KENDRION

KENDRION INDUSTRIAL BRAKES

Module Line

Spring-applied single-disc brake module

Operating Instructions 77 500..A15

Typen: 77 50013A15 77 50019A15 77 50024A15
77 50029A15

PRECISION. SAFETY. MOTION.

Contents

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1. General information

1.1 Introduction

These operating instructions describe the operating principle and features of spring-applied single-disc brake modules types 77 500..A15. The safety information provided in this manual must be strictly observed during the set-up of the machine (e.g. motor) and during the start-up, operation and maintenance of the spring-applied brake modules.

Should any queries arise with respect to torques, torque variations, installation position, wear, wear reserve, switching work, break-in conditions, release range, ambient conditions and the like, please contact Kendrion (Villingen) and ask for clarification before starting to use the brake. Spring-applied single-disc brake modules are not ready-to-use devices, but are intended to be incorporated into or assembled with other equipment. Consequently, these brakes will be referred to as **components** in the following sections. The output side of the spring-applied single-disc brake modules has the same fitting dimensions as the motor end shield. As a result, the brakes are designed as fail-safe holding brakes with emergency stop function for attachment to servo motors.

1.2 Standards and directives

The state-of-the-art brakes have been designed, built and tested in accordance with the requirements of DIN VDE 0580 concerning electromagnetic devices and components. Being classified as "electromagnetic components", spring-applied single-disc brake modules are also subject to the Low Voltage Directive 2014/35/EU. The user is required to employ suitable switching devices and controls to ensure use of the brakes in accordance with EMC Directive 2014/30/EU.

1.3 Declaration of Incorporation (in accordance with Annex II, part 1, Section B of Machinery Directive 2006/42/EC)

We hereby declare that the products below comply with the essential health and safety requirements specified in Annex I of Machinery Directive 2006/42/EC:

Annex I, General Principles and Sections 1.1.2, 1.1.3, 1.1.5, 1.3.2, 1.5.1

The partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of Machinery Directive 2006/42/EC. The relevant technical documentation required for the partly completed machinery has been compiled in accordance with Annex VII, part B of Machinery Directive 2006/42/EC. The manufacturer undertakes to submit an electronic copy of the relevant technical documentation compiled for the partly completed machinery if reasonably requested by national authorities.

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Applied harmonized standards and other technical standards and regulations:

EN 60529	Enclosure protection ratings
DIN VDE 0580	Electromagnetic devices and components

Product: Electromagnetically released spring-applied single-disc brake module

Types: 77 50013A15 77 50019A15 77 50024A15 77 50029A15

Kendrion (Villingen) GmbH Villingen 13/03/2020 Authorized signatory: .....
Dominik Hettich
(Head of Development)

1.4 Declaration of Conformity

This Declaration of Conformity applies to products that have a CE mark on their rating plate.

We hereby declare that the products below, specifically the product versions brought into circulation, have been designed and built in accordance with the requirements of Directives 2014/35/EU (Low Voltage Directive) and 2011/65/EU (RoHS Directive). The products are classified as category 11 equipment subject to Directive 2011/65/EU (RoHS Directive). This declaration will cease to be valid if modifications are made to the product without prior permission from the manufacturer.

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1.5 Manufacturer's liability

The manufacturer will not assume any responsibility for damage caused by failure to use the products in accordance with their intended use or by failure to observe safety information and other instructions provided in this manual. The information in this manual was correct and up-to-date before going to print. The information contained herein shall not entitle users to raise claims with respect to components purchased at an earlier date.

2. Product description

2.1 Operating principle

The brake module is an electromagnetic device with built-in electromagnetically released spring-applied single-disc brake. The brake is designed to operate dry. The braking effect is produced by the spring force and neutralized electromagnetically. The brake can be equipped with an optional hand release so that it can be disengaged manually. The brake module with ball bearing supported brake shaft should preferably be mounted to the A-face end shield of electric motors.

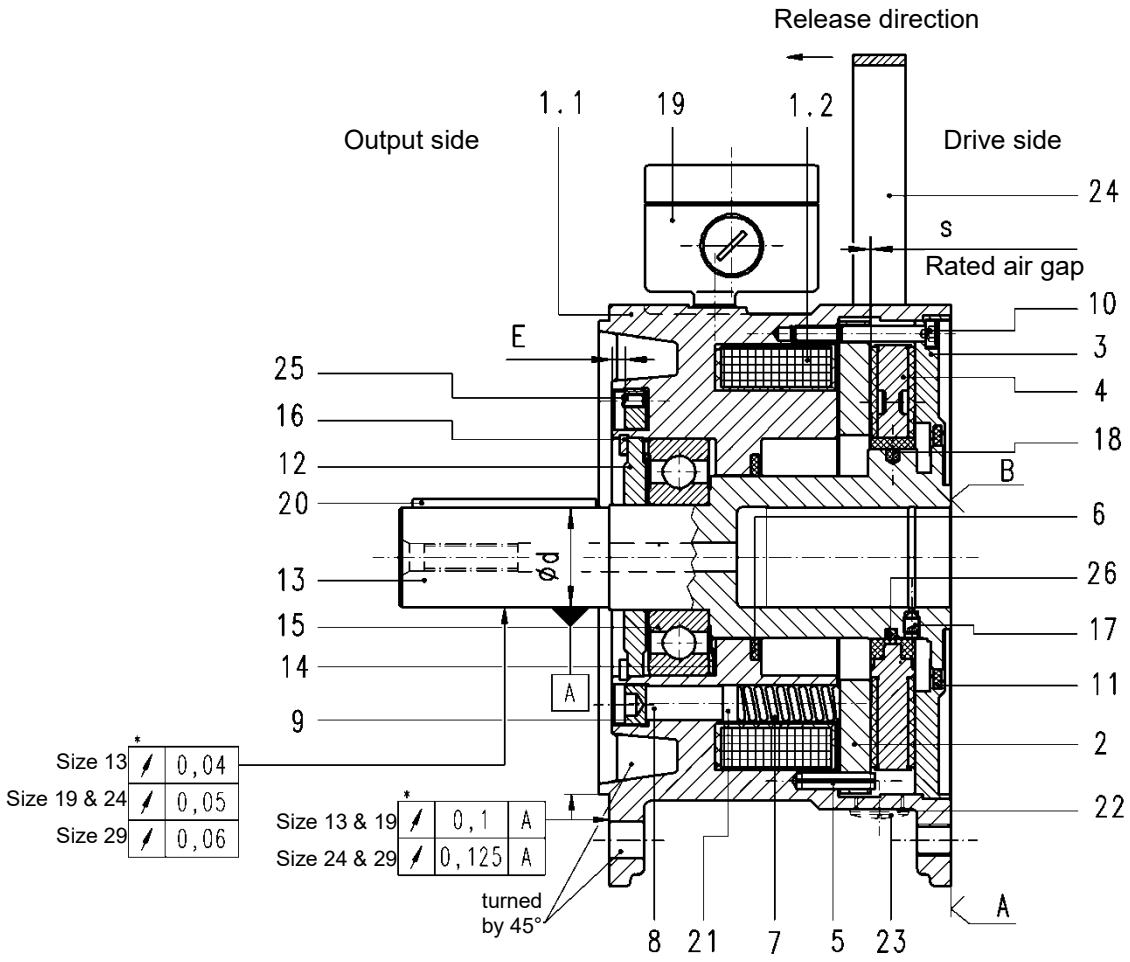
2.2 Brake design

The solenoid housing (1.1) with the encapsulated field coil (1.2) accommodates the armature (2), friction disc (4) and flange (3). The flange is fixed by means of the socket head cap screws (10). The compression springs (7) located in the solenoid housing (1.1) are supported on the adjusting ring (9) by the studs (8) (size 13 brakes: 8 & 21). These compression springs generate an axial force that is transmitted to the friction disc (4) through the armature (2). As a result, the friction disc (4) is clamped between the firmly fixed flange (3) and the armature (2) to produce the braking effect (torque). Straight pins (5) are provided which act as tangential torque supports for the armature (2) relative to the solenoid housing (1.1). When DC voltage is applied to the field coil (1.2), the electromagnetic force thus generated causes the armature (2) to be attracted, overcoming the force of the compression springs (7). The friction disc (4) is thus released and the braking effect is neutralized. As the brake module is a closed system, no forces are transmitted outwards away from the brake. Transmission of the braking force from the axially movable friction disc (4) to the brake shaft (13) is achieved through the form-fit connection of the square socket in the friction disc with the brake shaft (13), with the brake shaft being rigidly connected with the motor shaft. This applies to size 13, 19 and 24 brakes. When a size 29 brake is used, the friction disc is connected with the brake shaft by means of the teeth provided on the disc and shaft. The ball bearing (15) located between the solenoid housing (1.1) and brake shaft (13) ensures that the brake can be centred relative to the brake shaft (13) and motor shaft when it is mounted to the motor flange. The bearing also absorbs transverse forces that act radially on the brake shaft (13). The ball bearing (15) is factory-sealed. An additional sealing ring (6) is provided which protects the friction disc (4) against dirt, grease or oil ingress in case the factory-installed ball bearing sealing rings are damaged and ensures that abrasive grit and dust produced by the friction disc cannot escape. On the drive side, the flange (3) and brake shaft (13) are sealed by the sealing ring (11). The optional hand release (24) allows the spring-applied single-disc brake module to be released manually (e.g. in case of power failure). The brake is connected directly to the terminals located in the junction box (19). The transmissible torque of the brake module can be changed with the adjusting ring (9). Rubber bolts (18) and an O-ring (26) are provided to reduce noise and vibrations produced by the friction disc (4).

Reference sign list to Fig. 7/1:			
1.1	Solenoid housing	15	Ball bearing (accessories)
1.2	Field coil	16	Circlip (accessories)
2	Armature	17	Screw plug (accessories)[1)]
3	Flange	18	Rubber bolt (accessories)[2)]
4	Friction disc	19	Junction box
5	Straight pin	20	Feather key
6	Sealing ring	21	Stud (additional item for size 13 brakes)
7	Compression spring	22	Sealing disc
8	Stud	23	Cover (2 x arranged at 180°)[3)]
9	Adjusting ring	24	Hand release (accessories)
10	Socket head cap screw	25	Set screw[1)]
11	Sealing ring	26	O-ring (accessories)[4)]
12	Disc (loose item)	E	Adjusting ring clearance
13	Brake shaft (accessories)	A	Contact surface motor side
14	Spring washer (accessories)	B	Contact surface brake shaft (13)

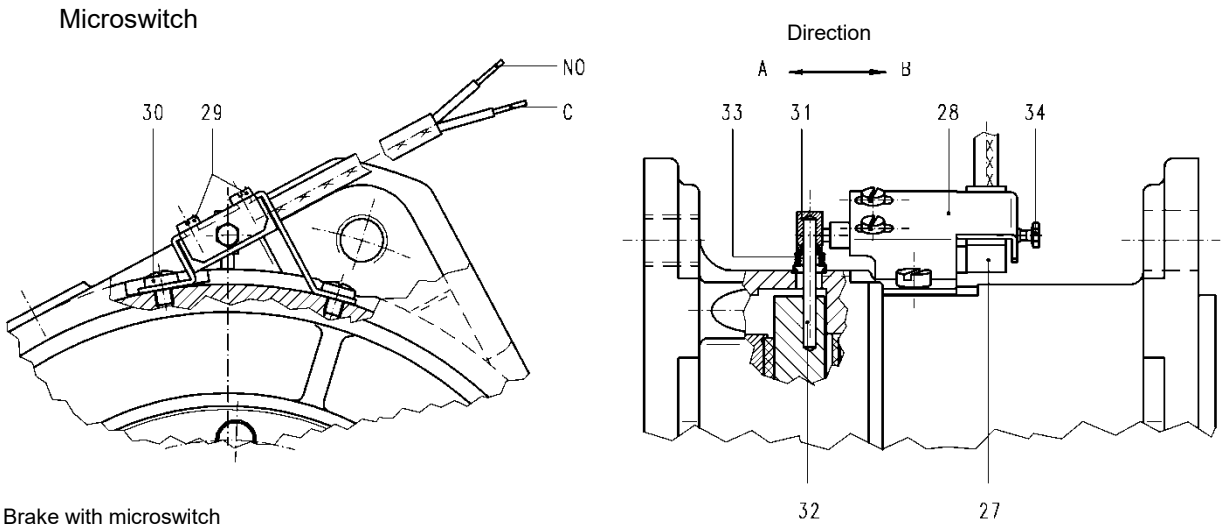
Table 6/1: Reference sign list for spring-applied single-disc brake module

[1)] bonded with Loctite 243; installed in brake shaft (13)
[2)] accessories for size 19 and 24 brakes; included as standard parts of friction disc (4) in size 13 brakes
[3)] only used in brakes without hand release (24)
[4)] only in size 29 brakes



* Radial and axial runout tolerance if brake is mounted as specified in mounting instructions, measured to EN 50347-N.

Fig. 7/1: Spring-applied single-disc brake module 77 500..A15



Brake with microswitch
Microswitch protection rating IP65

Fig. 7/2: Microswitch installation on spring-applied single-disc brake module 77 500..A15

Reference sign list to Fig. 7/2:			
27	Microswitch	31	Stud
28	Strap	32	Straight pin
29	Socket head cap screw (2x)	33	Bellows
30	Oval head screw (2x)	34	Hexagon head cap screw M2.5x8 (not supplied)

Table 8/1: Reference sign list for spring-applied single-disc brake module

3. Installation

3.1 Mechanical installation

3.1.1 Brake shaft (13) installation (accessories)

The press-fit connection of the brake shaft (13) with the motor shaft ensures that the brake shaft rotates along with the motor shaft as a result of the frictional engagement. An additional form-fit connection with a feather key, for example, is not allowed. The motor shaft must not have a keyway.

Attention!

The fits and surface roughness required for the motor shaft depend on the adjusted transmissible torque of the brake module. They must be selected by the brake user in such a way that reliable transmission of the generated brake torques is ensured.

Before heating the brake shaft (13), make sure that the brake shaft (13) and motor shaft end are dry and free from grease and that the following parts have been removed: screw plug (17) – any brake size, rubber bolts (18) (accessories) – sizes 19 + 24, O-ring (26) (accessories) – size 29. Check the position of the motor shaft contact shoulder relative to the contact surface of the brake on the motor flange and correct it by installing shim rings, if necessary. The permitted tolerance is ± 0.5 mm. Before mounting the brake shaft (13), check the radial runout on the motor shaft end and mark the maximum runout angle on the front face of the motor shaft. After completion of the above operations, heat the brake shaft (13) evenly in an electric oven or by means of an inductive heating system until it has reached a temperature of 280°C to 300°C. Once heated, slip the brake shaft (13) onto the motor shaft end until it touches the contact shoulder. Secure it axially until it has cooled down. When rubber bolts (18) are used (accessories, size 19 and 24 brakes), insert the bolts (18) into the bores in the brake shaft (13) after the shaft has cooled down (see Fig. 7/1). When using a size 29 brake, insert the O-ring (26) (accessories) into the groove in the brake shaft (13) (see Fig. 7/1). Check that the O-ring is correctly positioned. Apply grease to the rubber bolts (18) or O-ring (26) to reduce slip-on forces during brake mounting.

Note!

Make sure that the brake shaft (13) is mounted in such a way that the radial runout mark is offset by 180° relative to the runout mark on the motor shaft. After the brake shaft has cooled down, screw the screw plug (17) into the brake shaft (13) and secure it with Loctite type 243. This applies to all brake sizes. If rubber bolts (18) (accessories, size 19 + 24 brakes) or an O-ring (26) (accessories, size 29 brakes) are used, check that they are correctly positioned (rubber bolts (18): rounded end pointing outwards in the bores of the brake shaft (13) square socket; O-ring (26): located in the groove near the brake shaft teeth).

3.1.2 Mounting the brake module to the motor

Mount the brake module in a vertical position with the motor shaft pointing vertically upwards. Close the oil supply bore in the brake shaft (13) with the screw plug (17). Mount the brake module to the motor by slipping it onto the brake shaft (13) until it makes contact with the motor flange. Ensure that the brake is parallel to the motor shaft and that a form-fit connection is established between the brake shaft (13) and the square socket (size 13, 19, 24 brakes) or with the internal teeth (size 29 brakes) of the friction disc (4). The friction disc (4) is factory-centred in the spring-applied single-disc brake module to ensure easy installation.

Attention!

Ensure that the friction surfaces of the friction disc (4), the guide surfaces of the square socket (size 13, 19, 24 brakes) or the teeth of the friction disc (4) (size 29 brakes) are free from grease or oil. Do not use any lubricant to improve the axial guide properties of the friction disc (4). Avoid damage to the sealing rings (6 & 11).

Slightly tighten the mounting screws after having completed the preliminary assembly procedure described above. (Refer to Table 9/1 for information on the recommended mounting screws.) Ensure that the spring-applied single-disc brake module is released electromagnetically after the power connections (see Section 3.3) have been made. Manual brake release by means of an attached hand release (24), for example, is not allowed. To complete brake mounting, use the ball bearing set (accessories). Place the spring washers (14) into the solenoid housing (1.1) as shown in Fig. 7/1. Size 13 and 19 brakes require only one spring washer each, size 24 and 29 brakes must be equipped with two spring washers. In order to install the ball bearing (15), apply pressure evenly both to the inner and to the outer rings of the bearing (15) to force it onto the motor shaft until it touches the shaft shoulder of the brake shaft (13). The necessary pressure is generated by a mounting sleeve and the thread provided at the front end of the brake shaft (13). The solenoid housing (1.1) is thus centred through the ball bearing. Proceed to install the disc (12) and circlip (16). Tighten the mounting screws to the M_A tightening torque specified in Table 9/1. Refer to Table 9/1 for information on the recommended mounting screws.

Attention!

The M_A tightening torque specified for the mounting screws must be strictly observed (see Table 9/1). Tighten the mounting screws evenly in several steps.

Note!

The brake shaft and ball bearing must not be exposed to any axial shocks. The disc (12) is essential to ensure correct operation of the brake module and must only be replaced by an original spare part.

	Size			
	13	19	24	29
Mounting screws (type)	ISO 4010-M10x35-8.8	ISO 4010-M12x40-8.8	ISO 4010-M16x55-8.8	ISO 4010-M16x55-8.8
M_A tightening torque [Nm] (mounting screws)	51	87	214	214

Table 9/1: Recommended mounting screws and M_A tightening torques

3.2 Installation of accessories (not applicable to brake shaft (13))

Hand release (24) (only applicable to retrofitted hand release):

Remove the two lateral covers (23) located opposite each other on the circumference of the brake module solenoid housing (1.1) (see Fig. 7/1). Screw the cams (24.1) with the threaded bush into the bores of the covers (23), making sure they are in the right position (see figure to the right). Apply Loctite 243 to secure the cams. Insert the hand release handle (24.2) into the square socket provided in the cams (24.1). The hand release can be operated by pushing the handle (24.2) in one direction. The mechanical release forces F required to release the brake and the maximum permitted release forces (actuation forces) F_{max} are specified in Table 10/1. The release forces F are based on the highest transmissible (standard) torque (see "Technical specifications").

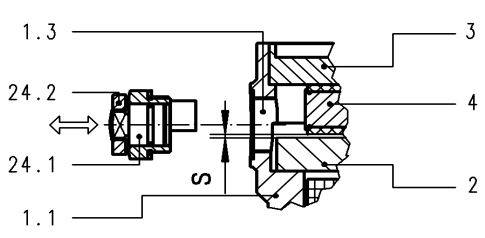


Fig. 9/1: Hand release and air gap control

Reference sign list to Fig. 9/1:			
1.1	Solenoid housing	4	Friction disc
1.3	Bore for air gap measurement	24.1	Cam (complete)
2	Armature	24.2	Hand release handle
3	Flange	s	Air gap

Table 10/1: Reference sign list for spring-applied single-disc brake module

	Size			
	13	19	24	29
Threaded bush tightening torque M_A [Nm]	20	26	35	35
Release force F [Nm]	80	130	200	240
Max. permitted release force (actuation force) F_{max} [N]	120	180	280	330

Table 10/1: Release force F, max. permitted release force (actuation force) F_{max} of hand release (24), M_A tightening torque of threaded bush of cams (24.1)

Note!

Machinery-specific regulations and requirements (e.g. for hoists, cranes and elevators) must be observed when using brake modules with hand release (24).

Caution!

The brake torque can be neutralized manually by means of the hand release (24). Consequently, the brake module must be installed in such a way that any unintentional actuation of the hand release (24) – e.g. by removing the hand release handle – is excluded.

Warning!

Check that the mechanical hand release (24) is in a central position (see Fig. 7/1) when not in use. This is crucial to ensure reliable brake engagement. Otherwise, the full braking effect of the spring-applied single-disc brake module may not be reached. In this case, the machine (e.g. motor) must be stopped immediately and must not be restarted until correct operation of the hand release (24) and automatic return of the release handle in its central position (see Fig. 7/1) has been ensured.

Ball bearing set (ball bearing (15), spring washer (14), circlip (16)):

The ball bearing set (available as an accessory) is required as a second bearing for the motor shaft. The complete ball bearing set must be installed as described in Section 3.1.1.

Rubber bolts (18) (size 19 and 24 brakes), O-ring (26) (size 29 brakes):

To reduce the noise produced by the brake module during operation, rubber bolts (18) (size 19 and 24 brakes) or an O-ring (26) (size 29 brakes) can be installed in the brake shaft (13) as described in Section 3.1.1.

3.3 Electrical connection and operation

Connect the spring-applied single-disc brake module to a DC power source. Connection to an AC power source is via a bridge or half-wave rectifier (19.2). Brakes equipped with a built-in rectifier (19.2) can be connected directly to the AC power source. The contact assignments are shown in Fig. 11/2. Brake modules with terminal (19.2) must be connected directly to the DC power source. The customer-specific connecting cable must be connected to the terminal (19.2) or built-in rectifier (19.2) by means of a cable gland (PG 11, clamping range 7.5 mm to 10 mm). Remove the cover (19.1) of the junction box (19) so that the individual strands of the connecting cable can be connected to the terminal (19.2) or to the built-in rectifier (19.2).

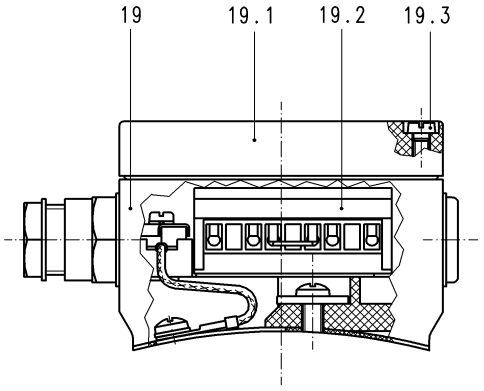


Fig. 11/1: Junction box (19) with terminal (19.2) or rectifier (19.2)

Rectifier series	Rectifier type	Rated input voltage range U_1/VAC (40-60 Hz)	Output voltage U_2/VDC	Max. output current R-load I/ADC	Max. output current L-load I/ADC
32 07332B40	half-wave	0-500 (±10%)	U_1 • 0.445	1.6	2.0
32 07333B40	bridge	0-500 (±10%)	U_1 • 0.890	1.6	2.0
The relevant rectifier specification sheets must be observed!					

Table 11/1: Recommended rectifiers for single-phase AC voltage supply via connecting terminal (19.2)

Attention!

When installing the cover (19.1) and junction box (19), tighten the socket head cap screws (19.3) to M_A = 1.6 Nm. Do not damage the flat seal between the junction box (19) and cover (19.1).

Brakes with built-in rectifiers (19.2) are equipped with a half-wave or bridge-rectifier (19.2). The built-in rectifier (19.2) can be wired in such a way that AC side switching (normal coupling time t_1) or DC side switching (short coupling time t_1) is possible (see Fig. 9/2). Various rectifier versions are available from Kendrion (see examples in Table 11/1) to allow the brake to be connected directly to an AC power source via the built-in terminal (19.2). Depending on the brake size and torque, voltage ripple due to intermittent power supply may cause brake humming or incorrect brake operation. Perfect brake operation must be ensured by the user or system manufacturer by providing suitable electrical controls.

Attention!

When connecting the rectifier (19.2), the terminals must be tightened to a tightening torque of M_A = 0.4Nm.

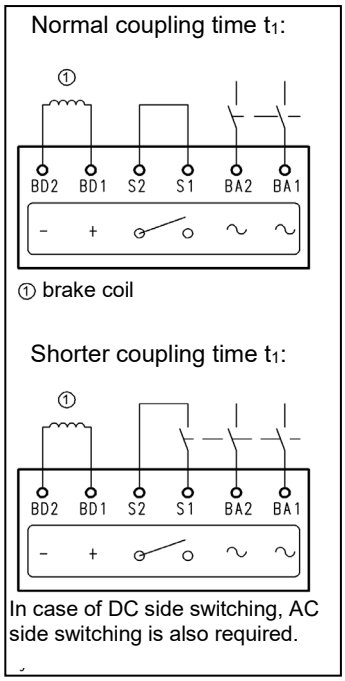
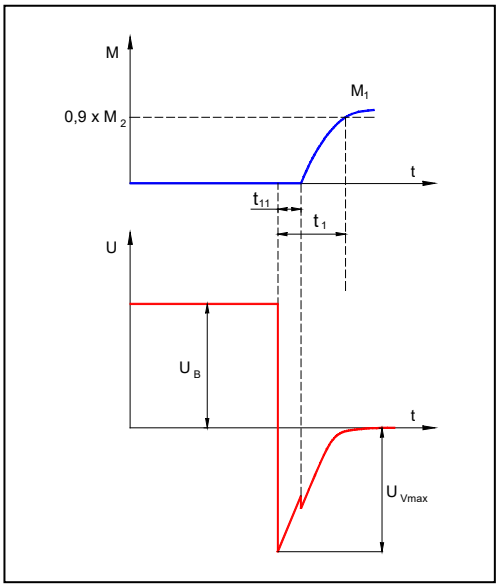


Fig. 11/2: Rectifier (contact assignment)

3.3.1 DC power supply

The figure to the right shows the voltage curve after the field coil (1.2) has been de-energized.



U_B operating voltage (coil voltage)
U_{Vmax} disconnection voltage

Attention!

The peak voltage U_{Vmax} during disconnection without protective circuit may reach **several thousand volts** in the millisecond region. This may cause irreversible damage to the field coil (1.2), switching contacts and electronic components. Sparking will occur on the switch during disconnection. Consequently, a protective circuit must be provided to reduce the current during disconnection and to limit the voltage. The maximum permitted overvoltage during disconnection is 1500 V. If Kendrion rectifiers are used (see Table 11/1), the protective circuit required for the built-in electronic components and field coil (1.2) is included in the rectifier and limits the disconnection voltage to approx. 300 V. This also applies to contacts S1 and S2 (DC side disconnection).

Attention!

Sensitive electronic components (e.g. logical components) and mechanical circuitry elements may also be damaged by the lower voltage.

3.3.2 AC power supply

Direct brake connection to an AC power source is only possible if a rectifier is used. The coupling times vary depending on the switching type (DC side switching or AC side switching) (see Section 3.3).

Half-wave rectification:

In case of half-wave rectification, the U_2 coil voltage is lower by factor 0.445 than the rectifier input voltage. Half-wave rectifiers produce voltage with high residual ripple which, depending on the brake module size, may slightly reduce the switching times when compared to bridge rectifiers. Due to the shorter switching times and the lower coil voltage, half-wave rectifiers are generally preferred to bridge rectifiers. However, brake humming may occur when small size brakes are used.

Bridge rectification:

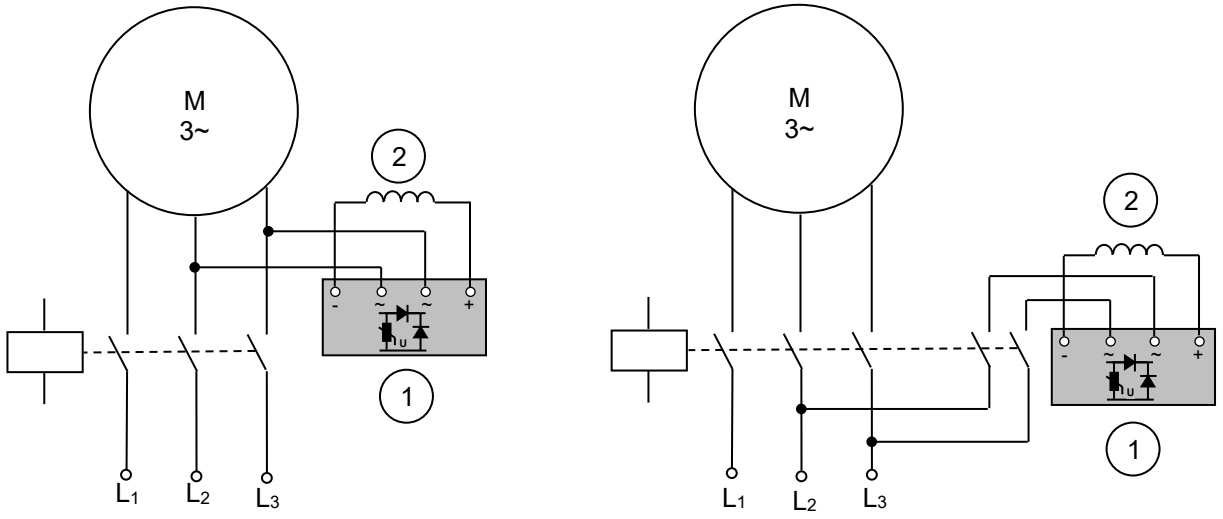
Bridge rectifiers provide voltage with minimum residual ripple. This means that brake humming can be avoided even if small size brake modules are used. In case of bridge rectification, the U_2 coil voltage is lower by factor 0.89 than the rectifier input voltage.

AC side switching:

The easiest wiring method is to connect the rectifier in parallel with the brake in the terminal box of the machine (e.g. motor). It must be considered, however, that the motor may act as a generator after AC voltage has been removed and thus extend the coupling time significantly (by factor 4-6 or over). The disconnection times remain unchanged.

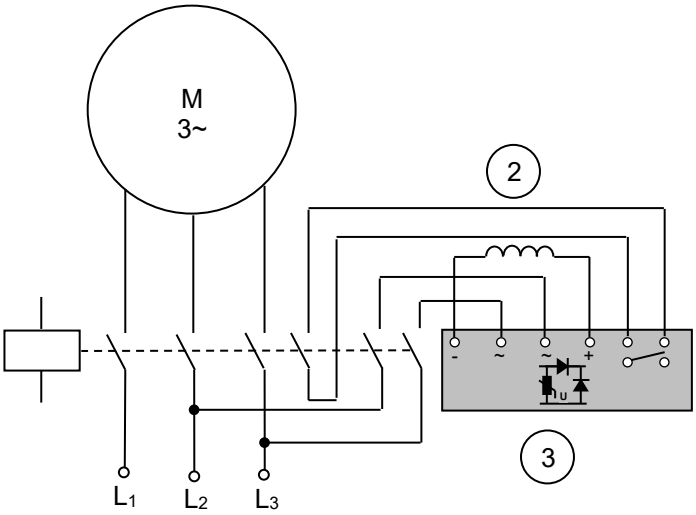
DC side switching:

In case of DC side brake switching, an auxiliary contact is provided on the motor contactor, for example. This auxiliary contact is designed to interrupt the power supply on the DC side of the brake module (see Fig. 9/2).



Connected in parallel with the machine (e.g. motor)

AC side switching



DC side switching

1 Half-wave rectifier

2 Brake module field coil (1.2)

3 Half-wave rectifier with DC side disconnection

Fig. 13/1: Suggested wiring of brake module (circuit diagram, AC or DC side switching, connected in parallel with the machine (e.g. motor))

Attention!

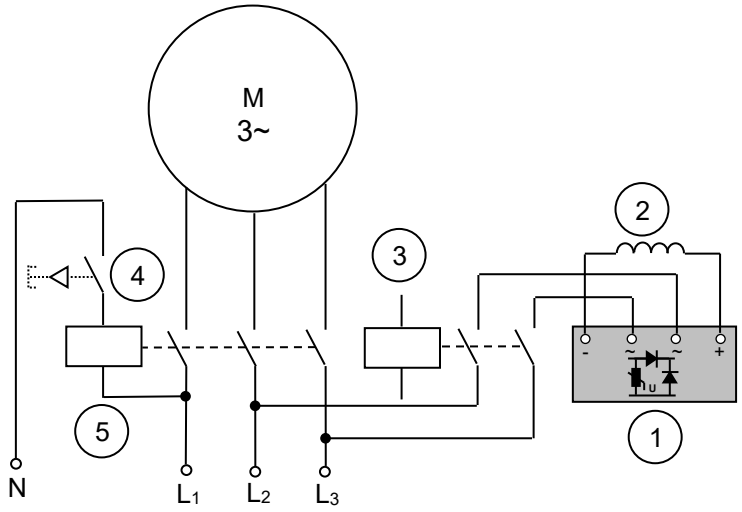
In case of DC side switching, the brake module must be provided with a protective circuit to avoid overvoltage. Additional protective elements (e.g. varistors, spark arresters, etc.) must be installed to avoid damage such as burns or fusing of contacts to external circuitry elements.

Warning!

Work on the brake must only be carried out by suitably qualified personnel. Make sure that no voltage is applied during brake connection. The specifications on the rating plate and the information provided in the circuit diagram in the terminal box or in the operating instructions must be strictly observed.

3.3.3 Electrical connection of brake modules with microswitch (27)

If brakes are equipped with a microswitch (27) to control the state (released/engaged) of the spring-applied single-disc brake module, the microswitch (27) must be tied into the control circuit of the machine (e.g. motor) (see suggested wiring of brake module and microswitch (27) in Fig. 15/1). This is crucial to ensure that the microswitch (27) prevents start-up of the machine (e.g. motor) before the spring-applied single-disc brake module has been released. The optional microswitch (27) must be ordered together with the brake as it cannot be retrofitted to the brake at a later date. The microswitch (27) is factory-adjusted prior to shipment of the brake module.



1	Rectifier	4	Microswitch S (27, NO contact)
2	Field coil (1.2) of brake module	5	Actuating relay (contactor) of microswitch S (27)
3	Actuating relay (contactor) of brake module		

Fig. 14/1: Suggested wiring of brake module with microswitch (27) – circuit diagram for AC side switching

Note!

Machinery-specific regulations and requirements (e.g. for hoists, cranes and elevators) must be observed when using brakes with microswitch (27).

Warning!

The motor circuitry must be protected in such a way that no unintentional motor start-up can occur when the microswitch (27) contact closes.

Note!

The suggested brake wiring solution with microswitch (27) shown in Fig. 15/1 is based on the general recommendations for wiring electromagnetic components in electrical machinery (e.g. motors) without load torque impact. When the brake is used for applications during which a load torque is generated, the system user is responsible to ensure correct and safe wiring of the microswitch (27) and brake module.

Warning!

The brake module is a DC operated system. Permanent voltage variations on the power source of the electromagnetic brake must be limited to +/-10% of the rated voltage.

The following checks must be carried out when connecting the brake:

- Check that the connecting cables are suitable for the intended use and for the voltage and amperage of the brake.
- Check that the connecting cables are secured with screws, clamps or other suitable fixtures to avoid interruptions in the power supply.
- Check that the connecting cables are long enough for the intended use and that suitable torsion, strain and shear relief features as well as bending protections are provided.
- Check that the PE conductor (only for protection class I) is connected to the earthing point.
- Check that no foreign matter, dirt or humidity is trapped inside the terminal box.
- Check that unused cable entries and the terminal box are suitably sealed to ensure compliance with the protection class requirements to EN 60529.

3.4 Electromagnetic compatibility

As required by the German Electromagnetic Compatibility Act (EMVG), electromagnetic compatibility is essential to ensure immunity to external electromagnetic fields and conducted interference. Furthermore, the emission of electromagnetic fields and line-conducted interference during brake operation must be minimized. Since the brake features depend on the circuitry and operation, a declaration of conformity with the applicable EMC standard can only be furnished for the wiring type, but not for a specific brake. The 77 500..A15 series of spring-applied single-disc brake modules are designed for industrial applications to which the following EMC standards apply: Generic Immunity Standard VKE 0839, part 6-2 (EN 61000-6-2), and Generic Emission Standard VDE 0839, part 81-2 (EN 50081-2). Other applications may be subject to different generic standards which must be considered by the manufacturer of the overall system. The requirements in terms of electromagnetic compatibility of devices and components are determined by basic standards derived from the generic standards. Brake wiring recommendations will be provided in the following sections to ensure compliance with the individual basic standards that are relevant for industrial brake use and other applications. Please refer to the specification sheets for additional information on electromagnetic compatibility, especially with respect to the recommended electronic rectifiers specified in Section 3.3.

Immunity according to EN 61000-4:

EN 61000-4-2 Electrostatic discharge:
The spring-applied single-disc brake modules comply at least with severity level 3 without requiring additional measures. The recommended rectifiers specified in Section 3.3 conform to severity level 3 without additional measures.

EN 61000-4-3 Electromagnetic fields:
The spring-applied single-disc brake modules comply at least with severity level 3 without requiring additional measures. The recommended rectifiers conform to severity level 3 without additional measures.

EN 61000-4-4 Fast transients (burst):
The spring-applied single-disc brake modules comply at least with severity level 3 without requiring additional measures. The recommended rectifiers conform to severity level 3.

EN 61000-4-5 Surge:
The spring-applied single-disc brake modules comply at least with severity level 3 without requiring additional measures. The recommended rectifiers conform to severity level 3.

EN 61000-4-9 Pulse magnetic fields, EN 61000-4-10 Damped oscillatory magnetic fields:
Since the operating magnetic fields of the electromagnetic brakes are stronger many times over than interference fields, the brake function will remain unaffected. The spring-applied single-disc brake modules comply at least with severity level 4. The recommended rectifiers conform at least to severity level 3.

EN 61000-4-11 Voltage dips, short interruptions, and short supply voltage variations:

a) Voltage interruptions:
Spring-applied single-disc brake modules that comply with the requirements of DIN VDE 0580 are de-energized after the specified switching times at the latest. The switching time depends on the control and mains conditions (e.g. generator effect of running down motors). Voltage interruptions of shorter duration than the response delay specified by DIN VDE 0580 will not cause any malfunctions. The user must ensure that any consequential damage is avoided (e.g. motor start-up before the brake module has been released caused by phase failure in the case of two-phase energized motors or by the slipping of an electromagnetically engaged system due to torque drop). The functional reliability of the electromagnetic brake and its electronic accessories remains unaffected if the aforementioned consequential damage is avoided.

b) Voltage dips and short supply voltage variations:
Electromagnetically released systems:
Voltage dips and supply voltage variations to below 60% of the rated voltage and lasting longer than the response delay specified by DIN VDE 0580 may cause the brake to be de-energized temporarily. Consequential damage as described under a) above must be avoided by the user by taking adequate precautions.

Electromagnetically engaged systems:
Voltage dips and supply voltage variations to below the minimum tolerance threshold will cause torque reductions. The user is required to take adequate precautions to avoid consequential damage.

Radio interference suppression in accordance with EN 55011:
The brake modules and the recommended electronic rectifiers are classified as Group 1 equipment in accordance with EN 55011. As far as the emissions from this equipment are concerned, one distinguishes between field guided radiated interference and line-conducted interference.

a) Radiated interference:
When operated with DC voltage or rectified 50/60Hz AC voltage, all brakes comply with the limit values applicable to Class B equipment.

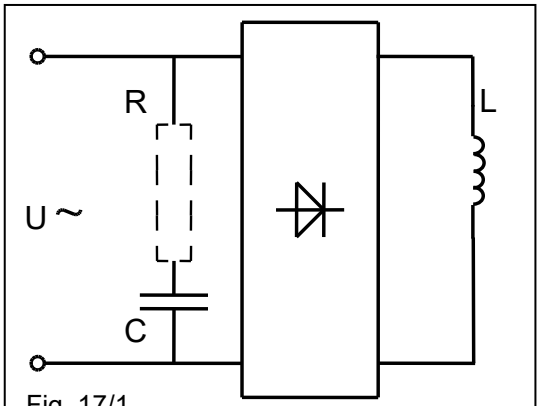


Fig. 17/1

b) Conducted interference:
When connected to a DC power source, the electromagnetic brakes meet the limit values applicable to Class A equipment. If the brakes are connected to a 50/60Hz AC power source and equipped with electronic rectifiers or other electronic controls, interference suppression measures as shown in Fig. 15/1 must be taken to ensure compliance with the limit values applicable to Class A equipment. Interference suppression capacitors should be used which must be dimensioned to suit the connection data of the electromagnetic components and the specific mains conditions. The recommended rectifiers specified in Section 3.3 are CE mark certified in accordance with the EMC Directive. They have built-in interference suppression components and comply at least with the requirements of EN 55011 for Class A equipment, unless otherwise specified in the specification sheet. When brakes are used with the specified rectifiers or with other types of rectifiers, the recommended values listed in Table 18/1 should be observed. Interference suppression components should be installed as close as possible to the consumer. Interference caused during switching operations of the electromagnetic component is generally attributable to the inductive load. Where necessary, assemblies designed to limit the disconnection voltage (e.g. anti-parallel diode) or voltage limiting components (e.g. varistors, suppressor diodes, resistance diodes and the like) can be installed. However, such components will inevitably change the switching times of the brake and increase the generated noise level. The rectifiers specified in Section 3.3 are equipped with free-wheel diodes and/or varistors to limit the disconnection voltage. In case of DC side switching, a varistor rated for the type-specific maximum operating voltage and connected in parallel with the field coil (1.2) limits the peak voltage to the values specified in Table 18/2 .

If the brake is used in connection with other electronic accessories, the user is responsible to ensure compliance with EMC requirements. Compliance with applicable standards concerning the design and operation of components, sub-assemblies or equipment employed shall not relieve the user and manufacturer of the overall system from their obligation to furnish proof of conformity of the overall system with such standards.

Rectifier series	Rated input voltage range U_1/VAC (40-60 Hz)	DC at L-load (ADC)	Capacitor (nF(VAC))
Half-wave rectifier 32 07332B40	up to 500 (±10%)	up to 2.0	no additional interference suppression measures required
Bridge rectifier 32 07333B40	up to 500 (±10%)	up to 2.0	no additional interference suppression measures required

Table 18/1

Max. rectifier operating voltage (VAC)	Recommended disconnection voltage for DC side switching (V)
250	700
440	1200

Table 18/2

3.5 Set-up & start-up

Warning!

Ensure that the machine (e.g. motor) has been switched off and secured against accidental or unintentional start-up before you perform the functional check of the brake.

Attention!

When using machines (e.g. motors) with vertically upward directed shaft end, any ingress of fluids (water, drilling emulsion, cooling lubricant) into the ball bearing (15) of the brake module must be avoided. The brake module must be mounted in such a way that sufficient heat dissipation is ensured.

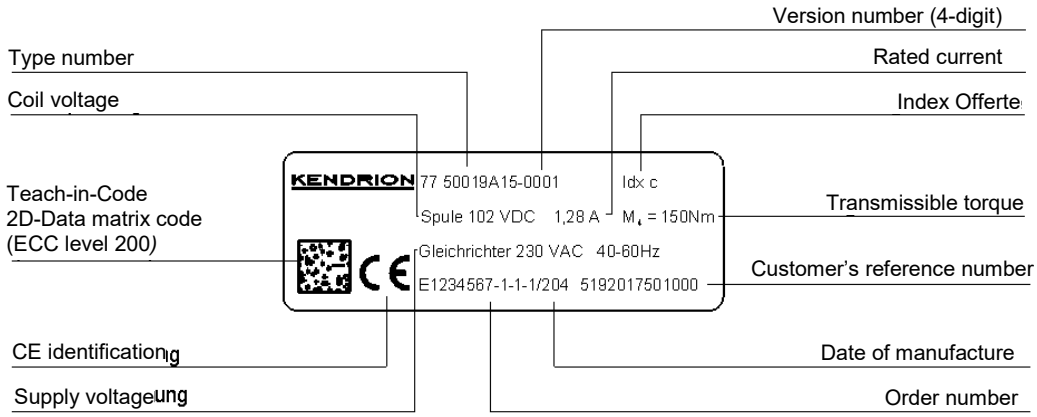
3.5.1 Functional checks

The following checks must be carried out:

Check compliance with the specifications provided on the rating plate with respect to the mounting position and protection class. After the spring-applied single-disc brake module has been connected, turn the motor shaft while the brake is released to check that the friction disc (4) and brake shaft (13) move smoothly. Proceed to perform a functional test of the axial armature movement. Check that the axial and radial runout is within the tolerance range specified in EN 50347-N (see Fig. 7/1). Information on ball bearing break-in conditions, bearing lubrication intervals etc. is provided in the bearing specification sheets and in the motor manual.

After completion of mounting, all necessary covers and guards must be installed.

Specifications on rating plates (order-specific, example brake type 77 50019A15):



Note: The product number of the spring-applied single-disc brake module consists of the type number followed by the version number, e.g. 77 50019A15-0001.

Warning!

Before starting the machine (e.g. motor) test run without driven components, the feather key (if used) must be secured in such a way that it cannot be hurled out. The shaft must not be exposed to load torques. Before the machine is re-started, the brake module must be de-energized.

Caution!

The brake module surface temperature may rise to over 100°C. Heat-sensitive parts such as conventional cables or electronic components must not be fixed to or be in contact with these surfaces. If necessary, suitable protections and hand guards must be installed to avoid accidental contact with hot surfaces! If the shaft needs to be turned during set-up operations while the machine (e.g. motor) is switched off, the brake module must be released electromagnetically.

Attention!

High-voltage tests performed during brake installation within an overall system or during start-up must be carried out in such a way that damage to the built-in electronic accessories is avoided. The limits for high-voltage tests and follow-up tests specified by DIN VDE 0580 must be observed.

Attention!

Check that the brake has been connected in accordance with the specifications provided on the rating plate before it is put into operation. Even short-term operation outside the specified supply voltage limits may cause irreversible damage to the brake or electronic accessories. Such damage may not be apparent immediately. DC side switching of the brake module without protective circuit as described in Section 3.4 will cause damage to electronic rectifiers, electronic accessories, switching contacts and to the field coil (1.2).

3.5.2 Manual release of the brake module

The spring-applied single-disc brake module can be released manually by means of a mechanical hand release (24) (accessories). In case of failure of the regular power supply, it is also possible to use a commercial UPS (e.g. UPS battery system) for the electrical release of the brake module. For this purpose, the brake user is required to install a UPS system that complies with the voltage specifications given on the brake module rating plate.

Warning!

Extreme caution is advised during manual release (jog mode) of the spring-applied single-disc brake module (e.g. for maintenance work on the machine (e.g. motor) or in case of failure of the regular power supply and use of a UPS system). If the drive system is unbalanced, the load torque may accelerate the drive. The brake user is required to take adequate precautions to ensure that no hazardous situations are caused by the load torque when the brake module is released and engaged in jog mode.

3.6 M_4 transmissible torque adjustments

The brake modules are factory-adjusted to the M_4 transmissible (standard) torque specified in the specification sheet. The M_4 transmissible torque is specified on the rating plate. The torque can be adjusted by means of the adjusting ring (9). After completion of adjustment, the ring must be locked by means of the set screw (25). The adjusting ring clearance "E" (see Fig. 7/1) is marked on the bottom of the machined pocket in the solenoid housing near the set screw (25). After having loosened the set screw (25), the torque can be changed within the limits specified in Table 20/1 by changing the adjusting ring clearance "E" with a pin spanner. After having changed the torque, the new adjusting ring clearance "E" must be marked on the solenoid housing. The adjusting ring must be locked by means of the set screw (25), making sure, however, that the set screw (25) is not within the reach of the studs (8). Secure the set screw (25) with Loctite 243, for example. While torque variations only have a minor impact on coupling times t_1, the disconnection time t_2 is reduced proportionally to the torque reduction.

	Size			
	13	19	24	29
Change in the transmissible torque ΔM_4/mm [%]	approx. 25	approx. 15	approx. 12	approx. 14
M_4 transmissible torque (standard) [Nm]	56	150	310	500
M_4 transmissible torque range [Nm]	25 - 56	60 - 155	140 - 310	280 - 520

Table 20/1: Change in the M_4 transmissible torque [%] from 1 mm axial adjustment of the adjusting ring (9); M_4 transmissible torque (standard value) and M_4 transmissible torque range

Attention!

When adjusting the adjusting ring (9) on the basis of the values given in Table 20/1, ensure that the M_4 transmissible torque is not below the minimum torque required. The changed adjusting ring clearance "E" must be marked on the bottom of the machined pocket in the solenoid housing. The adjusted theoretical M_4 transmissible torque must be entered in the blank field provided on the rating plate of the brake module (see rating plate example). After adjustment of the M_4 transmissible torque, the brake user is required to ensure that the adjusting ring (9) is secured with the set screw (25). The tightening torque to be applied is M_A = 3Nm. The adjusting ring (9) must be turned in such a way that the set screw (25) can be located between the studs (8). The M_4 tolerance is ±15%.

4. Maintenance

4.1 Checks and service

The spring-applied single-disc brake module does not require any particular maintenance except that the air gap 's' and the degree of wear of the friction disc (4) must be measured at regular intervals. For this purpose, the brake must be released electromagnetically (while the motor is shut down) to allow the air gap 's' between the armature (2) and friction disc (4) to be measured through the threaded bore (1.3) by means of a feeler gauge. The air gap can only be measured after having removed the cover (23) or – when using brakes with hand release – after having removed the handle (24.2) and complete cam (24.1) of the hand release (see Fig. 9/1). If the maximum air gap s_{max} (see "Technical specifications") is reached the friction disc (4) must be replaced to maintain the functional reliability and safety of the brake. When replacing the friction disc (4), check the friction surfaces of the armature (2) and flange (3). It is not possible to perform adjustments (air gap adjustments) to compensate for wear. The ball bearing (15) is factory-lubricated with grease for a maximum service period of 3 years. If the ball bearing (15) (accessories) needs to be replaced, make sure to use bearings of the same type or of identical design. The sealing rings (6 & 11) do not require any maintenance. However, they should be replaced every time the brake module is opened. The new sealing rings (6 & 11) must be glued in place after having cleaned the contact surfaces. To this end, Loctite 480 or an equivalent adhesive must be applied to individual spots on the front face of the solenoid housing (1.1) and on the circumference of the flange (3) before the sealing rings (6 & 11) are inserted and pressed in place.

Warning!

Whenever inspection and maintenance work is carried out, ensure that

- the machine (e.g. motor) is secured against accidental or unintentional start-up.
- no load torque acts on the shaft.
- the lock provided to prevent accidental start-up of the machine (e.g. motor) is removed after completion of inspection and maintenance work.
- all friction surfaces are free from grease and oil. An oily or greasy friction disc (4) cannot be cleaned.
- no swelling or glazing of the friction lining has occurred.
- the machine (e.g. motor) cannot be switched on accidentally.
- the brake module has been switched off and disconnected from the power supply.

4.2 Brake module removal from motor and replacement of component parts

Before removing the brake module from the motor, cautiously remove all components still fitted to the brake shaft (13), such as gear, clutch halves, etc. Unscrew the mounting screws to allow the brake to be removed.

After having removed the mounting screws, the brake module can be pulled off the motor shaft by means of a withdrawal device. This device must be applied to the mounting corners on the output side flange of the solenoid housing (1.1) and supported on the front face of the brake shaft (13). To avoid damage to the centring bore in the brake shaft (13), a shim ring can be inserted under the withdrawal device.

Note!

Substantial forces may have to be applied as the ball bearing (15) needs to be pulled off together with the brake module. Extreme caution is advised during these operations. If the brake module is in a horizontal position when removing it from the motor shaft, the brake must be supported in radial direction. Ball bearings (15) must not be reused after removal, regardless of their service life.

If individual components of the brake module need to be replaced, loosen the set screw (25) and unscrew the adjusting ring (9) to unload the compression springs (7). Then unscrew the socket head cap screws (10) so that the flange (3) and all other components can be removed. Use only grease-free cleaning agents to clean the brake components, when necessary. Bear in mind that the friction disc (4) cannot be cleaned. When using brakes equipped with microswitch (27), the armature (2) can only be removed after having taken off the stud (31) and the straight pin (32). Used studs (31) and straight pins (32) must be replaced by new parts after the brake module has been reassembled.

Installation of the brake module must be carried out in reverse order of removal after the thread of the adjusting ring (9) and the studs (8 / 21) have been slightly greased.

The following instructions must be strictly followed when replacing individual brake components:

- Centre the friction disc (4) relative to the centre of the brake module.
- Adjust the microswitch (27) when using brakes equipped with microswitch.
- Ensure that the friction disc is free from grease and oil.
- Adjust the required clearance "E" of the adjusting ring (9) (see marking on bottom of machined pocket in solenoid housing).
- Tighten the socket head cap screws (10) in the flange (3) to the tightening torques specified in Table 22/1.

	Size			
	13	19	24	29
M_A tightening torque for socket head cap screws (10) of flange (3) [Nm]	5	9	14	22

Table 22/1: M_A tightening torque for socket head cap screws (10) of flange (10)

Attention!

When mounting the spring-applied single-disc brake module, tighten the mounting screws and socket head cap screws (10) to the tightening torques specified in Table 9/1 and Table 22/1. Secure the adjusting ring (9) with the set screw (25) (M_A tightening torque = 3 Nm). Apply Loctite 243 to the set screw (25). When maintenance work is carried out on the junction box (19) (see Section 3.3), the socket head cap screws (19.3) must be tightened to M_A = 1.6Nm when installing the cover (19.1) with the junction box (19). Do not damage the seal between the junction box (19) and cover (19.1).

Attention!

Depending on its operating condition, it may no longer be possible to release the spring-applied single-disc brake module when the maximum air gap s_{max} (see "Technical specifications") has been exceeded. In this case, the braking action cannot be neutralized. This may cause thermal overloading of and irreversible damage to the brake module if the machine (e.g. motor) is started before the brake has been released. Thermal overloading of the machine (e.g. motor) may occur if the machine (e.g. motor) is not started while the brake is still engaged.

4.3 Microswitch (27) adjustment (only applicable to brake modules with microswitch (27))

When using brake modules equipped with a microswitch (27), the microswitch may need to be adjusted during maintenance and service work. The microswitch can only be adjusted after the brake has been released electrically and the socket head cap screws (29) have been slightly loosened. Check whether the microswitch (27) status is "open" or "closed" by using a continuity tester connected to "NO" and "C" (see Fig. 7/2). When "closed", push the microswitch (27) back beyond the change-over point in the direction indicated by "B". When "open", screw in the screw (34) (hexagon head cap screw M2.5x8, not supplied) to push the microswitch in the direction indicated by "A" precisely up to the change-over point. At this point, continue to tighten the screw (34) by the adjustment length "L" or by the screw-in angle α specified in Table 23/1 and position it correctly by tightening one of the socket head cap screws (29). Secure the second socket head cap screw (29) with Loctite type 241 and tighten it (M_A tightening torque specified in Table 23/1). Loosen the first socket head cap screw (29) – which has not yet been secured with Loctite 241 – and apply Loctite 241. Then tighten the screw. Remove the screw (34) after completion of the microswitch adjustment.

Switch the brake module on and off to check that the microswitch (27) works correctly.

C = common contact
NO = normally open contact

	Size			
	13	19	24	29
Adjustment length L of screw (34) [mm]	0.11	0.15	0.2	0.2
Screw-in angle α of screw (34) [°]	90	120	160	160
M_A tightening torque of socket head cap screw (29) [Nm]	0.7	0.7	0.7	0.7

Table 23/1: M_A tightening torque of socket head cap screws (29), adjustment length L and screw-in angle α of screw (34)

Warning!

The motor circuitry must be protected in such a way that no unintentional motor start-up can occur when the microswitch (27) contact closes. The M_A tightening torques specified for the socket head cap screws (29) must be strictly observed.

4.4 Brake shaft (13) removal

Proceed with extreme caution and follow all relevant safety instructions when removing the brake shaft (13). The brake shaft (13) must be removed by means of an oil pressure system (see Fig. 25/1). To this end, use a withdrawal device consisting of a forcing screw (37), a forcing pin (35) and an oil injector or oil pump (36). Remove the screw plug (17) and screw the oil injector or oil pump (36) joint into the oil inlet bore (17.1). Insert the forcing pin (35) on the front face of the brake shaft (13) up to the limit stop and slightly tighten it by means of the forcing screw (37). The pressure oil must be supplied through the oil inlet bore. The oil pressure should be gradually increased to about 60 % of the maximum pressure p_{max}. Then the pressure should be kept constant for about 60 minutes. Proceed to increase the pressure to the maximum oil pressure p_{max}.

After the maximum pressure has been reached, screw in the forcing screw (37) smoothly and evenly so that the brake shaft (13) can be pulled off the motor shaft. While removing the brake shaft, the tangential torque arm should be applied to the square socket (size 13, 19, 24 brakes) or to the external teeth of the brake shaft (13) (size 29 brakes). Pressure oil type LHDF900 with a viscosity of 900 mm^2/s at 20°C supplied by SKF can be used, for instance. The technical specifications applicable to the brake shaft (13) removal are given in Table 24/1.

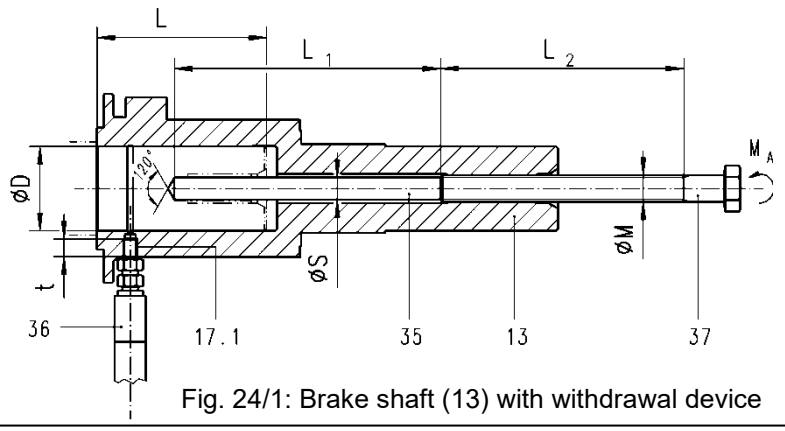


Fig. 24/1: Brake shaft (13) with withdrawal device

Reference sign list to Fig. 25/1:			
13	Brake shaft	L_1	Forcing pin (35) length
17.1	Oil inlet bore	L_2	Forcing screw (37) thread length
35	Forcing pin	D	Shaft end diameter (motor)
36	Oil pump	S	Forcing pin (35) diameter
37	Forcing screw	M	Forcing screw (37) thread diameter
L	Shaft end length (motor)	M_A	Forcing screw (37) loosening torque

Table 24/1: Reference sign list for spring-applied single-disc brake module

Caution!

As high pressures are generated during the removal of the brake shaft, personal protective equipment, such as face guards, gloves etc., and protective covers must be used.

	Size			
	13	19	24	29
Motor shaft height	AH 80	AH 100	AH 132	AH 160
Shaft end diameter (motor) D [mm]	32	38	44/48	55
Shaft end length (motor) L [mm]	58	80	82/110	110
Oil inlet bore / screw-in depth t [5] [mm]	M6/7.5	M6/8	R1/8''/9.5 R1/8''/10	R1/8''/10
Oil pressure p_{max} [bar]	1400	1400	1400	1400
Forcing pin (35) length L_1 [mm]	102	124	160	170
Forcing screw (37) thread length L_2 [mm]	130	130	170	170
Forcing pin (35) diameter S [mm]	9.8	9.8	13	17
Forcing screw (37) thread diameter M [mm]	12	12	16	20
Forcing screw loosening torque M_A [Nm]	15	35	60	90
Oil pump / oil injector joint tightening torque M_A [Nm]	4	4	10	10

Table 24/1: Technical specifications for brake shaft (13) removal

[5] Depending on motor type and motor shaft end.

4.5 Spare parts and accessories

Size	Designation, order number				
	Hand release (24)	Brake shaft (13) [6]	Ball bearing set [7]	Rubber bolt (18), O-ring (26) [8]	Friction disc (4)
Type	A	A	A	A	S
13	76 14113B00940	77 50013A00800 77 50013A00810	upon request	-	77 50013A00400
19	76 14119B00940	77 50019A00800 77 50019A00810 77 50019A00850	upon request	334690	77 50019B15400
24	76 14124B00940	77 50024A00800 77 50024A00810	upon request	334690	77 50024B15400
29	77 50029A00940	77 50029A00800 77 50029A00810 77 50029A00830	upon request	602542	77 50029B15410

Table 25/1: Spare parts (S) and accessories (A)

The brake shaft (13) is designed for standard motor shafts as specified in the specification sheet. Different dimensions and fits are available upon request.

5. Motor design

The brake module must be mounted to a motor that complies with the following requirements:

- Motor mounting type IMB5 or IMB35
- Motor shaft end and flange tolerances (axial and radial runout) to EN 50347-R
- Brake module shaft end and flange tolerances to EN 50347-N after mounting to motor
- Motor shaft without keyway because of brake shaft removal from motor shaft by means of an oil pressure system
- The fits and surface roughness depths of the brake shaft bore and motor shaft (Rz<6.3) required to ensure reliable press-fit must be agreed with the brake manufacturer.
- Balancing of the brake shaft with a half key (half key balancing) to DIN ISO 8821
- The permitted transverse forces acting on the shaft end of the motor/brake unit and the permitted axial forces are specified in the motor specification sheet.

Note!

Mounting of the brake module to the motor may cause heat build-up on the A-face motor end shield as heat dissipation towards the machine wall is inhibited. Consequently, only fan-cooled motors must be used.

[6] Brake shaft (13) type and dimensions as specified in offer drawings of specific brake types.
[7] Ball bearing set consisting of ball bearing (15), spring washer (14), circlip (16).
[8] Size 29 brakes.

6. Drive components, balancing

The installation and removal of driven components, such as clutch, gear, pulley, etc., on or from the brake shaft must be carried out using suitable devices and tools. Use the thread in the brake shaft for installation purposes and heat the components prior to assembly, if possible. In order to protect the centring piece and thread in the brake shaft, a shim must be inserted before removing driven components (see Fig. 27/1). The brake shaft is balanced with a half key (half key balancing to DIN ISO 8821). Check that the correct balancing method is used when installing the driven components.

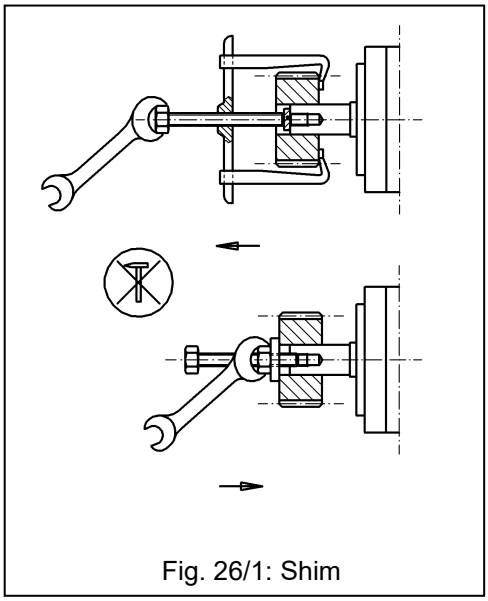


Fig. 26/1: Shim

Note!

General precautions must be taken to prevent accidental contact with driven components. The brake is an electromagnetic device which may generate electromagnetic stray flux. In general, driven components remain unaffected by the presence of such stray flux.

Attention!

If a driven component with built-in magnetically conductive bearing is mounted on the brake shaft (e.g. a shaft-mounted gear unit), the electromagnetic stray flux may gather above the bearing and thus increase the bearing temperatures. If you intend to use such a driven component, consult the brake manufacturer at an early planning stage for information on corrective actions. During installation and removal of driven components, ensure that no shocks (e.g. hammer blow) or axial forces above those specified in the motor specification sheet are transmitted to the ball bearing of the brake module via the brake shaft. If the brake shaft is exposed to axial forces and torques transmitted by the driving component, the brake user is required to ensure that the connection is correctly dimensioned. This is crucial to ensure reliable and safe transmission of the axial forces and torques. Any tangential or axial displacement of the driven components on the brake shaft must be avoided.

7. Condition at delivery

The brake module is delivered in a preassembled condition with factory-adjusted M_4 transmissible (standard) torque. The brake shaft with screw plug, spring washer, ball bearing, circlip, feather key, hand release, rubber bolts (size 19 and 24 brakes) and O-ring (size 29 brakes) are not included in the scope of supply. The ball bearing set (ball bearing, spring washer, circlip), hand release, brake shaft with screw plug, rubber bolts (size 19 and 24 brakes) and O-ring (size 29 brakes) can be ordered as accessories. The brake module can be equipped with an optional microswitch. The friction disc is centred relative to the centre of the brake module to facilitate brake mounting. In order to avoid any shift of the friction disc, the brake module should only be released electromagnetically or by means of the hand release when the friction disc is guided by the brake shaft. Brakes equipped with microswitches are delivered with factory-adjusted microswitch. Upon receipt of the shipment, the spring-applied brake must be checked for transit damage before storage. Ordered accessories are delivered together with the brake. The spring-applied single-disc brake module is delivered ready for mounting with factory-adjusted air gap 's' and factory-adjusted M_4 transmissible torque. The brake module should be transported and stored in a vertical position with the output side flange of the solenoid housing (1.1) pointing upwards. This flange must be provided with eye bolts (e.g. to DIN 580) to be fixed to two diagonally opposite fixing bores. These eye bolts are required to attach lifting and handling equipment secured with nuts for internal transport purposes or for mounting the brake module to the motor.

Note!

If the brake module is equipped with a microswitch, ensure that the microswitch is not exposed to shocks and vibrations during brake transport and storage. This is crucial to avoid changes in the microswitch adjustment. The same precautions must be taken for the junction box of the brake module. If the brake is not installed immediately upon delivery, it must be stored in a dry, dust-free and vibration-proof place.

Note!

The environmental conditions specified in Table 27/1 and in EN IEC 60721-3-2 / EN IEC 60721-3-1 must be considered during transport and storage of the brake, especially when long-term storage is envisaged.

	Environmental conditions	
	Conditions for storage to EN IEC 60721-3-1	Conditions for transport to EN IEC 60721-3-2
Mechanical environmental conditions	1M11	2M4
Climatic environmental conditions	1K21 and 1Z2	2K12
Biological environmental conditions	1B1	2B1
Mechanically active substances	1S11	2S5
Chemically active substances	1C1	2C1

Table 27/1: Environmental conditions for storage and transport as specified in EN IEC 60721-3-1 and EN IEC 60721-3-2

8. Emissions

8.1 Noise

The spring-applied single-disc brake module produces switching noise during engagement and release. The noise level is determined by the installation conditions, circuitry and air gap. Depending on the mounting position, operating conditions and state of the friction surfaces, audible vibrations (squealing) may be produced during braking.

8.2 Heat

Braking operations and gradual heating of the field coil cause the solenoid housing temperature to increase substantially. Under adverse conditions, the surface temperature may rise to well over 60°C.

Caution!

Risk of burns in case of contact with hot surfaces! Suitable covers and hand guards must be installed to provide protection against accidental contact.

9. Troubleshooting

Fault	Cause	Corrective actions
Brake release failure	• Air gap too large	Check the air gap. Install a new friction disc, if necessary.
	• No voltage applied to brake module	Check the electrical connection and correct faults, if found.
	• Voltage applied to field coil too low	Check the field coil supply voltage and correct faults, if found.
	• Armature plate blocked mechanically	Eliminate mechanical blocks and install a new brake module, if necessary.
	• Damaged rectifier	Check the rectifier and replace it, if necessary.
	• Damaged field coil	Check the resistance of the field coil. Install a new brake module, if necessary.
	• Friction disc thermally overloaded	Install a new friction disc.
Delayed brake release	• Air gap too large	Check the air gap. Install a new friction disc, if necessary.
	• Voltage applied to field coil too low	Check the field coil supply voltage and correct faults, if found.
Brake engagement failure	• Voltage applied to field coil in unpowered condition too high (residual voltage)	Check whether residual voltage is applied to the field coil and correct faults, if found.
	• Armature plate blocked mechanically	Eliminate mechanical blocks and install a new brake module, if necessary.
Delayed brake engagement	• Voltage applied to field coil too high	Check the field coil supply voltage and correct faults, if found.
Brake torque too low	• Air gap too large	Check the air gap. Install a new friction disc, if necessary.
	• Oily or greasy friction surfaces	Install a new friction disc.
	• Broken compression spring	Install a new brake module.
Microswitch failure	• Damaged microswitch	Install a new microswitch
	• Microswitch switching point not correct	Readjust the microswitch switching point.

Table 28/1: Possible faults, causes and corrective actions (list not exhaustive)

10. Safety

The brakes described in these operating instructions have been designed and built on the basis of an analysis of hazards and in accordance with the requirements of the applicable harmonized standards and technical specifications. They correspond to the state of the art and provide maximum safety. However, safety hazards can only be avoided if the user of the equipment takes adequate precautions and makes sure that safety instructions are strictly adhered to. It is the duty of the machine owner to plan these measures and to check their implementation.

The machine owner is required to ensure that:

- the brakes are only used in accordance with their intended use (see Section 2 "Product description").
- the brakes are in perfect working order and checked at regular intervals.
- a complete and fully legible copy of these operating instructions is kept available at the place of use of the brakes at all times.
- all applicable local and machinery-specific regulations and requirements are complied with.
- start-up, maintenance and repair work is only done by authorized and suitably qualified personnel.
- such personnel are kept informed on all relevant occupational safety and environmental protection issues and familiar with these operating instructions and with the safety information contained herein.
- the brakes are not exposed to other strong magnetic fields.

10.1 Intended use

The brakes described in these operating instructions are intended to be assembled with machines, in particular electric motors, for use on industrial plant. Operation in potentially explosive or firedamp atmospheres is not allowed. The brakes must be used in accordance with the operating requirements detailed in this manual. The rated power limits specified herein must not be exceeded.

10.2 General safety information

Brake modules fitted to motors feature hazardous live components and rotating parts and may exhibit hot surfaces. Any work associated with the transport, connection, start-up and periodical maintenance of the brakes must be carried out by authorized and suitably qualified specialist personnel in accordance with EN 50110-1, EN 50110-2, IEC 60364-1. Failure to observe safety, operating and maintenance instructions may cause serious personal injury and severe damage to the equipment. Whenever special measures are required in accordance with the instructions contained herein, such measures should be agreed with the brake manufacturer before the machinery into which the brake is to be incorporated is set up. Should any queries arise with respect to torques, torque variations, installation positions, wear, wear reserve, switching work, break-in conditions, release range, ambient conditions and the like, please contact Kendrion and ask for clarification before using the brake. Retrofitting or modification work to be carried out on the brake is subject to the approval from Kendrion. Accident prevention regulations applying to the specific field of application of the brake must be strictly observed. The brakes described in this manual are **not** designed for use as **"safety brakes"**. This means that torque reductions caused by factors beyond the user's control cannot be excluded.

10.2.1 Set-up

Special versions (including their circuitry) and variants may have different technical specifications. Please contact the manufacturer quoting the brake type and product number should any queries arise. Requirements in terms of the permitted number of switching operations per hour and the maximum switching work per switching operation specified in the technical specifications must be strictly observed during the set-up of machines and plant (inching mode). Failure to observe these instructions may irreversibly diminish the braking effect and cause malfunctions. Normal operating conditions are those specified by DIN VDE 0580. The protection rating conforms to EN 60529. In case of deviations, special measures must be taken after prior consultation with the manufacturer. If vertical brake operation is envisaged, any special requirements must be agreed with the manufacturer. Bear in mind that the friction disc may freeze if ambient temperatures fall below -5°C or if the brake remains unpowered for prolonged periods of time. In this case, special precautions must be taken after consultation with the manufacturer.

10.2.2Start-up

The brakes must not be put into operation when:

- power supply cables/wires or connections are damaged.
- the solenoid housing or coil sheath is damaged.
- other defects are suspected.

10.2.3 Installation

The voltage level and voltage type specified on the rating plate must be strictly observed when connecting the brakes described in these operating instructions. Sufficient heat dissipation must be ensured when the brake is fitted to or incorporated into other equipment. Adequate precautions must be taken to avoid overvoltage during disconnection or voltage peaks. The magnetic field of the products may cause interference outside the brake or even feedback to the brake in case of adverse installation conditions. Should you have queries concerning mounting and fitting conditions, please contact the brake manufacturer and ask for clarification.

Adequate safety measures (to DIN 31000 / DIN VDE 0100-420) must be taken by the brake user to avoid hazards to persons and animals or property damage caused by:

- direct or indirect effects of electromagnetic fields,
- heated components,
- mobile parts.

10.2.4 Operation

Ensure that live components such as plug contacts or the field coil are not exposed to water. The brake cable connections must not be crushed, squeezed or exposed to mechanical loads. Make absolutely sure that the friction surfaces of the friction elements are not contaminated with grease, oil or other fluids to avoid substantial torque reduction. Bear in mind that the original torque cannot be restored even if the friction surfaces are cleaned after contact with fluids. The gradual wear of the spring-applied single-disc brake module (only when used as dynamic brake) and the resulting torque reduction must be taken into consideration in the set-up of the machine/equipment. Due to the diverse ambient conditions in which the brakes may be used, always check that the brake is in perfect working order before start-up. Torque reductions cannot be excluded if the brake module is used for applications where only minimum friction work is required. In such cases, the user should ensure that the brake module occasionally performs sufficient friction work.

Notice!

During brake operation, ensure that the coil temperature does not rise above the permissible limit temperature applicable to the insulating materials of the specified insulation class (see Table 33/1 “Technical specifications”). Fast cooling of the field coil with scavenging air is not allowed. Ensure that the permissible relative humidity range (see Table 34/2) is not exceeded.

Note!

The maximum air gap s_{max} (see Table 33/1 "Technical specifications") must not be exceeded throughout the entire service life of the brake module. (Please refer to Section 4 "Maintenance" for details.)

10.2.5 Maintenance, repair and replacement

Brake service, maintenance, repair or replacement must only be carried out by qualified specialist personnel in accordance with EN 50110-1, EN 50110-2, IEC 60364-1. Failure to perform repairs according to requirements may cause serious personal injury or equipment damage. Make sure that no voltage is applied to the brakes when carrying out maintenance work.

10.3 Warning symbols

Personal injury or equipment damage			
Symbol / Term		**Warns against...**	**Potential risks and hazards**
	Danger	imminent personal injury	fatal accidents or serious injury
	Warning	potential risk of serious personal injury	fatal accidents or serious injury
	Caution	potential risk of personal injury	minor injury
	Attention!	potential risk of equipment damage	damage to components or other equipment
Information			
Symbol / Term		**Provides information on …**	
	Note	the safe use and operation of the product	

11. Definitions

(based on: DIN VDE 0580 2011-11, not exhaustive)

Switching torque M_1 — torque acting on the shaft during brake or clutch slip

Rated torque M_2 — switching torque specified by the manufacturer to identify the brake. The rated torque M_2 is the mean value of at least 3 measurements of the maximum switching torque M_1 after completion of the transient response.

Transmissible torque M_4 — highest torque that can be applied to the engaged brake or clutch without causing the brake/clutch to slip

Residual torque M_5 — torque transmitted by the released brake or clutch

Load torque M_6 — torque acting on the drive of the engaged brake or clutch; determined by the power requirement of the driven machine at a given speed

Switching work W — heat generated by friction inside the brake or clutch as a result of the switching operation

Maximum switching work W_{max} — maximum switching work to which the brake or clutch may be exposed

Switching power P — switching work converted into heat per unit of time

Maximum switching power P_{max} — maximum permitted switching work converted into heat per unit of time

Coil ON time t_5 — time between power on and power off

Coil OFF time t_6 — time between power off and power on

Total cycle time t_7	coil ON time plus coil OFF time
Duty cycle	percentage relationship of coil ON time to total cycle time
Switching operation	one complete switching on and off operation
Switching frequency Z	number of regular switching operations per hour
Response delay during coupling t_{11}	time between power off (releasing systems) or power on (engaging systems) and beginning of torque increase
Rise time t_{12}	time it takes to reach 90% of the M_2 rated torque from the beginning of the torque increase
Coupling time t_1	response delay t_{11} plus rise time t_{12}
Response delay during disconnection t_{21}	time between power on (releasing systems) or power off (engaging systems) and beginning of torque decrease
Fall time t_{22}	time it takes for the torque from the beginning of the torque decrease to fall to 10% of the M_2 rated torque
Disconnection time t_2	response delay t_{21} plus fall time t_{22}
Slip time t_3	time from the beginning of the torque increase up to the end of the braking process (brakes) or until the synchronization torque M_3 has been reached (clutches)
Making time t_4	response delay t_{11} plus slip time t_3 (braking or acceleration time)
Operating condition at operating temperature	condition at which the steady-state temperature is reached. The operating temperature corresponds to the overtemperature according to DIN VDE 0580 plus the ambient temperature. Unless otherwise specified, the ambient temperature is 35°C.
Overtemperature $\Delta\vartheta_{31}$	difference between the temperature of the electromagnetic device or a part thereof and the ambient temperature
Limit temperatures of coil insulating materials	in accordance with DIN VDE 0580. The individual insulating materials are classified by insulation classes to DIN IEC 60085.
Rated voltage U_N	supply voltage specified by the manufacturer for voltage windings to identify the device or component
Rated current I_B	amperage determined by the manufacturer for the specified operating conditions. Unless otherwise specified, the rated current refers to the rated voltage, 20°C winding temperature and to the rated frequency for a given operating mode of voltage windings.
Rated power P_N	power value to identify the device or component
Rated power at 20°C winding temperature P_B	determined from the rated current of voltage-controlled devices and components and the R_{20} resistance at 20°C winding temperature

12. Technical specifications

Product built and tested to DIN VDE 0580

	Size			
	13	19	24	29
Transmissible (standard) torque range M_4 [Nm]	25 - 56	60 - 150	140 - 310	280 - 500
Max. reachable transmissible torque M_4 [Nm]	56	155	310	520
Max. speed n_{max} [rpm]	6000	5500	4500	3700
Max. switching work W_{max} (Z=1) [kJ]	15	60	150	275
Max. switching power P_{max} [kJ/h]	40	160	260	400
Max. number of emergency stops Z_{total}	10000 (W = 2.7 kJ)	5000 (W = 10 kJ)	4000 (W = 23 kJ)	5000 (W = 33 kJ)
Rated power P_N [W]	97	131	167	190
Coupling time t_1 [9] [ms]	30	60	100	450
Response delay t_{11} [9] [ms]	12	25	40	50
Disconnection time t_2 [9] [ms]	110	260	330	350
Moment of inertia J – drive shaft and friction disc [10] [kgcm²]	9.3	48	141	266
Weight m [11] [kg]	10	21	46	66
Rated air gap s [mm]	$0.3^{+0,2}$	$0.35^{+0,2}$	$0.4^{+0,25}$	$0.45^{+0,25}$
Max. air gap s_{max} (at 70% of rated current) [mm]	0.65	0.8	1.05	1.2
Duty cycle [%]	100	100	100	100
Standard rated voltage [VDC]	24, 102, 178			
Insulation class	F			
Pollution degree	2			
Protection rating	IP 55			
Brake type	holding brake with emergency stop function			

Table 33/1: Technical specifications

	Size			
	13	19	24	29
Speed n [rpm]	250	125	125	125
Coil ON time t_5 [s]	6	6	6	6
Coil OFF time t_6 [s]	1	1	1	1
Break-in period t_{total} [min]	3	3	3	3

Table 33/2: Break-in process parameters for spring-applied single-disc brake module

	Size			
	13	19	24	29
Switching operations (emergency stops) Z [h^{-1}]	2	2	2	2
Max. switching work W_{max} (n=1500 rpm) [kJ]	13	55	130	250
Max. switching work W_{max} (n=3000 rpm) [kJ]	8	45	112	200
Max. switching work W_{max} (n=4000 rpm) [kJ]	5.5	40	95	-

Table 33/3: Max. switching work W_{max} as a function of the speed n at Z=2 (evenly distributed) switching operations (emergency stops) per hour

9) Values apply at maximum transmissible (standard) torque M_4.
10) Values apply if friction disc is used with brake shaft type 77 500..A00810.
11) Weight inclusive of brake shaft and ball bearing set.

	Technical specifications
Switching capacity	250 VAC, 5 A
	400 VAC, 1.5 A
	24 VDC, 2 A
Min. switching power	12 VDC, 10 mA
Mechanical lifecycle [switching operations]	5 x 10^7
Contact type	NO (normally open contact)
Temperature range [°C]	-40 to +130
Protection rating	IP 67

Table 34/1: Microswitch specifications

	Rated operating conditions
Rated voltage tolerance	+10%
Frequency range	±1% of rated frequency
Ambient temperature ϑ_{13} [°C]	-5 to +40
Relative humidity	30% to 80% within ambient temperature range
Other climatic environmental conditions	3Z2 and 3Z4 to EN 60721-3-3
Mechanical environmental conditions	3M8 to EN 60721-3-3
Biological environmental conditions	3B1 to EN 60721-3-3
Mechanically active substances	3S2 to EN 60721-3-3
Chemically active substances	3C1 to EN 60721-3-3
Installation height	up to 2000 m a.m.s.l.

Table 34/2: Rated operating conditions for spring-applied single-disc brake module

Explanations on the technical specifications:
W_{max} (maximum switching work, Z=1) as specified in Table 33/1 is the switching work that must not be exceeded during braking operations at max. 1500 rpm. Braking operations at speeds greater than 1500 rpm substantially reduce the maximum permitted switching work per switching operation (see Table 33/3). The maximum number of switching operations (emergency stops) Z per hour and the resulting maximum permitted switching work W_{max} are specified in Table 33/3. If the brake is used for applications requiring a higher number of emergency stops per hour, for example, the maximum switching power P_{max} specified in Table 33/1 must be observed. The P_{max} and W_{max} values are approximate values; they apply to applications where the brake is mounted to fan-cooled motors and during emergency stops. The specified times apply to the following conditions: DC side brake switching, operating temperature, rated voltage, and rated air gap. All values are mean values that are subject to variation. In case of AC side brake switching, the coupling time t_1 is substantially longer. The specified transmissible torques M_4 characterize the torque level of the brakes. Depending on the application the brake is used for, the switching torque M_1 and the effective transmissible torque M_4 may differ from the specified M_4 values. The switching torque M_1 depends on the speed (rpm). If the friction surfaces are contaminated with oil or grease the transmissible torque M_4 and the switching torque M_1 may drop. The technical specifications apply after the break-in process has been completed (see Table 33/2). In case of vertical brake operation, the maximum switching power P_{max} is reduced by approximately 20%.

Note: A current level corresponding to 70% of the rated current is reached when the spring-applied single-disc brake module is operated at rated voltage and at a coil temperature of 130°C.

The required operating conditions specified in Table 34/2 and the information provided in the **MODULE LINE specification sheet** and offer drawing for the specific brake types must be observed during operation spring-applied single-disc brake module.

Specifications subject to change without notice!

13. Product number / type number / version number

The product number to be quoted in purchase orders and required to identify the brake version consists of the type number followed by the 4-digit version number. Individual brake types may be available in different versions. So the version number identifies the relevant brake model.

Example:

Type number: 77 50019A15 Version number: 0001

Product number: 77 50019A15-0001

14. Specialist repair shops

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15. Revision history

Date of issues	Changes
05/11/2002	New issue.
04/06/2003	Operating instructions revised in content.
12/05/2009	Operating instructions revised in content.
30/12/2009	Operating instructions revised in content.
24.04.2014	Operating instructions revised in content. Page 9, rectifier type, tightening torques. Page 10, DC power supply. Page 17, changed rating plate.
13.03.2020	Operating instructions revised in content. Updated layout (design) of operating instructions.

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