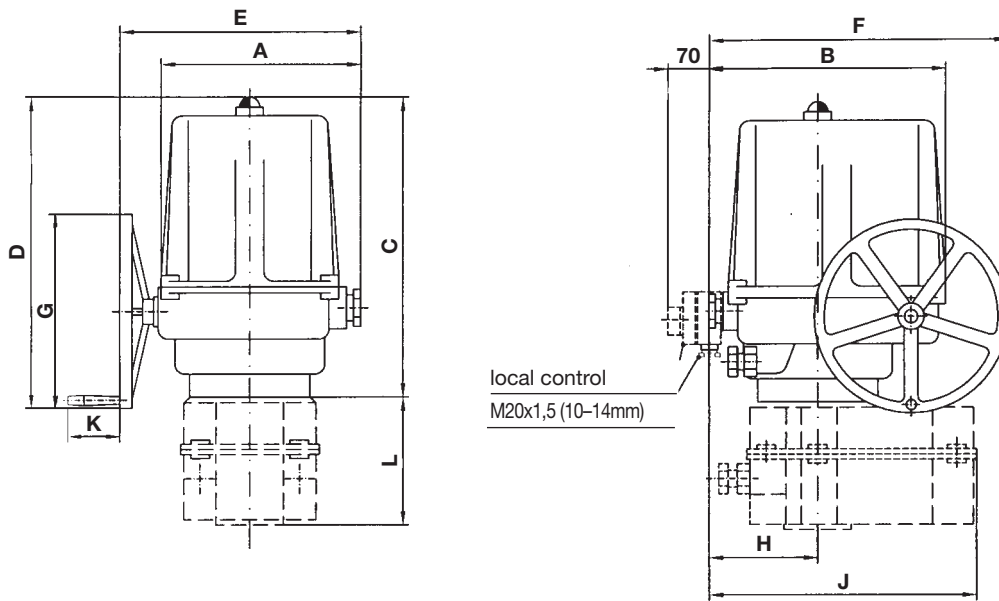
8th position – tripping torque and shifting time of output shaft according Table 1.

9th position – connection to valve according Table 2.

Table 2 – MODACT MOKA - way of mechanical connection
(specification of 9th place of type number)

Type Number	Flange size	Connection or square size with [mm]	Square position	Marking on the 9th place of type number
52325	F05	keyway	-	xxx0A
		14	basic	xxx1A
	F04	keyway	-	xxx2A
		11	basic	xxx3A
	F05	14	positioned at a 45°	xxx4A
	F04	11		xxx5A
	F04	12	basic	xxx6A
			positioned at a 45°	xxx7A
	F05	16	basic	xxx8A
positioned at a 45°			xxx9A	
52326	F07	keyway	-	xxx0A
		17	basic	xxx1A
	F05	keyway	-	xxx2A
		14	basic	xxx3A
	F07	17	positioned at a 45°	xxx4A
	F05	14		xxx5A
	F05	16	basic	xxx6A
			positioned at a 45°	xxx7A
	F07	19	basic	xxx8A
positioned at a 45°			xxx9A	
52327	F10	keyway	-	xxx0A
		22	basic	xxx1A
	F07	keyway	-	xxx2A
		17	basic	xxx3A
	F10	22	positioned at a 45°	xxx4A
	F07	17		xxx5A
	F07	19	basic	xxx6A
			positioned at a 45°	xxx7A
	F10	24	basic	xxx8A
positioned at a 45°			xxx9A	
27		basic	xxxAA	
		positioned at a 45°	xxxBA	
52328	F12	keyway	-	xxx0A
		27	basic	xxx1A
	F10	keyway	-	xxx2A
		22	basic	xxx3A
	F12	27	positioned at a 45°	xxx4A
	F10	22		xxx5A
	F10	24	basic	xxx6A
			positioned at a 45°	xxx7A
	F10	27	basic	xxx8A
positioned at a 45°			xxx9A	
F12	32	basic	xxxAA	
		positioned at a 45°	xxxBA	
52329	F12	keyway	-	xxx0A
		27	basic	xxx1A
			positioned at a 45°	xxx4A
		32	basic	xxx5A
			positioned at a 45°	xxx6A
Electric actuator output shaft (when viewing towards the local position indicator). The handwheel tallies with the CLOSED position		Keyway connection		
		closed		
				
		Square		
		basic position closed		
				
		angular position on 45° closed		
				

Dimensional sketch of **MODACT MOKA** electric actuators

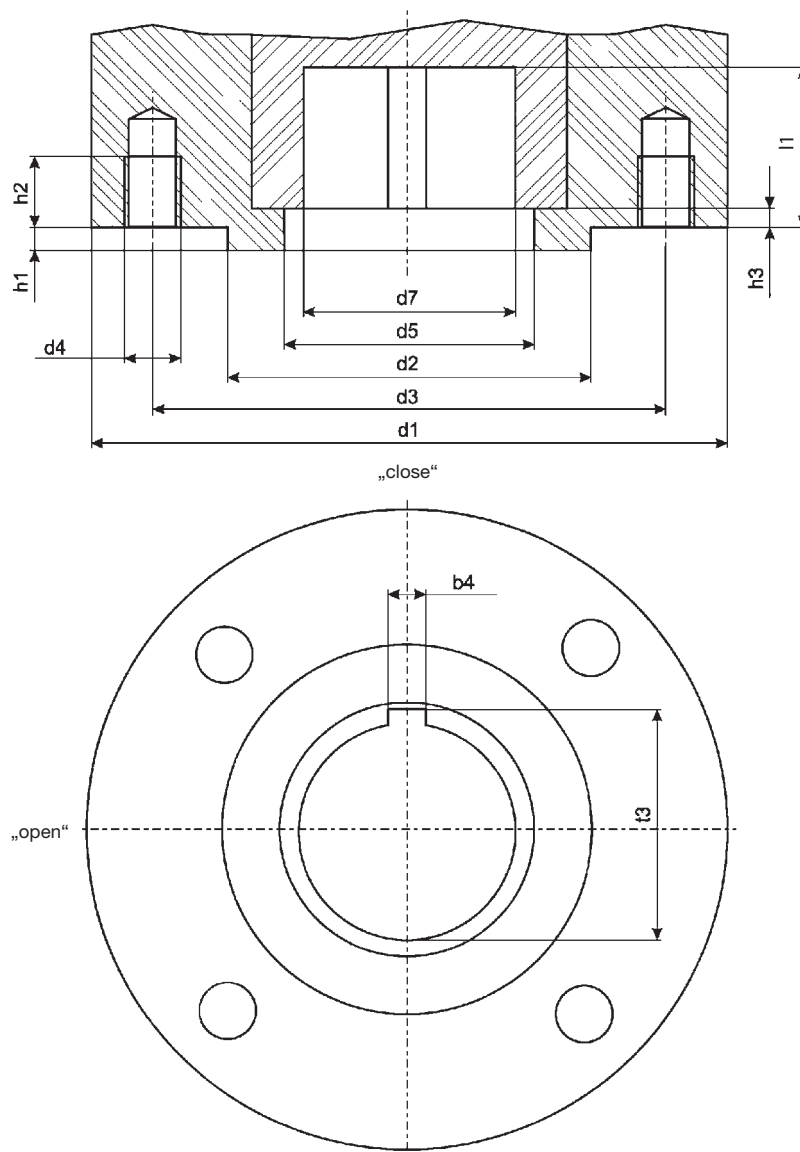


Type	A	B	C	D	E	F	G	H	J	K	L
MOKA 63	173	203	247	244	213	245	160	98	-	72	-
MOKA 125	204	237	325	347	252	290	200	111	-	73	-
MOKA 250	204	237	325	347	252	290	200	111	263	73	128
MOKA 500	250	290	386	398	325	362	250	128	-	78	-
MOKA 1000	250	290	386	398	325	362	250	128	323	76	155

Connection dimensions of **MODACT MOKA** actuators

– for valves and control devices with spindles that are provided with a tight-fit keyway

Position of the keyway, according to ISO 5211 and DIN 3337 (The groove is in the CLOSE position whereas the OPEN position is on the left side when viewing the local position indicator).



Size, mm

Flange	d_1	d_2 f 8	d_3	d_4	d_7 H 9	h_1 max.	h_2 max.	h_3 max.	l_1 min.	b_4 ls 9	t_3	d_5
F04	65	30	42	M6	18	3	12	3	26	6	20,5	25
F05		35	50		22				30		24,5	28
F07	90	55	70	M8	28	13	35	8	30,9	40		
F10	125	70	102	M10	42	16	45	12	45,1	50		
F12	150	85	125	M12	50	20	53	14	53,5	70		

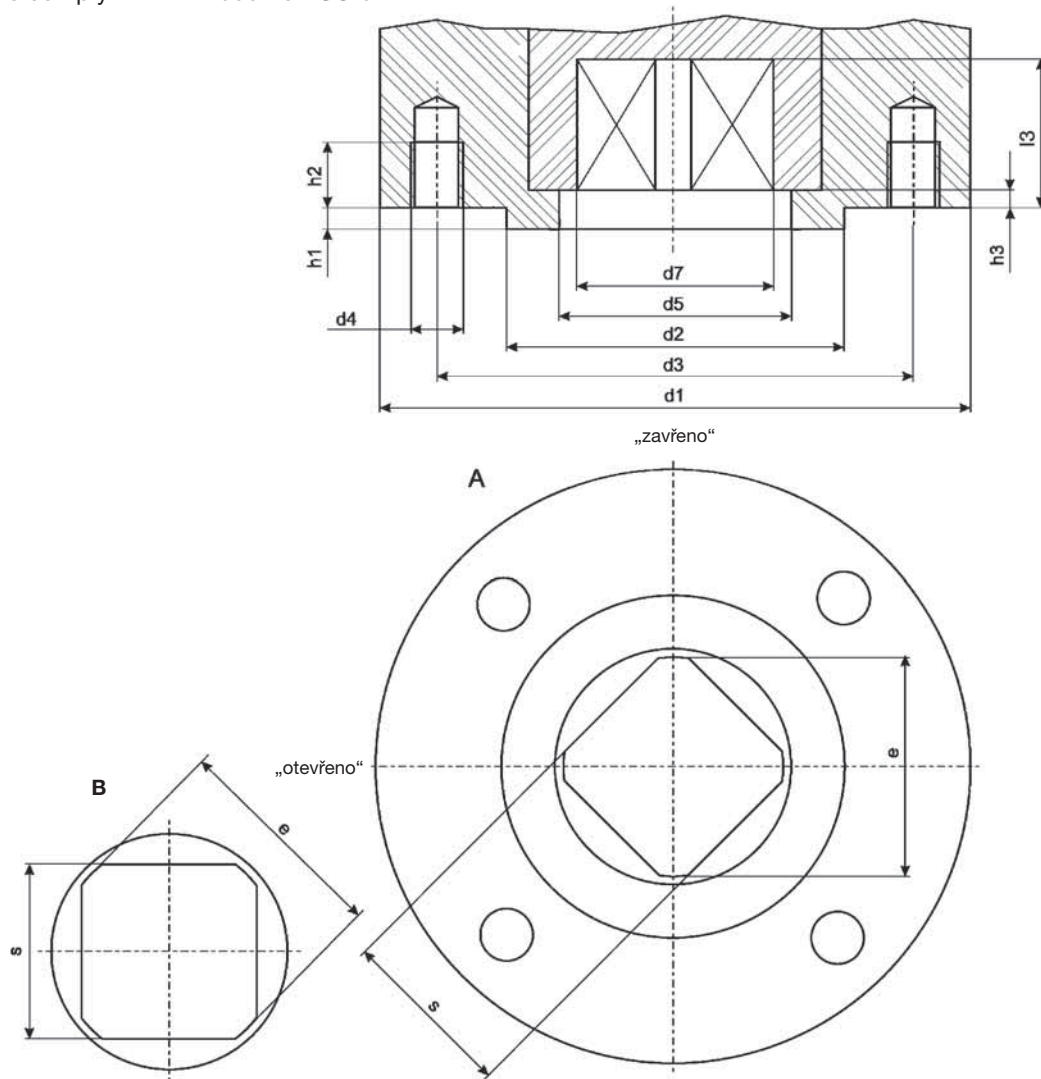
Connection dimensions of **MODACT MOKA** actuators

– for valves and control devices with spindles that are provided with a square hole

A – Square-end joint in the basic position

B – Square-end joint positioned at an angle of 45°

Position of the square hole in the end position of the actuator. The OPEN position is on the left of the CLOSE position, when viewing the local position indicator. The square hole corresponds to DIN 79. The connecting dimensions comply with DIN 3337 or ISO 5211.

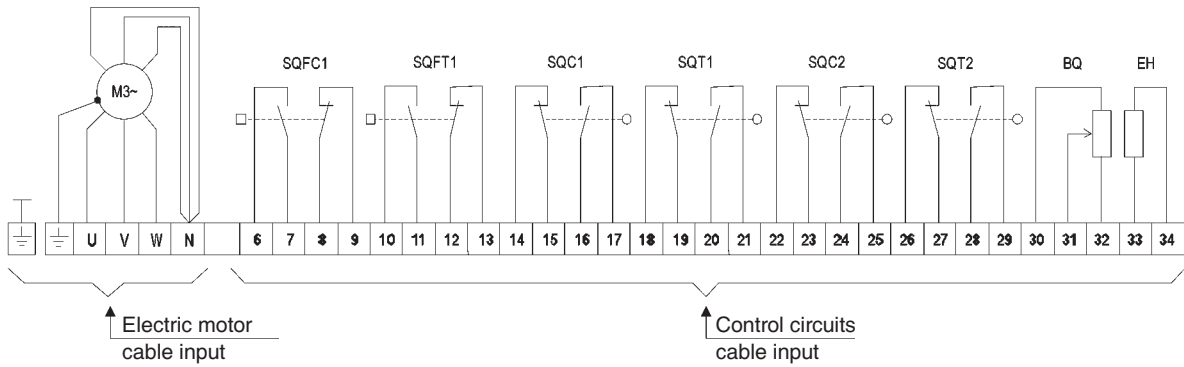


Size, mm

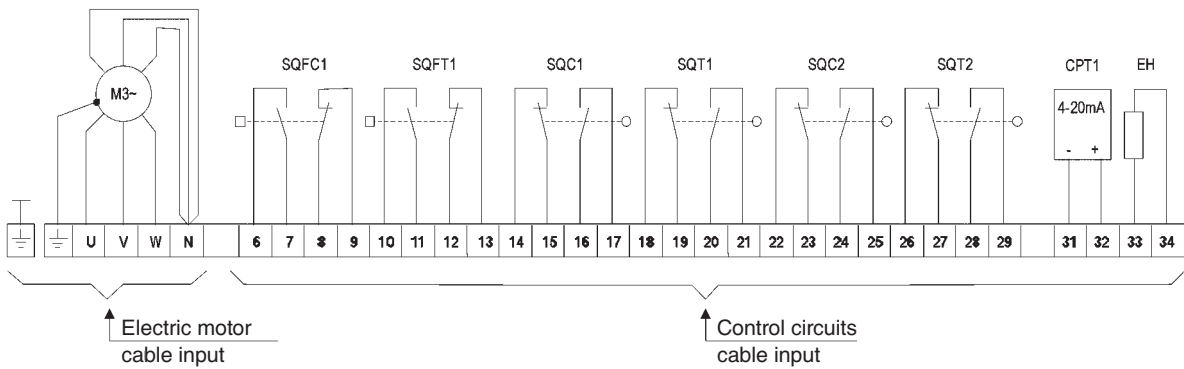
Flange	d ₁	d ₂ f 8	d ₃	d ₄	h ₁ max.	h ₂ min.	h ₃ max.	h ₄		s H11	e min.	l ₃ min.	d ₅
								max.	min.				
F04	55	30	42	M6	3	12	3	1,5	0,5	11	14,1	15,1	25
F05	65	35	50							12	16,1	16,1	
F07	90	55	70	M8	3	13	3	3	0,5	14	18,1	19,1	28
										16	21,2	22,1	
F10	125	70	102	M10	3	16	3	3	1	17	22,2	23,1	40
										19	25,2	26,1	
F12	150	85	125	M12	3	20	3	3	1	22	28,2	30,1	50
										24	32,2	33,1	
										27	36,2	37,1	70
										32	42,2	44,1	

Wiring diagrams of MODACT MOKA electric actuators

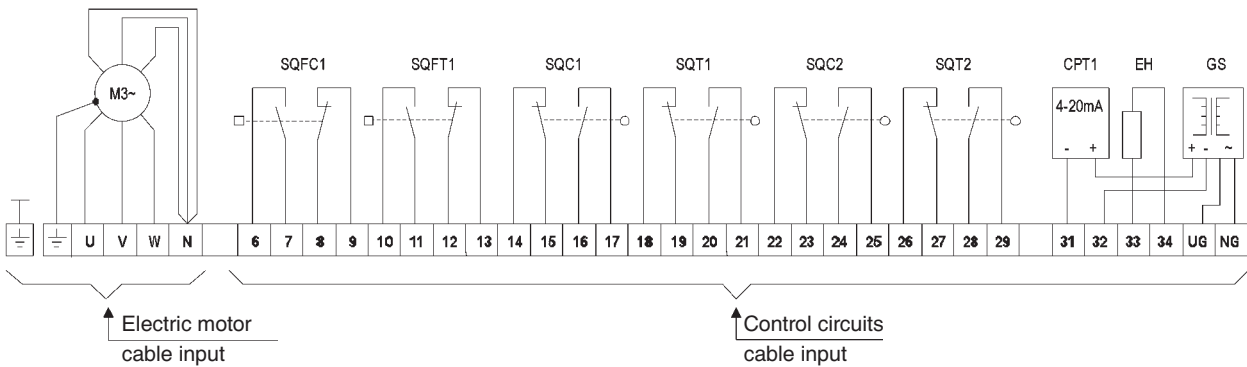
Design with potentiometer or without transmitter



Design with pasive current position transmitter



Design with active current position transmitter (with power source)

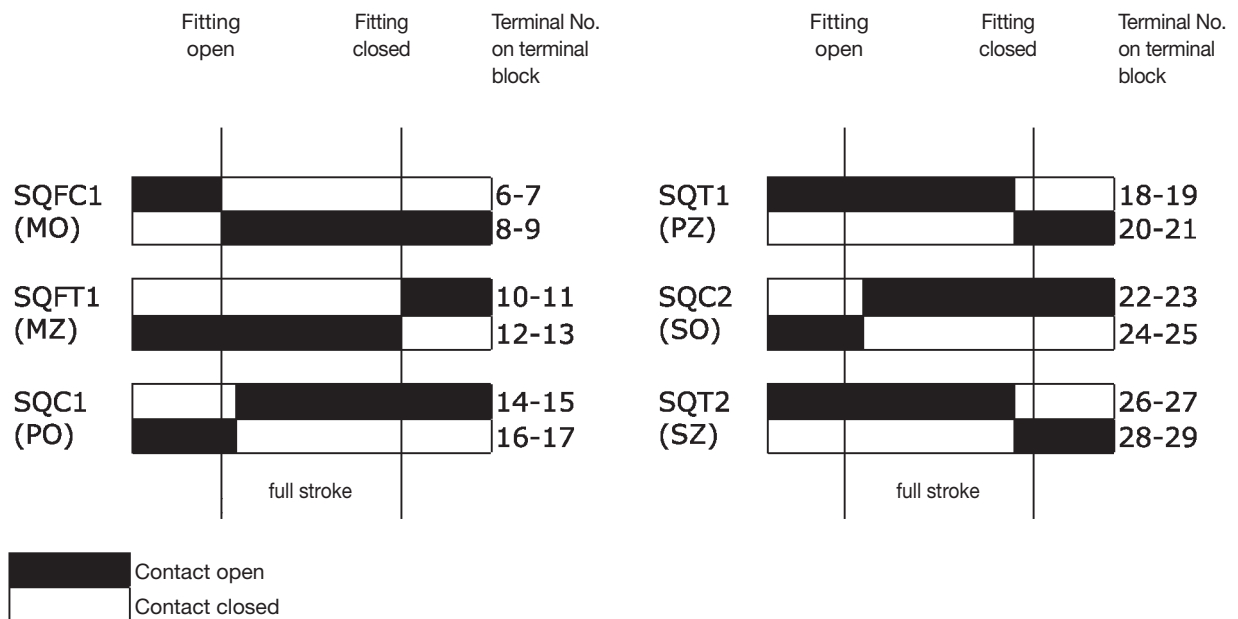


Legend:

- | | |
|---|---|
| SQFC1 (MO) – OPEN torque-limit switch | EH – Anti-condensation heater |
| SQFT1 (MZ) – CLOSE torque-limit switch | BQ – Anti-condensation heater |
| SQC1 (PO) – OPEN position-limit switch | CPT1AA – Current position transmitter CPT |
| SQT1 (PZ) – CLOSE position-limit switch | GS – Power supply of current position transmitter |
| SQC2 (SO) – OPEN signalling switch | M3~ – Three-phase motor |
| SQT2 (SZ) – CLOSE signalling switch | |

Both ends of all windings of the electric motor are brought out (in the wiring diagrams they are marked U1, U2, V1, V2, W1, W2). The connection “star” or “delta” can be used for external connection. The electric motor in this actuator has “star” connection, which means that the ends U2, V2, W2 are connected together and to terminal N. Terminal S is usually not connected and serves to special purposes when bringing-out of electric zero of the winding is required.

Operation diagram of torque-, position-limit and signalling units





Development, production and services of electric actuators and switchboards.
Top-quality sheet-metal processing (TRUMPF equipment), powder paint shop.

SURVEY OF PRODUCED ACTUATORS

KP MINI, KP MIDI

Electric rotary (90°) actuators (up to 30 Nm)

MODACT MOK, MOKED, MOKP Ex

Electric rotary (90°) actuators for ball valves and flaps

MODACT MOKA

Electric rotary (90°) actuators for nuclear power stations application outside containment

MODACT MONJ, MON, MOP, MONED, MONEDJ, MOPED

Electric rotary multi-turn actuators

MODACT MO EEX, MOED EEX

Explosion proof electric multi-turn actuators

MODACT MOA

Electric multi-turn actuators for nuclear power stations application outside containment

MODACT MOA OC

Electric multi-turn actuators for nuclear power stations application inside containment

MODACT MPR VARIANT

Electric rotary (160°) lever actuators with a variable output speed

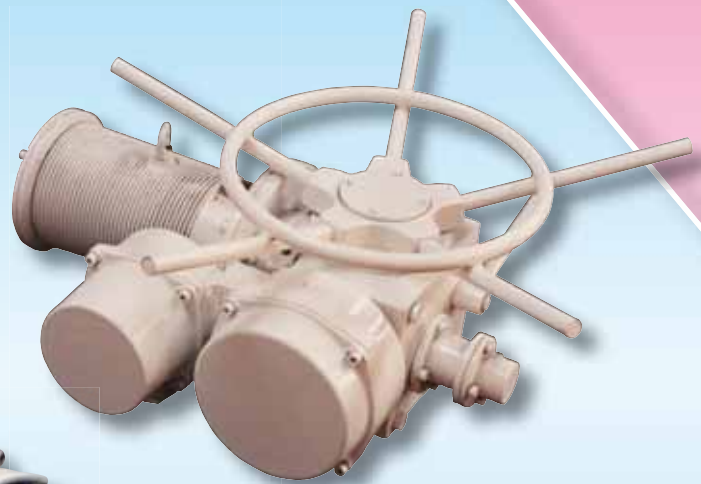
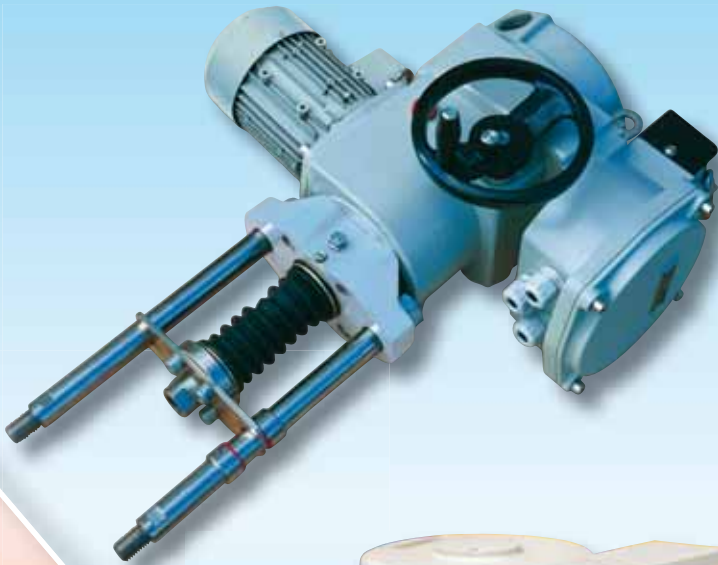
MODACT MPS KONSTANT, MPSED

Electric rotary (160°) lever actuators with a constant output speed

MODACT MTN, MTP, MTNED, MTPED

Electric linear thrust actuators with a constant output speed

Deliveries of assembled actuator + valve (or MASTERGEAR gearbox) combinations



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