8 BK brakes

8.1 Description of BK brakes (CMP40 to CMP63)

The mechanical brake is a holding brake implemented as a permanent magnet brake.

The standard voltage supply of the brake is DC 24 V, and it operates with a fixed braking torque per brake size.

The BK brake cannot be retrofitted and usually operates without brake rectifier or brake control unit.

If servomotors are operated on the MOVIAXIS® servo inverter, overvoltage protection is provided. If servomotors are operated on MOVIDRIVE® or inverters of other manufacturers, overvoltage protection must be implemented by the customers themselves using varistors, for example.

Observe the notes in the relevant operating instructions for the inverters concerning the switching sequence of motor enable and brake control during standard operation.

The BK brake can be used up to a rated speed of 6000 rpm.

The BK brake is a permanent magnet holding brake with emergency stop function. It is different from the BP brakes through its fixed coil polarity.

The BK brake can be used for the following rated speeds depending on the motor size:

Motor type	Brake type	Speed class
CMP40S/M	BK01	3000 / 4500 / 6000
CMP50S/M	BK02	
CMP63S	BK03	
CMP50L	BK04	
CMP63L/M	BK07	

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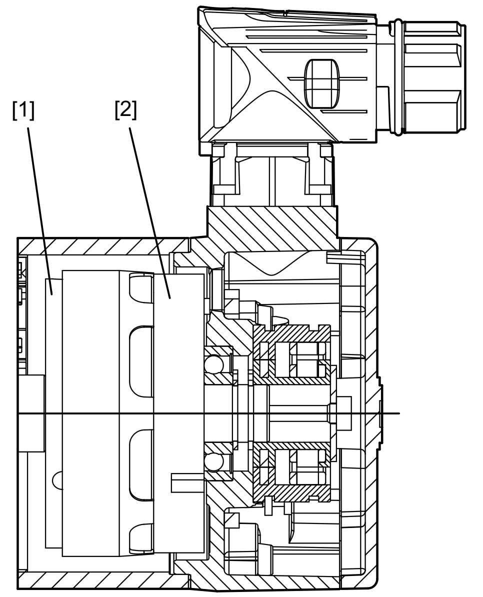
8.2 Principle of the BK brake

8.2.1 Basic design

The BK brake is a DC-operated permanent magnet brake that is released electrically and is applied using the magnetic force of the permanent magnets.

The system meets all fundamental safety requirements: The brake is applied automatically if the power fails.

Principle structure of the 24 V permanent magnet brake:



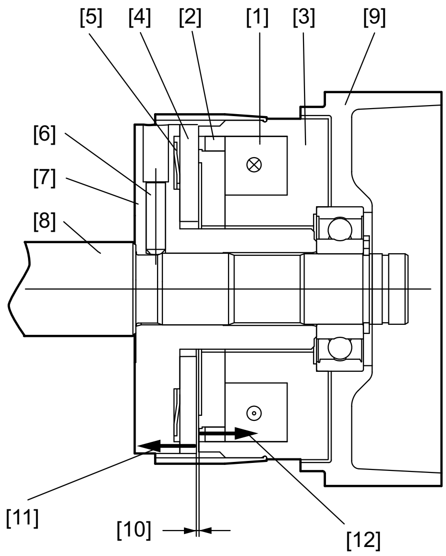
8806784523

[1] Armature
[2] Complete brake

8.2.2 Basic function

In de-energized condition, the pressure plate is forced against the magnet body by the force of the permanent magnets. The motor is braked.

When the brake coil is energized with the corresponding DC voltage, the resulting electromagnetic force cancels the force of the permanent magnets. Now the force of the return spring pulls the pressure plate to the armature and in this way enables the rotor to turn.



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[1]	Brake coil	[7]	Armature
[2]	Permanent magnet	[8]	Motor shaft
[3]	Magnet body	[9]	Endshield
[4]	Pressure plate	[10]	Working air gap
[5]	Return spring	[11]	Electromagnetic force and force of the return spring
[6]	Set screw	[12]	Permanent magnet force

8.3 General information about BK brakes

The size of the brakemotor and its electrical connection must be selected carefully to ensure the longest possible service life.

The following aspects described in detail must be taken into account:

1. Selecting the braking torque according to the project planning data (→ 🗎 235).
2. Dimensioning and routing of the cable (→ 🗎 243).
3. Selecting the brake contactor (→ 🗎 243).
4. Important design information (→ 🗎 236).

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8.4 Selecting the BK brake

The braking torque is determined when the drive motor is selected. The drive type, application areas and the standards that have to be taken into account are also used for brake selection.

If the application has to be held in place at standstill with the brake against external forces (such as wind or press forces), then you have to take account of the specifications for hoists.

Selection criteria:

- Type of servomotor
- Amount of braking torque

The brake type is selected on the basis of the braking torque. For the assignment of motor / brake type / braking torque, refer to chapter "Technical data of BK brakes“ (→ 🗎 241).

8.4.1 Selecting the BK brake

The brake type is selected on the basis of the braking torque. For the assignment of motor/brake type/braking torque, refer to chapter "Technical data of BK brakes“ (→ 🗎 241).

8.4.2 Values determined / calculated during brake selection:

Basic specification	Link/supplement/comment
Motor type	Brake type, brake control system
Braking torque	The braking torque is determined from the requirements of the application with regard to the maximum deceleration and the maximum permitted distance or time, as well as to the permitted braking work.
Brake application time	Type of brake control (important for electrical design, wiring diagrams)
Braking time **Braking distance** **Deceleration** **Braking accuracy**	The required data can only be observed if the aforementioned parameters meet the requirements

Selecting the brake

The brake suitable for the relevant application is selected by means of the following main criteria:

- Required braking torque
- Required working capacity

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Braking torque

The braking torque is usually selected according to the required holding torque and the required deceleration.

The nominal braking torque values of the BK brakes have been determined and checked in accordance with DIN VDE 0580.

Working capacity

The required working capacity of the brake is determined by the application parameters and indicates the amount of braking energy the brake has to receive during a braking operation.

INFORMATION

Application of the brake is no longer ensured if the permitted braking work per braking operation W_1 is exceeded during deceleration from speed, or once the total permitted braking work Winsp is reached. In this case, no braking occurs.

8.5 Important design information

8.5.1 EMC (electromagnetic compatibility)

The EMC instructions in the servo inverter documentation must also be taken into account for operating SEW servomotors with brake.

The instructions on laying cables (→ 🗎 243) must always be adhered to.

8.5.2 Maintenance intervals

The time to maintenance is determined on the basis of the expected brake wear. This value is important for setting up the maintenance schedule for the machine to be used by the customer’s service personnel (machine documentation).

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8.6 BK brake project planning

8.6.1 Data for brake dimensioning

The data of the application must be known for projecting a brake. The abbreviations used for project planning are summarized in the following table:

Designation	Meaning	Unit
η_G	Efficiency of the gear unit	
J_{ext}	External mass moment of inertia (in relation to motor shaft)	kgm^2
J_{Mot}	Mass moment of inertia of the motor	kgm^2
M_{1max}	Maximum dynamic braking torque in case of emergency switching off	Nm
$M_{1m,\ 100\ °C}$	Minimal averaged dynamic braking torque in case of emergency switching off at 100 °C	Nm
$M_{2,\ 20\ °C}$	Nominal torque for slipping brake disk (relative speed between brake disk and friction surface: 1 m/s) at 20 °C	Nm
$M_{4,\ 100\ °C}$	Minimum static braking torque (holding torque) at 100 °C	Nm
$M_{aEmergOff}$	Maximum permitted emergency switching off torque of the gear unit	Nm
i	Gear unit reduction ratio	
M_L	Static load torque, in relation to motor shaft	Nm
n	Motor speed	rpm
n_m	Motor speed, from application or travel diagram	rpm
n_D	Increase of motor speed until brake application	rpm
$n_{m\ EmergStop}$	Real emergency stop speed, relevant for check	rpm
s_b	Stopping distance	mm
t_2	Brake application time	s
t_B	Braking time	s
t_r	Response time or signal transmit time	s
v	Speed	m/s
W_1	Permitted braking work per braking operation	J
W_2	Permitted braking work per hour	J

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8.6.2 Hold function

The selected braking torque $M_{4,\ 100\ °C}$ must at least be higher than the highest static load torque of the application.

$$M_{4,100°C} > M_L$$

8.6.3 Emergency switching off function for lifting applications

To ensure a deceleration of the load, for lifting applications, the lowest averaged dynamic braking torque $M_{1m,\ 100\ °C}$ must be higher than the highest static load torque of the application.

$$M_{1m,100°C} > M_L$$

8.6.4 Speed difference during brake application

Due to the interaction of response time (signal transmit time), brake application time and the gravitational acceleration, the hoist may be in "free fall" for a short time. This results in an increased motor speed by nD (hoist downwards) or in a decreased motor speed by nD (horizontal drive and hoist upwards).

Calculating the emergency stop speed (hoist downwards):

$$n_{m,EmergencyStop} = n_m + n_D$$

Calculating the emergency stop speed (horizontal drive and hoist upwards):

$$n_{m,EmergencyStop} = n_m - n_D$$

$$n_D = \frac{9,55 \times M_L \times (t_r + t_2)}{J_{Mot} + J_{ext} \times \eta_G}$$

8.6.5 Working capacity in case of emergency switching off

Braking work per braking cycle in case of emergency switching off:

$$W_1 = \frac{(J_{Mot} + J_{ext} \times \eta_G) \times n_{m,\text{EmergStop}}^2 \times M_{1m,100°C}}{182.4 \times \left(M_{1m,100°C} \pm M_L\right)}$$

Observe the sign of the highest static load torque M_L in the formula. Use:

+ For vertical upward and horizontal movement
– For vertical downward movement

The calculated braking work W_1 is compared with the permitted braking work per braking operation W_1 of the BK brake (see "Technical data of BK brakes" (→ 🗎 241)).

According to the possible number of emergency switching off braking operations, it must also be compared with the permitted braking work per hour W_2 of the BK brake (see "Technical data of BK brakes" (→ 🗎 241)).

$$W_{1(BKbrake)} > W_{1(calculated)}$$

The following maximum permitted inertia ratios apply:

Motor type	Brake type	Permitted J_{ext} / J_{Mot}
CMP40S/M	BK01	without restrictions
CMP50S/M	BK02	
CMP63S	BK03	J_{ext} / J_{Mot} ≤ 30
CMP50L	BK04	
CMP63M/L	BK07	J_{ext} / J_{Mot} ≤ 20

J_{ext} External mass moment of inertia in kgm^2
J_{Mot} Mass moment of inertia of the motor in kgm^2

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8.6.6 Braking time / stopping distance

Braking time hoist downwards

$$t_B = \frac{(J_{Mot} + J_{ext} \times \eta_G) \times n_{m,\ EmergStop}}{9.55 \times (M_{1m,100°C} - M_L)}$$

Braking time horizontal drive, hoist upwards

$$t_B = \frac{(J_{Mot} + J_{ext} \times \eta_G) \times n_{m,EmergStop}}{9.55 \times (M_{1m,100°C} + M_L)}$$

Stopping distance

$$s_b = v \times 1000 \times (t_2 + t_r + \frac{1}{2} \times t_B)$$

8.6.7 Permitted gear unit load in case of emergency switching off

When using a gearmotor, in case of emergency switching off, the maximum dynamic braking torque in case of emergency switching off M_{1max} (see "Technical data of BK brakes" (→ 🗎 241)) must not exceed the maximum permitted emergency switching off torque $M_{aEmergOff}$ of the gear unit.

The value of the maximum permitted emergency switching off torque $M_{aEmergOff}$ is specified in the "Synchronous Servo Gearmotors" catalog.

$$M_{aEmergOff} \geq M_{1max} \times i \times \eta_G$$

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8.7 Technical data of BK brakes

The following table shows the technical data of BK brakes. They operate with a fixed braking torque per brake size.

Brake type	$M_{4,\,100\,°C}$ Nm	$M_{1m,\,100\,°C}$ Nm	M_{1max} Nm	W_1 kJ	W_2 kJ	W_{insp} 10^3 kJ	P W	t_1 ms	t_2 ms
BK01	1.9	1.4	3.4	0.056	1.12	0.112	8.8	35	20
BK02	2.4	1.9	5.3	0.175	3.50	0.350	6.7	80	20
BK03	3.8	2.0	7.9	0.371	7.42	0.742	13.4	50	30
BK04	3.9	2.4	7.0	0.288	5.76	0.576	13.4	50	30
BK07	7.1	3.9	12.8	0.740	14.8	1.48	15.0	70	30

$M_{4,\,100\,°C}$ Minimum static braking torque (holding torque) at 100 °C
$M_{1m,\,100\,°C}$ Minimum averaged dynamic braking torque in case of emergency switching off at 100 °C
M_{1max} Maximum dynamic braking torque in case of emergency switching off
W_1 Permitted braking work per braking operation
W_2 Permitted braking work per hour
W_{insp} Permitted total braking work (braking work until maintenance)
P Power consumption of the coil
t_1 Brake response time
t_2 Brake application time

INFORMATION

The response and application times are guide values that were determined at maximum braking torque.

Possible response times of switching elements or controllers were not taken into account.

8.7.1 Motor assignment

The BK brake can be used for the following rated speeds and braking torques depending on the motor size:

Motor type	Brake type	$M_{4,\,100\,°C}$ Nm	Speed class
CMP40S/M	BK01	1.9	3000 / 4500 / 6000
CMP50S/M	BK02	2.4	
CMP63S	BK03	3.8	
CMP50L	BK04	3.9	
CMP63M/L	BK07	7.1	

$M_{4,\,100\,°C}$ Minimum static braking torque (holding torque) at 100 °C

8.7.2 Operating currents for BK brakes

	BK01	BK02	BK03	BK04	BK07
Braking torque $M_{4,\ 100\ °C}$ in Nm	1.9	2.4	3.8	3.9	7.1
Braking power in W	8.8	6.7	13.4	13.4	15

Nominal voltage U_N **V_{DC}**	**I** **A_{DC}**	**I** **A_{DC}**	**I** **A_{DC}**	**I** **A_{DC}**	**I** **A_{DC}**
24 (21.6 – 26.4)	0.365	0.280	0.557	0.557	0.623

$M_{4,\ 100\ °C}$ Minimum static braking torque (holding torque) at 100 °C
I Operating current
U_N Nominal voltage (nominal voltage range)

When dimensioning the 24 V supply, it is not necessary to consider a current reserve for releasing the brake, i.e. the ratio of inrush current to operating current is 1.

8.7.3 Resistance values of BK brake coils

	BK01	BK02	BK03	BK04	BK07
Braking torque $M_{4,\ 100\ °C}$ in Nm	1.9	2.4	3.8	3.9	7.1
Braking power in W	8.8	6.7	13.4	13.4	15

Nominal voltage U_N **V_{DC}**	**R** **Ω**	**R** **Ω**	**R** **Ω**	**R** **Ω**	**R** **Ω**
24 (21.6 – 26.4)	65.7	85.5	43.1	43.1	38.6

$M_{4,\ 100\ °C}$ Minimum static braking torque (holding torque) at 100 °C
R Coil resistance at 20 °C
V_N Nominal voltage (nominal voltage range)

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8.8 Dimensioning and routing of the cable

8.8.1 Selecting the cable

Select the cross section of the brake cable according to the currents in your application. Note the inrush current of the brake when selecting the cross section. When taking the voltage drop into account due to the inrush current, the value must not drop below 90% of the nominal voltage. The data sheets for the brakes provide information on the possible supply voltages and the resulting operating currents.

Information about the size of the cable cross-section and the cable lengths can be found in the "Cable assignments" (→ 🗎 344) tables.

Wire cross sections of max. 2.5 mm^2 can be connected to the terminals of the brake control systems. Intermediate terminals must be used if the cross sections are larger.

8.8.2 Routing information

Brake cables must always be routed separately from other power cables with phased currents unless they are shielded.

Ensure adequate equipotential bonding between the drive and the control cabinet (for an example, see the documentation Drive Engineering – Practical Implementation "EMC in Drive Engineering").

Power cables with phased currents include in particular:

- Output cables from frequency inverters and servo inverters, soft start units and brake units
- Incoming cables to braking resistors

8.9 Selecting the braking contactor

In view of the high current loading and the DC voltage to be switched at inductive load, the switchgear for the brake voltage has to have a special DC contactor.

Selecting the braking contactor for line operation is easy:

- The contactor is configured for DC3 operation with DC 24 V.

If the system complies with the specifications for direct brake control, then a BK brake can also be controlled directly via the brake output of a MOVIAXIS® servo inverter.

Direct brake control

Specifications for direct brake control:

- Only BK brakes of the CMP40 to 63 and DS56 motor types are permitted.
- Expressly excluded are all brakes from third parties.
- Use only prefabricated brakemotor cables from SEW-EURODRIVE.
- The brakemotor cable must be shorter than 25 m.
- Take into account all directly controlled brakes when selecting the 24 V supply for MOVIAXIS®.
- The 24 V supply of MOVIAXIS® must meet the requirements to ensure direct brake control.

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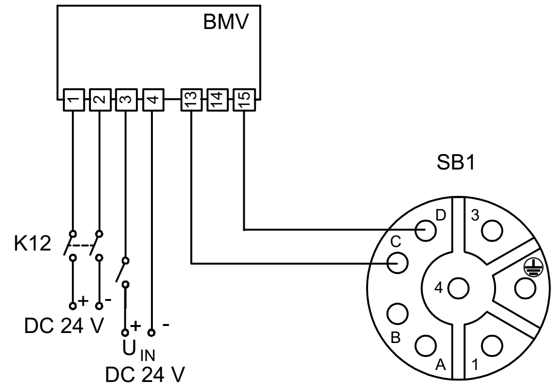
8.10 Block diagram of brake control – plug connectors

In every application, BK holding brakes can be controlled via the BMV brake relay or a customer relay with varistor overvoltage protection.

In the following block diagrams, the contactor for the supply voltage of the brake rectifier is designated as K12.

The following applies to BMV: In applications without requirements on functional safety, the brake need only be connected via connections 3 and 4 (depicted as N.O. contact without name). In applications with requirements on functional safety (such as hoists), all poles must be switched off to ensure that the brake is applied even in the event of a fault in the brake rectifier.

8.10.1 BMV brake controller



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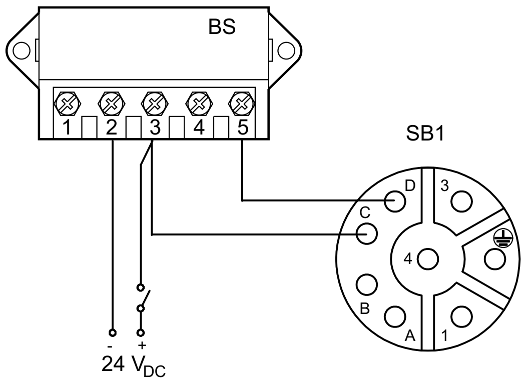
Connection 1, 2   Power supply
Connection 3, 4   Signal (inverter)

8.10.2 BS brake contactor



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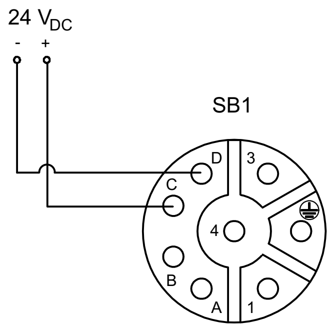
8.10.3 Direct 24 V brake supply



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In the following cases, the brake must be protected from overvoltage, for example by means of a varistor protection circuit:

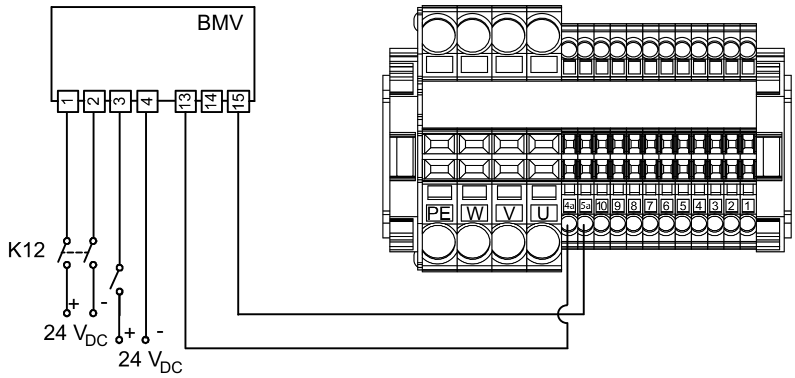
- Operation on non-SEW inverters,
- If the brake is not directly supplied from the SEW inverter.

8.11 Block diagram of brake control – terminal box

In the following block diagrams, the contactor for the supply voltage of the brake rectifier is designated as K12. Except for BMV, BMKB and BMK, it is used to also switch the brake.

BMV and BMK: In applications without requirements on functional safety, the brake need only be connected via connections 3 and 4 (depicted as N.O. contact without name). In applications with requirements on functional safety (such as hoists), all poles must be switched off to ensure that the brake is applied even in the event of a fault in the brake rectifier.

8.11.1 BMV brake controller – CMP50, CMP63



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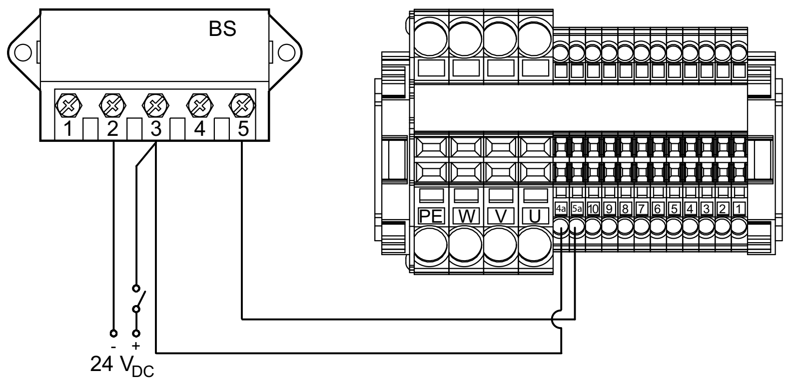
Connection 1, 2 Power supply
Connection 3, 4 Signal (inverter)

8.11.2 BS brake contactor – CMP50, CMP63



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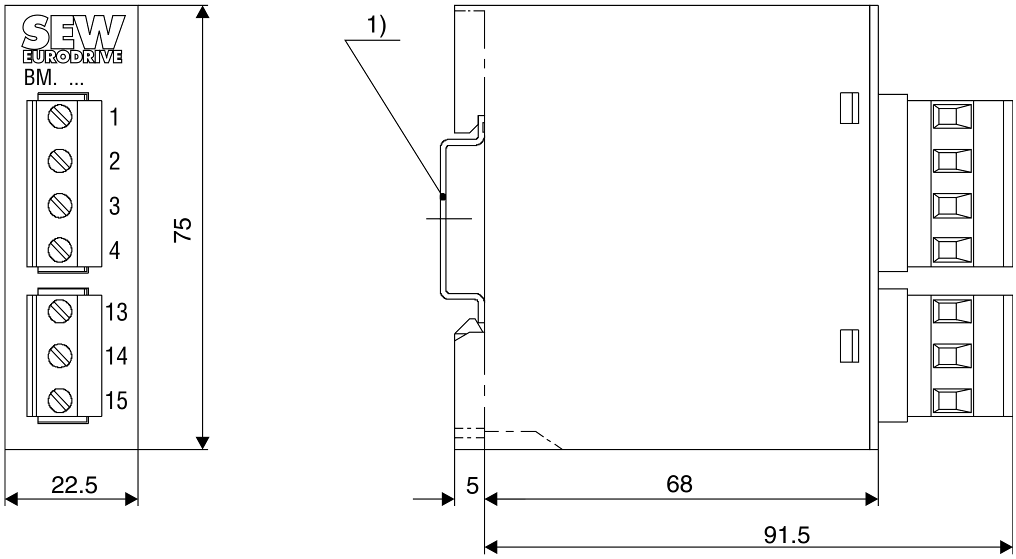
8.12 Dimensions drawings for BK brake controls

8.12.1 BMV

For information regarding the use of the BMV brake control, refer to chapter "Block diagram of brake control" (→ 🗎 244).



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1) Support rail mounting according to EN 50022-35-7.5 (not included in the delivery)

9 BP brakes

9.1 Description of BP brakes (CMP71 to CMP100)

The mechanical brake is a holding brake implemented as a spring-loaded brake.

The brake has a standard supply voltage of DC 24 V and operates with one or two braking torque ratings for each motor size (→ 256).

The brake cannot be retrofitted and usually operates without brake rectifier or brake control unit.

If servomotors are operated on the MOVIAXIS® servo inverter, overvoltage protection is provided.

If servomotors are operated on MOVIDRIVE® or inverters of other manufacturers, overvoltage protection must be implemented by the customers themselves using varistors, for example.

Observe the notes in the relevant operating instructions for the inverters concerning the switching sequence of motor enable and brake control during standard operation.

The BP brake can be used for the following rated speeds depending on the motor size:

Motor type	Brake type	Speed class
CMP71S/M/L	BP1	2000 / 3000 / 4500 / 6000
CMP80S/M/L	BP3	2000 / 3000 / 4500
CMP100S/M/L	BP5	

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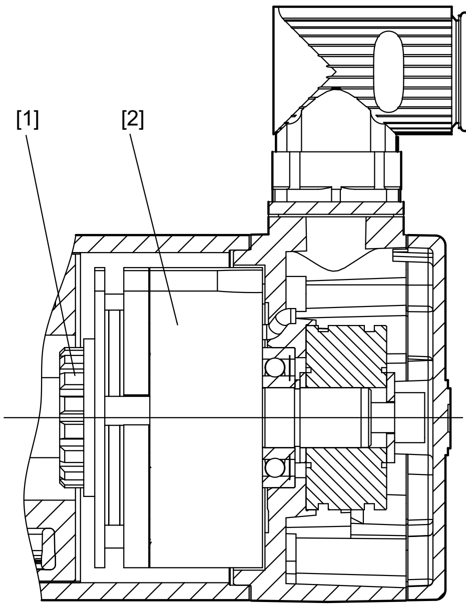
9.2 Principle of the BP brake

9.2.1 Basic design

The SEW brake is an electromagnetic disk brake with a DC coil that releases electrically and brakes using spring force.

The system meets all fundamental safety requirements: the brake is applied if the power fails.

Principle structure of the 24 V spring-loaded brake:



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[1] Driver
[2] Complete brake

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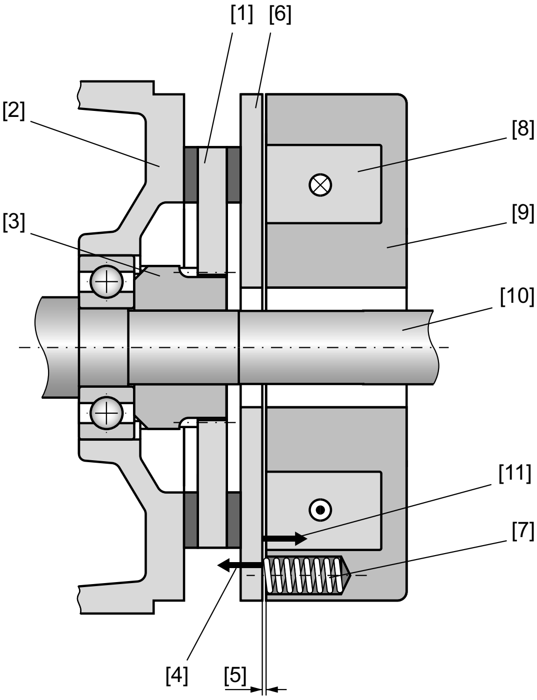
9.2.2 Basic function

The pressure plate is forced against the brake disk by the brake springs when the electromagnet is de-energized. The brake is applied to the motor. The number and type of brake springs determine the braking torque. When the brake coil is connected to the corresponding DC voltage, the force of the brake springs [4] is overcome by magnetic force [11], thereby bringing the pressure plate into contact with the magnet. The brake disk moves clear and the rotor can turn.



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[1]	Brake disk	[7]	Brake spring
[2]	Brake endshield	[8]	Brake coil
[3]	Driver	[9]	Magnet body
[4]	Spring force	[10]	Motor shaft
[5]	Working air gap	[11]	Electromagnetic force
[6]	Pressure plate		

9.3 General information about BP brakes

The size of the brakemotor and its electrical connection must be selected carefully to ensure the longest possible service life.

The following aspects described in detail must be taken into account:

1. Selecting the braking torque according to the project planning data (→ 🗎 251).
2. Dimensioning and routing of the cable (→ 🗎 259).
3. Selecting the brake contactor (→ 🗎 259).
4. Important design information (→ 🗎 252).

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9.4 Selecting the BP brake

The braking torque is determined when the drive motor is selected. The drive type, application areas and the standards that have to be taken into account are also used for brake selection.

If the application has to be held in place at standstill with the brake against external forces (such as wind or press forces), then you have to take account of the specifications for hoists.

Selection criteria:

- Type of servomotor
- Amount of the braking torque

The brake type is selected on the basis of the braking torque. For the assignment of motor / brake type / braking torque, refer to chapter "Technical data of BP brakes" (→ 🗎 256).

9.4.1 Selecting the BP brake

The brake type is selected on the basis of the braking torque. For the assignment of motor / brake type / braking torque, refer to chapter "Technical data of BP brakes" (→ 🗎 256).

9.4.2 Values determined / calculated during brake selection:

Basic specification	Link/supplement/comment
Motor type	Brake type, brake control system
Braking torque	The braking torque is determined from the requirements of the application with regard to the maximum deceleration and the maximum permitted distance or time, as well as to the permitted braking work.
Brake application time	Type of brake control (important for electrical design, wiring diagrams)
Braking time **Braking distance** **Deceleration** **Braking accuracy**	The required data can only be observed if the aforementioned parameters meet the requirements

Selecting the brake

The brake suitable for the relevant application is selected by means of the following main criteria:

- Required braking torque
- Required working capacity

Braking torque

The braking torque is usually selected according to the required holding torque and the required deceleration.

The nominal braking torque values of the BP brakes have been determined and checked in accordance with DIN VDE 0580.

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Working capacity

The required working capacity of the brake is determined by the application parameters and indicates the amount of braking energy the brake has to receive during a braking operation.

INFORMATION

Application of the brake is no longer ensured if the permitted braking work per braking operation W_1 is exceeded during deceleration from speed, or once the total permitted braking work Winsp is reached. In this case, no braking occurs.

9.5 Important design information

9.5.1 EMC (electromagnetic compatibility)

The EMC instructions in the servo inverter documentation must also be taken into account for operating SEW servomotors with brake.

The instructions on laying cables (→ 🗎 259) must always be adhered to.

9.5.2 Maintenance intervals

The time to maintenance is determined on the basis of the expected brake wear. This value is important for setting up the maintenance schedule for the machine to be used by the customer's service personnel (machine documentation).

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9.6 BP brake project planning

9.6.1 Data for brake dimensioning

The data of the application must be known for projecting a brake. The abbreviations used for project planning are summarized in the following table:

Designation	Meaning	Unit
η_G	Efficiency of the gear unit	
J_{ext}	External mass moment of inertia (in relation to motor shaft)	kgm^2
J_{Mot}	Mass moment of inertia of the motor	kgm^2
M_{1max}	Maximum dynamic braking torque in case of emergency switching off	Nm
$M_{1m,\ 100\ °C}$	Minimal averaged dynamic braking torque in case of emergency switching off at 100 °C	Nm
$M_{2,\ 20\ °C}$	Nominal torque for slipping brake disk (relative speed between brake disk and friction surface: 1 m/s) at 20 °C	Nm
$M_{4,\ 100\ °C}$	Minimum static braking torque (holding torque) at 100 °C	Nm
$M_{aEmergOff}$	Maximum permitted emergency switching off torque of the gear unit	Nm
i	Gear unit reduction ratio	
M_L	Static load torque, in relation to motor shaft	Nm
n	Motor speed	rpm
n_m	Motor speed, from application or travel diagram	rpm
n_D	Increase of motor speed until brake application	rpm
$n_{m\ EmergStop}$	Real emergency stop speed, relevant for check	rpm
s_b	Stopping distance	mm
t_2	Brake application time	s
t_B	Braking time	s
t_r	Response time or signal transmit time	s
v	Speed	m/s
W_1	Permitted braking work per braking operation	J
W_2	Permitted braking work per hour	J

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9.6.2 Hold function

The selected braking torque $M_{4,\ 100\ °C}$ must at least be higher than the highest static load torque of the application.

$$M_{4,100°C} > M_L$$

The following table shows the number of permitted switching cycles of the BP brake until end of service life when used exclusively as holding brake.

Motor type	Brake type	Permitted switching cycles
CMP71	BP1	4,000,000
CMP80	BP3	2,500,000
CMP100	BP5	1,500,000

9.6.3 Emergency switching off function for lifting applications

To ensure a deceleration of the load, for lifting applications, the lowest averaged dynamic braking torque $M_{1m,\ 100\ °C}$ must be higher than the highest static load torque of the application.

$$M_{1m,100°C} > M_L \times 1.2$$

9.6.4 Speed difference during brake application

Due to the interaction of response time (signal transmit time), brake application time and the gravitational acceleration, the hoist may be in "free fall" for a short time. This results in an increased motor speed by nD (hoist downwards) or in a decreased motor speed by nD (horizontal drive and hoist upwards).

Calculating the emergency stop speed (hoist downwards):

$$n_{m,EmergencyStop} = n_m + n_D$$

Calculating the emergency stop speed (horizontal drive and hoist upwards):

$$n_{m,EmergencyStop} = n_m - n_D$$

$$n_D = \frac{9{,}55 \times M_L \times (t_r + t_2)}{J_{Mot} + J_{ext} \times \eta_G}$$

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9.6.5 Working capacity in case of emergency switching off

Braking work per braking cycle in case of emergency switching off:

$$W_1 = \frac{(J_{Mot} + J_{ext} \times \eta_G) \times n_{m,\text{EmergStop}}^2 \times M_{1m,100°C}}{182.4 \times \left(M_{1m,100°C} \pm M_L\right)}$$

Observe the sign of the highest static load torque M_L in the formula. Use:

- \+ For vertical upward and horizontal movement
- – For vertical downward movement

The calculated braking work W_1 is compared with the permitted braking work per braking operation W_1 of the BP brake (see "Technical data of BP brakes" (→ 🗎 256)).

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According to the possible number of emergency switching off braking operations, it must also be compared with the permitted braking work per hour W_2 of the BP brake (see "Technical data of BP brakes (→ 🗎 256)).

$$W_{1(BPbrake)} > W_{1(calculated)}$$

9.6.6 Braking time / stopping distance

Braking time hoist downwards

$$t_B = \frac{(J_{Mot} + J_{ext} \times \eta_G) \times \text{n}_{m,\text{ EmergStop}}}{9.55 \times \left(M_{1m,100°C} - \text{M}_L\right)}$$

Braking time horizontal drive, hoist upwards

$$\text{t}_\text{B} = \frac{(\text{J}_\text{Mot} + \text{J}_\text{ext} \times \eta_G) \times \text{n}_\text{m,EmergStop}}{9.55 \times \left(\text{M}_\text{1m,100°C} + \text{M}_\text{L}\right)}$$

Stopping distance

$$s_b = v \times 1000 \times (t_2 + t_r + \frac{1}{2} \times t_B)$$

9.6.7 Permitted gear unit load in case of emergency switching off

When using a gearmotor, in case of emergency switching off , the maximum dynamic braking torque in case of emergency switching off M_{1max} (see "Technical data of BK brakes" (→ 🗎 241)) must not exceed the maximum permitted emergency switching off torque $M_{aEmergOff}$ of the gear unit.

The value of the maximum permitted emergency switching off torque $M_{aEmergOff}$ is specified in the "Synchronous Servo Gearmotors" catalog.

$$\text{M}_\text{aEmergOff} \geq \text{M}_{2,20°\text{C}} \times \text{i} \times \eta_\text{G}$$

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9.7 Technical data of BP brakes

The following table shows the technical data of the brakes. The type and number of brake springs determines the level of the braking torque. If not specified otherwise in the order, brakemotors are delivered with the braking torques indicated with gray background.

Motor type	Brake type	$M_{2,\ 20\ °C}$ Nm	$M_{4,\ 100\ °C}$ Nm	$M_{1m,\ 100\ °C}$ Nm	W_1 kJ	W_2 kJ	W_{insp} 10^3 kJ	P W	t_1 ms	t_2 ms
CMP71S	BP1	7	4.2	2.8	1.4	16.8	2.6	19.5	200	75
		14	8.4	5.6						
CMP71M/L	BP1	7	4.2	2.8	1.4	16.8	2.6	19.5	200	75
		14	8.4	5.6						
CMP80S	BP3	16	9.6	6.4	2.2	26.4	4.1	28	200	75
		31	18.6	12.4						
CMP80M/L	BP3	16	9.6	6.4	2.2	26.4	4.1	28	200	75
		31	18.6	12.4						
CMP100S	BP5	24	14.4	9.6	3.6	43.2	6.7	33	200	75
		47	28.2	18.8						
CMP100M/L	BP5	24	14.4	9.6	3.6	43.2	6.7	33	200	75
		47	28.2	18.8						

(gray)	Standard braking torque
	Optional braking torque
$M_{2,\ 20\ °C}$	Nominal torque for slipping brake disk (relative speed between brake disk and friction surface: 1 m/s) at 20 °C
$M_{4,\ 100\ °C}$	Minimum static braking torque (holding torque) at 100 °C
$M_{1m,\ 100\ °C}$	Minimum averaged dynamic braking torque in case of emergency switching off at 100 °C
W_1	Permitted braking work per braking operation
W_2	Permitted braking work per hour
W_{insp}	Permitted total braking work (braking work until maintenance)
P	Power consumption of the coil
t_1	Brake response time
t_2	Brake application time

INFORMATION

The response and application times are guide values that were determined at maximum braking torque.

Possible response times of switching elements or controllers were not taken into account.

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9.7.1 Motor assignment

The BP brake can be used for the following rated speeds and braking torques depending on the motor size:

Motor type	Brake type	$M_{2, 20\,°C}$ Nm		Speed class
CMP71S	BP1	7	14	2000 / 3000 / 4500 / 6000
CMP71M/L		7	14	
CMP80S	BP3	16	31	2000 / 3000 / 4500
CMP80M/L		16	31	
CMP100S	BP5	24	47	2000 / 3000 / 4500
CMP100M/L		24	47	

$M_{2, 20\,°C}$ Nominal torque for slipping brake disk (relative speed between brake disk and friction surface: 1 m/s) at 20 °C
(grey) Standard braking torque
Optional braking torque

9.7.2 Operating currents for BP brakes

	BP1	BP3	BP5
Braking torque $M_{2, 20\,°C}$ in Nm	14	31	47
Braking power in W	19.5	28	33

Nominal voltage U_N **V_{DC}**	**I** **A_{DC}**	**I** **A_{DC}**	**I** **A_{DC}**
24 (21.6 – 26.4)	0.81	1.17	1.38

$M_{2, 20\,°C}$ Nominal torque for slipping brake disk (relative speed between brake disk and friction surface: 1 m/s) at 20 °C
I Operating current
U_N Nominal voltage (nominal voltage range)

When dimensioning the 24 V supply, it is not necessary to consider a current reserve for releasing the brake, i.e. the ratio of inrush current to operating current is 1.

9.7.3 Resistance values of BP brake coils

	BP1	BP3	BP5
Braking torque $M_{2,\ 20\ °C}$ in Nm	14	31	47
Braking power in W	19.5	28	33

Nominal voltage U_N **V_{DC}**	**R** **Ω**	**R** **Ω**	**R** **Ω**
24 (21.6 – 26.4)	29.4	20.5	17.3

$M_{2,\ 20\ °C}$ Nominal torque for slipping brake disk (relative speed between brake disk and friction surface: 1 m/s) at 20 °C

R Coil resistance at 20 °C

V_N Nominal voltage (nominal voltage range)

9.7.4 Permitted switching work (emergency switching off operation)

The permitted number of switching cycles per hour is 10.

The minimum pause time between 2 switching cycles is 6 minutes.

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9.8 Dimensioning and routing of the cable

9.8.1 Selecting the cable

Select the cross section of the brake cable according to the currents in your application. Note the inrush current of the brake when selecting the cross section. When taking the voltage drop into account due to the inrush current, the value must not drop below 90% of the nominal voltage. The data sheets for the brakes provide information on the possible supply voltages and the resulting operating currents.

Information about the size of the cable cross-section and the cable lengths can be found in the "Cable assignments" (→ 🗎 344) tables.

Wire cross sections of max. 2.5 mm^2 can be connected to the terminals of the brake control systems. Intermediate terminals must be used if the cross sections are larger.

9.8.2 Routing information

Brake cables must always be routed separately from other power cables with phased currents unless they are shielded.

Ensure adequate equipotential bonding between the drive and the control cabinet (for an example, see the documentation Drive Engineering – Practical Implementation "EMC in Drive Engineering").

Power cables with phased currents include in particular:

- Output cables from frequency inverters and servo inverters, soft start units and brake units
- Incoming cables to braking resistors

9.9 Selecting the braking contactor

In view of the high current loading and the DC voltage to be switched at inductive load, the switchgear for the brake voltage has to have a special DC contactor.

Selecting the braking contactor for line operation is easy:

- The contactor is configured for DC3 operation with DC 24 V.

If the system complies with the specifications for direct brake control, then a BP brake can also be controlled directly via the brake output of a MOVIAXIS® servo inverter.

However, the brakes of CMP80 and CMP100 motors can never be directly connected to MOVIAXIS®. For detailed information, refer to the "MOVIAXIS® Multi-Axis Servo Inverter" system manual.

Direct brake control

Specifications for direct brake control:

- Only BP brakes of the CMP71 motor type is permitted.
- Expressly excluded are brakes of the motor types CMP80 and greater, CMPZ motors, and all non-SEW brakes.
- Only prefabricated brakemotor cables from SEW-EURODRIVE must be used.
- The brakemotor cable must be shorter than 25 m.
- When dimensioning the 24 V supply of MOVIAXIS®, all directly controlled brakes must be considered.
- The 24 V supply of MOVIAXIS® must meet the requirements to ensure direct brake control.

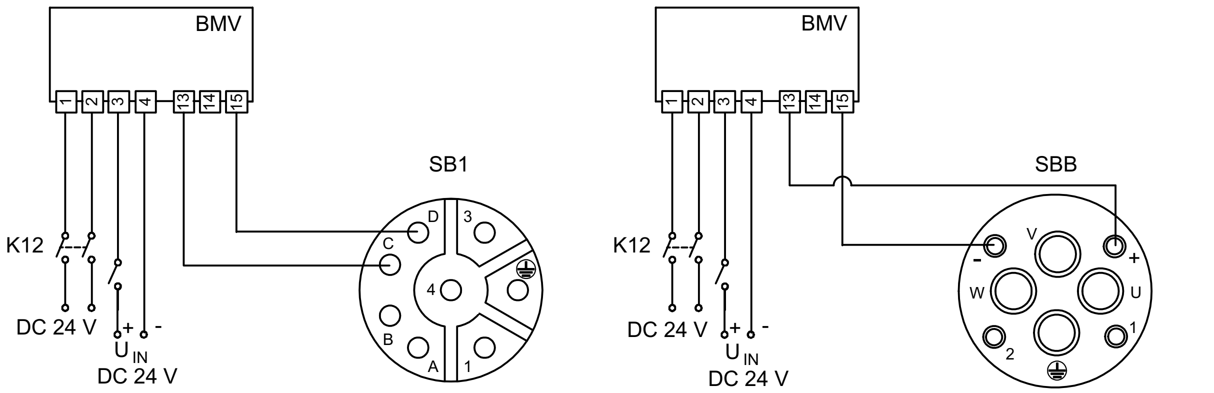
9.10 Block diagram of brake control – plug connectors

In every application, BP holding brakes can be controlled via the BMV brake relay or a customer relay with varistor overvoltage protection.

In the following block diagrams, the contactor for the supply voltage of the brake rectifier is designated as K12.

The following applies to BMV: In applications without requirements on functional safety, it is sufficient to switch the brake via connections 3 and 4 (depicted as N.O. contact without name). In applications with requirements on functional safety (such as hoists), all poles must be switched off to ensure that the brake is applied even in the event of a fault in the brake rectifier.

9.10.1 BMV brake controller



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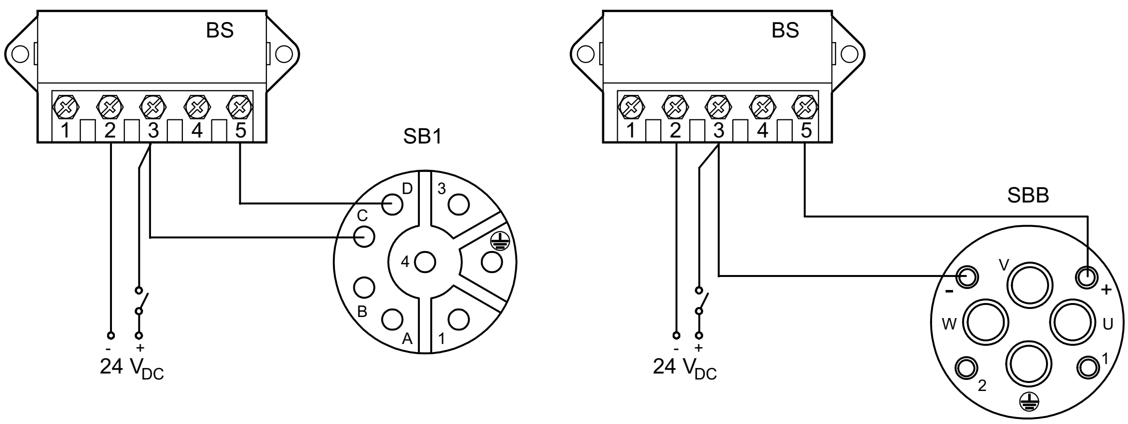
Connection 1, 2	Power supply
Connection 3, 4	Signal (inverter)

9.10.2 BS brake contactor



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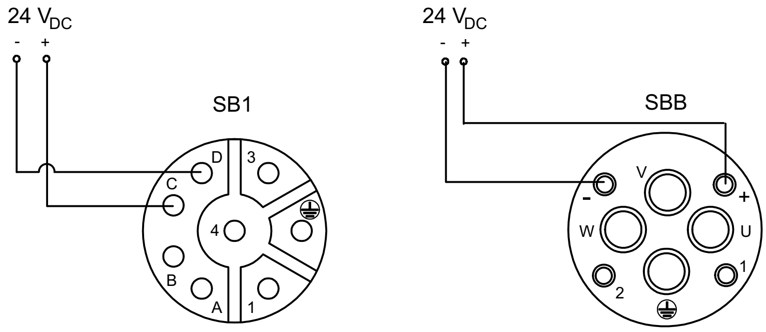
9.10.3 Direct 24 V brake supply



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In the following cases, the brake must be protected from overvoltage, for example by means of a varistor protection circuit:

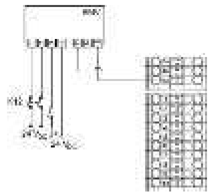
- Operation on non-SEW inverters,
- If the brake is not directly supplied from the SEW inverter.

9.11 Block diagram of brake control – terminal box

In the following block diagrams, the contactor for the supply voltage of the brake rectifier is designated as K12. Except for BMV, BMKB and BMK, it is used to also switch the brake.

BMV and BMK: In applications without requirements on functional safety, it is sufficient to switch the brake via connections 3 and 4 (depicted as N.O. contact without name). In applications with requirements on functional safety (such as hoists), all poles must be switched off to ensure that the brake is applied even in the event of a fault in the brake rectifier.

9.11.1 BMV brake controller



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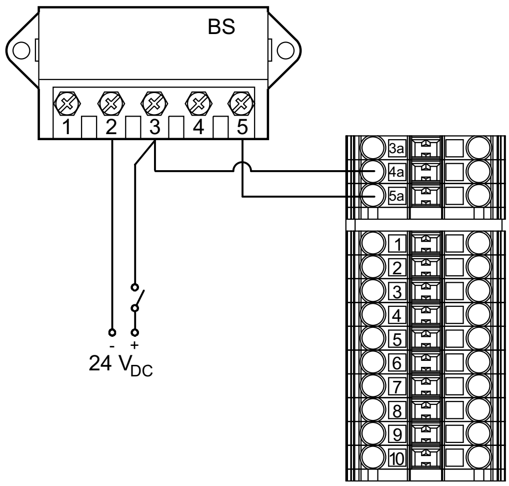
Connection 1, 2 Power supply
Connection 3, 4 Signal (inverter)

9.11.2 BS brake contactor



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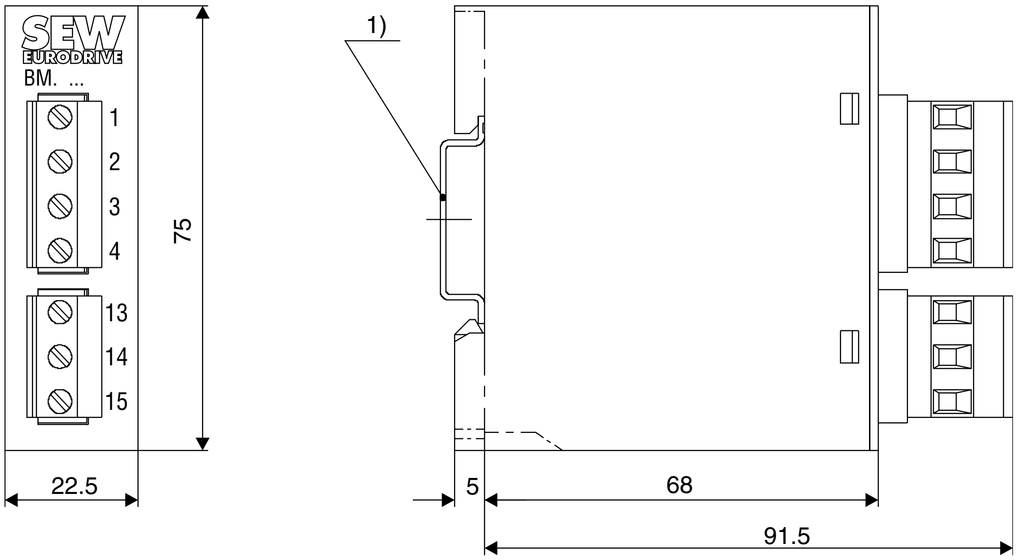
9.12 Dimension drawings for BP brake controls

9.12.1 BMV

For information regarding the use of the BMV brake control, refer to chapter "Block diagram of brake control" (→ 🗎 260).



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1) Support rail mounting according to EN 50022-35-7.5 (not included in the delivery)

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10 BY brakes

10.1 Description of BY brakes (CMPZ71 to CMPZ100, CMP112)

On request, SEW-EURODRIVE motors can be supplied with an integrated mechanical brake. The brake is a DC-operated electromagnetic disk brake with a high working capacity that is released electrically and is applied using spring force. The brake is applied in case of a power failure. It meets the basic safety requirements.

The brake can also be released mechanically if equipped with manual brake release. The manual brake release function is self-reengaging (..HR). A hand lever is supplied.

The /HR manual brake release option in combination with a /VR forced cooling fan is only available for CMP112.

The brake is controlled by a brake controller that is either installed in the control cabinet or in the terminal box.

A main advantage of brakes from SEW-EURODRIVE is their very short design. The integrated construction of the brakemotor permits particularly compact and sturdy solutions.

Observe the notes in the relevant operating instructions concerning the switching sequence of motor enable and brake control during standard operation.

The BY brake can be used for the following rated speeds depending on the motor size:

Motor type	Brake type	Speed class
CMPZ71S/M/L	BY2	2000 / 3000 / 4500 / 6000
CMPZ80S/M/L	BY4	2000 / 3000 / 4500
CMPZ100S/M/L	BY8	
CMP112S/M/L/H/E	BY14	

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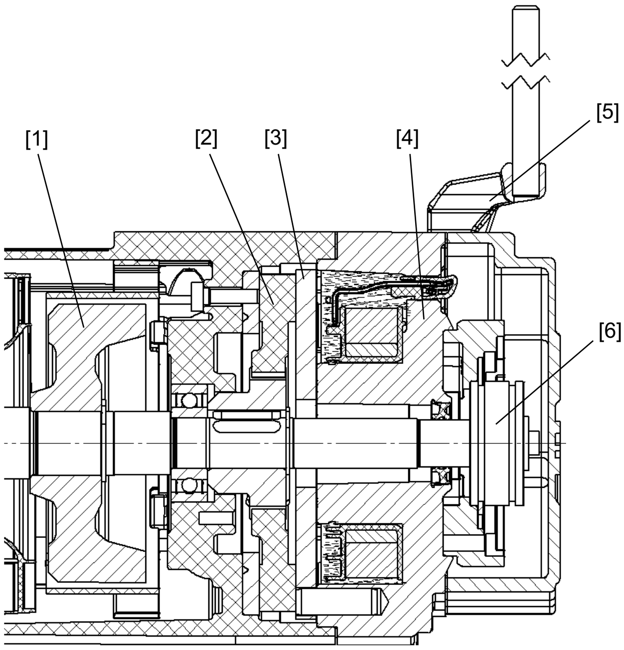
10.2 Principle of the BY brake

10.2.1 Basic function

The pressure plate is forced against the brake disk by the brake springs when the electromagnet is de-energized. The brake is applied to the motor. The number and type of brake springs determine the braking torque. When the brake coil is connected to the corresponding DC voltage, the force of the brake springs is overcome by magnetic force, thereby bringing the pressure plate into contact with the magnet. The brake disk moves clear and the rotor can turn.

Basic structure of the working brake:



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[1]	Additional flywheel mass	[4]	Complete magnet body
[2]	Brake disk	[5]	Releasing lever
[3]	Pressure plate	[6]	RH1M encoder

10.3 General information

The BY working brake can be mounted on CMPZ71 to CMPZ100 motors (motor design with additional flywheel mass) and on CP112 motors.

The size of the brakemotor and its electrical connection must be selected carefully to ensure the longest possible service life.

The following aspects described in detail must be taken into account:

1. Selecting the braking torque according to the project planning data (→ 🗎 266).
2. Dimensioning and routing of the cable (→ 🗎 283).
3. Selecting the brake contactor (→ 🗎 283).
4. Important design information (→ 🗎 267).

10.4 Selecting the BY brake

The mechanical components, brake type and braking torque are determined when the drive motor is selected. The drive type or application areas and the standards that have to be taken into account are used for the brake selection.

Selection criteria:

- Servomotor motor size
- Number of braking operations during service and number of emergency braking operations
- Working brake or holding brake
- Level of braking torque ("soft braking"/"hard braking")
- Hoist application
- Minimum/maximum deceleration
- Encoder system used

The brake type is selected on the basis of the braking torque. For the assignment of motor/brake type/braking torque, refer to chapter "Technical data of BY brakes" (→ 🗎 273).

10.4.1 Selecting the BY brake

The brake type is selected on the basis of the braking torque. For the assignment of motor / brake type / braking torque, refer to chapter "Technical data of BY brakes" (→ 🗎 273).

10.4.2 Values determined / calculated during brake selection:

Basic specification	Link/supplement/comment
Motor type	Brake type, brake control system
Braking torque	The braking torque is determined from the requirements of the application with regard to the maximum deceleration and the maximum permitted distance or time, as well as to the permitted braking work.
Brake application time	Type of brake control (important for electrical design, wiring diagrams)
Braking time **Braking distance** **Deceleration** **Braking accuracy**	The required data can only be observed if the aforementioned parameters meet the requirements

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Selecting the brake

The brake suitable for the relevant application is selected by means of the following main criteria:

- Required braking torque
- Required working capacity

Braking torque

The braking torque is usually selected according to the required holding torque and the required deceleration.

Detailed motor data can be found in chapter "Technical data of BY brakes" (→ 🗎 273).

The nominal braking torque values of BY brakes have been determined and checked in accordance with DIN VDE 0580.

Working capacity

The required working capacity of the brake is determined by the application parameters and indicates the amount of braking energy the brake has to receive during a braking operation.

INFORMATION

Application of the brake is no longer ensured if the permitted braking work per braking operation W_1 is exceeded during deceleration from speed, or once the total permitted braking work Winsp is reached. In this case, no braking occurs.

10.5 Important design information

10.5.1 EMC (electromagnetic compatibility)

The EMC instructions in the servo inverter documentation must also be taken into account for operating SEW servomotors with brake.

The instructions on laying cables (→ 🗎 283) must always be adhered to.

10.5.2 Maintenance intervals

The time to maintenance is determined on the basis of the expected brake wear. This value is important for setting up the maintenance schedule for the machine to be used by the customer’s service personnel (machine documentation).

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10.6 BY brake project planning

10.6.1 Data for brake dimensioning

The data of the application must be known for projecting a brake. The abbreviations used for project planning are summarized in the following table:

The data of the application must be known for projecting a brake. The abbreviations used for project planning are summarized in the following table:

Designation	Meaning	Unit
η_G	Efficiency of the gear unit	
J_{ext}	External mass moment of inertia (in relation to motor shaft)	kgm^2
J_{Mot}	Mass moment of inertia of the motor	kgm^2
M_{1max}	Maximum dynamic braking torque in case of emergency switching off	Nm
$M_{1m,\ 100\ °C}$	Minimal averaged dynamic braking torque in case of emergency switching off at 100 °C	Nm
$M_{2,\ 20\ °C}$	Nominal torque for slipping brake disk (relative speed between brake disk and friction surface: 1 m/s) at 20 °C	Nm
$M_{4,\ 100\ °C}$	Minimum static braking torque (holding torque) at 100 °C	Nm
$M_{aEmergOff}$	Maximum permitted emergency switching off torque of the gear unit	Nm
i	Gear unit reduction ratio	
M_L	Static load torque, in relation to motor shaft	Nm
n	Motor speed	rpm
n_m	Motor speed, from application or travel diagram	rpm
n_D	Increase of motor speed until brake application	rpm
$n_{m\ EmergStop}$	Real emergency stop speed, relevant for check	rpm
NB	Number of braking operations until maintenance	
s_b	Stopping distance	mm
t_2	Brake application time	s
t_B	Braking time	s
t_r	Response time or signal transmit time	s
v	Speed	m/s
W_1	Permitted braking work per braking operation	J
W_{insp}	Permitted total braking work (braking work until maintenance)	J

10.6.2 Hold function

The selected braking torque $M_{4,\ 100\ °C}$ must at least be higher than the highest static load torque of the application.

$$M_{4,100°C} > M_L$$

10.6.3 Emergency switching off function for lifting applications

To ensure a deceleration of the load, for lifting applications, the lowest averaged dynamic braking torque $M_{1m,\ 100\ °C}$ must be higher than the highest static load torque of the application.

$$M_{1m,100°C} > M_L \times 1.4$$

10.6.4 Speed difference during brake application

Due to the interaction of response time (signal transmit time), brake application time and the gravitational acceleration, the hoist may be in "free fall" for a short time. This results in an increased motor speed by nD (hoist downwards) or in a decreased motor speed by nD (horizontal drive and hoist upwards).

Calculating the emergency stop speed (hoist downwards):

$$n_{m,EmergencyStop} = n_m + n_D$$

Calculating the emergency stop speed (horizontal drive and hoist upwards):

$$n_{m,EmergencyStop} = n_m - n_D$$

$$n_D = \frac{9{,}55 \times M_L \times (t_r + t_2)}{J_{Mot} + J_{ext} \times \eta_G}$$

10.6.5 Working capacity in case of emergency switching off

The working capacity of the brake is determined by the permitted braking work done W_1 per braking operation and the total permitted braking work W_{insp} until maintenance of the brake.

You find the total permitted braking work W_{insp} in chapter "Technical data of BY brakes".

Permitted number of braking operations until maintenance of the brake:

$$NB = \frac{W_{insp}}{W_1}$$

Braking work per braking operation:

$$W_1 = \frac{(J_{Mot} + J_{ext} \times \eta_G) \times n_{m,\text{EmergStop}}^2 \times M_{1m,100°C}}{182.4 \times \left(M_{1m,100°C} \pm M_L\right)}$$

The calculated braking work W_1 is compared with the permitted braking work per braking operation W_1 of the BY brake (see "Technical data of BY brakes" (→ 🗎 273)).

$$W_{1(BYbrake)} > W_{1(\text{calculated})}$$

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10.6.6 Emergency switching off features

The limits of the permitted maximum braking work must not be exceeded, not even for emergency switching off.

The emergency switching off features are based on the directions of movement.

1. **Braking during vertical movement**

   In hoist applications, the limits of the permitted maximum braking work (including emergency switching off) must not be exceeded.

   Consult SEW-EURODRIVE if you need values for increased emergency switching off braking work in hoist applications.

2. **Braking during horizontal movement**

   For horizontal motion like in travel drive applications, higher braking work might be permitted per cycle in emergency stop situations under the following conditions.

   - Selected braking torque

     All braking torques are permitted (unlike BE.. brakes of DR.. series AC motors).

   - Brake wear

     The specific wear of the brake lining increases significantly in case of an emergency stop. It can reach a factor of 100 under certain circumstances.

     This additional wear must be taken into account when determining the maintenance cycle.

   - Braking process

     During the braking process, the effective dynamic braking torque can be reduced due to the heating of the brake lining during braking. In extreme cases, the effective braking torque can be reduced up to 80% of $M_{1m,100°C}$. Take this into account when you determine the braking distance.

     Example: BY8 with $M_{1m,100°C}$ = 56 Nm, minimal effective 80%

     $M_{1m,\ 100\ °C}$ = 44.8 Nm

   - Braking speed

     Consult SEW-EURODRIVE if you need values for increased emergency switching off braking work in travel drive applications (values that differ from the technical data for BY brakes in this document).

3. **Braking during inclined movement**

   As the inclined movement has a vertical and a horizontal component, the permitted emergency switching off braking work is predominantly determined according to point 1.

   Contact SEW-EURODRIVE if you are unable to classify the direction of motion as solely vertical or solely horizontal.

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10.6.7 Braking time / stopping distance

Braking time hoist downward

$$t_B = \frac{(J_{Mot} + J_{ext} \times \eta_G) \times n_{m,EmergencyStop}}{9.55 \times (M_{1m,100°C} - M_L)}$$

Braking time horizontal drive, hoist upward

$$t_B = \frac{(J_{Mot} + J_{ext} \times \eta_G) \times n_{m,EmergencyStop}}{9.55 \times (M_{1m,100°C} + M_L)}$$

Stopping distance

$$s_b = v \times 1000 \times (t_2 + t_r + \frac{1}{2} \times t_B)$$

10.6.8 Permitted gear unit load in case of emergency switching off

When using a gearmotor, in case of emergency switching off , the maximum dynamic braking torque in case of emergency switching off M_{1max} (see "Technical data of BK brakes" (→ 🗎 241)) must not exceed the maximum permitted emergency switching off torque $M_{aEmergOff}$ of the gear unit.

The value of the maximum permitted emergency switching off torque $M_{aEmergOff}$ is specified in the "Synchronous Servo Gearmotors" catalog.

$$M_{aEmergOff} \geq M_{2,20°C} \times i \times \eta_G$$

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10.7 Technical data of BY brakes

The following tables list the technical data of the brakes. The type and number of brake springs determines the level of the braking torque. If not specified otherwise in the order, brakemotors are delivered with the braking torques indicated with gray background.

Motor type	Brake type	$M_{2,\ 20\ °C}$ Nm	$M_{4,\ 100\ °C}$ Nm	$M_{1m,\ 100\ °C}$ Nm	P W	t_1 ms	t_2 ms	t_3 ms
CMPZ71S	BY2	7	4.2	4.9	27	25	23	130
		10	6	7				
		14	8.4	9.8				
		20	12	14				
CMPZ71M/L	BY2	7	4.2	4.9	27	25	23	130
		10	6	7				
		14	8.4	9.8				
		20	12	14				
CMPZ80S	BY4	14	8.4	9.8	38	30	17	110
		20	12	14				
		28	16.8	19.6				
		40	24	28				
CMPZ80M/L	BY4	14	8.4	9.8	38	30	17	110
		20	12	14				
		28	16.8	19.6				
		40	24	28				
CMPZ100S	BY8	28	16.8	19.6	45	55	25	210
		40	24	28				
		55	33	38.5				
		80	48	56				
CMPZ100M/L	BY8	28	16.8	19.6	45	55	25	210
		40	24	28				
		55	33	38.5				
		80	48	56				
CMP112S	BY14	50	30	35	76	60	20	100
		70	42	49				
		100	60	70				
		140	84	98				
CMP112M/L	BY14	50	30	35	76	60	20	100
		70	42	49				
		100	60	70				
		140	84	98				

Motor type	Brake type	$M_{2, 20 °C}$ Nm	$M_{4, 100 °C}$ Nm	$M_{1m, 100 °C}$ Nm	P W	t_1 ms	t_2 ms	t_3 ms
CMP112L/H/E	BY14	50	30	35	76	60	20	100
		70	42	49				
		100	60	70				
		140	84	98				

(shaded) Standard braking torque
Optional braking torque

$M_{2, 20 °C}$ Nominal torque for slipping brake disk (relative speed between brake disk and friction surface: 1 m/s) at 20 °C
$M_{4, 100 °C}$ Minimum static braking torque (holding torque) at 100 °C
$M_{1m, 100 °C}$ Minimum averaged dynamic braking torque in case of emergency switching off at 100 °C
P Power consumption of the coil
t_1 Brake response time
t_2 Brake application time AC / DC
t_3 Brake application time AC

INFORMATION

The response and application times are guide values that were determined at maximum braking torque.

Possible response times of switching elements or controllers were not taken into account.

The following table lists the permitted friction work from which the braking procedure is triggered, depending on the start speed. The lower the speed, the higher the permitted braking work.

INFORMATION

If you do not stop the motor in an inverter-controlled manner but use the brake for mechanical deceleration, you must check whether the brake can supply the braking work required for the brake application speed in an emergency switching off situation (→ 🗎 271).

INFORMATION

If the braking work W_1 (all applications) is exceeded, the increased braking work W_1 (only travel drive applications) can be used in the case of a travel drive application. Emergency switching off features (→ 🗎 271).

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Rated speed rpm	Brake type	$M_{2, 20\,°C}$ Nm	W_1 for all applications kJ	W_1 only for travel drive applications kJ	W_{insp} 10^3 kJ
2000	BY2	7	20	40	35
		10	18	36	
		14	15	30	
		20	12	24	
	BY4	14	24	48	50
		20	19.5	39	
		28	17	34	
		40	10.5	21	
	BY8	28	48	96	60
		40	44	88	
		55	32	64	
		80	18	36	
	BY14	50	39	77	200
		70	37	73	
		100	28	56	
		140	18	37	
3000	BY2	7	20	40	35
		10	18	36	
		14	14	28	
		20	11	22	
	BY4	14	20	40	50
		20	15	30	
		28	10	20	
		40	4.5	9	
	BY8	28	36	72	60
		40	32	64	
		55	18	36	
		80	7	14	
	BY14	50	34	69	200
		70	29	58	
		100	16	32	
		140	10	19	

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Rated speed rpm	Brake type	$M_{2,\ 20\ °C}$ Nm	W_1 for all applications kJ	W_1 only for travel drive applications kJ	W_{insp} 10^3 kJ
4500	BY2	7	16	32	35
		10	14	28	
		14	10	20	
		20	6	12	
	BY4	14	15	30	50
		20	9	18	
		28	5	10	
		40	3	6	
	BY8	28	22	44	60
		40	18	36	
		55	11	22	
		80	4	8	
	BY14	50	25	49	200
		70	14	28	
		100	8.6	17	
		140	4.3	8.6	
6000	BY2	7	14	28	35
		10	13	26	
		14	8	16	
		20	4.5	9	

$M_{2,\ 20\ °C}$ Nominal torque for slipping brake disk (relative speed between brake disk and friction surface: 1 m/s) at 20 °C

W_1 Permitted braking work per cycle

W_{insp} Permitted total braking work (braking work until maintenance)

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10.7.1 Motor assignment

The BY brake can be used for the following rated speeds and braking torques depending on the motor size:

Motor type	Brake type	$M_{2,\,20\,°C}$ Nm				Speed class
CMPZ71S	BY2	7	10	14	20	2000 / 3000 / 4500 / 6000
CMP71ZM/L		7	10	14	20	
CMPZ80S	BY4	14	20	28	40	2000 / 3000 / 4500
CMP80ZM/L		14	20	28	40	
CMPZ100S	BY8	28	40	55	80	2000 / 3000 / 4500
CMPZ100M/L		28	40	55	80	
CMP112S	BY14	50	70	100	140	2000 / 3000 / 4500
CMP112M/L		50	70	100	140	
CMP112L/H/E		50	70	100	140	

$M_{2,\,20\,°C}$ Nominal torque for slipping brake disk (relative speed between brake disk and friction surface: 1 m/s) at 20 °C

(shaded) Standard braking torque

Optional braking torque

10.7.2 No-load starting frequency

The following no-load starting frequency Z_0 must not be exceeded in order to prevent the BY brake from heating up.

Brake type	No-load starting frequency
BY2	7200 1/h
BY4	5400 1/h
BY8	3600 1/h
BY14	2400 1/h

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10.7.3 Determining the brake voltage

The brake voltage should always be selected on the basis of the available AC supply voltage or motor operating voltage. This means the user is always guaranteed the most cost-effective installation for lower braking currents.

The standard brake voltages are listed in the following table:

Brake type	BY2, BY4, BY8, BY14
Nominal voltage	DC 24 V[1)]
	AC 110 V
	AC 230 V
	AC 400 V
	AC 460 V

1) The 24 V brake voltage requires a strong current and is only possible with limited cable length.

When releasing the brake, the holding current can increase by up to 5.2 times. The voltage at the brake coil must not drop below 90% of the nominal voltage.

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10.7.4 Operating currents of BY brakes

The following tables list the operating currents of the brakes at different voltages. The following values are specified:

- Inrush current ratio I_B/I_H; I_B = accelerator current, I_H = holding current
- Holding current I_H
- Nominal voltage U_N

The acceleration current I_B (= inrush current) only flows for a short time (about 150 ms) when the brake is released or during voltage dips below 70% of nominal voltage.

The values for the holding currents I_H are rms values (with DC 24 V arithmetic mean value). Use suitable measuring instruments for current measurements.

	BY2	BY4	BY8	BY14
Braking torque $M_{2,\,20\,°C}$ in Nm	20	40	80	140
Braking power in W	27	38	45	76
Inrush current ratio I_B/I_H or I_B/I_G	5	4	4	5.2

Nominal voltage U_N		**I_H**	**I_G**	**I_H**	**I_G**	**I_H**	**I_G**	**I_H**	**I_G**
V_{AC}	**V_{DC}**	**A_{AC}**	**A_{DC}**	**A_{AC}**	**A_{DC}**	**A_{AC}**	**A_{DC}**	**A_{AC}**	**A_{DC}**
	24 (21.6 – 26.4)	–	1.05	–	1.4	–	1.6	–	2.8
110 (99 – 121)		0,425	–	0.58	–	0.69	–	1.542	–
230 (218 – 243)		0.19	–	0.26	–	0.305	–	0.689	–
400 (380 – 431)		0.107	–	0.147	–	0.172	–	0.387	–
460 (432 – 484)		0.095	–	0.131	–	0.154	–	0.345	–

$M_{2,\,20\,°C}$ Nominal torque for slipping brake disk (relative speed between brake disk and friction surface: 1 m/s) at 20 °C
I_H Holding current, r.m.s. value in the supply cable to the SEW brake rectifier
I_G Direct current with direct DC voltage supply
V_N Nominal voltage (nominal voltage range)

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10.7.5 Resistance values of BY brake coils

	BY2	BY4	BY8	BY14
Braking torque $M_{2, 20\,°C}$ in Nm	20	40	80	140
Braking power in W	27	38	45	76

Nominal voltage U_N		**R_B**	**R_T**	**R_B**	**R_T**	**R_B**	**R_T**	**R_B**	**R_T**
V_{AC}	**V_{DC}**	**Ω**	**Ω**	**Ω**	**Ω**	**Ω**	**Ω**	**Ω**	**Ω**
	24 (21.6 – 26.4)	5.2	20	4.3	13.3	3.8	11.2	1.6	6.5
110 (99 – 121)		16.3	64	13.7	42	12	35.5	4.9	20.5
230 (218 – 243)		82	320	69	210	60	177	24.6	102.8
400 (380 – 431)		260	1010	215	670	191	560	77.8	325.1
460 (432 – 484)		325	1270	275	840	240	700	97.9	409.3

$M_{2, 20\,°C}$ Nominal torque for slipping brake disk (relative speed between brake disk and friction surface: 1 m/s) at 20 °C
R_B Accelerator coil resistance at 20 °C
R_T Coil section resistance at 20 °C
U_N Nominal voltage (nominal voltage range)

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10.7.6 Braking work and braking torques

Brake type	Braking work until maintenance W_{insp}	Pressure plate order number	Braking torque settings					
			Braking torque $M_{2,\ 20\ °C}$	Type and number of			Order numbers for brake springs	
	10^6 J		Nm	Normal	Red	Blue	Normal	Red/blue
BY2	35	16450450	20	6	–	–	01866621	01837427
			14	4	2	–		
		16450965	10	3	–	–		
			7	2	2	–		
BY4	50	16445856	40	6	–	–	0186663X	01840037
			28	4	2	–		
		16447840	20	3	–	–		
			14	2	2	–		
BY8	60	16444876	80	6	–	–	16446011	16446038
			55	4	2	–		
		16447859	40	3	–	–		
			28	2	2	–		
BY14	200	16451422	140	4	–	4	13741837	13741845
			100	3	–	3		
		16451961	70	2	–	2		
			50	-	–	4		

10.7.7 B_{10d} values

Definition of the characteristic safety value B_{10d}:

The value B_{10d} specifies the number of cycles at which 10% of components have failed dangerously (definition according to standard EN ISO 13849). Failed dangerously means in this context that the brake is not applied when required. This means the brake does not deliver the necessary braking torque.

Size BY..	B_{10d} Switching cycles
BY2	8 000 000
BY4	6 000 000
BY8	3 000 000
BY14	2 000 000

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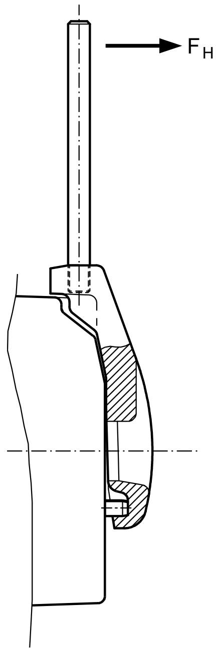
10.7.8 Manual brake release

In brakemotors with /HR option “Manual brake release with automatic reengaging function,” you can release the brake manually using the provided lever. The following table specifies the actuation force required at maximum braking torque to release the brake manually. The values are based on the assumption that you operate the lever at the upper end.



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Brake type	Motor type	Actuation force F_H in N
BY2	CMPZ71	50
BY4	CMPZ80	70
BY8	CMPZ100	90
BY14	CMP112	300

For BY2, BY4, and BY8, the manual brake release option /HR can no longer be combined with the forced cooling fan option /VR.

Manual brake release retrofit set

The manual brake release of the BY brake can be retrofitted. The following retrofit sets can be used depending on the brake size:

Retrofit set	Part number
BY2	17508428
BY4	17508525
BY8	17508622
BY14	17573300

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10.8 Dimensioning and routing the cable for terminal boxes

10.8.1 Selecting the cable

Select the cross section of the brake cable according to the currents in your application. Observe the inrush current of the brake when selecting the cross section. When taking the voltage drop into account due to the inrush current, the value must not drop below 90% of the nominal voltage. The data sheets for the brakes provide information on the possible supply voltages and the resulting operating currents.

Information about the size of the cable cross-section and the cable lengths can be found in the "Cable assignments" (→ 🗎 344) tables.

Wire cross sections of max. 2.5 mm^2 can be connected to the terminals of the brake control systems. Intermediate terminals must be used if the cross sections are larger.

10.8.2 Routing information

Brake cables must always be routed separately from other power cables with phased currents unless they are shielded.

Ensure adequate equipotential bonding between the drive and the control cabinet (for an example, see the documentation Drive Engineering - Practical Implementation "EMC in Drive Engineering").

Power cables with phased currents include in particular:

- Output cables from frequency inverters and servo inverters, soft start units and brake units
- Supply cables to braking resistors

10.9 Selecting the braking contactor

- Due to the high current loading and the DC voltage to be switched at inductive load, contactors in utilization category AC 3 (EN 60947-4-1) must always be used for controlling the brake rectifiers.
- For brake control via BSG and BMV, contactors in utilization category DC 3 must be used (EN 60947-4-1).

10.9.1 Standard design

If not specified otherwise in the order, CMP brakemotors are delivered with BY brake with BME for AC connection.

Switching via contactor

Brake type	AC connection	DC 24 V connection
BY2, BY4, BY8, BY14	BME	BSG

Control via inverter

Brake type	AC connection	DC 24 V connection
BY2, BY4, BY8, BY14	BMK	BMV

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10.10 Selecting the brake control system

Only SEW brake control systems are used for controlling the brake. All brake control systems are fitted with varistors as standard to protect against overvoltage.

The brakes are available with DC and AC voltage connection.

- AC voltage connection:
  - **BME**, equipped with DIN rail profile
- DC voltage connection:
  - **BSG**

There are two possible ways of electrical disconnection:

- Normal application times: cut-off in the AC circuit.
- Particularly short application times: cut-off in the AC and DC circuits.

The brake control systems are mounted in the control cabinet. Retaining screws are included in the delivery.

The following options are available:

- AC supply, cut-off in the AC and DC circuits without additional switch contact, particularly short application times: **BMP**.
- AC supply, brake heating function when switched off: **BMH**.
- The **BMK/BMKB/BMV** control system energizes the brake coil if the supply system and a DC 24 V signal (e.g. from the PLC) are present simultaneously. The brake is applied if one condition is not being met. BMK/BMKB/BMV allow for shortest response and application times.

INFORMATION

A disconnection of all poles is mandatory for **emergency stop** and for hoists in general (terminals 1 and 2 of the brake rectifier).

The following table lists SEW brake control systems for installation in the control cabinet. The different housings have different colors (= color code) to make them easier to distinguish.

Brake control	Function	Voltage	Holding current I_{Hmax} A	Type	Part number	Color code
BME	One-way rectifier with electronic switching	AC 150 to 500 V	1.5	BME 1.5	8257221	Red
		AC 42 to 150 V	3.0	BME 3	825723X	Blue
BMH	One-way rectifier with electronic switching and heating function	AC 150 to 500 V	1.5	BMH 1.5	825818X	Green
		AC 42 to 150 V	3	BMH 3	8258198	Yellow
BMP	One-way rectifier with electronic switching, integrated voltage relay for switch-off in the DC circuit	AC 150 to 500 V	1.5	BMP 1.5	8256853	White
		AC 42 to 150 V	3.0	BMP 3	8265666	Light blue

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Brake control	Function	Voltage	Holding current I_{Hmax} A	Type	Part number	Color code
BMK	One-way rectifier with electronic switching, DC 24 V control input and cut-off in the DC circuit	AC 150 to 500 V	1.5	BMK 1.5	8264635	Water blue
		AC 42 to 150 V	3.0	BMK 3	8265674	Light red
BMKB	One-way rectifier with electronic switching, DC 24 V control input, cut-off in the DC circuit, and a diode to signal readiness for operation	AC 150 to 500 V	1.5	BMKB 1.5	8281602	Water blue
BSG	Control unit for DC 24 V connection with electronic switching	DC 24 V	5.0	BSG	8254591	White
BMV	Electric switching, DC 24 V control input and cut-off in the DC circuit	DC 24 V	5.0	BMV	13000063	White

10.10.1 Quick response times

A characteristic feature of the SEW brake is the patented two-coil system. This system consists of accelerator coil and coil section. The special SEW brake control system ensures that the accelerator coil is switched on with a high current inrush when the brake is released, after which the coil section is switched on. The result is a particularly short response time when releasing the brake. The brake disk moves clear very swiftly and the motor starts up with hardly any brake friction.

This principle of the two coil system also reduces self-induction so that the brake is applied more rapidly. The result is a reduced braking distance. The SEW brake can be cut off in the DC and AC circuits to achieve particularly short response times when applying the brake, for example for hoists.

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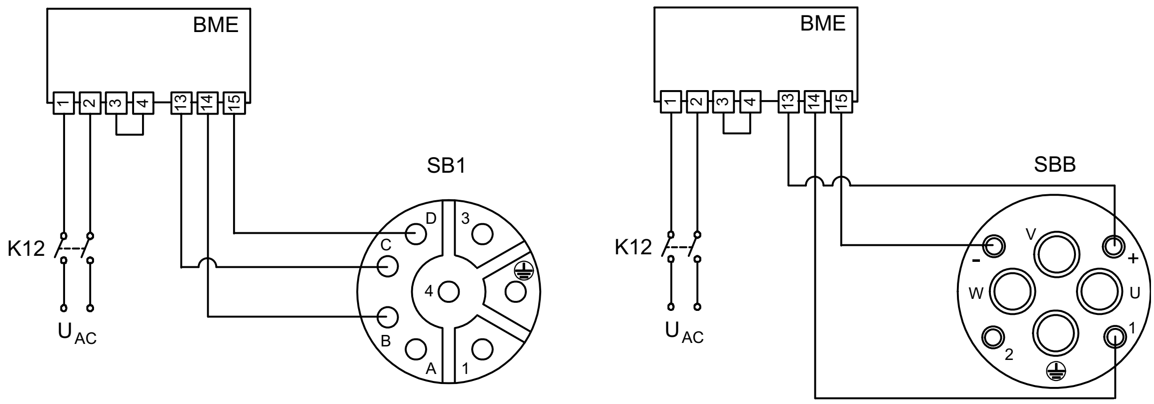
10.11 Block diagram of brake control – plug connectors

In the following block diagrams, the contactor for the supply voltage of the brake rectifier is designated as K12. Except for BMV, BMKB and BMK, it is used to also switch the brake.

BMV and BMK: In applications without requirements on functional safety, it is sufficient to switch the brake via connections 3 and 4 (depicted as N.O. contact without name). In applications with requirements on functional safety (such as hoists), all poles must be switched off to ensure that the brake is applied even in the event of a fault in the brake rectifier.

10.11.1 BME brake rectifier

Cut-off in the AC circuit / standard application of the brake with SB1, SBB.



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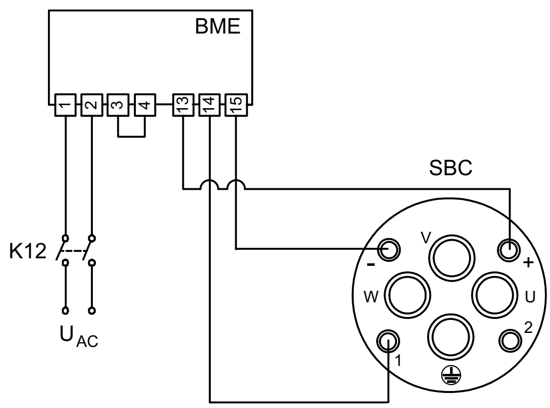
Cut-off in the AC circuit / standard application of the brake with SBC.



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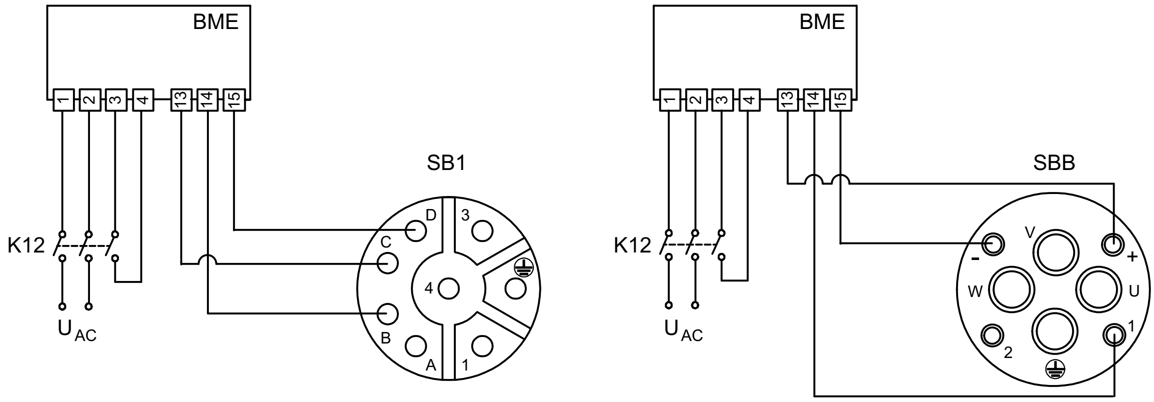
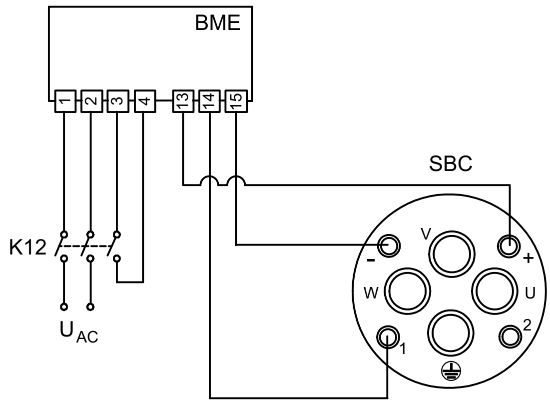
Cut-off in the DC and AC circuits / rapid application of the brake with SB1, SBB.



2901969419

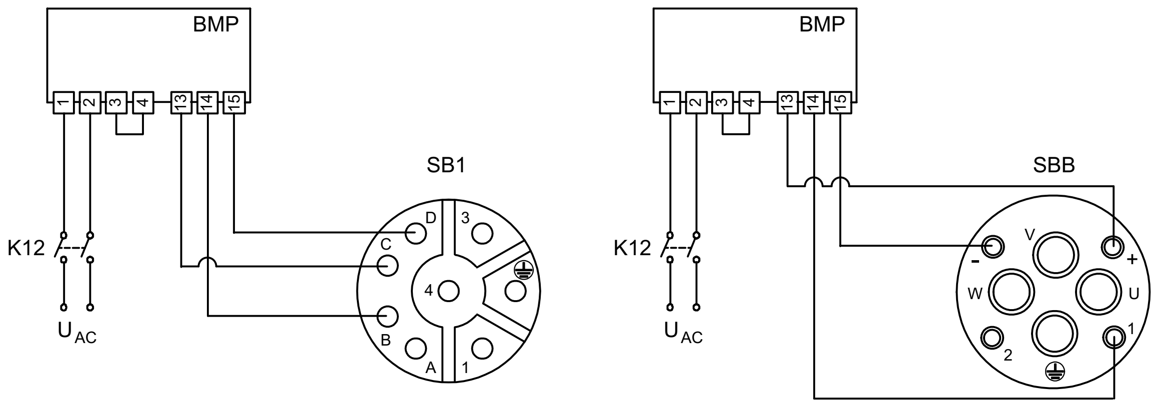
Cut-off in the DC and AC circuits / rapid application of the brake with SBC.



9007206235910283

10.11.2 BMP brake rectifier

Cut-off in the DC and AC circuits / rapid application of the brake / integrated voltage relay with SBB.



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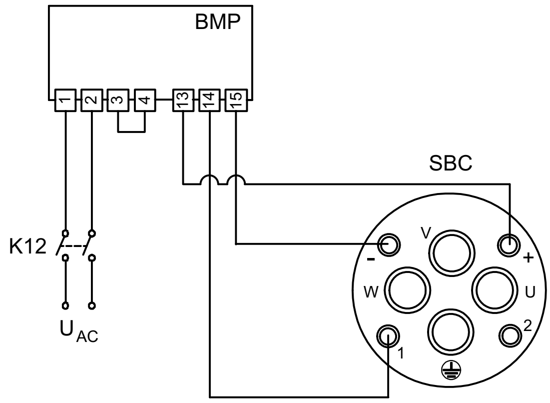
Cut-off in the DC and AC circuits / rapid application of the brake / integrated voltage relay with SBC.



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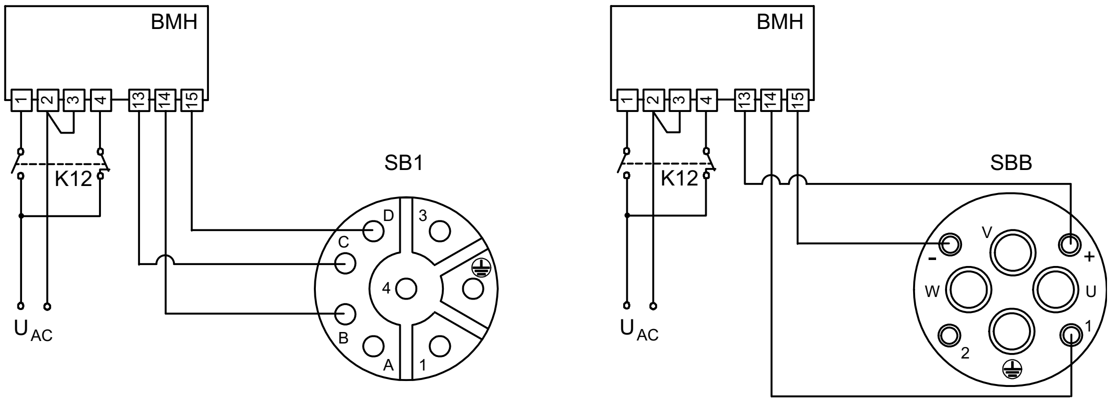
10.11.3 BMH brake rectifier

Cut-off in the AC circuit / standard application of the brake with SBB.



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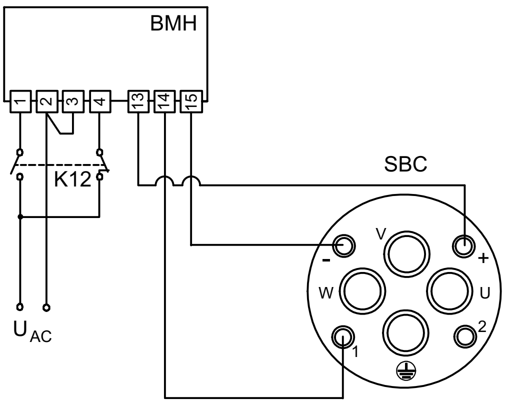
Cut-off in the AC circuit / standard application of the brake with SBC.



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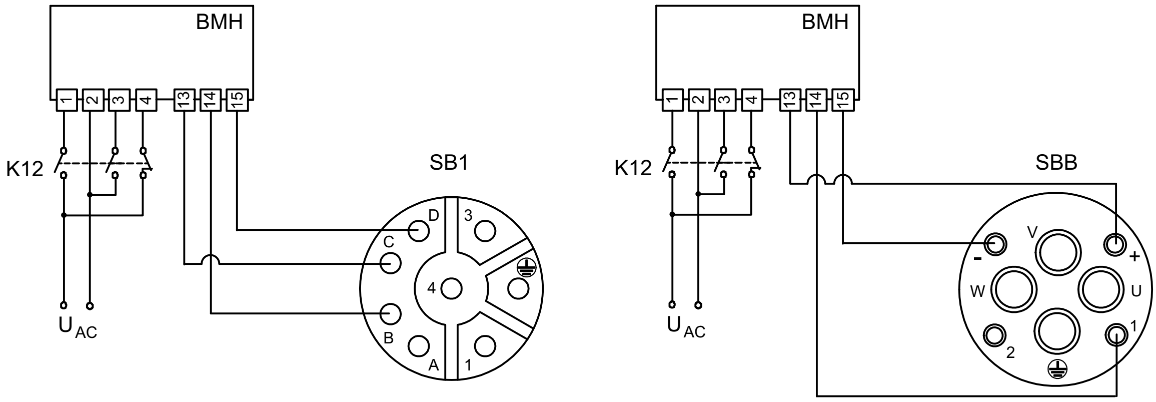
Cut-off in the DC and AC circuits / rapid application of the brake with SBB.



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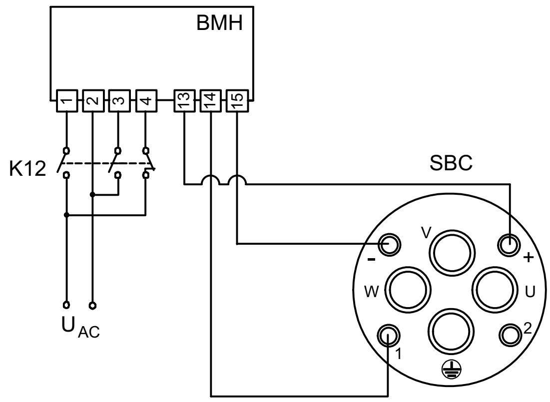
Cut-off in the DC and AC circuits / rapid application of the brake with SBC.



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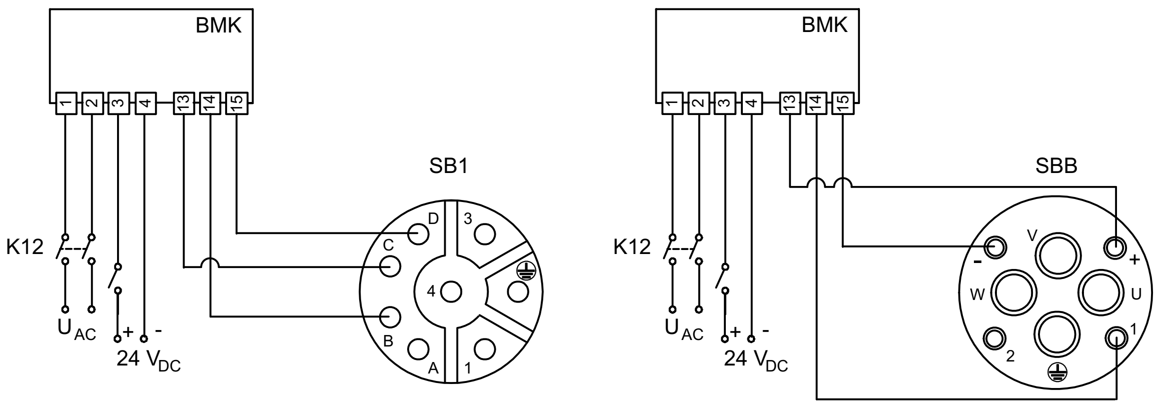
10.11.4 BMK brake controller

Cut-off in the DC and AC circuits / rapid application of the brake / integrated voltage relay / DC 24 V control input integrated with SBB.



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Connection 1, 2	Power supply
Connection 3, 4	Signal (inverter)

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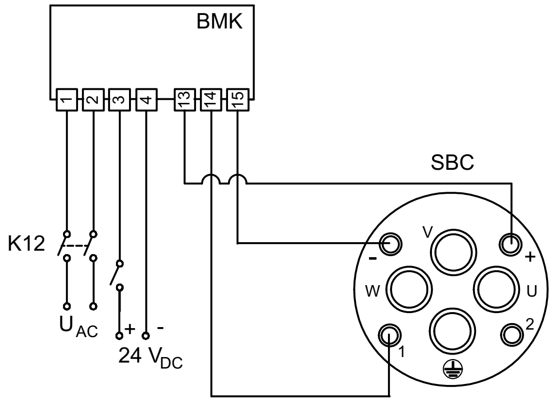
Cut-off in the DC and AC circuits / rapid application of the brake / integrated voltage relay / DC 24 V control input integrated with SBC.



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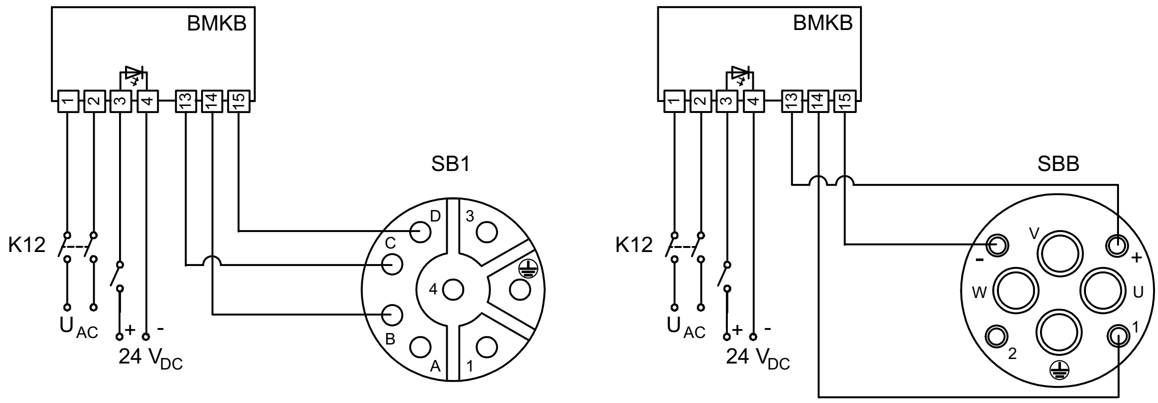
Connection 1, 2 Power supply
Connection 3, 4 Signal (inverter)

10.11.5 BMKB brake controller

Cut-off in the DC and AC circuits / rapid application of the brake / integrated voltage relay / DC 24 V control input integrated / indication of readiness for operation with diode with SBB.



2901981835

Connection 1, 2	Power supply
Connection 3, 4	Signal (inverter)

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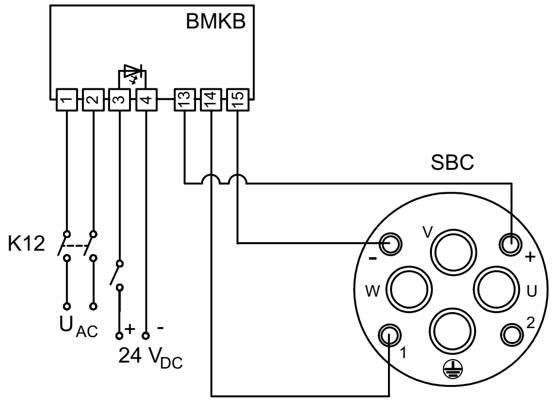
Cut-off in the DC and AC circuits / rapid application of the brake / integrated voltage relay / DC 24 V control input integrated / indication of readiness for operation with diode with SBC.



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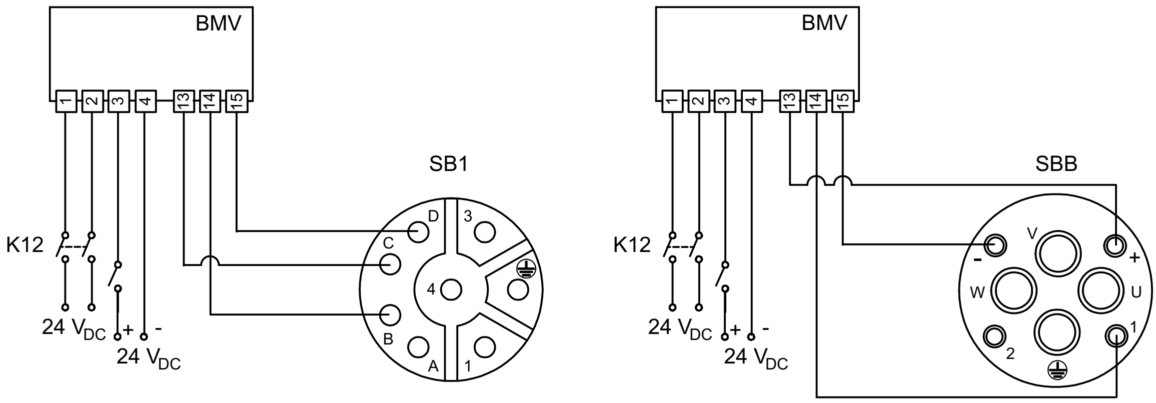
Connection 1, 2 Power supply
Connection 3, 4 Signal (inverter)

10.11.6 BMV brake controller

Cut-off in the DC and AC circuits / rapid application of the brake / DC 24 V control input integrated with SBB.



2901984523

Connection 1, 2 Power supply
Connection 3, 4 Signal (inverter)

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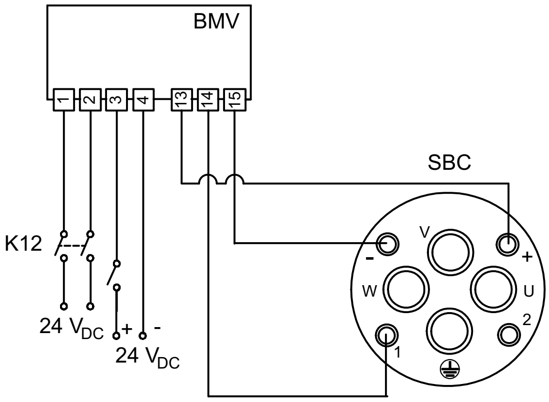
Cut-off in the DC and AC circuits / rapid application of the brake / DC 24 V control input integrated with SBC.

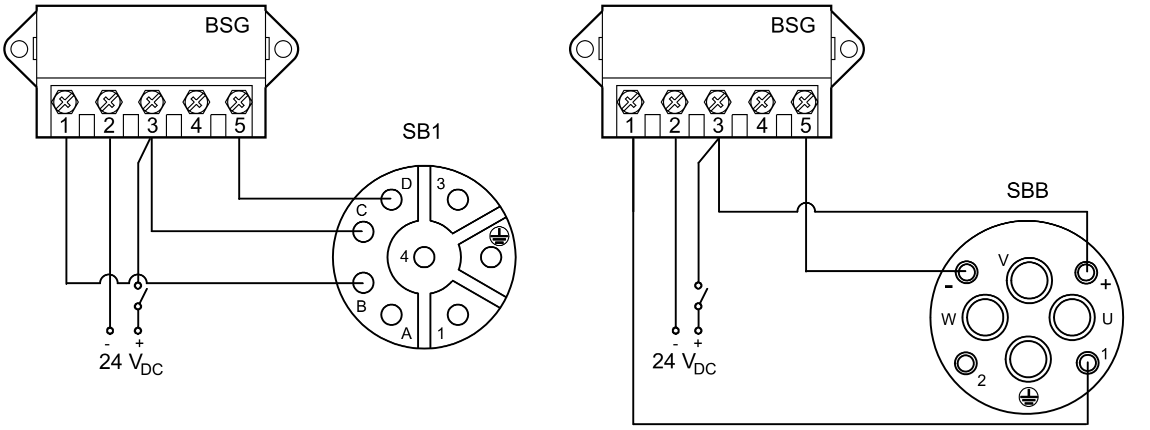


9007206236127243

Connection 1, 2 Power supply
Connection 3, 4 Signal (inverter)

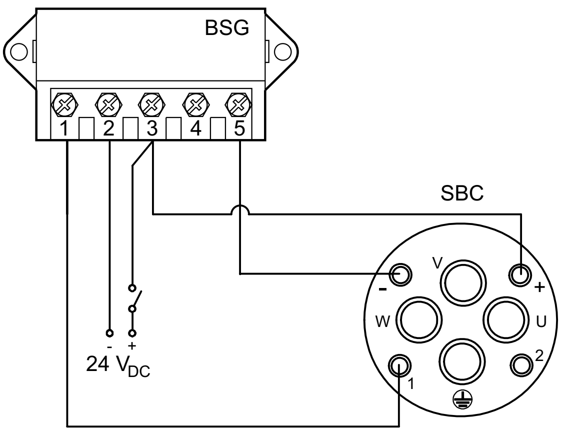
10.11.7 BSG brake control unit

For DC 24 V supply with SBB.



2901987211

For DC 24 V supply with SBC.



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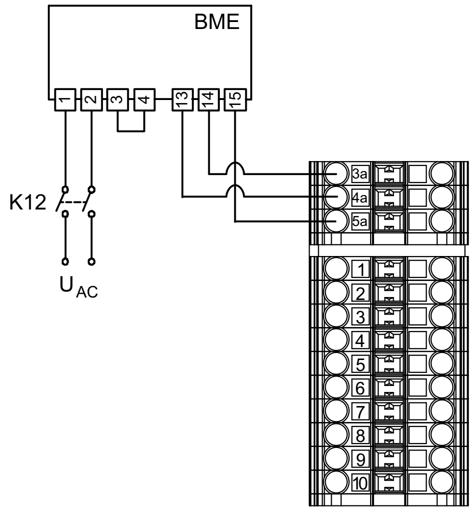
10.12 Block diagram of brake control – terminal box

In the following block diagrams, the contactor for the supply voltage of the brake rectifier is designated as K12. Except for BMV, BMKB and BMK, it is used to also switch the brake.

BMV and BMK: In applications without requirements on functional safety it is sufficient to switch the brake via connections 3 and 4 (depicted as N.O. contact without name). In applications with requirements on functional safety (such as hoists), all poles must be switched off to ensure that the brake is applied even in the event of a fault in the brake rectifier.

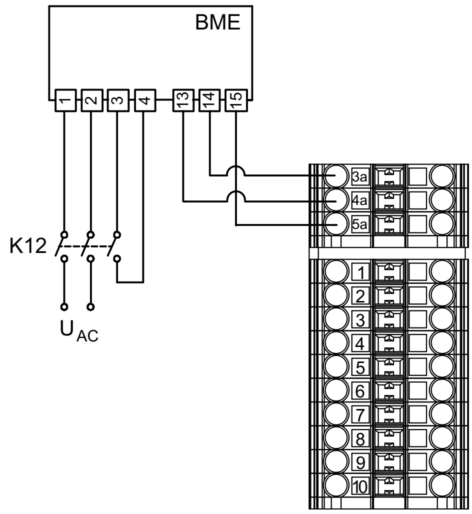
10.12.1 BME brake rectifier

Cut-off in the AC circuit / standard application of the brake.



2901761291

Cut-off in the DC and AC circuits / rapid application of the brake.



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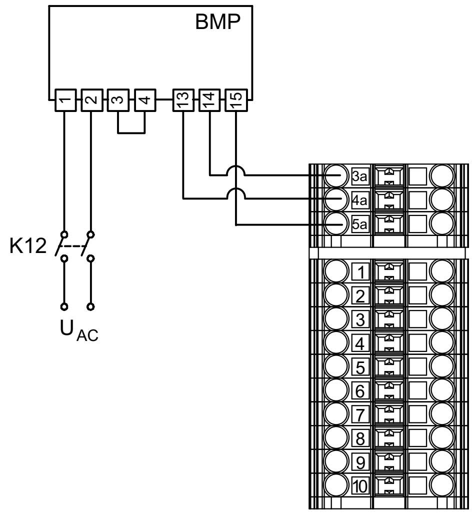
10.12.2 BMP brake rectifier

Cut-off in the DC and AC circuits / rapid application of the brake / integrated voltage relay.



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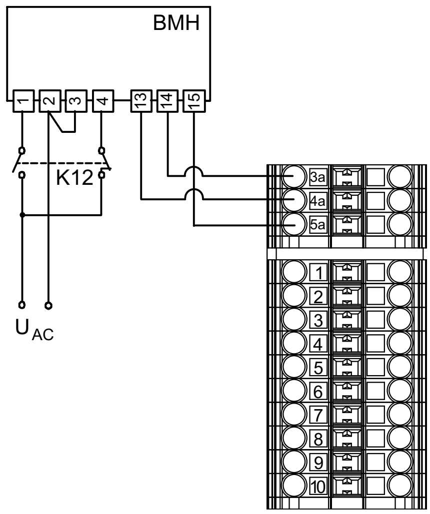
10.12.3 BMH brake rectifier

Cut-off in the AC circuit / standard application of the brake.



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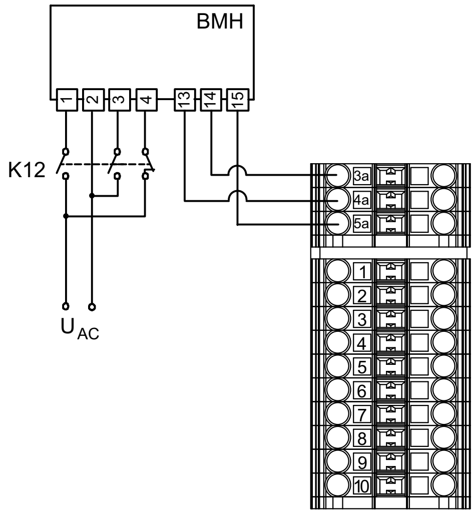
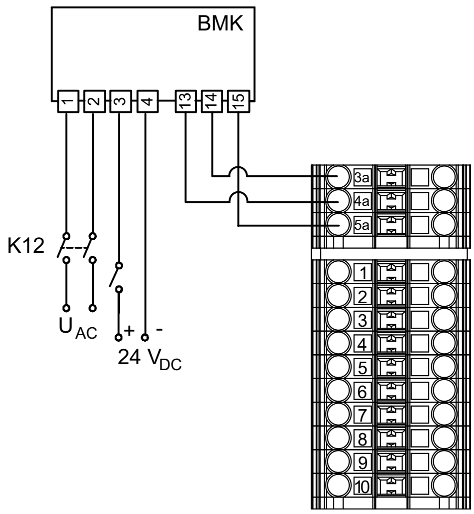
Cut-off in the DC and AC circuits / rapid application of the brake.



2901999627

10.12.4 BMK brake rectifier

Cut-off in the DC and AC circuits / rapid application of the brake / integrated voltage relay.



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Connection 1, 2 Power supply
Connection 3, 4 Signal (inverter)

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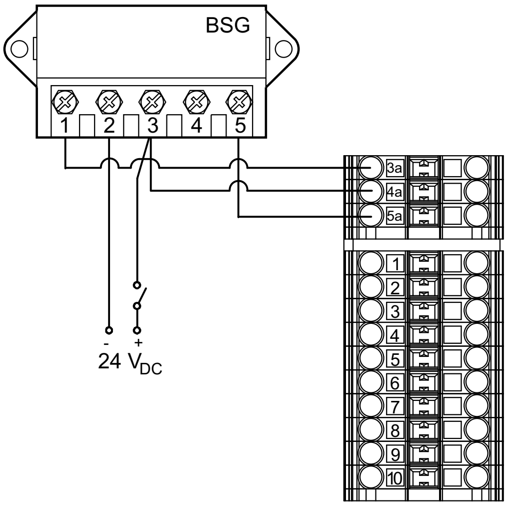
10.12.5 BSG brake control unit

For DC voltage supply with DC 24 V.



2901775371

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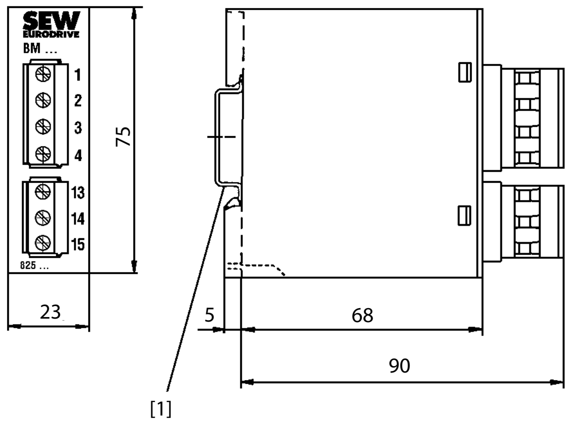
10.13 Dimension drawings for BY brake control

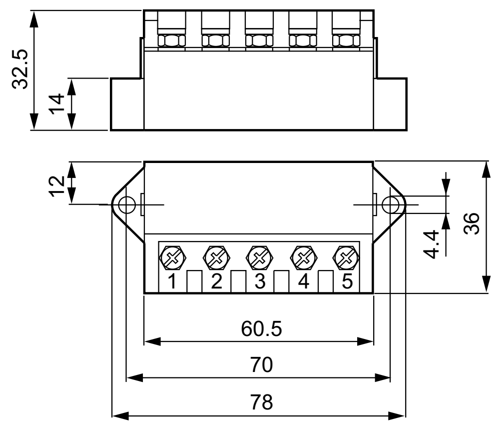
10.13.1 Dimension drawing for BME, BMP, BMH, BMK, BMKB, BMV



4810854155

[1] Support rail mounting according to EN 50022-35-7.5 (not included in the delivery)

10.13.2 Dimensions BSG



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10.14 Safety-rated BY..(FS) brakes

You find more detailed information on functional safety in the "Safe Brake System – Synchronous Servomotors" manual.

10.14.1 Safety functions

By adding a safety-rated brake to a brake system, the following safety functions can be implemented:

- SBA (safe brake actuation)
- SBH (safe brake hold)

INFORMATION

- SBA and SBH additionally require the SBC safety function for safety-related shutdown of the power supply of the brake.
- Depending on the configuration and use in the application, a drive can generate more torque than the brake is able to hold/stop. When activating the SBA/SBH safety function, the drive must be switched off with the STO safety function.
- SBA and SBH are defined by SEW-EURDORIVE based on the standard DIN EN 61800-5-2.

10.14.2 Performance levels that can be achieved

Brakes are a component of a safe brake system. The performance level of the safe brake system that can be achieved is influenced by the following factors:

- The safety architecture, category (cat.) selected in accordance with EN ISO 13849
- How often the system is used in the application (B10d, MTTFd)
- An available brake diagnosis (DC)
- The application in which the system is used (horizontal or vertical application)

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10.14.3 Differences between BY and BY(FS) brakes

The most important differences between the technical properties of the standard BY.. brake and the safety-rated BY..(FS) brake are listed below.

	BY.. standard brake	FS brake BY (FS)
Brake type	All	All
Field of application Holding brake	 Yes	 Yes (with emergency switching off properties)
Working brake	Yes	No
Ambient temperature		
-20 °C to +40 °C	Yes	Yes
Other ambient temperatures	Yes	No
Braking torques	All	Restrictions depending on the mounting position
Brake options		
Manual brake release	All	HF not permitted HR cannot be retrofitted
Maintenance of the drive		
Customer	Yes	No
SEW-EURODRIVE	Yes	Yes
Motor type		
CMP. motors	CMPZ71 – CMPZ100, CMP112	CMPZ71 – CMPZ100
Motor options		
KY	Yes	Must be used
TF	Yes (special design)	No
Z	Yes	Yes
Speed class		
6000 rpm	Yes	No
Encoder		
	All except for AK0H encoders	Approved: • RH1M • EK1H • AK1H • AK1H(FS)
Gear unit combination with pinion bore / pinion shaft end	All	Restriction of the permitted braking torques
Gear units		
RM..., R.07, R.17	Yes	No
WT.., W..10, W..20, W..30	Yes	No

	BY.. standard brake	FS brake BY (FS)
PS.C	Yes	No
Hollow shaft with shrink disk	Yes	Restriction of the permitted braking torques
TorqLOC®	Yes	No
Gear unit adapter	Yes	No
Double gear unit	Yes	No
Special designs	Yes	No (on request from SEW-EURODRIVE)
Mounting position	All	Restriction of the permitted braking torques
SEW measures	Standard	• Additional assembly steps • Additional documentation • Traceability up to batch monitoring • Manipulation protection at critical points
Category	B	1
B_{10d} value	Standard Specification per size	Higher values than the standard Specification per size

All the other components, such as the gear unit type, suitable ratio i, service factor f_B, load change, output shaft, etc. must be selected and evaluated by the customer.

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10.14.4 Safety-rated brake control

If the BY..(FS) brake is used in safety-related applications, then brake control must be taken into consideration in the safety evaluation.

Various brake controllers are available for controlling disk brakes with a DC coil, depending on the requirements and the operating conditions. All brake control systems are fitted with varistors as standard to protect against overvoltage.

INFORMATION

Under certain conditions, non-safety-rated brake controls can also be used in safe brake systems.

Contact SEW-EURODRIVE for more information.

Safety-related BST brake module

The safety-related BST brake module safely disconnects the energy supply to the brake.

The BST brake module offers one these safety functions:

- SBC (safe brake control), up to PL d according to EN ISO 13849

The BST brake module offers many advantages compared to conventional technology:

- Less space required in the control cabinet (no contactor and no motor protection switch)
- Improved energy balance (energy efficient as the regenerative energy from the DC link can be used)
- Reduced wiring work
- Easy installation
- Easy safety assessment
- No wear

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Approved unit combinations

The following BST types are permitted for safety-related applications:

Type designation	Part number	Approved disk brakes from SEW-EURODRIVE
BST 0.6S-460V-00	08299714	All brake coils with a coil voltage of AC 460 V and a coil power of ≤ 120 W. Several brake coils can be connected for redundant systems. In this case, the total power must not exceed 120 W.
BST 0.7S-400V-00	13000772	All brake coils with a coil voltage of AC 400 V and a coil power of ≤ 120 W. Several brake coils can be connected for redundant systems. In this case, the total power must not exceed 120 W.
BST 1.2S-230V-00	13001337	All brake coils with a coil voltage of AC 230 V and a coil power of ≤ 120 W. Several brake coils can be connected for redundant systems. In this case, the total power must not exceed 120 W.

Brake type	Synchronous motor			
	CMP.71	CMP.80	CMP.100	CMP112
BY2	x			
BY4		x		
BY8			x	
BY14				x

The following unit combinations (inverter/BST) are approved.

Inverter type	Unit design	Comments
MOVIDRIVE® B	3 × AC 380 – 500 V Sizes 0 – 7	Connection of BST to size 7 with DC link adapter.
MOVIAXIS®	Connection to all supply and regenerative modules as well as capacitance and buffer modules.	Installation via connection set BST to MXP, MXR, MXC, and MXNB.

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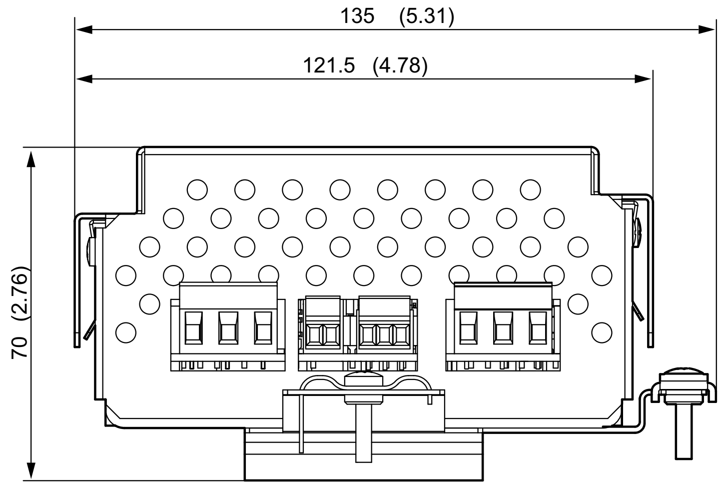
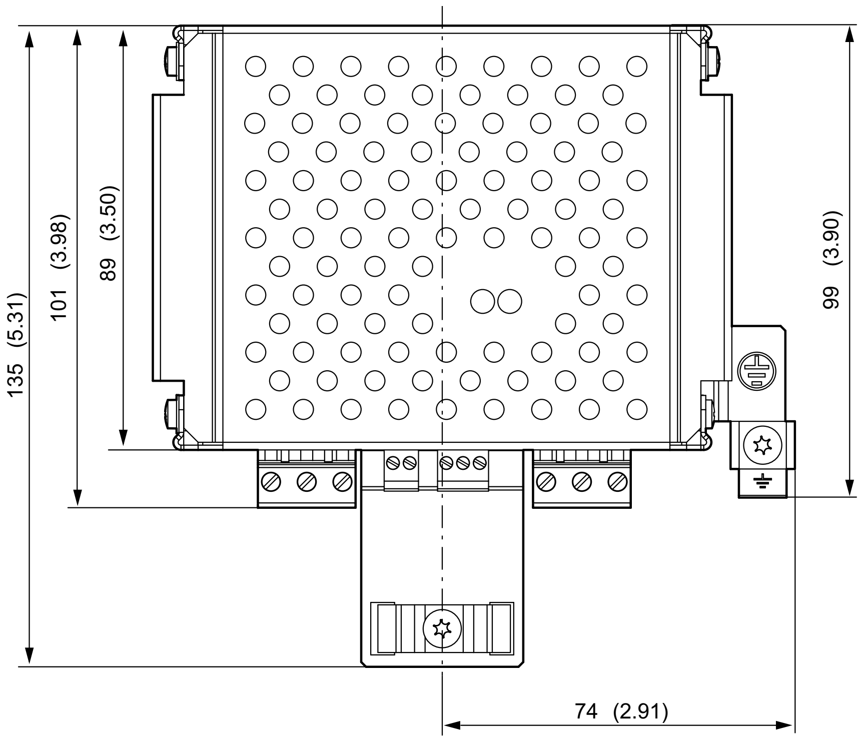
10.14.5 Dimension drawing of BST in control cabinet design

The following figure shows the dimension drawings of BST in control cabinet design.

Dimensions in mm





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10.14.6 Safety characteristics of BST brake modules

	Characteristic values according to EN ISO 13849-1
Classification	PL d
System structure	Category 3
Probability of dangerous failure per hour (PFH value)	0 (fault exclusion)
Mission time / service life	20 years
Safe condition	Brake de-energized
Safety function	SBC (safe brake control) according to IEC 61800-5-2

10.14.7 Braking work and braking torques

For the V3 mounting position (brake on the bottom with manual brake release), the braking torques marked in gray in the following table are not available:

Brake type	Braking work until maintenance	Braking torque settings		
		Braking torque $M_{2,\ 20\ °C}$	Type and number of brake springs	
	10^6 J	Nm	Normal	Red
BY2	35	20	6	-
		14	4	2
		10	3	-
		7	2	2
BY4	50	40	6	-
		28	4	2
		20	3	-
		14	2	2

10.14.8 B_{10d} values BY..(FS)

Definition of the characteristic safety value B_{10d}:

The value B_{10d} specifies the number of cycles at which 10% of components have failed dangerously (definition according to standard EN ISO 13849). Failed dangerously means in this context that the brake is not applied when required. This means the brake does not deliver the necessary braking torque.

Size	B_{10d}
BY..(FS)	Switching cycles
BY2	15 000 000
BY4	12 000 000
BY8	9 000 000

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