7 Brake and backstop

On request, SEW-EURODRIVE motors can be supplied with an integrated mechanical brake or backstop.

The BE.. brake is part of SEW-EURODRIVE's modular brake system. You can choose from up to 3 different brake sizes for mounting to the motor. Various braking torque steps are available for each brake size. This means that a wide range of braking torque steps is available for each motor size.

Furthermore, the brakes can be equipped with additional options such as manual brake release or function and wear monitoring system.

AC motors from SEW-EURODRIVE can be equipped with a backstop /RS instead of a BE.. brake. It is used in applications where a fixed main direction of rotation of the drive is necessary and where unintended movements in the opposite direction have to be avoided.

For further information on the backstop /RS, refer to chapter "Mechanical backstop" (→ 🗎 416).

7.1 BE.. brake from SEW-EURODRIVE

BE.. brakes from SEW-EURODRIVE are DC-operated electromagnetic disk brakes. They open electrically and brake using spring force. The brake is installed on the B-side and integrated into the motor. The advantage is that brakemotors from SEW-EURODRIVE are very short and robust. Furthermore, brakemotors from SEW-EURODRIVE are designed to be especially low in noise. They are thus especially suited for environments sensitive to noise.

The brake coil can be adapted to different connection voltages. It is powered via a brake control which is either placed in the terminal box of the motor or in the control cabinet.

The brake is applied in case of a power failure. It is therefore suited for basic safety requirements in travel and hoist applications (e.g. according to EN 115).

Due to the high overload capacity in case of emergency stops, the BE.. brake is ideally suited as a holding brake in controlled applications. The working capacity is available for emergency stop braking operations.

DRN.. motors with BE.. brake can be used in ambient temperature ranges of -40 °C to +100 °C. They can be delivered in degrees of protection IP54, IP55, IP65 and IP66.

7.1.1 Mounted to the B-side of the motor

With manual brake release as an option

The brake can also be released without voltage supply if equipped with a manual brake release. This enables, for example, manual lowering of hoists or "weathervane" mode for cranes.

Two options are available for manual brake release:

1. With automatic manual brake release (option designation /HR), a hand lever is included in the delivery.
2. For the lockable manual brake release (option designation /HF), a set screw is included in the delivery.

22134204/EN – 12/2017

7.1.2 With patented two-coil system

The BE.. brake is a DC-operated electromagnetic spring-loaded brake. It is equipped with the patented two-coil system from SEW-EURODRIVE. It works particularly rapid and wear-free in supply system startup in combination with brake controls from SEW-EURODRIVE with acceleration function.

When using the two-coil system, BE.. brakes are suitable for high switching frequencies as they are required for fast cycle applications for example.

While operation of the brake is also possible without acceleration function or with a direct DC voltage supply without SEW-EURODRIVE brake control for sizes BE05 – 2, all brakes of sizes BE5 and higher are optimized for using the two-coil system.

This allows for particularly energy-efficient operation as the power loss can be reduced in stop state. For brakes without two-coil system, the magnetic circuit has to be dimensioned larger for implementing the same braking torque and wear distance.

7.1.3 With SEW-EURODRIVE brake control in the terminal box or control cabinet

Usually, the brake is controlled by a brake control that is installed in either the motor terminal box or the control cabinet. You can choose from a wide range of brake controls. In addition to various connection voltages, brake controls for specific application requirements are available as well:

- With acceleration function for high switching frequency (by using the patented two-coil system, e.g. BGE../BME../BSG..)
- With rapid switch-off function for high stopping accuracy (with integrated or additional high-speed relays, e.g. BMP../BSR../BUR..)
- With integrated heating function (BMH..)
- With additional DC 24 V control inputs for PLC or inverter (e.g. BMK.. or BMV..)
- With SBC safety function for safe disconnection of the energy supply to the brake (BST..)

BE05 – 2 brakes can also be delivered for operation at an external DC voltage source without additional brake control, if requested by the customer.

7.1.4 Available as safety brake according to EN ISO 13849

BE.. brakes are also available as safety brakes according to EN ISO 13849 for safety-relevant applications.

The use of a safety brake allows for safety functions which force the motor to stop and hold it safely in its position:

- SBA (Safe Brake Actuation)
- SBH (Safe Brake Hold)

A suitable integration into a safe brake system (SBS) allows for all performance levels (up to PL e).

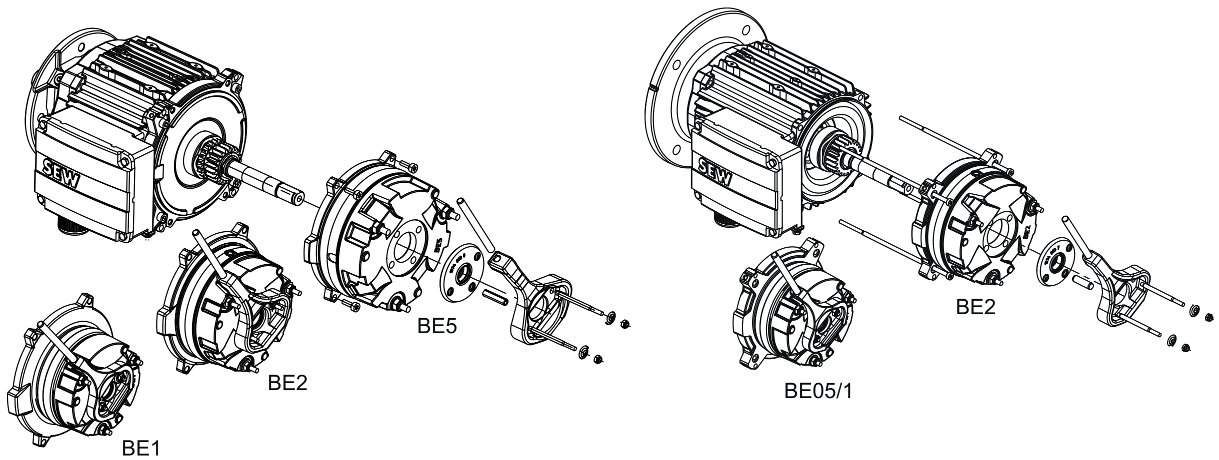
22134204/EN – 12/2017

7.1.5 Maintenance-friendly and suitable for Condition Monitoring

A difference is made between integral and modular design when BE.. brakes and motors from SEW-EURODRIVE are connected.

- Integrated design of the brake for motors up to size 80 means the B-side endshield of the motor is an integral part of the brake with a friction surface.
- Modular design of the brake for motors from size 90 means the brake has a separate friction disk. The complete bearing of the motor is maintained even when the brake is removed.

The modular brake allows for mounting of up to four brake sizes to one motor. The B-side endshield is to be regarded like a connecting flange, which accommodates the BE.. brake pre-mounted on a friction disk. When it comes to maintenance of the drive, the modular structure has the particular advantage that the brake can be removed without having to remove the entire drive from the system or disassembling it.



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Adjustability

BE.. brakes allow you to adjust the working air gap quickly and easily as standard. This makes it possible to use the brake linings over a long period of time even in wear-intensive applications.

Internal brake plug connector from BE20 – 122

Brakemotors from SEW-EURODRIVE equipped with a brake of size BE20 or higher have an internal brake plug connector. The plug connector allows to maintain the brake without having to loosen the cabling in the terminal box of the motor.

Optional with air gap monitoring

For predictive planning of the service intervals, BE.. brakes can optionally be designed with air gap monitoring.

The diagnostic unit /DUE (Diagnostic Unit Eddy Current) is used for monitoring the working air gap. The diagnostic unit /DUE consists of the following components:

- An evaluation unit in the motor terminal box that is supplied via a 24 V DC voltage.
- A sensor, integrated in the magnet body of the brake

The diagnostic unit /DUE monitors the switching status of the brake and the wear on the basis of the current air gap. This information is given as digital or analog signals.

22134204/EN – 12/2017

7.1.6 Accessories overview brake/motor

Depending on the demands placed on the brake, different brake mounting sizes with different braking torque steps are available for mounting to the respective motor.

The following tables show the possible combinations of motor and brake as well as the braking torque steps for each brake to achieve the desired nominal braking torque:

	Motors								
Brake	**DRN80**	**DRN90**	**DRN100**	**DRN112 DRN132S**	**DRN132M DRN132L**	**DRN160 DRN180**	**DRN200 DRN225**	**DRN250 DRN280**	**DRN315**
BE05									
BE1									
BE2									
BE5									
BE11									
BE20									
BE30									
BE32									
BE60[1)]									
BE62[1)]									
BE120[1)]									
BE122[1)]									

1) Not available as BE.. safety brake.

22134204/EN – 12/2017

7.1.7 Braking torque graduations

Depending on the demands placed on the brake, different braking torque graduations are available depending on the brake sizes.

The following table shows the available braking torque graduations depending on the brake size:

Braking torque (M_B)	BE05	BE1	BE2	BE5	BE11	BE20
1.8[1]	■					
2.5[1]	■					
3.5	■					
5	■	■				
7		■	■			
10		■	■			
14			■	■		
20			■	■	■	
28				■	■	
40				■	■	■
55				■	■	■
80					■	■
110					■	■
150						■
200						■

1) Not available for BE.. safety brakes.

Braking torque (M_B)	BE30	BE32	BE60	BE62	BE120	BE122
75	■					
100	■	■				
150	■	■				
200	■	■	■			
300	■	■	■			
400		■	■	■	■	
500		■	■			
600		■	■	■	■	
800[1]				■	■	■
1000[1]				■	■	
1200[1]				■		■
1600[1]						■
2000[1]						■

1) Not available for BE.. safety brakes.

INFORMATION

Note that there may be limitations for the braking torques M_B to be selected depending on the motor design, especially for:

- AC motors for ambient temperatures above +60 °C.
- AC motors with BE safety brake in combination with the manual brake release option.

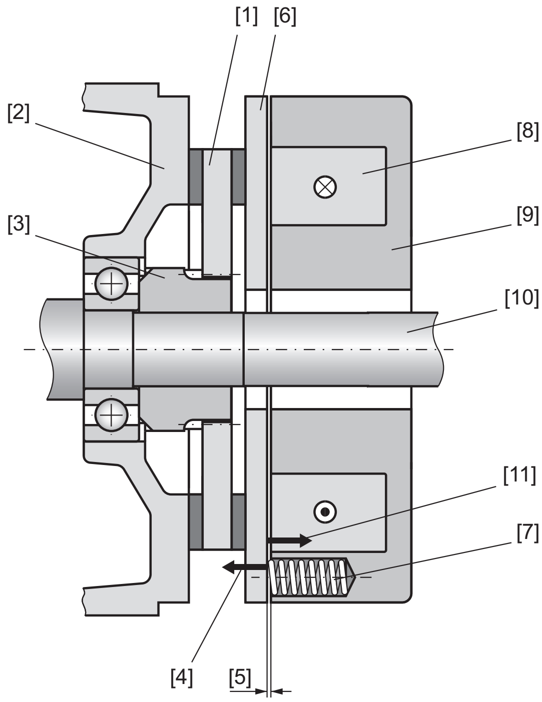
→ Consult SEW-EURODRIVE in these cases.

7.2 Technical details

7.2.1 Basic design and functional principle

The essential parts of the brake system are the mobile pressure plate [6], the brake springs [7], the brake lining carrier [1], the brake endshield [2] and the brake coil [8] (accelerator coil BS + coil section TS = holding coil HS). The magnet body consists of the magnet body housing [9] with cast winding and a tapping.

The pressure plate is forced against the brake lining carrier 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 lining carrier moves clear and the rotor can turn.



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

22134204/EN – 12/2017

7.2.2 Braking torque definition

The braking torques of the BE.. brakes are defined on the basis of DIN VDE 0580. A distinction is made between the following braking torques here:

Abbreviation according to DIN VDE 0580	Designation	Description
M_1	Dynamic braking torque	Torque acting upon the motor shaft with a slipping brake (brake safely disconnected). It depends on the current operating temperature and the current friction speed/motor speed.
M_2	Virtually static braking torque (= nominal braking torque M_B)	Braking torque with slowly slipping brake (relative speed between the friction components: 1 m/s) at 20 °C
M_4	Static braking torque	Breakaway torque that is necessary to rotate the motor shaft from a standstill with the brake closed.

The nominal braking torque M_B of the brakes is subjected to 100% final testing in the factory at SEW-EURODRIVE within the scope of quality control and is within a tolerance range of -10% and +50% in the as-delivered condition.

This nominal value M_B is used both during brake selection and also during planning. The differences between M_1 (dynamic braking torque) and M_4 (static braking torque) and the nominal braking torque are taken into consideration by SEW-EURODRIVE with the formulas and the calculation coefficients that are used when doing this.

The characteristic values M_1 and M_4 are therefore not relevant within the scope of the planning and selection of the brake. For more extensive applicative requirements of the brake, such as carrying out a brake diagnosis, the characteristic values M_1 and M_4 must be examined and evaluated separately.

INFORMATION

The characteristic values M_1 and M_4 can differ significantly from the nominal braking torque M_B depending on the wear and operating state of the brake in some cases, and can particularly be outside the above-mentioned tolerance range for M_B.

If you require more specific information, contact SEW-EURODRIVE.

22134204/EN – 12/2017

7.2.3 Use as a working or holding brake

The BE.. brakes are suitable for both line-operated motors (non-controlled applications) and inverter-operated motors (controlled applications).

Working brake

With line-operated motors, the brake is used for stopping the motor during normal operation. Brake application from the operating speed is the normal case here.

Holding brake

With inverter-operated motors, on the other hand, it is assumed that the brake will primarily be used for holding when at standstill. In this context we are talking about a "holding brake". Brake application from a speed only takes place in the event of emergency stop braking (uncontrolled stopping of the drive, comparable with stop category 0 in accordance with EN 60204-1). Normally, the brake is activated after electronic stopping (stop category 1 in accordance with EN 60204-1) at speeds of < 20 1/min.

The type of use must be taken into consideration during the selection and planning of the brake, see chapter "Selection and project planning" (→ 🗎 260).

22134204/EN – 12/2017

7.2.4 Supply voltage

Brake voltage

BE.. brakes are available in various voltage types.

As standard, the brake voltage is assigned as follows:

- Fixed voltage AC 230 V: DRN80 – DRN132S
- Fixed voltage AC 400 V: DRN132M – DRN315

The brakes are also available with other windings upon request, so that they are suitable for operation at the relevant DC and AC voltage sources.

If for example, a motor in a certain voltage range is delivered in combination with a global motor, the brake voltage is also confirmed as voltage range.

Design	Motor sizes and brake sizes	
	DRN80 – DRN180	DRN180 – DRN315
	BE05 – BE20	BE30 – BE122
Fixed voltage	AC 230 V	
	AC 400 V	
	DC 24 V	–
Voltage range 50 Hz	AC 220 – 242 V	
	AC 380 – 420 V	
Voltage range 50/60 Hz	AC 220 – 277 V	
	AC 380 – 480 V	

INFORMATION

Continuous operation of the brake on a global motor in the voltage range 60 Hz is only permitted when the global motor is operated in direct line operation. Otherwise the brake cooling cannot be ensured.

When the motor is operated at an inverter, the effective cyclic duration factor (cdf) of the brake must be limited to 40%, or the motor must be equipped with a forced cooling fan.

INFORMATION

In some cases, extra-low voltages cannot be avoided due to safety regulations. But extra-low voltages result in higher costs and efforts for cables, switching devices, transformers, rectifiers, and overvoltage protection (for example in case of direct DC 24 V voltage supply) than brakes that are operated at an AC voltage system using a brake control by SEW-EURODRIVE, see chapter "Cable selection" (→ 🗎 267).

Brake voltage supply

The supply voltage for brakes with a brake rectifier for operation on AC voltage is either supplied separately or picked up from the supply system of the motor in the terminal box. Only motors with a fixed speed can be supplied by the motor supply voltage from the terminal board of the motor. For motors with variable speed, the supply voltage for the brake must be supplied separately.

Furthermore, bear in mind that the brake response is delayed by the remanence voltage of the motor if the brake is powered by the motor terminal board. In hoists and hoist-like applications, this type of voltage supply is only permitted with an additional current relay (BSR control), which ensures the application of the brake also when the hoist is moving downward. The brake application time t_2l for cut-off in the AC circuit, specified in the brake's technical data, applies to a separate voltage supply to the brake only.

If the brake is directly supplied from the motor terminal board, the brake application times may extend to a multiple of the value $t_{2,\,I}$ depending on the application and the remanence voltage of the motor.

INFORMATION

In variable-speed motors, the brake voltage must not be picked up at the terminal board because the voltage there is not steady and constant.

This includes:

- Pole-changing motors
- Motors operated on an inverter

INFORMATION

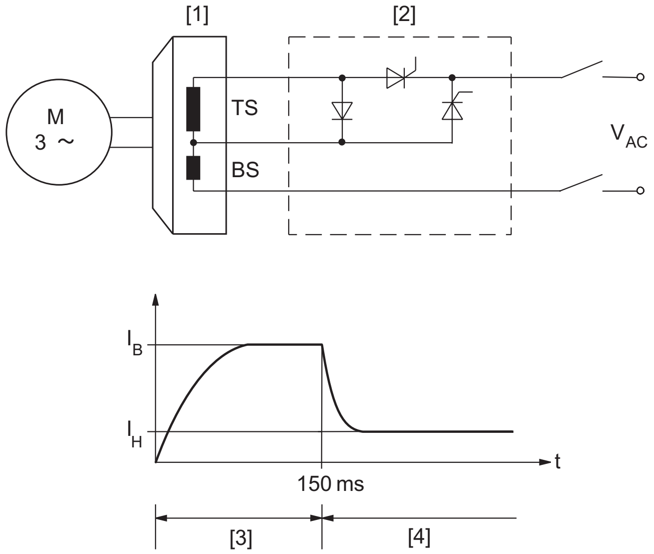
Motors with a fixed speed are often operated on soft start devices that work with phase angle controls, for example. In these cases, the brake must not be supplied from the terminal board as the voltage present at the terminal board is not constant.

22134204/EN – 12/2017

7.2.5 Two-coil system and brake controls

Particularly short response times at switch-on

BE.. brakes are equipped with the two-coil system patented by SEW-EURODRIVE. When using special brake control systems from SEW-EURODRIVE with acceleration function, the brake control ensures that only the accelerator coil is switched on first, followed by the holding coil (entire coil). The powerful impulse magnetization (high acceleration current) of the accelerator coil results in a very short response time, particularly in large brakes, without reaching the saturation limit. The brake lining carrier moves clear very swiftly and the motor starts up with hardly any braking losses.



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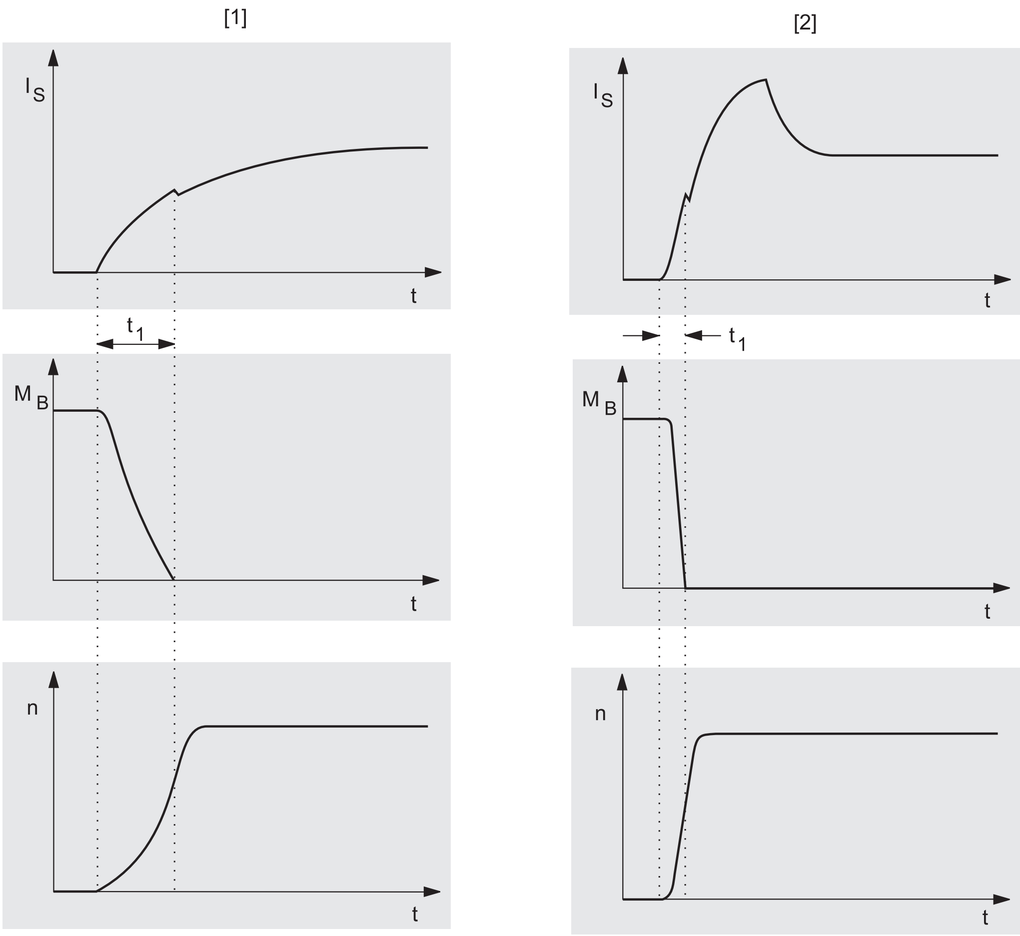
BS Accelerator coil
TS Coil section
[1] Brake
[2] Brake control
[3] Acceleration
[4] Hold
I_B Acceleration current
I_H Holding current
BS + TS = Holding coil HS

The particularly short response times of the BE.. brakes from SEW-EURODRIVE have the following advantages:

- Reduced run-up time of the drive
- Minimum heating of the motor during start-up and thus energy savings with negligible brake wear during start-up, see the following figure
- High switching frequency
- Long operating life of the brake lining and thus long maintenance intervals



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[1] Switch-on procedure for operation with rectifier without switching electronics, e.g. BG..
[2] Switch-on procedure for operation with rectifier from SEW-EURODRIVE with switching electronics, e.g. BGE.. (standard as of brakes BE5)
I_S Coil current
M_B Braking torque
n Rotational speed
t_1 Brake response time

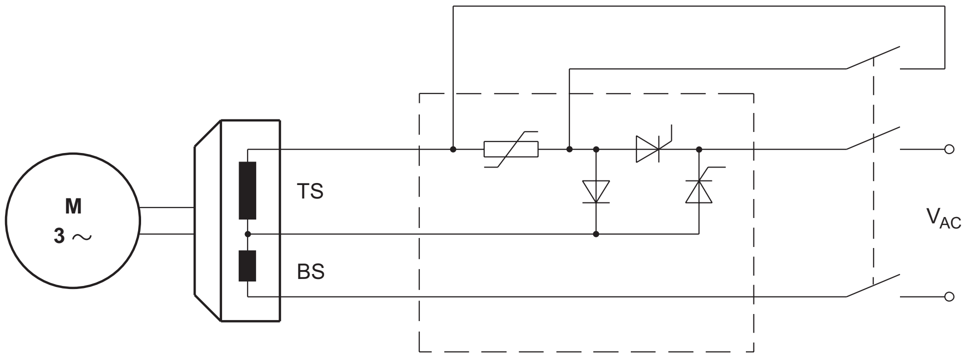
The system switches to the holding coil electronically as soon as the BE.. brake has released. The braking magnet is now only magnetized to such an extent (weak holding current) as to ensure that the pressure plate is held open with a sufficient degree of safety and minimum brake heating and the drive can turn freely.

Particularly short response time at switch-off

The response time for the application of the brake also depends on how rapidly the energy stored in the brake coil is dissipated when the power supply is switched off. A free-wheeling diode is used to dissipate the energy for a “cut-off in the AC circuit”. The current decreases at an exponential rate.

The current dissipates much more rapidly via a varistor when the DC and AC circuits are cut-off at the same time as the coil's DC circuit. The response time is considerably reduced. Conventionally, cut-off in the DC and AC circuits is implemented using an additional contact on the brake contactor (suitable for an inductive load).

Under certain conditions, you can also use the SR.. electronic current relays or UR voltage relays for interrupting the DC circuit, see the following section.



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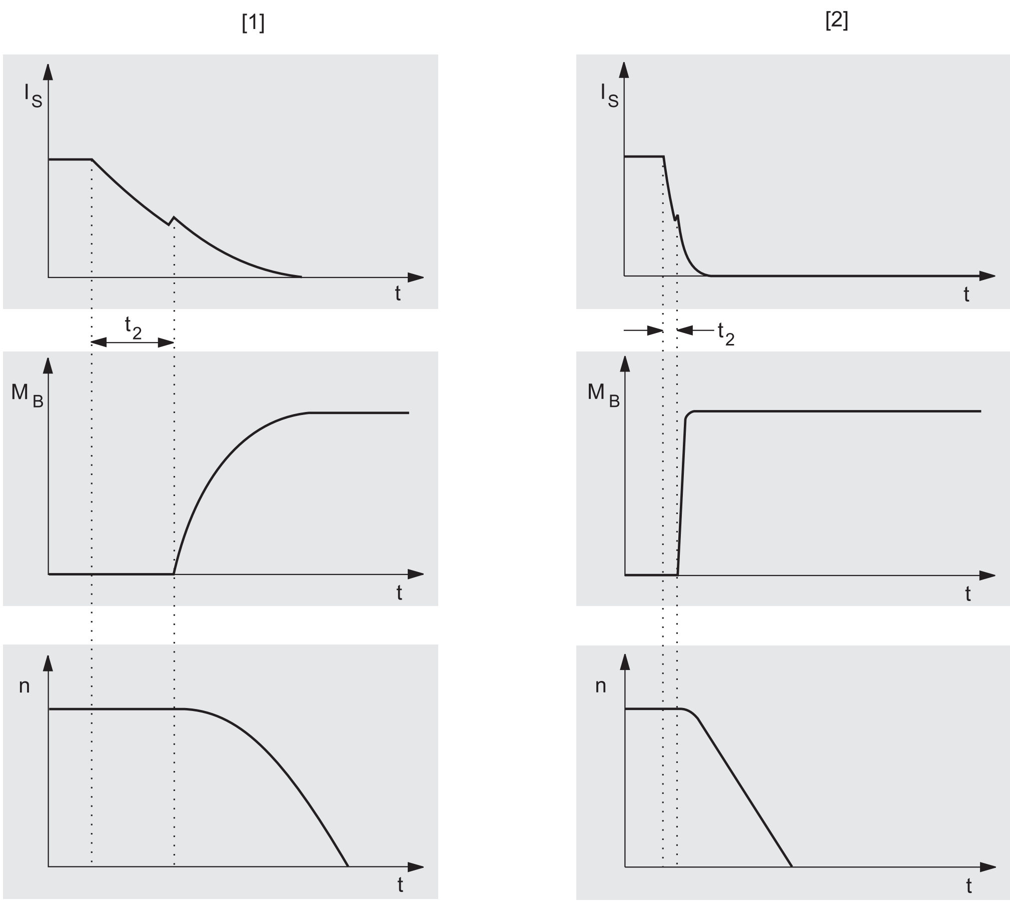
22134204/EN – 12/2017



[1] Brake application to cut-off in the AC circuit
[2] Brake application to cut-off in the AC and DC circuits
I_S Coil current
M_B Braking torque
n Rotational speed
t_2 Brake application time

Due to their mechanical principle, the degree of wear on the linings, and on-site basic physical conditions, brakemotors are subject to an empirically determined repetition accuracy of the braking distance of ±12%. The shorter the response times, the smaller the absolute value of the braking distance variation.

Cut-off in the DC and AC circuits makes it possible to shorten the brake application time t_2 considerably.

Cut-off in the DC and AC circuits is enabled by the following:

- A separate electromechanical switch contact, see chapter "Brake control block diagrams" (→ 🗎 284).
- The selection of a BMP.. or BMK.. brake control with integrated voltage relay for control cabinet installation, see chapter "Installation in control cabinet" (→ 🗎 262).
- Wear-free electronic relays in the terminal box (see chapter Selecting the brake voltage and brake control**).**
  – Current relay (BSR..) for motors with fixed speed
  – Voltage relay (BUR..) for adjustable-speed motors

Relay retrofitting options suited to the motor and voltage are provided in the chapters "Installation in control cabinet" (→ 🗎 262) and Installation in motor wiring space. Refer to the operating instructions for the part numbers.

Influence of low and fluctuating ambient temperatures

In case of low and fluctuating ambient temperatures, motors are exposed to the risk of condensation and icing. Functional limitations of the brake due to corrosion and ice can be prevented by using the BMH.. brake control with the additional "anti-condensation heating" function.

The heating function is activated externally. As soon as the brake has been applied and the heating function switched on during lengthy breaks, both coil sections of the brake control system are supplied with reduced voltage in an inverse-parallel connection by a thyristor operating at a reduced control factor setting. On the one hand, this practically eliminates the induction effect (brake does not release). On the other hand, it results in heating in the coil system, increasing the temperature by approx. 25 K in relation to the ambient temperature.

The heating function must be ended before the brake resumes its normal switching function following a heating period (see brake control "BMH, K1 contactor" (→ 🗎 294)).

Increased ambient temperature or restricted ventilation

In addition to the functional considerations, increased ambient temperature, insufficient supply of cooling air and/or the dimensioning of the motor according to thermal class 180 (H) are valid reasons for installing the brake control system in the control cabinet.

For marginal conditions of this type, SEW-EURODRIVE always recommends using brake controls with electronic switching.

This is mandatory especially for brakemotors for increased ambient temperatures above +40 °C.

DC 24 V control input

The control input with DC 24 V is an advantage especially for controlled applications where the brake control is to be switched e.g. via a higher-level controller or an inverter.

The available brake controls BMK..,BMKB.. and BMV.. are only intended for control cabinet installation.

22134204/EN – 12/2017

Safe brake control

The safe BST brake module allows to control the brake and to implement the SBC safety function (Safe Brake Control) according to EN 61800-5-2 in a device.

The safe BST brake module replaces the conventional brake controls. The brake can be functionally switched with the DC 24 V control input e.g. via a higher-level controller or an inverter. The brake can be switched in a safety-related manner with the functionally safe DC 24 V control input e.g. via a higher-level safety relay.

The electronic structure of the BST without mechanical switching elements has its advantages for high switching cycles as well as in the safety-related overall evaluation. The usual calculation of the theoretical failure probability $MTTF_d$ and the monitoring of the switch contacts is omitted.

The safe BST brake module fulfills the following safety requirement:

- Performance level d according to EN ISO 13849-1

IP degree of protection, corrosion protection and ambient temperature range

BE.. brakes can be designed according to application-related ambient conditions.

IP degree of protection

Standard design BE.. brakes have degree of protection IP54. As an alternative, they can be ordered in degrees of protection IP55, IP56, IP65 and IP66 depending on the motor design.

Corrosion protection

As standard, BE.. brakes are designed with a resistant corrosion protection.

As an option, they can be ordered with the surface protection option without restrictions depending on the motor design, see chapter "Surface protection" (→ 🗎 414).

Ambient temperature range

Standard design BE.. brakes are suitable for operation at ambient temperatures between -20 to +40 °C.

- If the two-coil system and a brake control in the control cabinet are used, the brake can be operated at ambient temperatures up to -40 °C. In this temperature range, the use of the heating function is recommended when using the BMH.. brake control.
- AC motors with BE.. brake can also be designed for increased ambient temperatures of up to +100 °C. Note that the availability of individual braking torque steps may be restricted, see chapter "Braking torque graduations" (→ 🗎 234). In case of questions, contact SEW-EURODRIVE.

7.2.6 Design for functional safety

The BE05 – BE 32 brake can be ordered as safety brake according to EN ISO 13849 if required.

By adding a BE.. safety brake into a safe overall system, safety functions can be implemented which force the motor to stop (safe braking) and hold the motor in its position (safe holding).

General

When implementing safety functions in machines, the components have to be evaluated regarding their suitability for implementing a safety function.

When using a safety brake from SEW-EURODRIVE, the following safety-related requirements, e.g. according to EN ISO 13849 – parts 1 and 2, are already considered:

- Application of basic safety principles
- Application of proven safety principles
- Information on the characteristic safety value B_{10d}
- Common Cause Failure (CCF)
- Notice of influences and ambient conditions
- Determination of the category (Cat.)
- Retraceability by the unique motor assignment
- Production monitoring with 100% final inspection
- Compliance with normative requirements regarding documentation

For safety brakes, SEW-EURODRIVE has already solved this safety-related requirement as an advantage for the machine designer. The machine designer can rely on the manufacturer confirmation (e.g. through product documentation or TÜV certificate) in his safety-related overall evaluation and considerably reduce own efforts for evaluation and documentation of a brake.

If other components (standard components) are used for implementing safety functions, the machine designer has to evaluate the safety-related requirements.

Underlying standards

The safety assessment is based on the following standard and safety class:

Safety brakes	
Safety class/underlying standard	Category (Cat.) according to EN ISO 13849-1

TÜV certification

The following certificate is available for the described safety brakes:

- Certificate of the TÜV NORD Systems GmbH & Co. KG

The TÜV certificate is available from SEW-EURODRIVE on request.

Safety functions of the safety brake

The implementation of a safety function with electromechanical brakes requires that the brake is applied on request. The safety function is activated when the brake is applied. The brake coil has to be de-energized and the energy stored in the brake coil reduced.

22134204/EN – 12/2017

By adding a BE.. safety brake into a safe overall system, the following safety functions can be implemented:

- SBA – Safe Brake Actuation
- SBH – Safe Brake Hold

INFORMATION

Safety functions SBA and SBH are defined by SEW-EURODRIVE in accordance with the standard EN 61800-5-2 .

The implementation of the SBA and SBH safety functions additionally require the safety functions SBC and STO in the overall system. For safety-related requests of the brake, SBC and STO ensure that the brake applies and that the drive does not generate a torque against the applied brake.

The SBC and STO safety functions are not part of the brake and have to be additionally implemented in the overall safety system. The performance level (PL) of the SBC and STO safety functions must at least meet the required performance level (PLr) of the application.

SEW-EURODRIVE recommends to stop the drive using the stop category 1 according to EN 60204-1 prior to activating the SBC and STO safety functions.

Performance levels that can be achieved

The brake complements a safe braking system consisting of several system components.

The achievable performance level of the resulting safe braking system according to EN ISO 13849-1 is mainly determined by:

- The selected safety structure, category (Cat.)
- Reliability of the used system components (PL, B_{10d}, $MTTF_d$, etc.)

  The $MTTF_d$ value is calculated specifically for the application based on the B_{10d} value for the brake and the switching frequency of the application.
- Diagnostic coverage (DC_{avg})

  The diagnostic coverage is fulfilled with a brake diagnostics.
- The failure due to a common cause (CCF) with categories 2, 3, and 4.

The achieved performance level must be determined for the selected safe braking system based on an overall evaluation of the system. Observe the characteristic safety values necessary for the brake.

For the characteristic safety values of the SEW-EURODRIVE components, refer to the product-related documentation as well as the library for the SISTEMA software available for download at www.sew-eurodrive.com.

22134204/EN – 12/2017

BE.. brake compared to the BE.. safety brake

Depending on the use of the BE.. brake, conditions and restrictions exist both for the brake as well as for the other drive components. Observe these points during configuration and ordering of the overall drive.

For a list of conditions and restrictions, refer to the manual "Project Planning for BE.. Brakes – DR.., DRN.., EDR.., and EDRN.. AC Motors – Standard Brake/Safety Brake".

22134204/EN – 12/2017

7.3 Options

7.3.1 Manual brake release

The BE.. brake can be released manually with a manual brake release. Two designs of the manual brake release are available:

- Lockable manual brake release /HF
- Manual brake release with automatic re-engaging function /HR

Lockable manual brake release /HF

For the lockable manual brake release /HF, a set screw is included in the delivery to permanently open the brake mechanically.

Avoid the /HF type of manual brake release for hoists and other statically stressed applications as it can lead to severe incidents when activated by accident.

Please note that the manual brake release /HF cannot be combined with the BE05 – BE32 safety brakes.

Manual brake release with automatic re-engaging function /HR

With automatic manual brake release /HR, a hand lever is included in the delivery. The screw-in hand lever serves for manually opening the brake for a short period of time. The mechanical components are pretensioned in such a way that the brake is applied automatically without hand pressure.

Manual brake release /HR is available for BE05 – 62 brakes. If you require BE120 – 122 with the /HR option, contact SEW-EURODRIVE.

INFORMATION

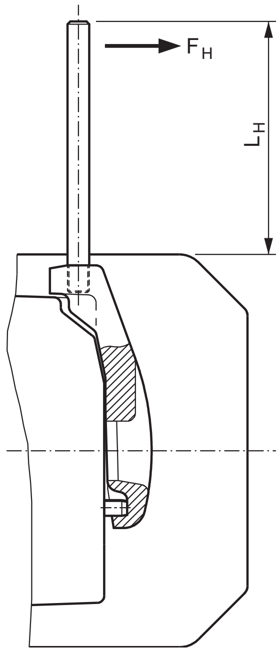
For BE05 – 32 safety brakes, the combinations with the /HR option can be limited for some cases.

22134204/EN – 12/2017

Technical details

Actuating forces manual brake release

In brakemotors with the /HR option "Manual brake release with automatic reengaging function", you can release the brake manually using the lever supplied. The following table specifies the actuation force required at maximum braking torque to release the brake by hand. The values are based on the assumption that you operate the lever at the upper end. The length of that part of the manual lever projecting out of the fan guard is stated as well.



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Nominal actuation force F_H for manual brake release /HR

Brake	**Nominal actuation force F_H**
	N
BE05	20
BE1	40
BE2	80
BE5	215
BE11	300
BE20	375
BE30 BE32	400
BE60 BE62	500

22134204/EN – 12/2017

Lever protrusion L_H

Motors	BE05	BE1	BE2	BE5	BE11	BE20	BE30 BE32	BE60 BE62
	Lever protrusion L_H in mm							
DRN80	71	71	82	–	–	–	–	–
DRN90	57	57	68	90	–	–	–	–
DRN100	–	54	65	87	–	–	–	–
DRN112 DRN132S	–	–	–	70	139	–	–	–
DRN132M DRN132L	–	–	–	–	121	189	–	–
DRN160	–	–	–	–	–	150	235	–
DRN180	–	–	–	–	–	139	224	–
DRN200	–	–	–	–	–	–	216	416
DRN225	–	–	–	–	–	–	176	376
DRN250 DRN280	–	–	–	–	–	–	–	358

7.3.2 Function/wear monitoring of the brake

The option diagnostic unit /DUE (Diagnostic Unit Eddy Current) is a contactless measuring system for function and wear monitoring of the BE.. brake.

This option is designed for industrial environments and is used to monitor the function and the maximum working air gap of the BE.. brakes from SEW-EURODRIVE.

The diagnostic unit /DUE comprises the following parts:

- An evaluation unit in the motor terminal box that is supplied via a DC 24 V voltage.
- A sensor, installed in the magnet body of brakes BE1 to BE122.

Retrofitting options

Brakemotors from SEW-EURODRIVE can be retrofitted with the diagnostic unit /DUE. However, the drive combination has to be checked to determine all necessary conversion parts. Contact SEW-EURODRIVE if you would like to retrofit an existing drive with the diagnostic unit /DUE.

Technical details

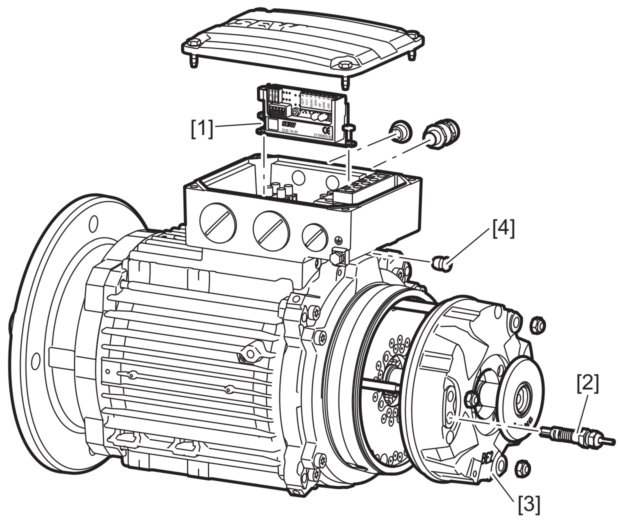
Structure

The bore required to insert the eddy current sensor is sealed by a cable gland when the /DUE diagnostic unit is installed.

The sensor is connected to the evaluation unit (installed in the terminal box and pre-calibrated at delivery) via a shielded twisted-pair cable.

The sensor diameter varies depending on the brake size.

Sensor diameter	Brakes
6 mm	BE1 – BE5
8 mm	BE11 – BE122



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[1] Evaluation unit
[2] Sensor
[3] Brake
[4] Grommet

22134204/EN – 12/2017

Functional description

It is a contactless measuring system, based on the current eddy principle. High-frequency alternating current flows through the sensor. The electromagnetic field induces eddy currents in the pressure plate that change the alternating current resistance of the sensor. The evaluation unit converts this change in impedance into an electrical signal (4 – 20 mA) that is proportional to the working air gap of the brake.

The function monitoring of the brake is realized via a digital signal (NO contact). A digital output (NC contact) signals if the wear limit was reached. Further, a current output allows for continuous monitoring of the brake wear. In addition to the outputs, LEDs at the evaluation unit indicate the function and the wear of the brake.

- The red LED indicates the state of wear of the brake.
- The green LED indicates the function of the brake.

Further diagnosis can also be carried out using the various light codes of the LEDs. For the exact meaning of the light codes, refer to the "AC Motors DR..71 – 315, DRN80 – 315" operating instructions.

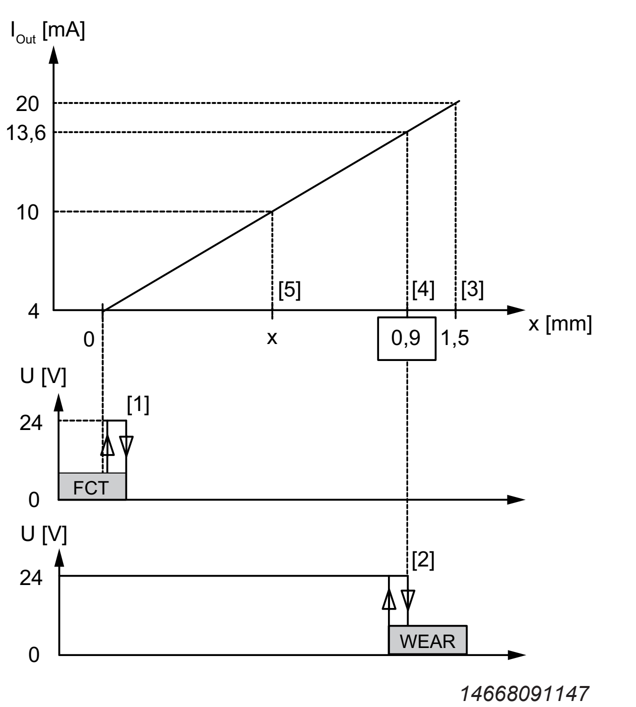
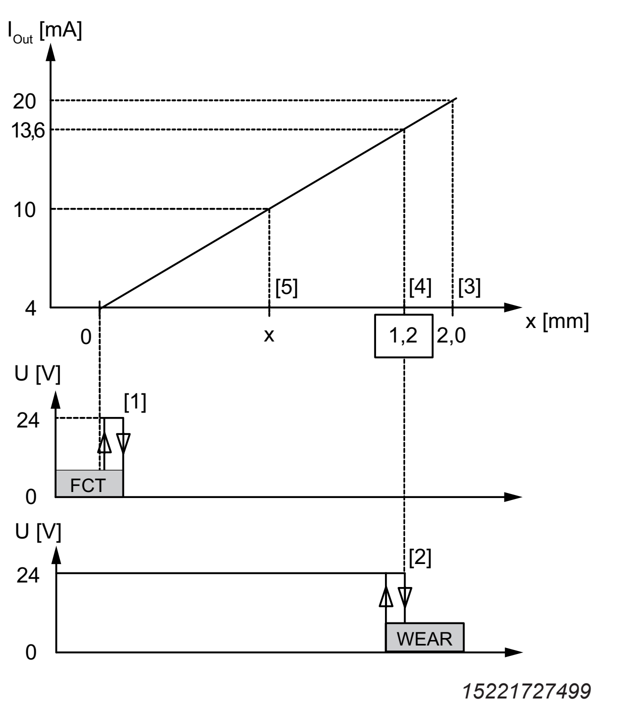
If the brake is ordered in combination with the diagnostic unit /DUE, the function and wear monitoring function is already installed, calibrated and set to the permitted wear limit for the brake in the factory.

Output signals for function and wear monitoring

The evaluation unit has the following signals for brake monitoring:

- 2 digital output signals. Signal FCT for brake function monitoring (brake released) and signal WEAR that is sent if the defined maximum permitted working air gap is reached.
- An analog output signal (range 4 mA – 20 mA) for continuous monitoring of the air gap.

The illustration shows the switching states of the diagnostic unit /DUE depending on the brake size and/or the sensor diameter as well as the current strength depending on the air gap.

DUE-d6 (6 mm)	DUE-d8 (8 mm)
	

[1] FCT: Digital output function (DC 24 V, DIN EN 61131-2)
[2] WEAR: Digital output wear (DC 24 V, DIN EN 61131-2)
[3] Measuring range of the sensor
[4] Maximum working air gap of the brake (exemplary)
[5] Currently measured working air gap (exemplary)

Connecting the evaluation unit

Additionally, observe the following note regarding the cabling and/or the connection of the evaluation unit:

The maximum permitted cable cross section at terminals "[k]" of the evaluation unit is 1.5 mm^2 with conductor end sleeve without plastic collar, 0.75 mm^2 with plastic collar. The recommended cable cross section at terminals "[k]" is 0.5 mm^2 with conductor end sleeve with plastic collar.

INFORMATION

Use shielded cables to wire the evaluation unit. Connect the shield to the GND potential, or use the shield plate at the user's signal evaluation.

SEW-EURODRIVE recommends routing the power cable of the drive and the cable of the diagnostic unit separately.

- Unless they are shielded, sensor cables must always be routed separately from other power cables with phased currents.
- Provide for a suitable equipotential bonding between drive and control cabinet.

Important characteristics of the cable used are:

- Total shielding (outer shield) of the cable
- 100 m maximum length for fixed installation
- 50 m maximum length for cable carrier installation

The required number of cores depends on the type of function/signals that are to be transferred to the higher-level controller and then processed.

At the factory, the diagnostic unit /DUE is pre-installed, calibrated and set to the wear limit permitted for the brake. The diagnostic unit has to be calibrated again after service or maintenance work such as sensor replacement or replacement of the evaluation electronics. The calibration can be take place directly at the evaluation electronics (at the terminal box) or alternatively via the higher-level controller. In the second case, the required signals for calibration have to be routed to the higher-level controller.

The reference ground GND and the reference ground analog output AGND have the same potential. In case this potential is not treated separately in the application, AGND is not necessary.

Number of required cores	Function	Abbreviation
3	Voltage supply	DC 24 V
	Reference ground	GND
	Digital output function	FCT
3	Voltage supply	DC 24 V
	Reference ground	GND
	Digital output wear	WEAR
4	Voltage supply	DC 24 V
	Reference ground	GND
	Digital output function	FCT
	Digital output wear	WEAR

Number of required cores	Function	Abbreviation
4	Voltage supply	DC 24 V
	Reference ground	GND
	Analog output current air gap	OUT
	Reference ground analog output	AGND
6	Voltage supply	DC 24 V
	Reference ground	GND
	Digital output function	FCT
	Digital output wear	WEAR
	Analog output current air gap	OUT
	Reference ground analog output	AGND
8	Voltage supply	DC 24 V
	Reference ground	GND
	Digital output function	FCT
	Digital output wear	WEAR
	Analog output current air gap	OUT
	Reference ground analog output	AGND
	Calibration zero value	ZERO
	Calibration of infinite value	INF

INFORMATION

If the calibration inputs ZERO and/or INF are routed to the outside to a PLC or a controller, they have to be continuously connected to AGND in normal operation to avoid EMC interferences in the calibration cables.

INFORMATION

Signal outputs of the evaluation unit /DUE that are switched may not be used as voltage supply for other evaluation units /DUE or comparable systems. Each evaluation unit /DUE has to be supplied separately.

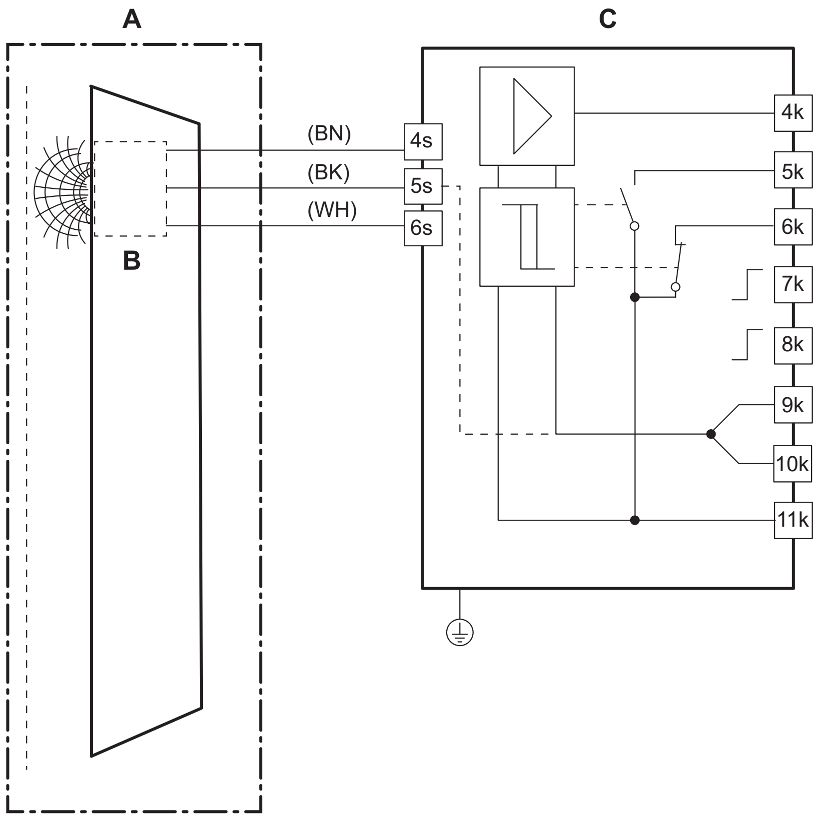
Technical data

			DUE-1K-00	
Installation in			BE1 – BE5	BE11 – BE122
Channels			1	
Sensor			DUE-d6	DUE-d8
Sensor diameter		mm	6	8
Measuring range		mm	1.5	2.0
Limit frequency			100 Hz (-3 dB)	
Temperature			Sensor and cable: -50 to +150 °C Evaluation unit: -40 to +105 °C	
Enclosure			Sensor: up to IP66 Evaluation unit: IP20 (in the closed terminal box up to IP66)	
Signal outputs			OUT1: 4 – 20 mA FCT1: DC 24 V (150 mA) WEAR1: DC 24 V (150 mA)	
Calibration outputs			ZERO: DC 24 V INF: DC 24 V	
Supply voltage			DC 24 V (±15%)	
Current consumption	max.[1]	mA	190	
	min.[2]	mA	40	
Electromagnetic compatibility			DIN EN 61800-3, environment 1	

1) All outputs are fully loaded with 150 mA each externally by e.g. relay
2) Only internal supply with current output at maximum gain

22134204/EN – 12/2017

Wiring diagram



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[A]	Brake	[4k]	Analog output wear 1 (air gap)
[B]	Eddy current sensor	[5k]	Digital output function 1 (NO contact)
[C]	Evaluation unit	[6k]	Digital output wear 1 (NC contact)
[4s]	Connection sensor A1 (brown cable)	[7k]	Input calibration zero value
[5s]	Connection sensor GND 1 (black cable)	[8k]	Input calibration infinite value
[6s]	Connection sensor B1 (white cable)	[9k]	Signal ground AGND
		[10k]	Ground potential GND
		[11k]	DC 24 V supply

The evaluation unit is supplied with DC 24 V via the terminals GND [10k] and DC 24 V [11k].

Order information

Type designation /DUE

Available for brakes BE1 – BE122

22134204/EN – 12/2017

7.4 Selection and project planning

The focus of the following sections is the preselection of the brake regarding the mountability and selection of designs and options.

In addition, extensive information is provided regarding the dimensioning of the surrounding structure so that a brakemotor from SEW-EURODRIVE can be installed into the system without difficulties.

For the necessary calculation steps and notes as well as characteristic values needed for the correct dimensioning of the brake according to the SEW-EURODRIVE specifications, refer to the following documents:

- "Project Planning for BE.. Brakes" manual – DR.., DRN.., EDR.., and EDRN.. AC Motors – Standard Brake/Safety Brake"
- "DR..71 – 315, DRN80 – 315 AC Motors" operating instructions

7.4.1 Procedure for selecting brakes and accessories

Both the brakemotor as well as its electrical connections have to be dimensioned according to the conditions of the application.

The following aspects must be taken into account:

Activity	Chapter
Selecting the brake or braking torque	"Pre-selecting the brake size and braking torque" (→ 🗎 261)
Determining the brake control	Selecting the brake voltage and brake control
Selecting the brake control system and connection type	"Selecting the brake control" (→ 🗎 262)
Dimensioning and routing the cable	"Cable selection" (→ 🗎 267)
Selecting the braking contactor	"Selecting the braking contactor" (→ 🗎 268)
Motor protection switch if necessary (protection of the brake coil)	"Motor overload circuit breaker" (→ 🗎 271)
Selecting the diagnostic unit	"Function/wear monitoring of the brake" (→ 🗎 253)

22134204/EN – 12/2017

7.4.2 Pre-selecting the brake size and braking torque

Basic specification	Link/supplement/comment
Motor	Brake/brake control
Braking torque [1)	Brake springs
Brake application time	Connection type of the brake control (important for creation of wiring diagrams)
Braking time Braking distance Deceleration Braking accuracy	The required data can only be observed if the aforementioned parameters meet the requirements
Braking work Brake service life	Maintenance interval (important for service)

1) The braking torque is determined from the requirements of the application with regard to the maximum deceleration and the maximum permitted distance or time.

For detailed information on selecting the size of the brakemotor and calculating the braking data, refer to the manual "Project Planning for BE.. Brakes – DR.., DRN.., EDR.., and EDRN.. AC Motors – Standard Brake/Safety Brake".

7.4.3 Selecting the brake connection voltage

The brake voltage should always be selected on the basis of the available line voltage or the rated motor voltage.

The standard brake voltage corresponds to the specifications in chapter "Supply voltage" (→ 🗎 239). Different brake voltages according to chapter "Operating currents" (→ 🗎 277) can be selected on request.

With multi-voltage motors, the connection voltage of the brake should preferably be specified to the low motor voltage (e.g. motor design 230⅄⅄/460⅄ results in a brake voltage of AC 230 V). For grid operation, the brake can be supplied directly by the motor terminal board independent of the line voltage.

22134204/EN – 12/2017

7.4.4 Selecting the brake control

Installation in control cabinet

The following tables list the technical data of brake control systems for installation in the control cabinet as well as the assignments to the brake sizes.

Series	Function	Voltage	Holding current I_{Hmax}	Type
BMS..	Half-wave rectifier without electronic switching.	AC 230 – 575 V	1.0	BMS 1.4
		AC 150 – 500 V	1.5	BMS 1.5
		AC 42 – 150 V	3.0	BMS 3
BME..	Half-wave rectifier with electronic switching	AC 230 – 575 V	1.0	BME 1.4
		AC 150 – 500 V	1.5	BME 1.5
		AC 42 – 150 V	3.0	BME 3
BMH..	Half-wave rectifier with electronic switching and heating function	AC 230 – 575 V	1.0	BMH 1.4
		AC 150 – 500 V	1.5	BMH 1.5
		AC 42 – 150 V	3.0	BMH 3
BMP..	Half-wave rectifier with electronic switching, integrated voltage relay for cut-off in the DC circuit	AC 230 – 575 V	1.0	BMP 1.4
		AC 150 – 500 V	1.5	BMP 1.5
		AC 230 – 575 V	2.8	BMP 3.1
		AC 42 – 150 V	3.0	BMP 3
BMK..	Half-wave rectifier with electronic switching, control input (DC 24 V) and cut-off in the DC circuit	AC 230 – 575 V	1.0	BMK 1.4
		AC 150 – 500 V	1.5	BMK 1.5
		AC 42 – 150 V	3.0	BMK 3
BMKB..	Half-wave rectifier with electronic switching, control input (DC 24 V), rapid stop, and LED status display	AC 150 – 500 V	1.5	BMKB1.5
BMV..	Brake control unit with electronic switching, control input (DC 24 V), and rapid stop	DC 24 V	5.0	BMV 5
BST..	Safe brake control with electronic switching, control input (DC 24 V), and safe control input (DC 24 V). Supply via inverter DC link.	AC 460	0.6	BST 0.6S
		AC 400	0.7	BST 0.7S
		AC 230	1.2	BST 1.2S

22134204/EN – 12/2017

Assignment of motor size and connection technology

	BE05 – BE2	BE5 – BE20	BE30 – BE32	BE60 – BE62	BE120 – BE22
BMS..		–	–	–	–
BME..					–
BMH..					–
BMP..					–
BMP3.1	–	–	–		
BMK..					–
BMV..			–	–	–
BST..				–	–

	Permitted
–	Not permitted

INFORMATION

Brake control systems for installation in the control cabinet with all standard motor plug connectors and cage clamp options.

22134204/EN – 12/2017

Installation in the motor terminal box

The following tables list the technical data of brake control systems for installation in the wiring space of the motor as well as the assignments to the brake sizes.

Series	Function	Voltage	Holding current I_{Hmax} in A	Type
BG..	Half-wave rectifier without electronic switching	AC 230 – 575 V	1.0	BG 1.4
		AC 150 – 500 V	1.5	BG 1,5
		AC 24 – 150 V	3.0	BG 3
BGE..	Half-wave rectifier with electronic switching	AC 230 – 575 V	1.0	BGE 1.4
		AC 150 – 500 V	1.5	BGE 1.5
		AC 42 – 150 V	3.0	BGE 3
BS..	Terminal block with varistor protection circuit	DC 24 V	5.0	BS24
BSG..	Brake control unit with electronic switching and rapid stop	DC 24 V	5.0	BSG
BMP..	Half-wave rectifier with electronic switching, integrated voltage relay for cut-off in the DC circuit.	AC 230 – 575 V	2.8	BMP 3.1

Assignment of motor size and connection technology

	BE05 – BE2	BE5 – BE20	BE30 – BE32	BE60 – BE62	BE120 – BE122
BG..		–	–	–	–
BGE..					–
BS..		–	–	–	–
BSG..			–	–	–
BMP3.1	–	–	–	1)	

(shaded)	Permitted
1)	Possible with DRN250 – DRN280
–	Not permitted

BG.. and BGE.. are always supplied wired up in the terminal box for cut-off in the AC circuit.

INFORMATION

Brake control systems for installation in the motor terminal box can be combined with most plug connectors and with cage clamps /KCC. There might be space restrictions when using the /KC1 option and customer-specific plug connectors.

There might also be restrictions in combinations with further electrical additional options (such as motor protection, strip heater, built-in encoder), or a larger terminal box might have to be used.

22134204/EN – 12/2017

Additional switching relay for installation on the motor terminal box

The following tables list the technical data of available current relays and voltage relays (SR.. and UR..). These relays are available for implementing cut-off in the DC circuit and in the AC circuit in the drive, see chapter "Particularly short response time at switch-off" (→ 🗎 243).

The two relays are optionally available for BE05 – BE32 brakes in addition to BGE 1.5 and BGE 3 brake control. The relays are provided for mounting to the motor terminal box.

INFORMATION

When using drives with the BSR.. option, the terminal box contour or size might be different after having mounted the relay.

Designations of the option: BSR.. (BGE.. with SR..) and BUR.. (BGE.. with UR..). The two options differ in the design and in the assignment rules.

BSR.. brake control combination

A combination of brake control and SR.. current relay can be used for motors with the following features:

- Grid operation
- Single-speed
- Constant voltage at the terminal board of the motor, see chapter "Brake voltage supply" (→ 🗎 239).

The supply voltage for the brake is tapped directly from the motor terminal board. Consequently, no separate cables are required for the voltage supply of the brake.

The relay is wired in such a way that it monitors the current in the motor winding. The current decreases when the motor is switched off. The relays disconnects the DC circuit of the brake virtually without delay.

The brake voltage usually corresponds to the phase-to-neutral voltage of the motor. For a motor with a nominal voltage of 230 V△/400 V⅄, the brake coil is equipped with a winding for operation at 230 V. As an option, the brake coil can also be configured for phase-to-phase voltage (e.g. motor 400 V, brake 400 V).

BUR.. brake control combination

A combination of brake control and UR.. voltage relay can be used for motors with the following features:

- Pole-changing
- Inverter controlled
- No constant voltage over time present at the motor terminal board

The combination can also be used for grid-operated, single-speed motors. If the brake is supplied with voltage from the motor terminal board, the remanence voltage of the motor would result in a delayed application of the brake after switching off.

With BUR.., the voltage for the brake must be supplied using a separate supply cable. The relay is wired in such a way that it monitors the AC circuit voltage at the input terminals of the BGE.. brake control system. The relay disconnects the DC circuit of the brake virtually without delay due to the voltage dip that occurs when switching off the brake supply.

Assignment of brake size and connection voltages

The maximum switchable current for holding the brake is DC 1 A (corresponds to about AC 0.77 A for BE.. brakes).

Based on this limit value, the following table lists possible combinations of the various brake sizes depending on common line voltages:

Voltage	**Brake sizes**			
AC V	**BE05 – BE5**	**BE11 – BE20**	**BE30 – BE32**	**BE60 – BE122**
120		–	–	–
230			–	–
400				–
460				–
500				–
575	–	–	–	–

SEW-EURODRIVE permanently assigns the BGE.. brake control and the SR.. current relay or UR.. voltage relay depending on the selected combination of brake and motor and connection voltage:

- BGE.. is assigned based on the connection voltage of the brake, see above section.
- The SR.. current relay is assigned depending on the motor size and the rated motor current for ⅄ connection.
- UR.. voltage relays are fixed assigned to BGE.. brake control systems. They are assigned by means of the connection voltage of the brake. UR15 is always assigned to BGE1.5, and UR11 is assigned to BGE3.

Motors	**Rated motor current I_N in ⅄ connection**	**Assigned SR.. current relay**
	A	
DRN80 – DRN132S	0.075 – 0.6	SR10
	0.6 – 10	SR11
	10 – 50	SR15
DRN132M – DRN225	10 – 30	SR15
	30 – 90	SR19

7.4.5 Dimensioning the periphery

Voltage supply/connection type

Connection type

Maintaining certain brake application times can be relevant to safety. The decision to implement cut-off in the AC circuit or cut-off in the DC and AC circuits must be documented clearly and unambiguously and must be adhered to during installation and startup.

The specified brake application times must be observed in particular during project planning (see also the manual "Project Planning for BE.. Brakes – DR.., DRN.., EDR.., and EDRN.. AC Motors – Standard Brake/Safety Brake").

Cable selection

Dimensioning and routing of the cable

Bear in mind the inrush current of the brake when dimensioning the cross section of the brake cable. When taking into account the voltage drop due to the inrush current, the value must not drop below 90% of the nominal brake voltage. Refer to the "Operating currents" (→ 🗎 277) tables for information about possible connection voltages and the resulting operating currents.

Refer to the table below for dimensioning the cable cross sections with regard to the acceleration currents for cable lengths ≤ 50 m.

BE05 – BE122

<table>
<tr><th rowspan="2">Brake</th><th colspan="6">Minimum cable cross section of the brake cables in mm² for cable lengths ≤ 50 meters and brake voltage (AC V)</th></tr>
<tr><th>24</th><th>60
DC 24 V</th><th>111 – 123</th><th>174 – 193</th><th>194 – 217</th><th>218 – 575</th></tr>
<tr><td>BE05</td><td rowspan="3">10</td><td rowspan="2">1.5</td><td rowspan="4">1.5</td><td rowspan="7">1.5</td><td rowspan="8">1.5</td><td rowspan="9">1.5</td></tr>
<tr><td>BE1</td></tr>
<tr><td>BE2</td><td>2.5</td></tr>
<tr><td>BE5</td><td rowspan="6">1)</td><td>4</td></tr>
<tr><td>BE11</td><td rowspan="2">10</td><td rowspan="3">2.5</td></tr>
<tr><td>BE20</td></tr>
<tr><td>BE30/32</td><td rowspan="3">1)</td></tr>
<tr><td>BE60/62</td><td rowspan="2">1)</td><td>2.5</td></tr>
<tr><td>BE120/122</td><td>1)</td><td>1)</td></tr>
</table>

1) Connection voltage not available for this brake size

Cable cross sections of max. 2.5 mm² can be connected to the terminals of the brake control systems. Intermediate terminals must be used if the cross sections are larger.

Brake cables must always be routed separately from other power cables with phased currents unless they are shielded, see chapter "Brakemotor operation with inverter" (→ 🗎 99).

Provide for a suitable equipotential bonding between drive and control cabinet.

22134204/EN – 12/2017

Power cables with phased currents include:

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

Selection and protection circuit of switching elements

Selecting the braking contactor

The high electrical load during switching of the brake (inductive load) requires suitable contactors/switch contacts to have the brake function properly.

Depending on the type and design of the brake, the switch contacts for the voltage supply of the brake must meet the following utilization categories:

- Switch contacts for the supply voltage for operation with AC voltage: AC-3 according to EN 60947-4-1, or AC-15 according to EN 60947-5-1.
- Switch contact for the supply voltage for operation with DC voltage: Preferably AC-3 or DC-3 according to EN 60947-4-1. As an alternative, contacts in utilization category DC-13 according to EN 60947-5-1 are also permitted.

For using the faster cut-off in the AC and DC circuits, also the DC circuit of the brake must be switched. The following applies:

- Switch contacts for optional cut-off in the DC circuit: AC-3 according to EN 60947-4-1.

INFORMATION

Semi-conductor relays with RC protection circuits are not suitable for switching brake rectifiers with the exception of BG.. and BMS..

When applications require cut-off in the DC and AC circuits of the brake, electronic switching devices from SEW-EURODRIVE can be used instead of separate switch contacts.

1. The brake rectifiers BMP.., BMV.. and BMK.., which perform the cut-off in the DC circuit internally, have been specially designed for installation in the control cabinet.
2. The additional relays SR.. and UR.. have been installed for mounting to the terminal box in combination with brake control.

Advantages of brake control systems from SEW-EURODRIVE with integrated cut-off in the DC circuit

Switching devices from SEW-EURODRIVE offer the following advantages:

- Special contactors with four AC-3 contacts are not required.
- For the above mentioned reasons, the contact for cut-off in the DC circuit is subject to high loads and, therefore, a high level of wear. In contrast, the electronic switches from SEW-EURODRIVE operate without any wear at all.
- Customers do not have to perform any additional wiring. The current and voltage relays are wired at the factory. Only the power supply and brake coil have to be connected for the BMP.. and BMK.. rectifiers.
- Two additional conductors between the motor and control cabinet are no longer required.
- No additional interference emission in the control cabinet from contact bounce when the brake is cut-off in the DC circuit.

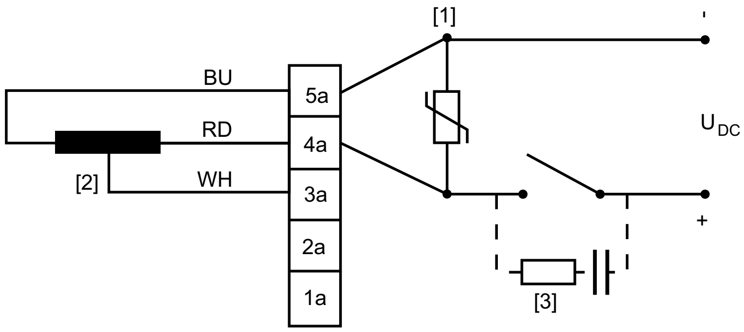
22134204/EN – 12/2017

Varistor overvoltage protection with direct DC voltage supply

The brakes of sizes BE05 to BE2 can be operated with direct DC voltage without brake control, see technical data in chapter "Operating currents" (→ 🗎 277).

In this case, a suitable overvoltage protection in the form of a varistor must be installed by the customer to protect the switch contacts and the brake coil. The varistor must be connected in parallel to the coil according to the below diagram.

The following figure shows a varistor for protecting the brake coil.



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[1]	Varistor	WH	White
[2]	Brake coil	RD	Red
[3]	RC element	BU	Blue

The required varistor is not included in the delivery, which means it has to be selected and dimensioned by the customer.

INFORMATION

Using a freewheeling diode as overvoltage protection instead of a varistor is not permitted, as this can significantly extend brake application times.

If there are still problems with EMC interference in the voltage supply line despite the varistor overvoltage protection, then a suitable RC element can also be connected in parallel to the switch contact.

INFORMATION

SEW-EURODRIVE always recommends using of a BS.., BSG.. or BMV.. brake control for brakes with DC 24 V supply. This brake control has a wear-free, electronic switch which prevents, in particular, contact-breaking sparks when switching off the brake which could lead to EMC interference. BMV.. controls also have a powerful overvoltage protection for the switch contacts and the brake coil.

Multi-motor operation of brakemotors

In many applications, several motors are used at the same time to implement a technical function. This is generally also possible for brakemotors. Bear in mind that in the event of a brake failure, all other brakes that are operated at the same time also have to apply to prevent damage to the drive components and the system.

INFORMATION

In general: If one brake fails, all other brakes must be cut-off in the AC circuit.

Simultaneous switching can be achieved by connecting any particular group of brakes in parallel to one brake control system. When several brakes are connected in parallel to the same brake rectifier, the total of all the operating currents (chapter "Operating currents" (→ 🗎 277)) must not exceed the nominal current of the brake control, see chapter "Selecting the brake control" (→ 🗎 262).

22134204/EN – 12/2017

7.4.6 Fusing the voltage supply

Like any other electrical operating resource, also a spring-loaded brake must be protected from overvoltage and short circuit. For brakes that are operated with a brake control from SEW-EURODRIVE at an AC voltage system, SEW-EURODRIVE recommends using a motor circuit breaker as fuse protection.

Motor overload circuit breaker

A motor circuit breaker prevents the destruction of the brake coil in the event of the brake coil being connected incorrectly or the brake rectifier being defect.

Electromagnetic motor circuit breakers such as ABB type M25-TM are suitable as short-circuit protection for the brake rectifier and as thermal protection for the brake coil.

INFORMATION

Electronic motor circuit breakers are not suitable for protecting brake rectifiers and brake coils due to their working principle (measuring the effective current value via a current transformer). Contact SEW-EURODRIVE.

The motor circuit breaker must be selected and set based on the nominal holding current of the brake. For holding currents, refer to chapter "Operating currents" (→ 🗎 277).

The following applies to the setting values:

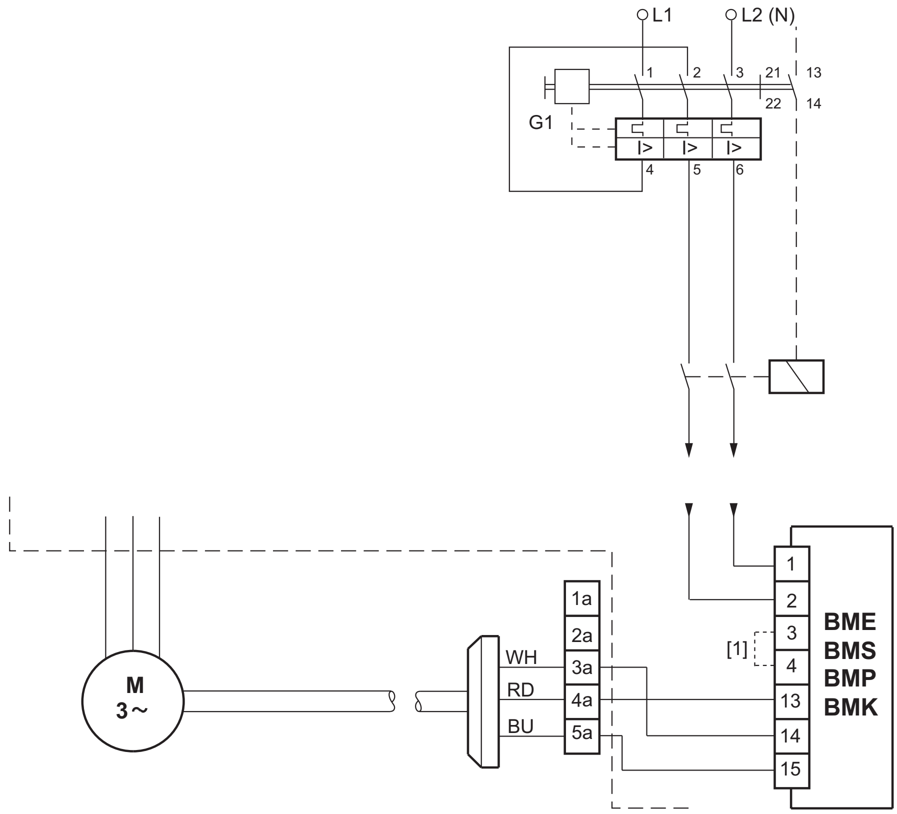
- Brakes with a fixed connection voltage or 50 Hz voltage range: Setting to 1.1 times the nominal holding current
- Brakes with a combined voltage range of 50/60 Hz: Setting to 1.25 times the nominal holding current

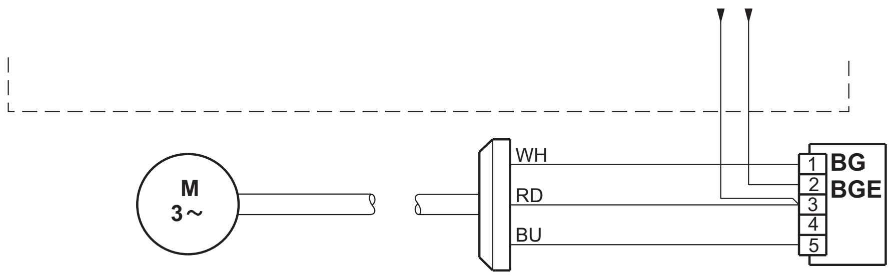
Motor circuit breakers are suitable for all brake rectifiers in the control cabinet and in the terminal box with separate voltage supply.

INFORMATION

Special conditions must be taken into account when using motor circuit breakers in combination with BMH.. brake control because of the heating current. Consult SEW-EURODRIVE in this case.

22134204/EN – 12/2017





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WH White
RD Red
BU Blue
[1] Customers must connect terminals 3 and 4 according to the relevant wiring diagram.

7.4.7 Brake diagnostics and friction surface activation

In applications with brakes, the braking torque represents an important criterion for the functionality of the brake. In the event of a reduction in or loss of braking torque, the functionality of the application is no longer ensured. As a result, the safety of the machine and/or even the safety of persons may be decreased. To prevent this from happening, the brake can optionally be checked using brake diagnostics. Brake diagnostics provides the user with information about the status and performance capability of the brake. The early detection of potential faults or functional limitations is the advantage of the diagnosis. This makes it possible to arrange maintenance or repair in good time.

Brake diagnostics may be required by standards, particularly in safety-related applications in accordance with EN ISO 13849 in which a safety function is implemented using a brake. The diagnostic coverage level (DC_{avg}) required by standards must be fulfilled depending on the required performance level (PL). The diagnostic coverage level is a key figure of the implemented brake diagnostics.

The braking torque that is present, which cannot be detected by conventional diagnostic systems such as a microswitch /DUB or diagnostic unit /DUE, is an essential criterion for checking a brake.

Diagnostic unit /DUE

The diagnostic unit /DUE for function and wear monitoring of the BE.. brake detects the switching status of the brake and its wear status by means of continuous measurement of the air gap. The diagnostic unit /DUE detects whether the magnetic circuit of the brake including the brake control basically works (brake opens and closes). Furthermore, the /DUE option makes it possible to detect a change to the air gap of the brake via a continuous air gap measurement. In this way, wear-related function restrictions can be detected and rectified by means of maintenance.

INFORMATION

The diagnostic unit /DUE detects the switching status and the degree of wear of the brake by interpreting the air gap. However, the /DUE option cannot determine the available braking torque. Additional applicative measures may be needed to check the braking torque.

Brake diagnostics as a functionality of control from SEW-EURODRIVE

At SEW-EURODRIVE, brake diagnostics is available as a software function for controllers of the advanced/power performance classes. This makes it possible to implement safety functions with brakes in horizontal and vertical applications up to the maximum requirement PL e. The functionality can be individually adapted to the applicative requirements during startup.

A considerable advantage of this diagnosis is the automatic load detection that has been implemented. In this way, the brake is reliably checked with the required test torque, even in changing applicative load situations. The provision of an additional test load for carrying out the diagnosis is not required.

Further information can be found in the "Project Planning for BE.. Brakes – DR.., DRN.., EDR.., and EDRN.. AC Motors – Standard Brake/Safety Brake" manual.

Notes on realizing brake diagnostics

Brake diagnostics can also be realized by the customer. The customer is responsible for evaluating the diagnostic coverage (DC_{avg}) and correct diagnosis of the brake for solutions such as these.

In order to avoid erroneous diagnosis results, particular attention must be paid to the following:

- Software-based brake diagnostics usually cannot determine the braking torque that is present at the brake. In addition to the braking torque, the torque determined by the diagnostics also includes applicative torques, such as friction. Measuring tolerances of the measuring equipment that is used and the temperature-dependent torque characteristics of the motor can also lead to considerable measurement deviations.
- Because of the possible measurement deviations and the different meaning of the nominal braking torque M_B and the static braking torque M_4, brake slippage cannot and must not occur, even significantly outside the tolerance range of the nominal braking torque M_B.

For the above mentioned reasons, the determination of the test torque to be selected must always be based on the planning requirements, such as maximum static load torque of the application and safety factors, if necessary.

INFORMATION

i

Performing brake diagnostics with a damaged brake or brake control unit can lead to undesirable movement of the unit. During the implementation and performance of these kinds of diagnostics, always ensure that the safety of persons and the system is guaranteed during this process.

In order to perform a static brake diagnosis, attention must be paid to the following in addition to the above-mentioned notes:

- In systems with more than one brake, e.g. a group drive or motor brake in combination with another brake in the system, each brake must be tested separately in accordance with the standards. Any mechanical stress during the separate diagnosis must be taken into consideration in the design of the machine or must be avoided using suitable automation.
- The brake diagnosis must be carried out with the machine in a test position that avoids injuries to persons and damage to the system in the event of possible movement, e.g. in the event of brake slippage.

If you have any queries with regard to the selection, parameterization, and use of diagnosis mechanisms, please contact SEW-EURODRIVE.

22134204/EN – 12/2017

Activating the friction surfaces

When a brake is used as a holding brake, the brake is not usually subjected to dynamic loading. This can cause a gradual reduction in the static friction torque M_4. As compensation, the friction surfaces can be reactivated by a targeted dynamic load. The activation procedure regenerates the top layer of the friction lining in order to compensate for the drop in the static friction torque M_4 caused by a lack of dynamic strain.

SEW-EURODRIVE recommends paying attention to the following during activation procedures such as this:

- Perform friction surface activation as infrequently as possible in order not to reduce the service life of the lining too much.
- The friction surfaces should preferably be activated using dynamic brake application at a significantly reduced motor speed (< 750 1/min).
- Activation of the friction surfaces by means of controlled start-up of the motor against the closed brake is only permissible if the motor speed does not exceed a value of 100 1/min and the activation time does not exceed 5 seconds.

In the event of uncertainty with regard to the design of activation of the friction surfaces, please contact SEW-EURODRIVE.

INFORMATION

Working brakes on line-operated motors (non-controlled operation) do not need activation, since they are sufficiently loaded by the operational braking procedures.

7.5 Technical data

INFORMATION

For information on the torque-dependent spring pack of BE.. brakes, refer to the operating instructions for AC motors.

Information	Source
Operating currents of the brake	"Operating currents" (→ 🗎 277)
Resistance of brake coils	Operating instructions
Cycle times	"Project Planning for BE.. Brakes" manual – DR.., DRN.., EDR.., and EDRN.. AC motors – Standard Brake/Safety Brake"
Permitted braking work per cycle	"Project Planning for BE.. Brakes" manual – DR.., DRN.., EDR.., and EDRN.. AC motors – Standard Brake/Safety Brake"
Permitted braking work until maintenance	"Project Planning for BE.. Brakes" manual – DR.., DRN.., EDR.., and EDRN.. AC motors – Standard Brake/Safety Brake"
Permitted working air gaps	Operating instructions
Spring pack tables	Operating instructions
Characteristic safety values B_{10D}	"Characteristic safety values" (→ 🗎 282)
Block diagrams	"Brake control block diagrams" (→ 🗎 284)
Dimension sheets brake controls	"Dimension drawings" (→ 🗎 297)

22134204/EN – 12/2017

7.5.1 Operating currents

General information on determining operating currents

The tables in this chapter list the operating currents of the brakes at different voltages. They apply to BE.. brakes.

The acceleration current I_B (= inrush current) flows only for a short time (approx. 160 ms for BE05 – BE62, 400 ms for BE60 – BE122 with BMP3.1 brake control) when the brake is released. When using BG, BS24, or BMS brake control and direct DC voltage supply without control unit (only possible with brake size BE05 – BE2), increased inrush current does not occur.

The values for the holding currents I_H are r.m.s. values. Only use current measurement units that are designed to measure r.m.s. values.

INFORMATION

The following operating currents and power consumption values are nominal values. They refer to a coil temperature of +20 °C.

Operating currents and power consumption usually decrease during normal operation due to heating of the coil.

Note that the actual operating currents can be higher by up to 25% depending on the ambient temperature and with coil temperatures below +20 °C.

Braking torque definition

The braking torques of the BE.. brakes are defined on the basis of DIN VDE 0580. A distinction is made between the following braking torques here:

Abbreviation according to DIN VDE 0580	Designation	Description
M_1	Dynamic braking torque	Torque acting upon the motor shaft with a slipping brake (brake safely disconnected). It depends on the current operating temperature and the current friction speed/motor speed.
M_2	Virtually static braking torque (= nominal braking torque M_B)	Braking torque with slowly slipping brake (relative speed between the friction components: 1 m/s) at 20 °C
M_4	Static braking torque	Breakaway torque that is necessary to rotate the motor shaft from a standstill with the brake closed.

The nominal braking torque M_B of the brakes is subjected to 100% final testing in the factory at SEW-EURODRIVE within the scope of quality control and is within a tolerance range of -10% and +50% in the as-delivered condition.

This nominal value M_B is used both during brake selection and also during planning. The differences between M_1 (dynamic braking torque) and M_4 (static braking torque) and the nominal braking torque are taken into consideration by SEW-EURODRIVE with the formulas and the calculation coefficients that are used when doing this.

The characteristic values M_1 and M_4 are therefore not relevant within the scope of the planning and selection of the brake. For more extensive applicative requirements of the brake, such as carrying out a brake diagnosis, the characteristic values M_1 and M_4 must be examined and evaluated separately.

INFORMATION

The characteristic values M_1 and M_4 can differ significantly from the nominal braking torque M_B depending on the wear and operating state of the brake in some cases, and can particularly be outside the above-mentioned tolerance range for M_B.

If you require more specific information, contact SEW-EURODRIVE.

Legend

The following tables list the operating currents of the brakes at different voltages.

The following values are specified:

P_B	Electric power consumption in the brake coil in watt.
V_N	Nominal voltage (nominal voltage range) of the brake in V (AC or DC).
I_H	Holding current in ampere r.m.s. value of the brake current in the supply cable to the SEW brake control.
I_{DC}	Direct current in ampere in the brake cable with direct DC voltage supply or Direct current in ampere in the brake cable with DC 24 V supply via BS24, BSG, or BMV.
I_B	Acceleration current in ampere (AC or DC) when operated with SEW brake control for high-speed excitation.
I_B/I_H	Inrush current ratio ESV.
I_B/I_{DC}	Inrush current ratio ESV for DC 24 V supply with BSG or BMV.

22134204/EN – 12/2017

BE05, BE1, BE2 brakes

	BE05, BE1	BE2
Rated brake coil power in W	32	43
Inrush current ratio ESV	4	4

Nominal voltage V_N		BE05, BE1		BE2	
		I_H	I_{DC}	I_H	I_{DC}
AC V	DC V	AC A	DC A	AC A	DC A
24 (23–26)	10	2.25	2.90	2.95	3.80
60 (57-63)	24	0.90	1.17	1.18	1.53
120 (111-123)	48	0.45	0.59	0.59	0.77
184 (174-193)	80	0.29	0.37	0.38	0.49
208 (194-217)	90	0.26	0.33	0.34	0.43
230 (218-243)	96	0.23	0.30	0.30	0.39
254 (244-273)	110	0.20	0.27	0.27	0.35
290 (274-306)	125	0.18	0.24	0.24	0.31
330 (307-343)	140	0.16	0.21	0.21	0.28
360 (344-379)	160	0.14	0.19	0.19	0.25
400 (380-431)	180	0.13	0.17	0.17	0.22
460 (432-484)	200	0.11	0.15	0.15	0.19
500 (485-542)	220	0.10	0.13	0.14	0.18
575 (543-600)	250	0.09	0.12	0.12	0.16

22134204/EN – 12/2017

Brakes BE5, BE11, BE20, BE30, BE32, BE60, BE62

	BE5	BE11	BE20	BE30, BE32	BE60, BE62
Rated brake coil power in W	49	77	100	120	195
Inrush current ratio ESV	5.9	6.6	7.5	8.5	9.2

Nominal voltage V_N		BE5	BE11	BE20	BE30, BE32	BE60, BE62
		I_H	I_H	I_H	I_H	I_H
AC V	DC V	AC A	AC A	AC A	AC A	AC A
60 (57-63)	24	1.28	2.05	2.55	–	–
120 (111-123)	–	0.64	1.04	1.28	1.66	–
184 (174-193)	–	0.41	0.66	0.81	1.05	–
208 (194-217)	–	0.37	0.59	0.72	0.94	1.50
230 (218-243)	–	0.33	0.52	0.65	0.84	1.35
254 (244-273)	–	0.29	0.47	0.58	0.75	1.20
290 (274-306)	–	0.26	0.42	0.51	0.67	1.12
330 (307-343)	–	0.23	0.37	0.46	0.59	0.97
360 (344-379)	–	0.21	0.33	0.41	0.53	0.86
400 (380-431)	–	0.18	0.30	0.37	0.47	0.77
460 (432-484)	–	0.16	0.27	0.33	0.42	0.68
500 (485-542)	–	0.15	0.24	0.29	0.38	0.60
575 (543-600)	–	0.13	0.22	0.26	0.34	0.54

22134204/EN – 12/2017

Brake BE120, BE122

	BE120, BE122
Rated brake coil power in W	220
Inrush current ratio ESV	6

Nominal voltage V_N	BE120, BE122
	I_H
AC V	AC A
230 (218-243)	1.45
254 (244-273)	1.30
290 (274-306)	1.16
360 (344-379)	0.92
400 (380-431)	0.82
460 (432-484)	0.73
500 (485-542)	0.65
575 (543-600)	0.58

22134204/EN – 12/2017

7.5.2 Characteristic safety values

Characteristic safety values for BE.. brakes

The values specified in the following table apply to BE.. brakes in standard applications.

	Characteristic safety values according to EN ISO 13849-1	
Classification	Category B	
System structure	1-channel (cat. 1) B)	
$MTTF_D$ value	Calculation via B_{10D} value	
B_{10D} value	BE05	16×10^6
	BE1	12×10^6
	BE2	8×10^6
	BE5	6×10^6
	BE11	3×10^6
	BE20	2×10^6
	BE30	1.5×10^6
	BE32	1.5×10^6
	BE60	1×10^6
	BE62	1×10^6
	BE120	0.25×10^6
	BE122	0.25×10^6

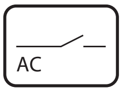
22134204/EN – 12/2017

Characteristic safety values for BE.. safety brakes

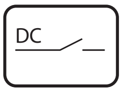
	Characteristic safety values according to EN ISO 13849-1	
Classification	Category 1	
System structure	1-channel (cat. 1)	
Operating mode	High demand	
Safe state	Brake applied	
Safety functions	Safe brake actuation (SBA) Safe brake hold (SBH)	
Service life	20 years, or T_{10D} value (depending on which value applies first)	
T_{10D} value	0.1 x $MTTF_D$	
$MTTF_D$ value	Calculation via B_{10D} value	
B_{10D} value	BE05	20×10^6
	BE1	16×10^6
	BE2	12×10^6
	BE5	10×10^6
	BE11	8×10^6
	BE20	5×10^6
	BE30	3×10^6
	BE32	3×10^6

7.5.3 Brake control block diagrams

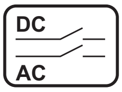
Legend



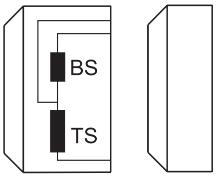
Cut-off in the AC circuit
(standard application of the brake)



Cut-off in the DC circuit
(fast application of the brake)



Cut-off in the DC and AC circuits
(rapid application of the brake)



Brake

BS = Accelerator coil

TS = Coil section

Auxiliary terminal strip in terminal box

Motor with delta connection

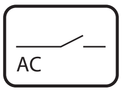
Motor with star connection

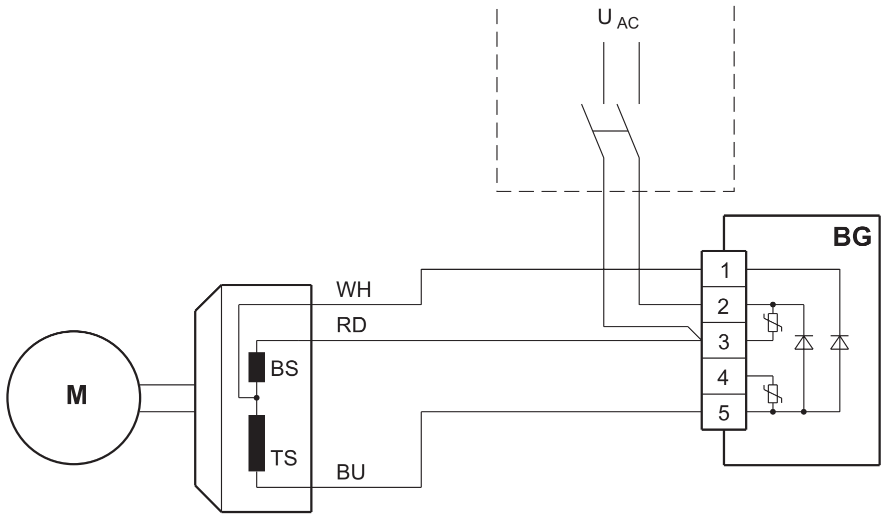
Control cabinet limit

WH	White
RD	Red
BU	Blue
BN	Brown
BK	Black

22134204/EN – 12/2017

BG.. brake control





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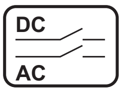

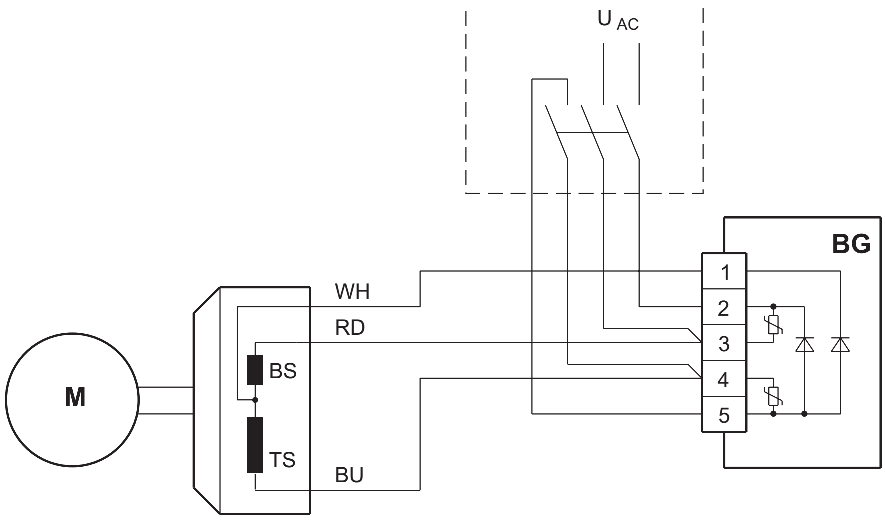

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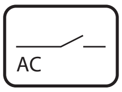
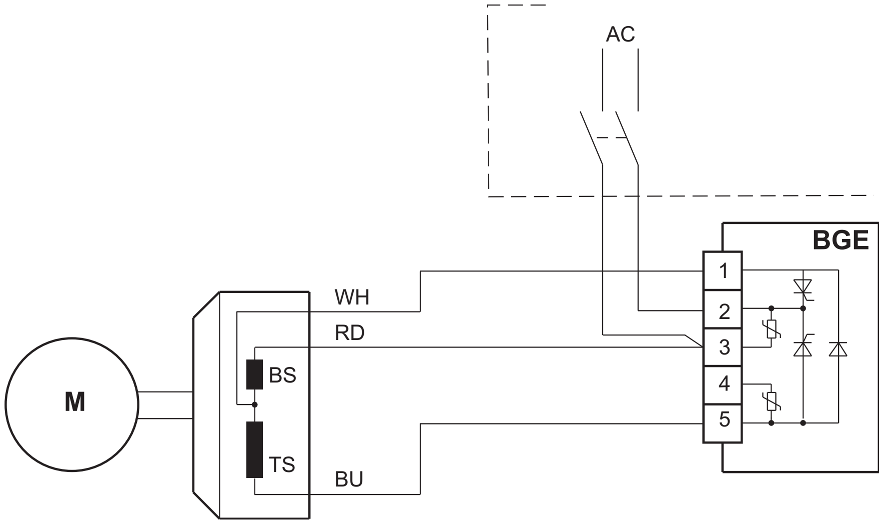
BGE.. brake control





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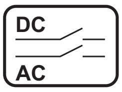

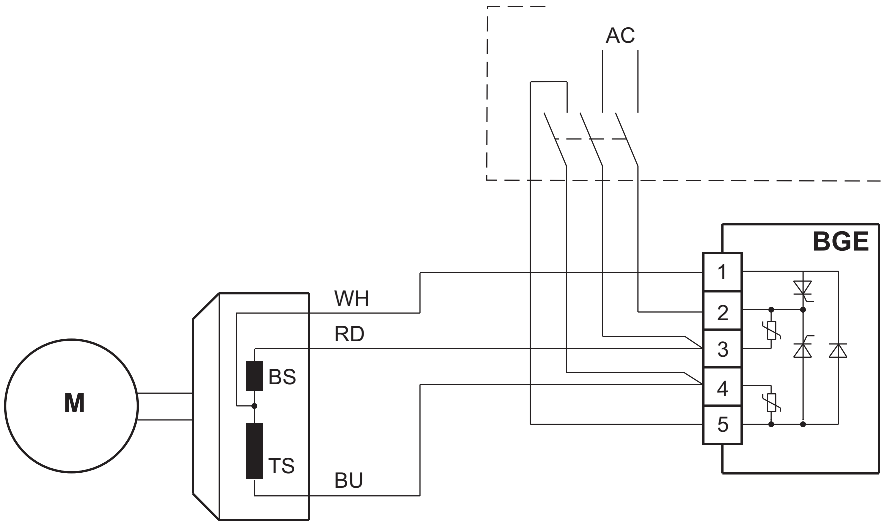

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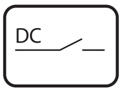
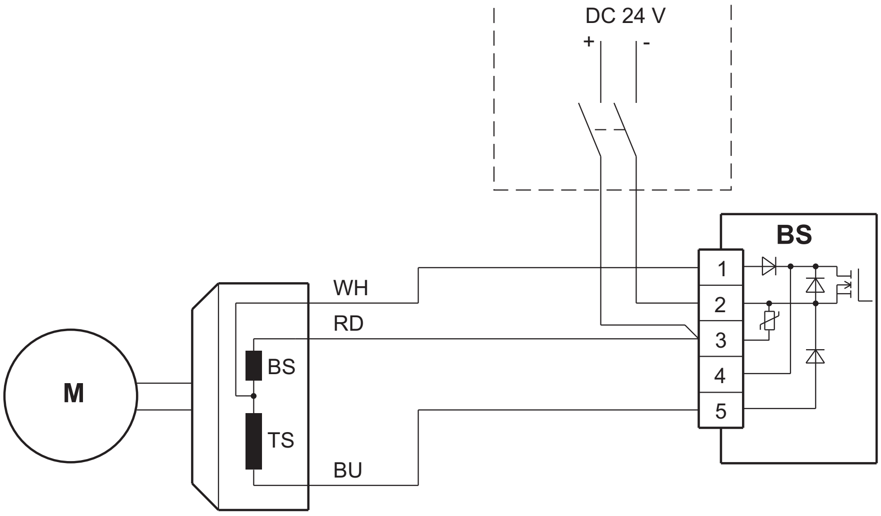
22134204/EN – 12/2017

BS.. brake control





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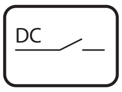
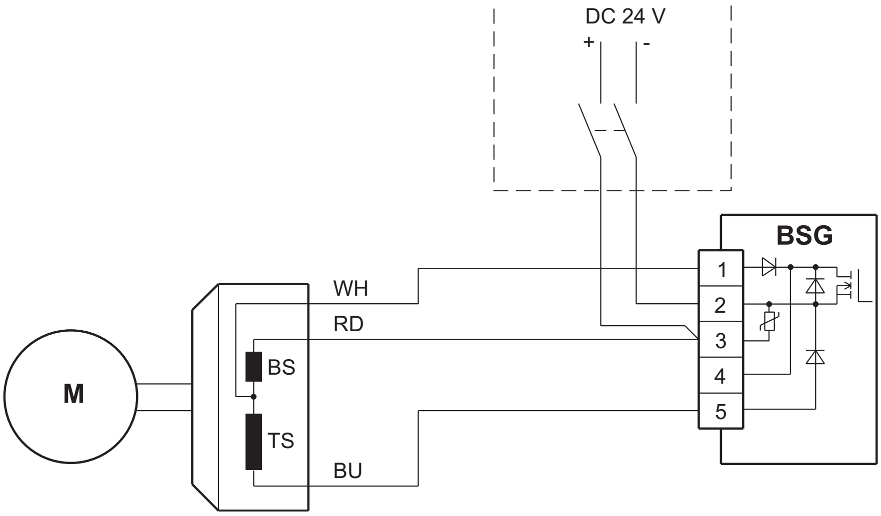
BSG.. brake control





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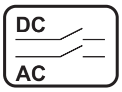
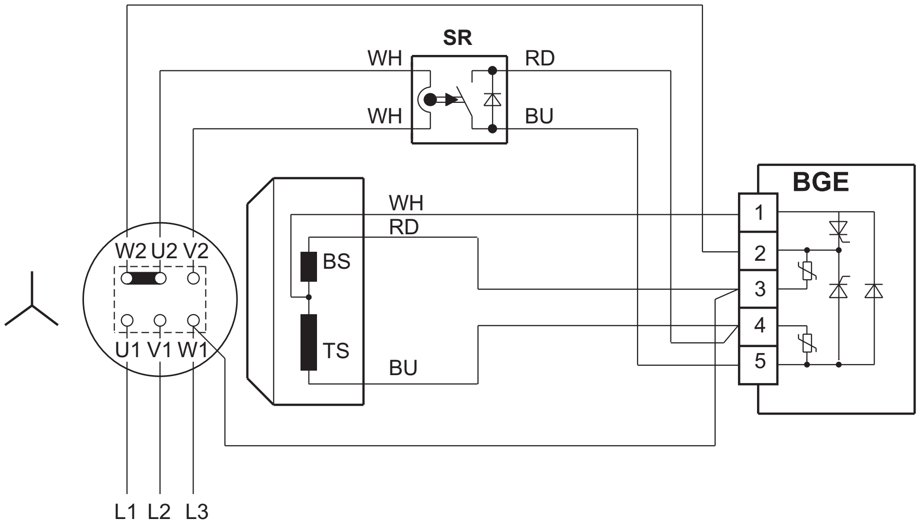
22134204/EN – 12/2017

BSR.. brake control

Brake voltage = phase-to-neutral voltage





Example: Motor 230 V △/400 V ⅄, brake AC 230 V

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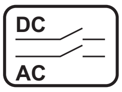

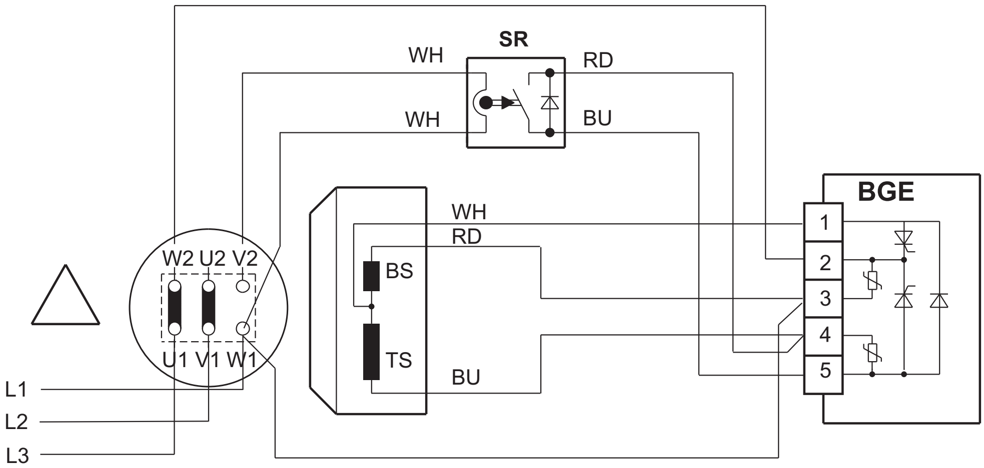

Example: Motor 400 V △/690 V ⅄ , brake: AC 400 V

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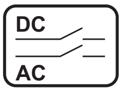
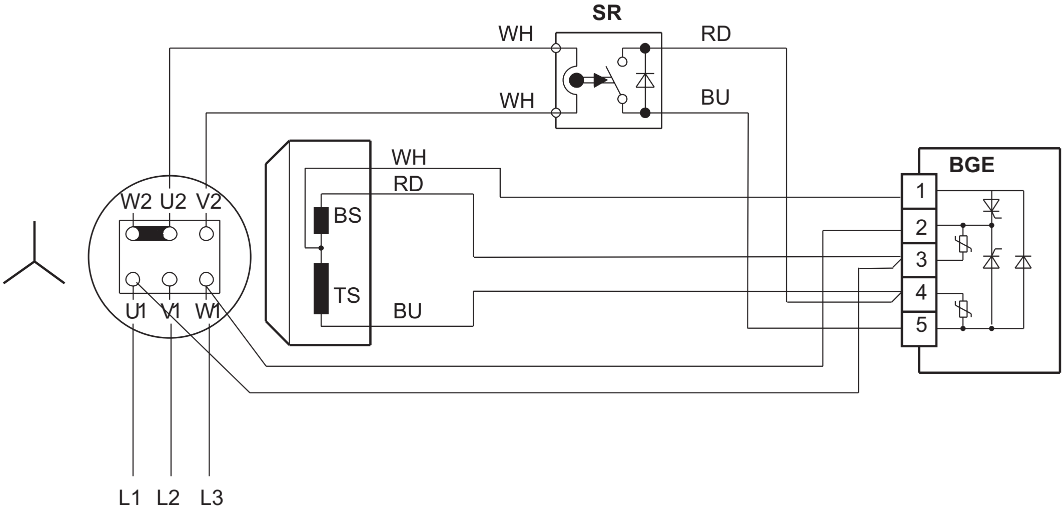
Brake voltage = phase-to-phase voltage

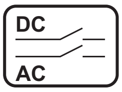


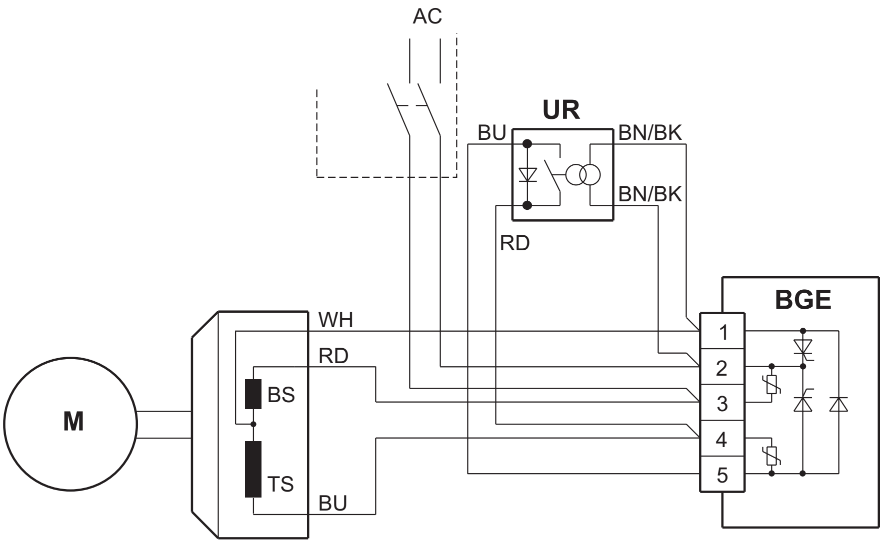


9007203240605067

The input voltage of the brake rectifier corresponds to the phase-to-phase voltage of the motor, e.g. motor: 400 V ⅄, brake: AC 400 V

BUR.. brake control

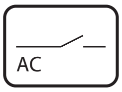


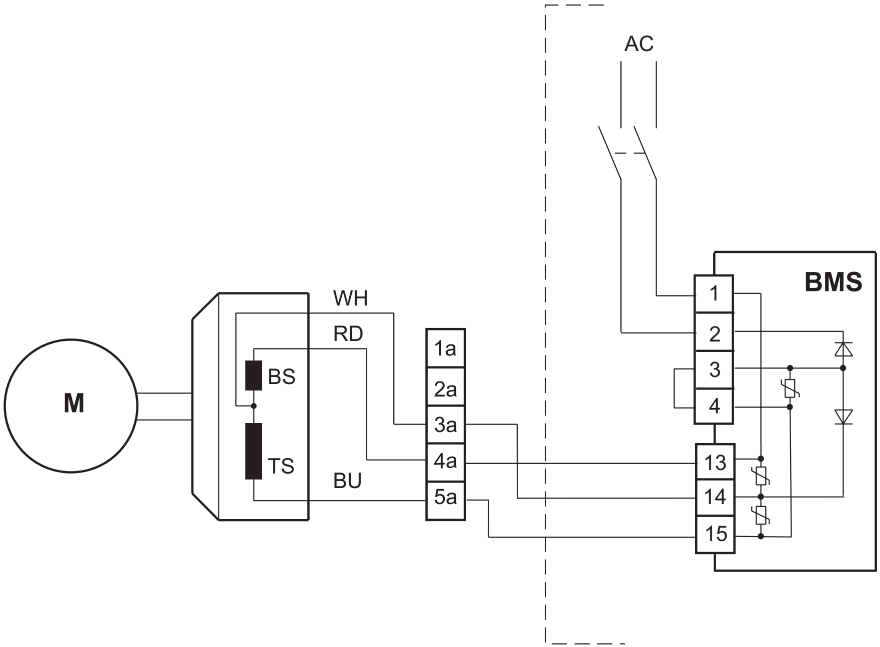


3985867147

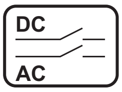
22134204/EN – 12/2017

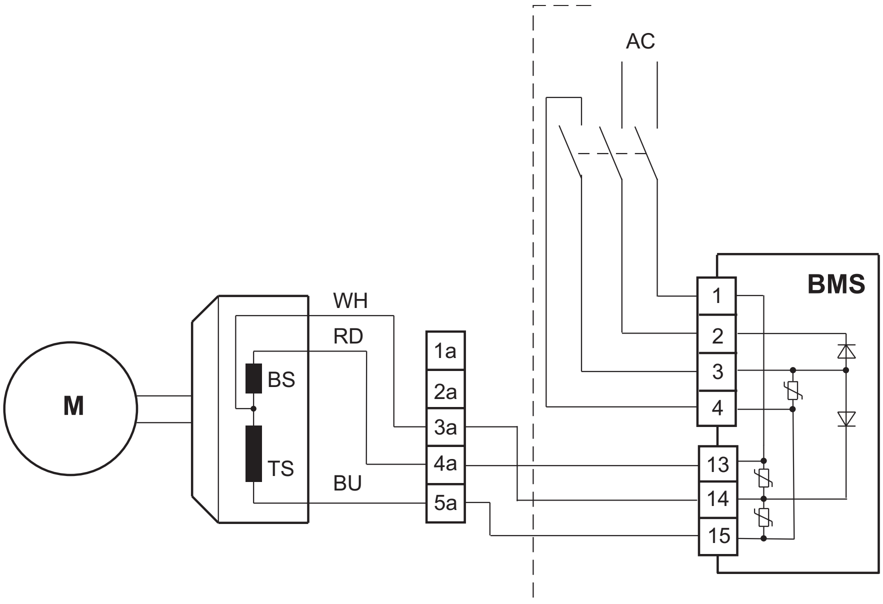
BMS.. brake control





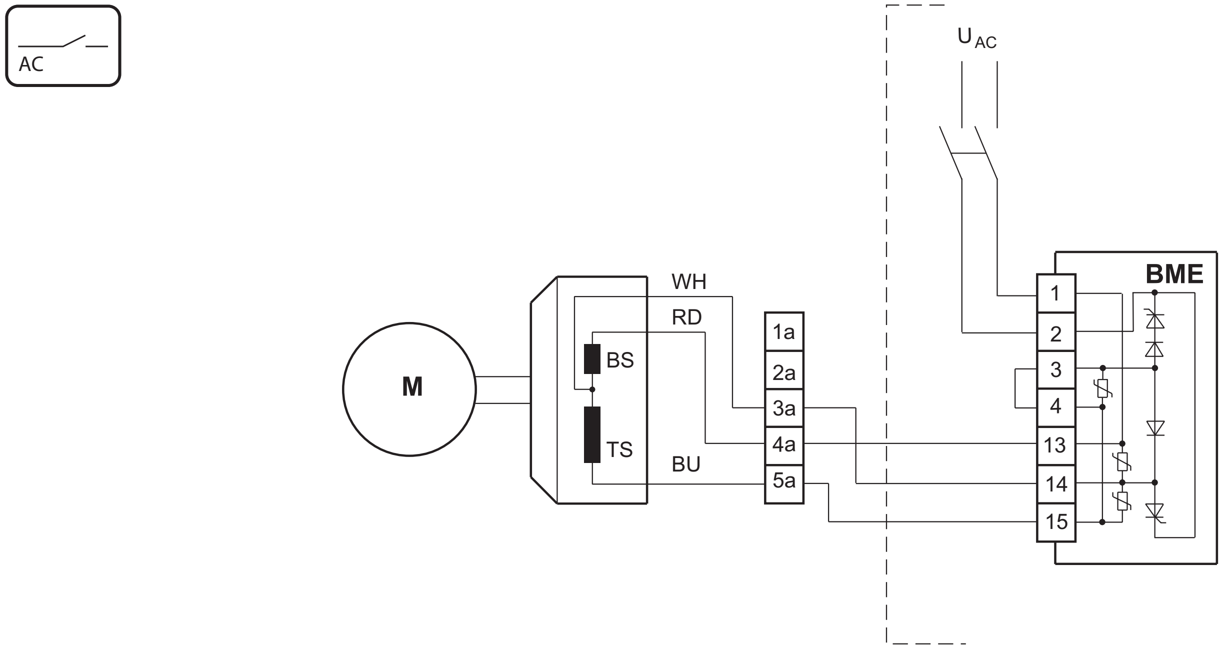
3985845387





3985847435

BME.. brake control



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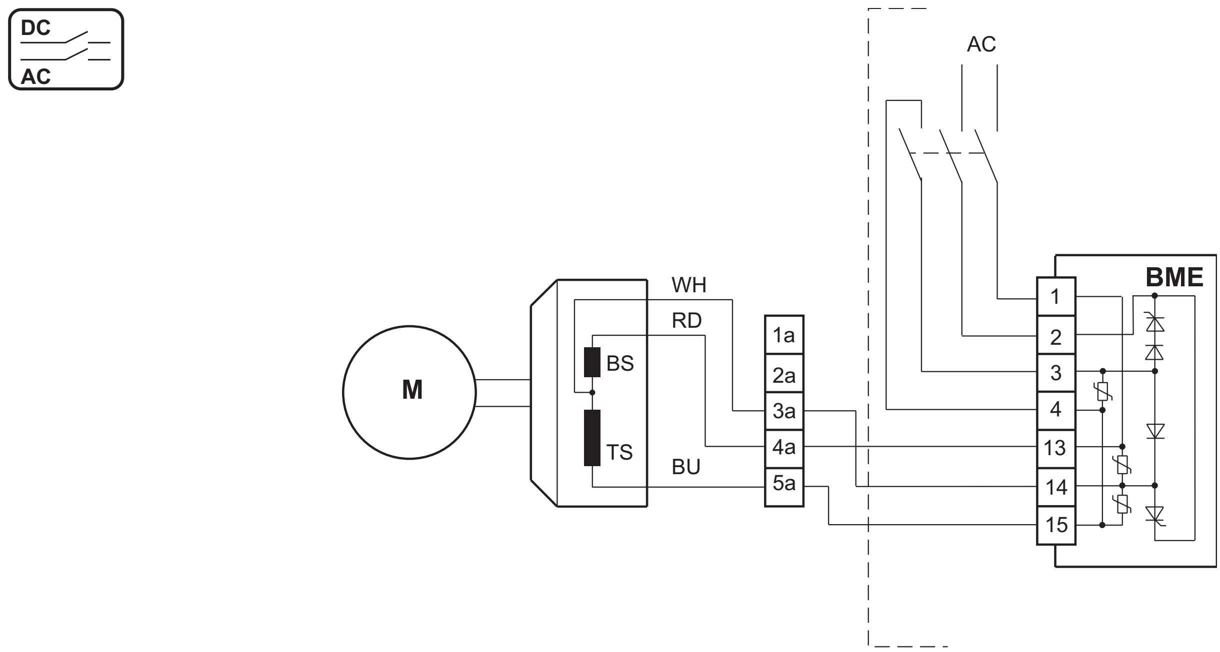
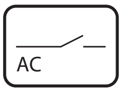
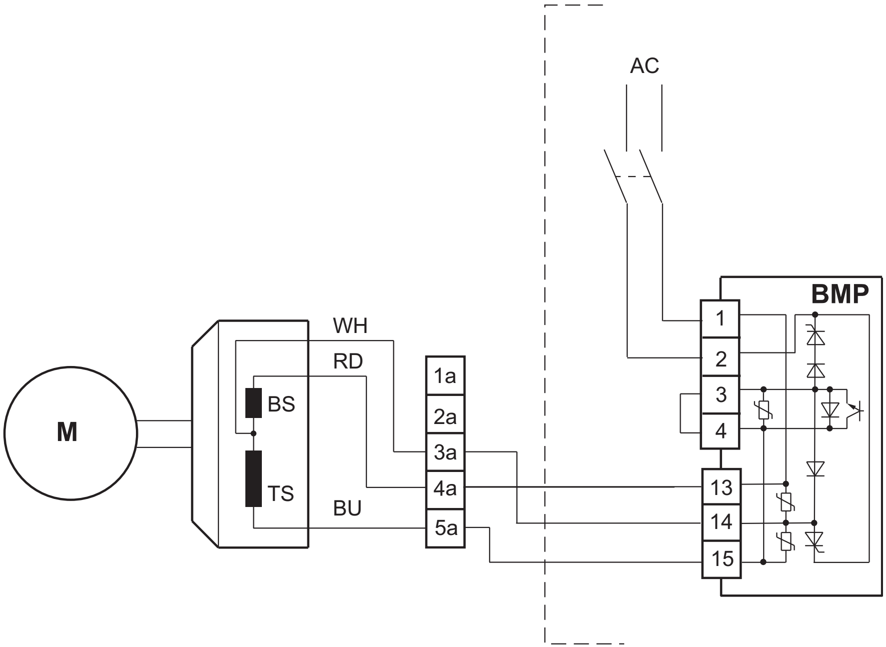


3985857675

BMP.. brake control





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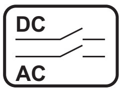
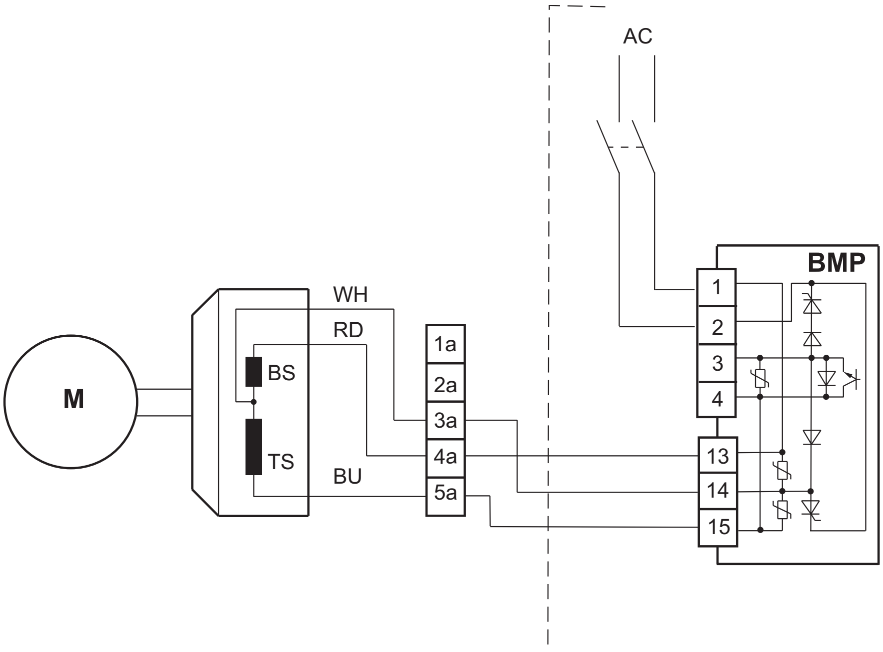
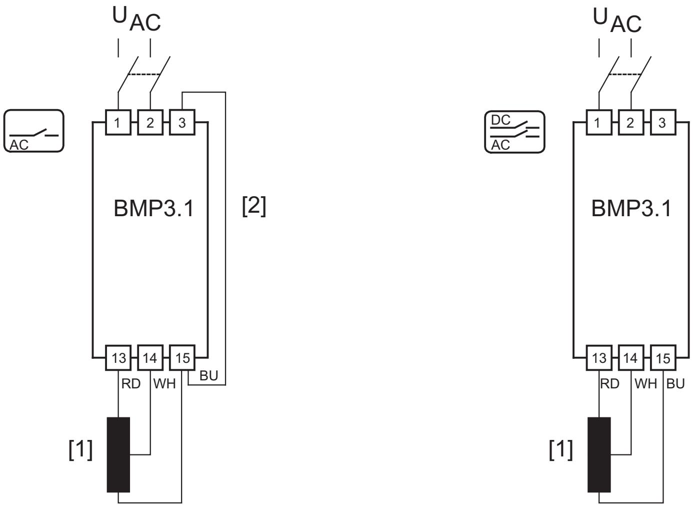




3985875339

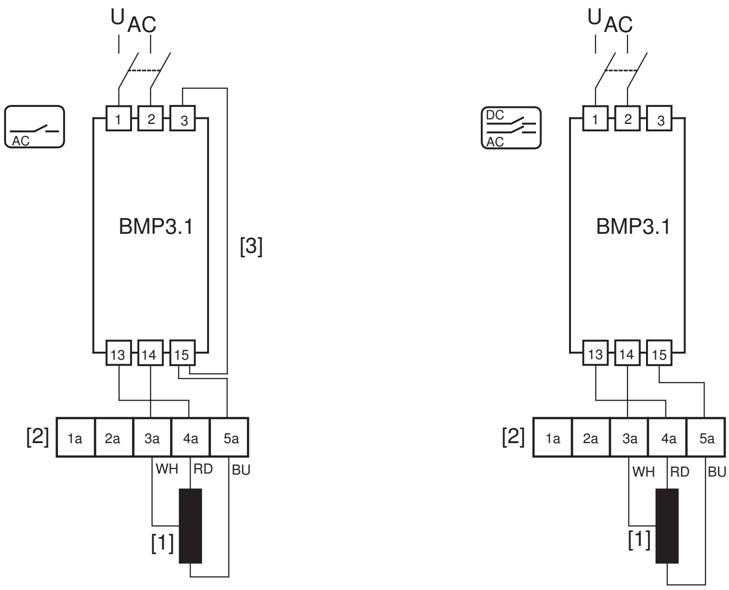
BMP 3.1 brake control (installation in terminal box)



18014402495360011

[1] Brake coil
[2] Wire jumper

BMP 3.1 brake control (installation in control cabinet)



18014402495362699

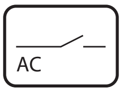
[1] Brake coil
[2] Terminal strip
[3] Wire jumper

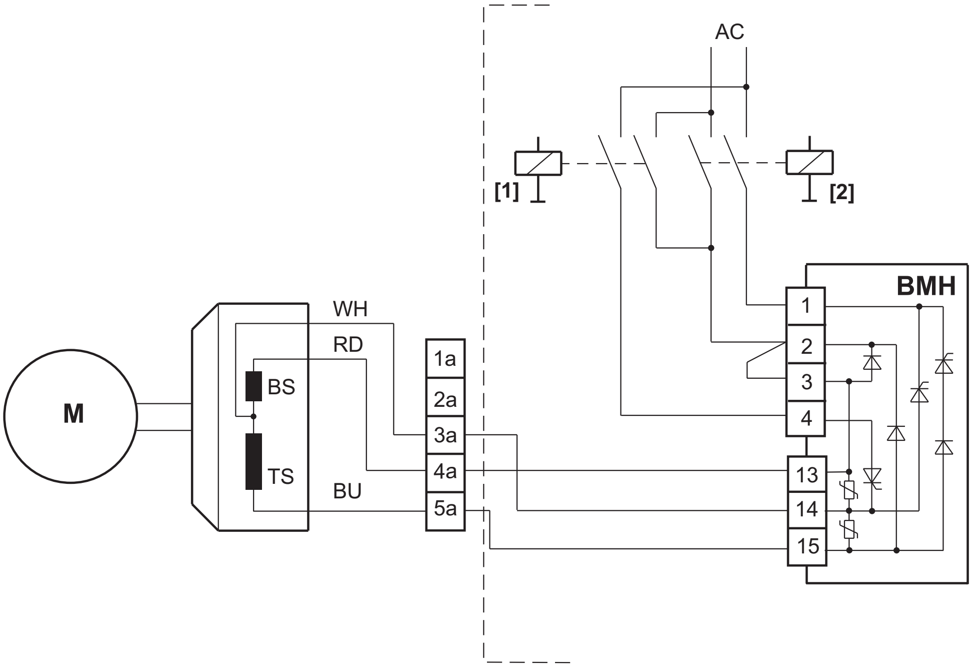
INFORMATION

There is no need for the jumper in alternating current operation (AC) if connection 5a is wired directly to connection 3.

22134204/EN – 12/2017

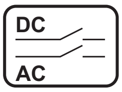
BMH.. brake control

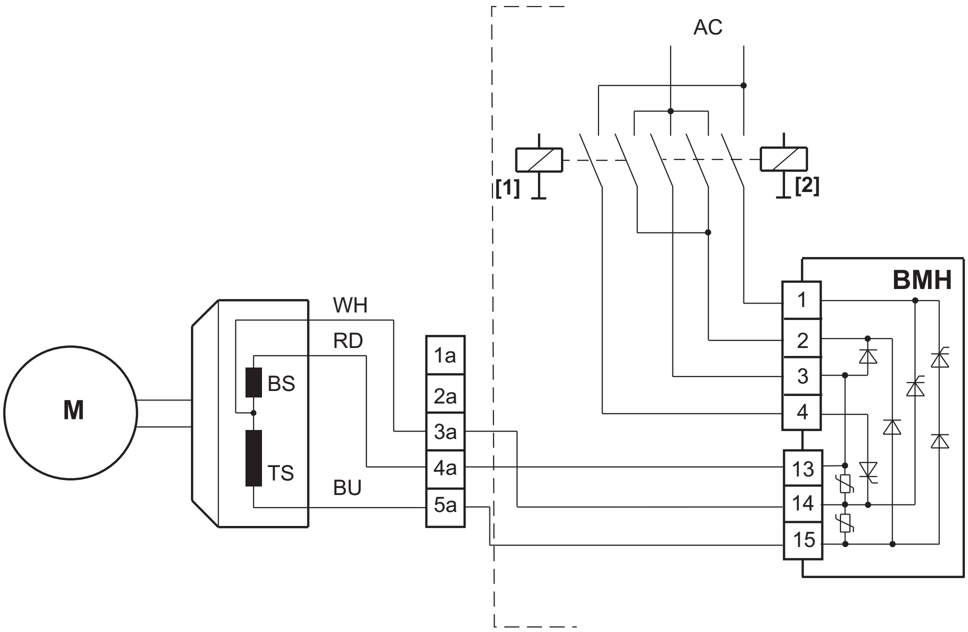




3985883787

[1] Heating
[2] Releasing



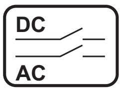


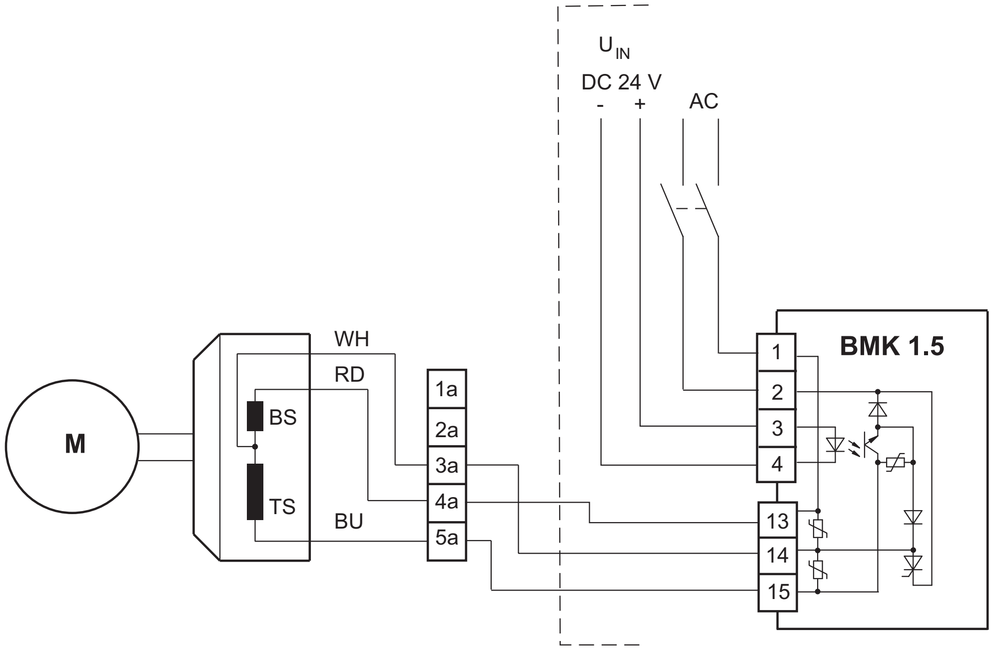
3985885835

[1] Heating
[2] Releasing

22134204/EN – 12/2017

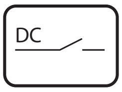
BMK.., BMKB.. brake control

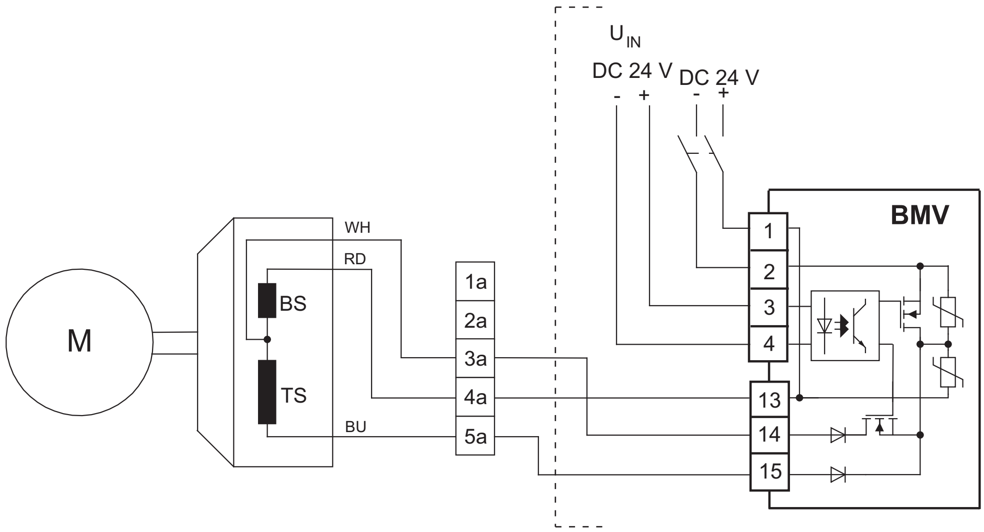




3985888907

BMV.. brake control

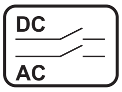




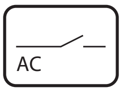
3985891979

V_{IN} Control signal

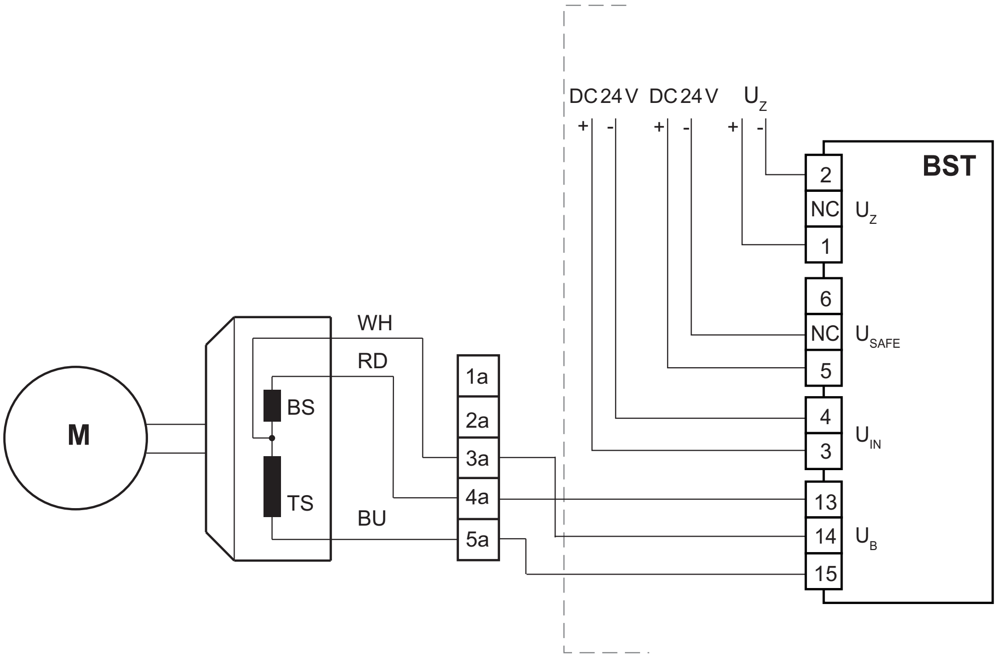
BST.. safe brake control



With functional control of the brake via V_{IN}.



With functional safe control of the brake via V_{SAFE}.



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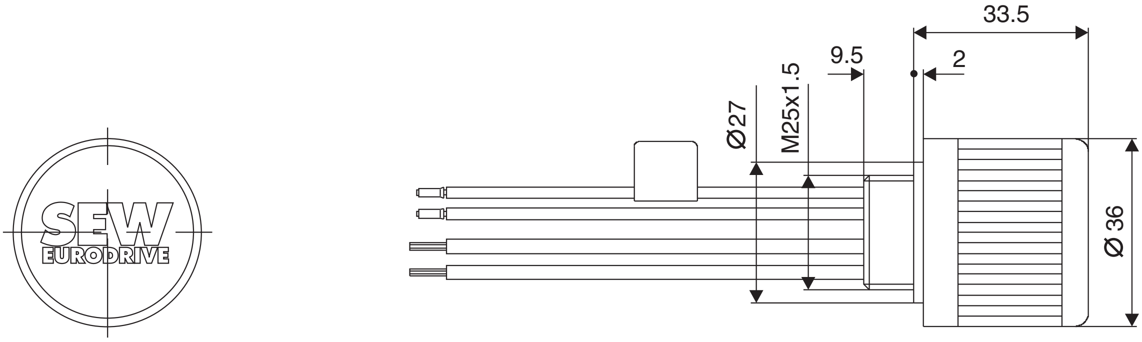
22134204/EN – 12/2017

7.5.4 Dimension drawings

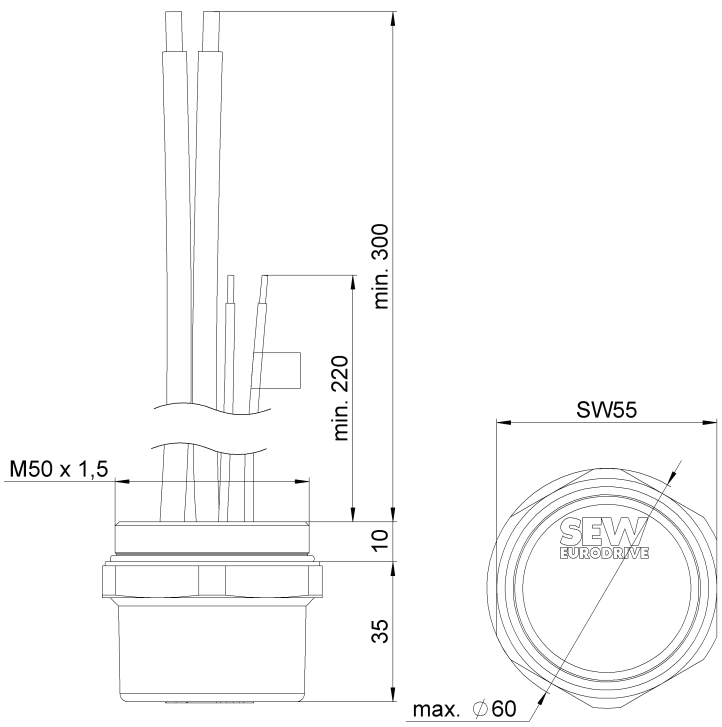
Dimension sheets brake controls

SR10, SR11, SR15, UR11, UR15



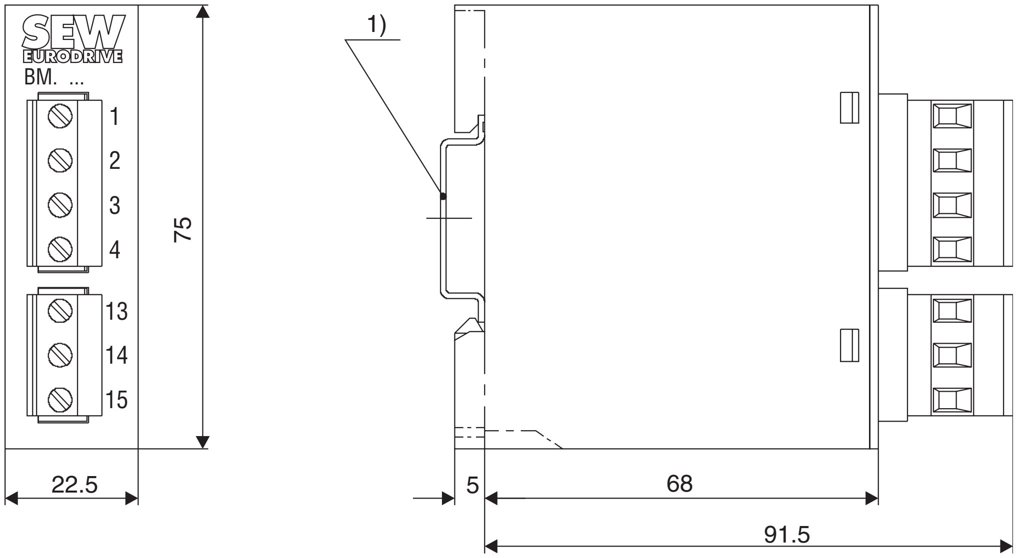
4040892299

SR19



5636837259

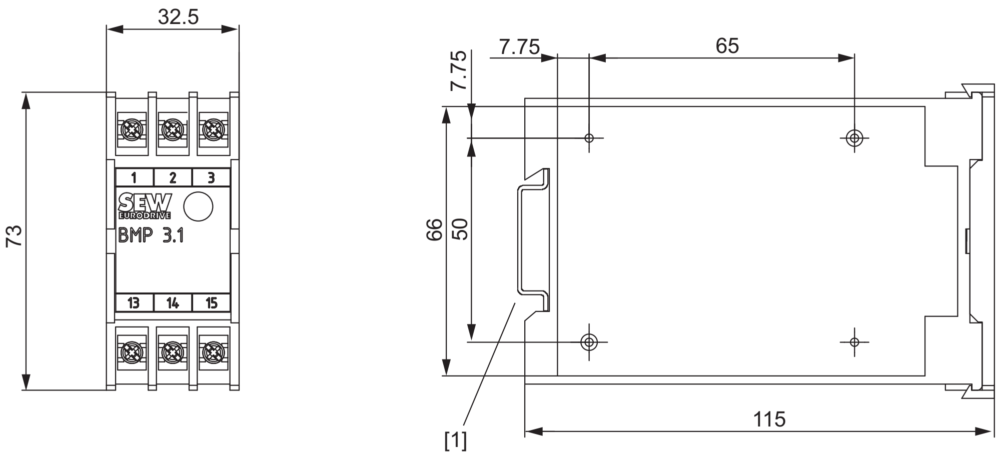
BMS.., BME.., BMH.., BMP.., BMK.., BMKB.., BMV..



4040894987

[1] Support rail mounting EN 50022-35-7.5

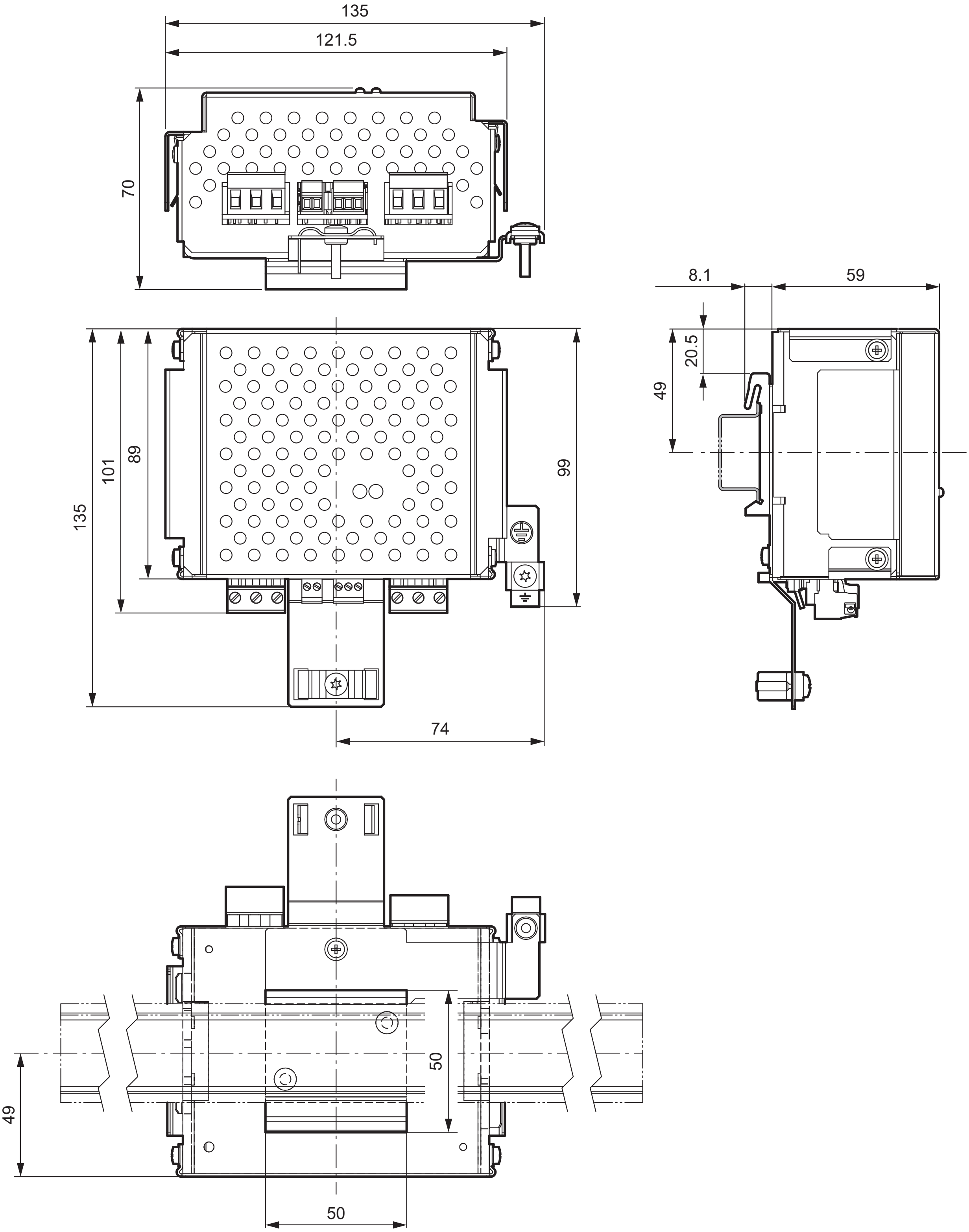
BMP3.1



4040897675

22134204/EN – 12/2017

BST..



18014398643297675