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ELECTROMAGNETIC DISC BRAKES
STE and STK SERIES
WITH CONSTANT BRAKING TORQUE
THEATRICAL VERSION

K-EN-STE-20151203

Spring actuated and electromagnetically released disk brake type STE and STK. Designed for braking rotating machine parts and their precision positioning, in all applications where the drive is required to have limited level of noise. The specifics of this type of drive has made us draw up a brake version whose crucial units are so designed that the "quiet operation" requirement demanded by the user is fulfilled. Drives fitted with brake series STE or STK can be used in objects where limited level of noise has huge significance, e.g. theatres, concert halls, etc. where, as stage equipment drives, they meet strict safety requirements. Brake design guarantees simple and problem-free installation. Various options of executions are at disposal with respect to fittings/accessories, brake supply, climatic conditions of utilization, enabling selection of appropriate option for definite utilization conditions.

They are designed for braking rotating parts of machines and their task is:

- emergency stopping, in order to ensure drive safety functions,
- immobilizing machine actuators, acting as a positioning device,
- minimizing run-on times of drives (to meed safety requirements according to Office of Technical Inspection (UDT) regulations,
- built onto an electric motor, the brake provides a self-braking motor, a drive unit meeting the requirements of utilisation safety and positioning.

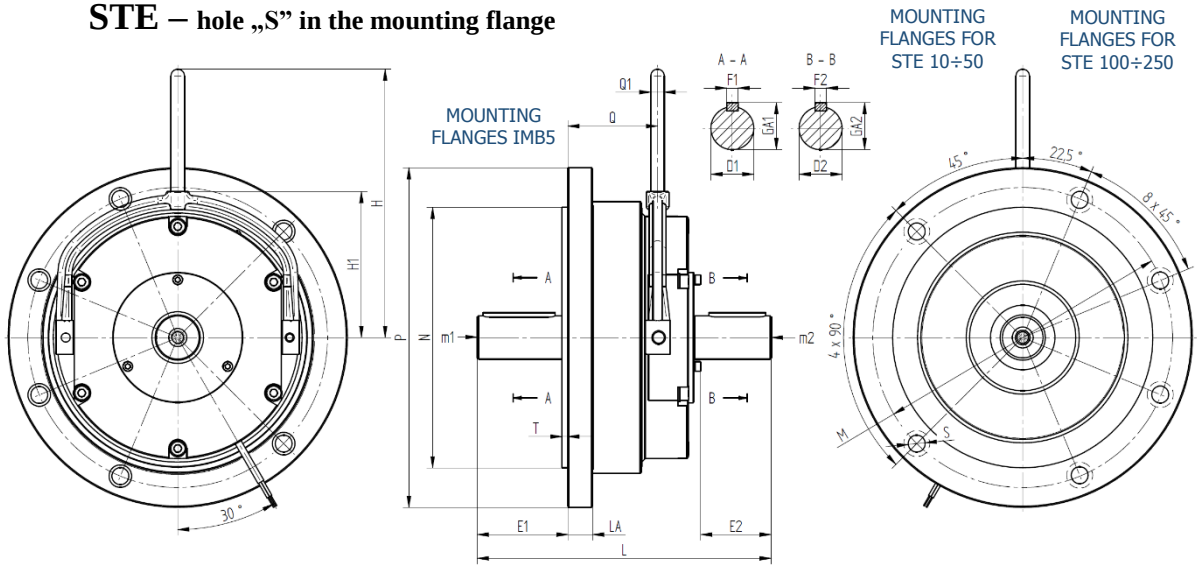
Brakes can be manufactured in variants suitable for various direct-current voltages: 104V, 180V which allows them to be supplied from standard alternating current sources, through appropriate rectifier.

Parameters			Unit	Brake type						
				STE 10 STK 10	**STE 15 STK 15**	**STE 25 STK 25**	**STE 50 STK 50**	**STE 100 STK 100**	**STE 160 STK 160**	**STE 250 STK 250**
Supply voltage		Un	[V]	104, 180						
Power		$P_{20°}$	[W]	55	65	75	140	250	340	400
Max. speed		$n_{max.}$	min^{-1}	3000						
Braking torque		M_h	Nm	100	150	250	500	1000	1600	2500
Weight		m	kg	18	25	35	45	100	140	180
Ambient temperature			°C	-20 ÷ +40						
Level of protection			-	IP54, IP55, IP65, IP 66						
Operating time *	On direct voltage side	t_{01}	ms	180	300	400	500	500	600	600
		t_{09}		90	110	200	270	300	500	50
	On alternating voltage side	t_{01}	ms	180	300	400	500	500	600	300
		t_{09}		Brake disconnection on alternating current side causes about five-times growth in braking time t_{09} with respect to disconnection on direct current side						

$t_{0,1}$ - releasing time (from switching on current to drop in braking torque to 10% M_{nom})
$t_{0,9}$ - braking time (from switching off current to attaining 90% M_{nom})

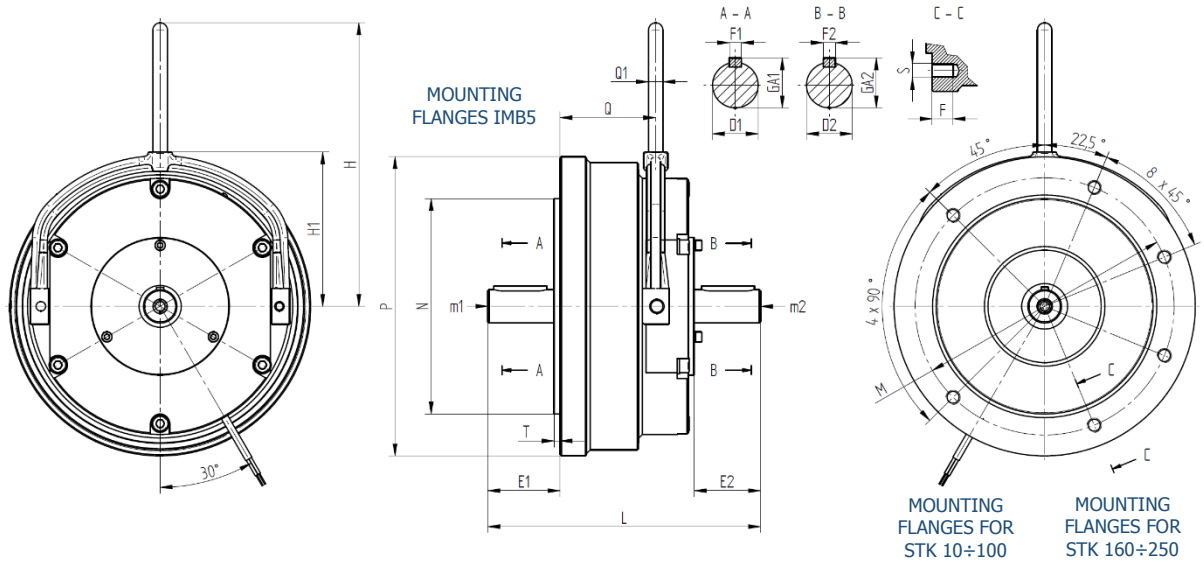
*) Values of releasing and braking times are given as approximations, since they depend on mode of assembly/installation, temperature and power supply.

STE – hole „S” in the mounting flange



Type	P	N	M	T	S	D1	GA1	F1	E1	D2	GA2	F2	E2	L	LA	H	H1	m1	m2	Q	Q1
STE10	300	230 j6	265	4	4 x 15	38 k6	41	10 h9	80	28 k6	31	8 h9	60	250	22	205	116	M12	M10	71	12
STE15	300	230 j6	265	4	4 x 15	38 k6	41	10 h9	80	38 k6	41	10 h9	60	260	22	230	130	M12	M12	78	12
STE25	350	250 j6	300	5	4 x 18	42 k6	45	12 h9	110	38 k6	41	10 h9	60	315	25	340	160	M16	M12	88	14
STE50	400	300 j6	350	5	4 x 18	55 m6	59	16 h9	110	55 m6	59	16 h9	80	350	30	466	182	M16	M16	102	14
STE100	450	350 j6	400	5	8 x 18	60 m6	64	18 h9	140	60 m6	64	18 h9	100	440	30	408	206	M16	M16	140	20
STE160	550	450 j6	500	5	8 x 18	65 m6	69	18 h9	140	65 m6	69	18 h9	120	470	30	440	232	M20	M20	150	20
STE250	550	450 j6	500	5	8 x 18	65 m6	69	18 h9	140	65 m6	69	18 h9	120	520	30	530	250	M20	M20	165	20

STK – rifled hole „S” in the mounting flange



Type	P	N	M	T	S	F	D1	GA1	F1	E1	D2	GA2	F2	E2	L	H	H1	m1	m2	Q	Q1
STK10	250	180 j6	215	4	4 x M12	20	28 j6	31	8 h9	60	28 j6	31	8 h9	50	220	205	116	M10	M10	71	12
STK15	250	180 j6	215	4	4 x M12	20	28 j6	31	8 h9	60	28 j6	31	8 h9	50	230	230	130	M10	M10	78	12
STK25	300	230 j6	265	4	4 x M12	20	38 k6	41	10 h9	80	38 k6	41	10 h9	60	315	340	160	M12	M12	88	14
STK50	350	250 j6	300	5	4x M16	25	42 k6	45	12 h9	110	42 k6	45	12 h9	80	350	466	182	M16	M16	102	14
STK100	400	300 j6	350	5	4 x M16	25	55 m6	59	16 h9	110	55 m6	59	16 h9	80	390	408	206	M16	M16	140	20
STK160	450	350 j6	400	5	8 x M16	25	60 m6	64	18 h9	140	60 m6	64	18 h9	100	450	440	232	M16	M16	150	20
STK250	550	450 j6	500	5	8 x M16	30	65 m6	69	18 h9	140	65 m6	69	18 h9	120	520	530	250	M20	M20	165	20

ELECTRICAL EQUIPMENT

A number of modules, ranging from simple circuits with classic designs, to complex assemblies ensuring quick action and drives positioning have been designed to drive the brakes. Relevant brake applications with switching in the primary or secondary circuits are ensured by half- or full-wave rectifiers and fast electronic circuits. The manufacturer recommends to use as low alternating current voltages as possible to supply the brakes. Appropriate choice of the control voltage will prevent or at least limit surges that may occur in power supply circuits. It is not recommended to use extensively long control wiring, which would be a source of harmful surges.

Rectifier B2-1P

The B2–1P rectifiers series forms a complete wave rectifier unit for direct installation. The terminal strip provided facilitates installation and connection to the circuit.

Rectifier B2-1P cooperates with brakes STE10 ÷ STE50.
Rectifier B2-1P cooperates with brakes STK10 ÷ STK50.

RECTIFIER PARAMETERS			
		B2-1P-400	**B2-1P-600**
Maximum input voltage (alternating voltage AC)	U_{IN}	400 VAC	600 VAC
Maximum output voltage (direct voltage DC)	U_{OUT}	0,45 U_{IN}	0,45U_{IN}
Maximum continuous output current rectifier	I_{OUT}	2A	2A

For example

Maximum input voltage (alternating voltage) - U_{IN} = 230VAC,

The resulting output voltage of the rectifier (direct voltage) - 0,45U_{IN}= 0,45 x 230=104VDC

Rectifier B5-1P

The B5–1P rectifiers series forms a complete wave rectifier unit for direct installation. The terminal strip provided facilitates installation and connection to the circuit.

Rectifier B5-1P cooperates with brakes STE10 ÷ STE50.
Rectifier B5-1P cooperates with brakes STK10 ÷ STK50.

RECTIFIER PARAMETERS			
		B5-1P-400	**B5-1P-600**
Maximum input voltage (alternating voltage AC)	U_{IN}	400 VAC	600 VAC
Maximum output voltage (direct voltage DC)	U_{OUT}	0,45 U_{IN}	0,45U_{IN}
Maximum continuous output current rectifier	I_{OUT}	5A	5A

For example

Maximum input voltage (alternating voltage) - U_{IN} = 230VAC,

The resulting output voltage of the rectifier (direct voltage) - 0,45U_{IN}= 0,45 x 230=104VDC

Rectifier B2-2P

The B2–2P rectifiers series forms a complete full-wave rectifier unit for direct installation. The terminal strip provided facilitates installation and connection to the circuit. The rectifier allows feeding input voltage max. 400VAC, 2A which after rectification provides DC voltage of value equal to 0,9 input voltage.

Rectifier B2-2P cooperates with brakes STE10 ÷ STE50.
Rectifier B2-2P cooperates with brakes STK10 ÷ STK50.

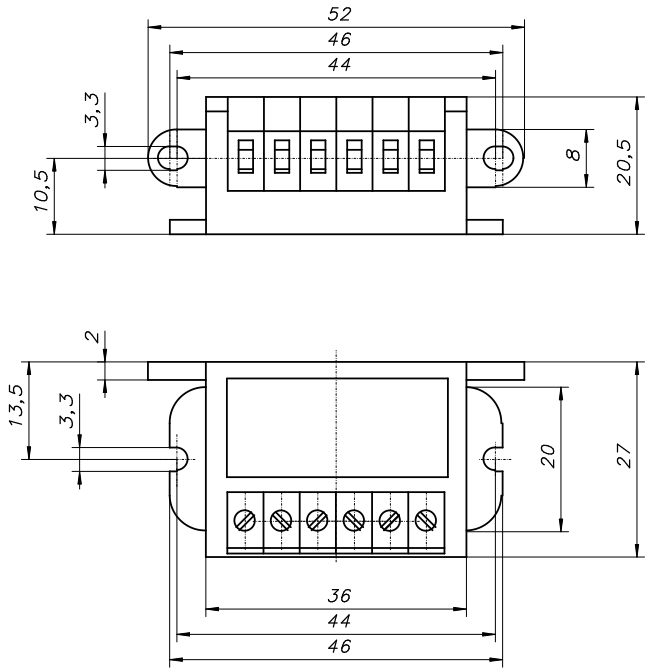
RECTIFIER PARAMETERS		
Maximum input voltage (alternating voltage AC)	U_{IN}	250 VAC
Maximum output voltage (direct voltage DC)	U_{OUT}	0,9U_{IN}
Maximum continuous output current rectifier	I_{OUT}	2A

For example

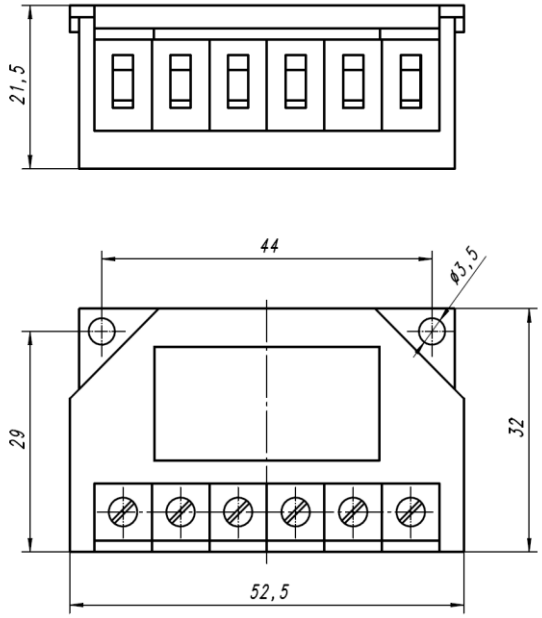
Maximum input voltage (alternating voltage) - U_{IN} = 230VAC,
The resulting output voltage of the rectifier (direct voltage) - 0,9U_{IN}= 0,9 x 230=207VDC

Rectifiers dimensions

B2-1P-400,
B5-1P-400,
B2-2P

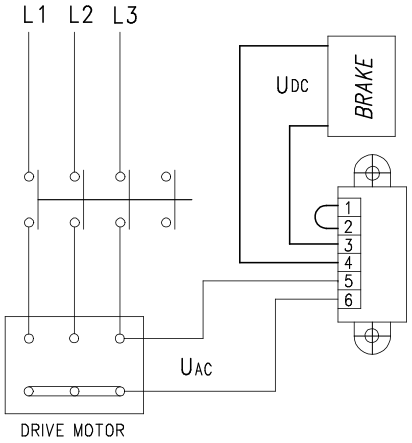


B2-1P-600,
B5-1P-600



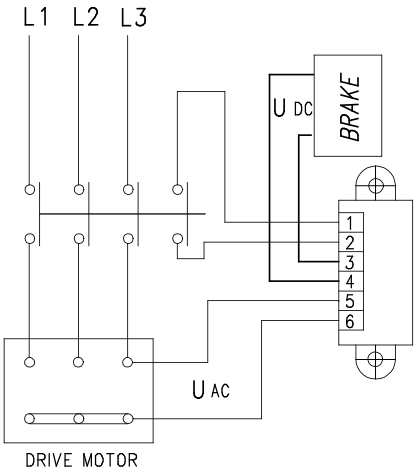
Disconnection of power supply on AC side

The diagram presents connection of rectifiers to supply circuit of motor. When disconnecting the voltage, the magnetic field causes the coil current to flow further through the rectifying diodes and drops slowly. The magnetic field reduces gradually causing prolonged time of braking action and consequently delayed increase of braking torque. If action time is irrelevant, brake should be connected on the AC side. When switching off, the supply circuits act as rectifying diodes.

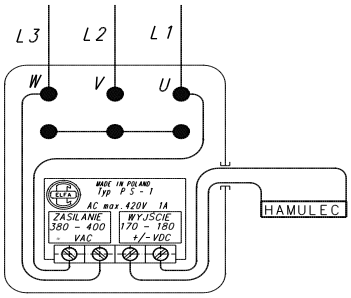


Disconnection of power supply on DC side

The diagram presents connection of rectifiers into electric motor circuit. The coil current is interrupted between the coil and supply (rectifier) circuit. The magnetic field reduces very quickly, **giving short time of braking action and consequently rapid growth of braking torque**. When switching off on DC voltage side, a high peak voltage is generated in the coil causing faster wear of contacts due to sparking. For protecting the coil against peak voltages and protecting the contacts against excessive wear, the rectifier circuit is provided with protective facility allowing brake connection on DC voltage side.



Rectifier PS-1



Circuit PS-1 is built on the basis of MOSFET type semiconductor technique which enabled achieving effects not available in traditional designs. The brake electromagnet energized through circuit of this construction enables the brake to achieve connection and disconnection time parameters analogous to breaking of circuit on direct current side. The parameters obtained are not however gained through utilization of additional electrical circuits and switches.

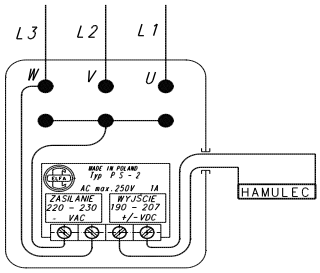
Simplicity of installation and parameters achieved enable very wide application, particularly in cases requiring positioning of drives, operation with high frequency of actuations compounded with repeatability of brake connecting and disconnecting times.

Supply circuit PS-1 forms a complete unit for direct installation. Provided with a four-terminal strip, it enables unhindered adaptation in every cooperating circuit. The circuit is adapted for supply from alternating current source of 380-400 VAC max. 420 VAC which after rectification and appropriate formation enables obtaining direct voltage of 170-180 VDC for brake supply.

The diagram below shows the method of connecting the circuit PS 1 into supply circuit of brake cooperating with 3x400 VAC electric motor with star-connected winding.

Rectifier PS-1 cooperates with brakes STE10 ÷ STE25,
Rectifier PS-1 cooperates with brakes STK10 ÷ STK25.

Rectifier PS-2



Circuit PS-2 is built on the basis of MOSFET type semiconductor technique which enabled achieving effects not available in traditional designs. The brake electromagnet energized through circuit of this construction enables the brake to achieve connection and disconnection time parameters analogous to breaking of circuit on direct current side. The parameters obtained are not however gained through utilization of additional electrical circuits and switches.

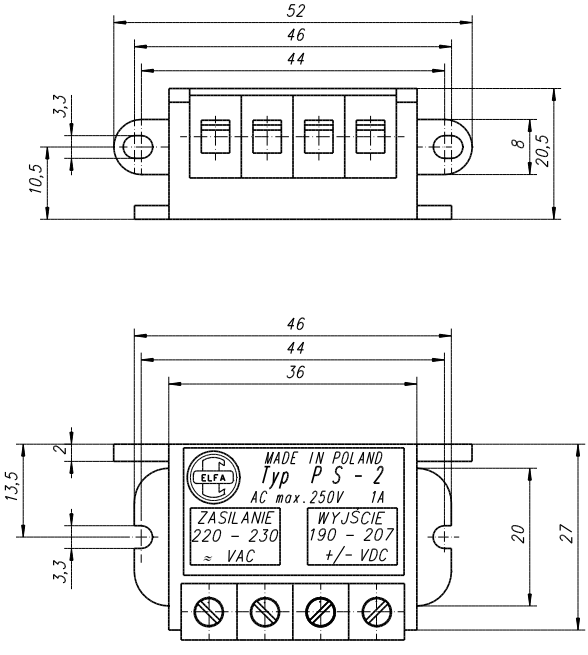
Simplicity of installation and parameters achieved enable very wide application, particularly in cases requiring positioning of drives, operation with high frequency of actuations compounded with repeatability of brake connecting and disconnecting times.

Supply circuit PS 2 forms a complete unit for direct installation. Provided with a four-terminal strip, it enables unhindered adaptation in every cooperating circuit. The circuit is adapted for supply from alternating current source of 220-230 VAC max. 250 VAC which after rectification and appropriate formation enables obtaining direct voltage of 190-207 VDC for brake supply.

The diagram below shows the method of connecting the circuit PS 2 into supply circuit of brake cooperating with 3x400 VAC electric motor with star-connected winding.

Rectifier PS-1 cooperates with brakes STE10 ÷ STE50,
Rectifier PS-1 cooperates with brakes STK10 ÷ STK50.

Rectifiers PS-1, PS-2 dimensions

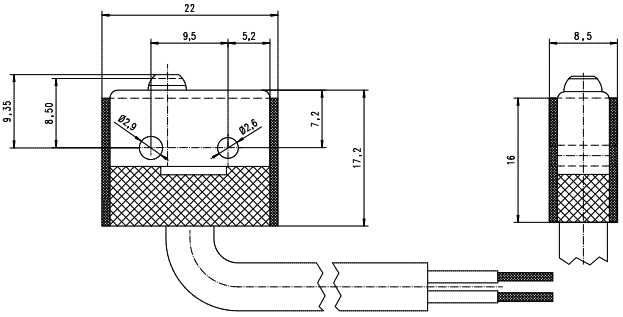


CONTROL AND SIGNALING CIRCUTS – microswitches

Having in mind the user who requires the control of the brake, we have designed special signaling and control circuits, which enable to control the state of the brake (engaged, disengaged) and the wear of the plate lining. The usage of these circuits enables to control the brake with the use of automatic elements, which ensure high level of safety and reliability. Due to its compact design, the microswitch can be used in any other applications, as long as its parameters meet design requirements.

MICROSWITCHES - ELECTRIC PARAMETERS		
Switch parameter	**Switch KZ**	**Switch KO**
Max. voltage AC	250 V AC	250 V AC
Max. AC switching current	5 A	6 A
Max. Voltage DC	28V DC	220V DC
Max. DC switching current	3 A / 28V DC	6A / 12V DC 3A / 24V DC 1A / 60V DC 0,5A / 110V DC 0,25A / 220V DC
Protection rating	IP 66	IP 66
Terminals	NO /NC	NO /NC

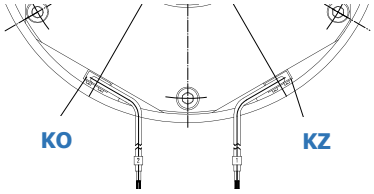
MICROSWITCH DIMENSIONS



Response monitoring microswitch – **KZ –** control of the state of brake (engaged, disengaged),

Microswitch of the brake lining control – KO – the microswitch indicates approaching the maximum wear of the brake disc and the necessity of the brake's regulation or replacement of the disc brake, which enables further work of the brake. The regulation procedure is described in the brake operating manual.

Response monitoring microswitch and microswitch of the brake lining control – KZ+KO



SAMPLE INSTALATION

PROCTECTIVE CIRCUITS – thermal protection

To protect electromagnet windings against heat build-up (slow-changing overloads) thermal sensor are used. In our offer we have PTC thermistors, which feature high resistance gradients when their rated temperature is reached - posistors - P or bimetallic thermal sensor - B.

Posistor-based sensors are made in the form of an insulated pill with connecting wires extending inside a teflon insulation, installed directly on the electromagnet windings. Sensor circuit terminals are routed outside the brake to the terminal box and connected to a separate connection block or terminal strip. So-called resistance relays are intended for thermistor-based PTC temperature sensors. When temperature of at least one of the sensors rises above the rated value, the circuit resistance suddenly increases triggering the relay.

Posistor thermal protection – P

Note! PTC sensor terminals must not be connected directly to the contactor.

The brake protection has the form of a bimetallic sensor. Brake operation is controlled by a sensor or by a set of sensors, which ensure its safe operation; excessive temperature indication is obtained from the thermal switch installed inside the brake electromagnet's housing rated for a specific temperature. When the limit temperature for the sensor is exceeded, the information for the automatic control equipment is sent or the brake circuit is disconnected.

Bimetallic thermal protection – B

STE
STK [ ] . [ ] [ ] . [ ] **VDC** [ ] **Nm** [ ] **...**

MECHANICAL SIZE
10, 15, 25, 50, 100, 160, 250

CONFIGURATION	
WITHOUT FITTING / ACCESORIES	0
LEVER FOR MANUAL RELEASE	1

Execution options for the customer's request:
- non-standard diameter of the sleeve gear brake d(H7)
- posistor thermal protection - **P**
- bimetallic thermal protection - **B**
- other voltage brake
- response monitoring microswitch (engaged, disengaged) - **KZ**
- microswitch of the brake lining control - **KO**
- microswitches set - **KZ+KO**

EXAMPLE:
STE 100. 11. 104VDC 900Nm P
STE 10. 03. 180VDC 100Nm KZ+KO
STK 250. 13. 104VDC 2500Nm MT
STK 50. 02. 180VDC 360Nm B

CLIMATIC VERSION
ACCORDING TO STANDARDS: e.g. MT, TH

NOMINAL BRAKING TORQUE [Nm]						
STE 10 STK 10	**STE 15 STK 15**	**STE 25 STK 25**	**STE 50 STK 50**	**STE 100 STK 100**	**STE 160 STK 160**	**STE 250 STK 250**
				1000		
100	150	250	500	900	1600	2500
80	120	180	360	800	1300	2100
60	75	120	270	700	1050	1800
				600		

OPERATING VOLTAGE [V DC]
104 , 180

PROTECTION RATING	
VERSION IP 54	0
VERSION IP 55	1
VERSION IP 65	2
VERSION IP 66	3

The producer reserves the right to modify as a result of developing the product.
It is possible to realize special versions.