



**KENDRION INDUSTRIAL BRAKES**

## **Classic Line**

Spring-applied single-disc brake

Operating Instructions 77 600..A15

Types: 77 600..A15   77 600..K15   77 600..K25  
77 600..A25   77 600..K16

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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 types Typen 77 600..A15, 77 600..A25, 77 600..K15, 77 600..K16 and 77 600..K25. 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.

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 brakes are not ready-to-use devices, but are intended to be incorporated into or assembled with other equipment. Consequently, they will be referred to as **components** in the following sections.

### 1.2 Standards and directives

The state-of-the-art spring-applied 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 brakes 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

**Types:** 77 600..A15 77 600..K15 77 600..K25  
77 600..A25 77 600..K16

The “..“ wildcard stands for the different brake sizes.

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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Kendrion (Villingen) GmbH

Villingen  
 13/03/2020

Authorized signatory: .....



Dominik Hettich  
 (Head of Development)

## 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.

## 1.6 Brake versions

Typ	Ausführung
77 600..A15	Basic brake component
77 600..A25	Brake component with special friction lining for enhanced switching energy $W_{max}$ and reduced rated torque $M_2$ compared to basic brake component 77 600..A15
77 600..K15	Brake component with enhanced corrosion protection
77 600..K16	Brake component with enhanced corrosion protection and halogen-free connection cable
77 600..K25	Brake component with special friction lining for enhanced switching energy $W_{max}$ , enhanced corrosion protection and reduced rated torque $M_2$ compared to basic brake component 77 600..A15

Tab. 4/1: Brake versions of spring-applied single-disc brakes (Classic Line).

The “..“ wildcard stands for the different brake sizes.

## 2. Product description

### 2.1 Operating principle

The spring-applied single-disc brake is designed to operate dry. The force generated by an electromagnetic field is utilised to overcome the braking effect produced by the spring force. The spring-applied single-disc brake engages in unpowered condition and releases when DC voltage is applied. Brakes equipped with a built-in rectifier (half-wave or bridge rectifier) can be connected directly to an AC power source. The form-fit connection between the friction disc and hub and the connection of the hub with the machine shaft (e.g. motor shaft) ensure that the torque generated by the spring-applied single-disc brake (brake torque) is reliably transmitted to the machine (motor). The brake can also be equipped with an optional hand release to allow the brake to be released manually.

### 2.2 Design

The solenoid housing (1.1) of the spring-applied single-disc brake accommodates the firmly fitted field coil (1.2) with the connecting cable resp. at brakes with a connector box (25) whose connecting terminals are located in the connector box (25). The solenoid housing (1.1) also includes the compression springs (3) which press the friction disc (5) over the armature (2) against the friction plate<sup>1)</sup> (10) and flange (11) to generate the braking effect of the spring-applied brake. The air gap 's' is determined by the position of the intermediate ring (6). The friction disc (5) features a square socket and can be moved on the hub (17) in axial direction. The customer-specific connecting cable can be fed into the connector box (25) through a cable gland (14) (PG 11). When DC voltage is applied to the field coil (1.2) of the spring-applied single-disc brake, the spring force is overcome by the electromagnetic field force. This causes the armature (2) to be released and the braking effect to be neutralised. The shaft to be braked is not subjected to any axial force by the brake. When using brakes with hand release (21), openings must be provided in the part enclosing the brake (e.g. fan cover) so that the hand release lever can be installed. The hand release (21) allows the brake to be released manually (e.g. in case of power failure). When the brake is equipped with a microswitch (19), the microswitch prevents any start-up of the machine (e.g. motor) before the brake has been released. Thanks to the centring diameters on the flange and housing sides (diameters  $d_2$  and  $d_7$ ), the spring-applied single-disc brake is ideal for applications with mounted transmitters (e.g. tachometer generators, encoders, etc.) after the cover (9) has been removed.

<sup>1)</sup> Size 10 to 16 brakes.

Reference sign list to Fig. 6/1:			
1.1	Solenoid housing	18	Fixing surface
1.2	Field coil	19	Microswitch
2	Armature	19.1	Cable gland
3	Compression spring	19.2	Microswitch cap
4	Stud	19.3	Locknut
5	Friction disc	19.4	Hexagon head cap screw
6	Intermediate ring	19.5	Machine screw
7	Adjusting ring	20	Protective cover
8	Set screw	20.1	Machine screws for protective cover
9	Cover hood	21	Hand release
10	Friction plate	21.1	Lever
11	Flange	21.2	Cam with threaded bush
12	Sealing ring	22	Fixing screws
13	Machine screw	23	Screw plug
14	Cable gland	25	Connector box
15	Sleeve (only size 24 brakes)s	25.1	Connector box cover
16	Rating plate	25.2	Connecting terminal or rectifier
17	Hub with labyrinth seal	25.3	Machine screw

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

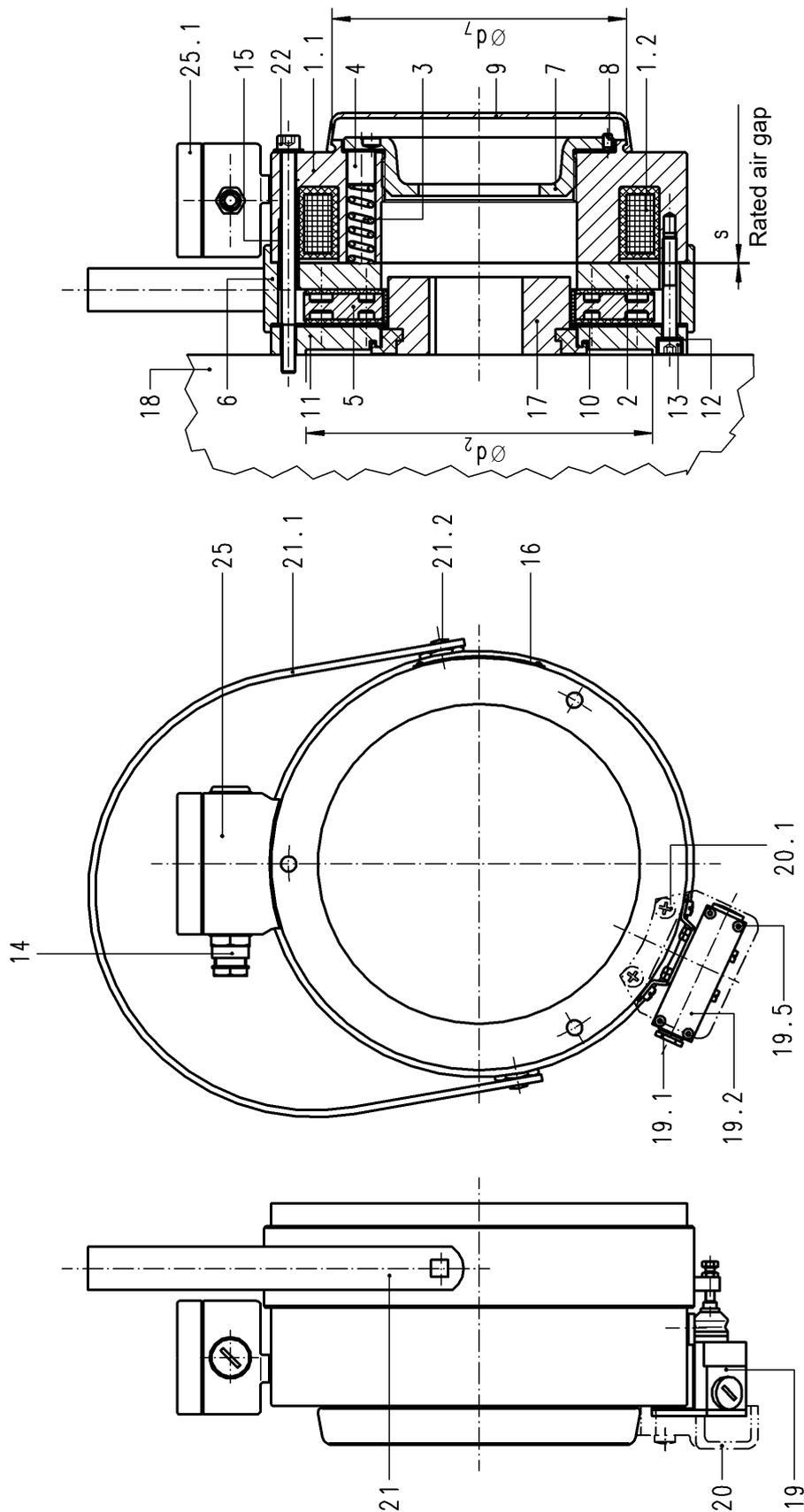
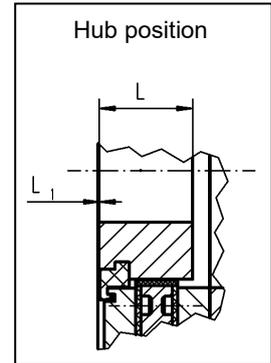


Fig. 7/1: Spring-applied single-disc brake 77 600..A..

## 3. Installation

### 3.1 Mechanical installation

The hub (17) must be slipped onto a shaft provided with a feather key to DIN 6885, sheet 1. The hub must be axially secured (by means of a shaft collar, circlip or the like). Make sure that the front face of the hub (17) is at the same height as the front face of the flange (11). The friction disc (5) must be slipped onto the hub (17) with the complete brake assembly and centred using centring diameter  $d_2$  (see Fig. 6/1 and Classic Line specification sheet) of the flange (11). Make sure that the friction disc (5) can be easily moved along the hub (17).



	Size					
	10	11	13	16	19	24
L [mm]	20,5	20,5	24	26,5	30	45
L <sub>1</sub> [mm]	0-0.8	0-0.8	0-1	0-1	0-1	0-1.2
M <sub>A</sub> [Nm]	5.5	5.5	5.5	9.5	9.5	22
M <sub>AZ</sub> [Nm]	1.5	1.5	3	5	5	11

Table 8/1: Hub dimensions (17); tightening torques of fixing screws (22) and machine screws (13)

Check that the fixing surface (18) meets the following requirements before installing the brake:

- Axial runout relative to the shaft <0.1mm (measuring radius = reference diameter)
- Surface roughness max. R<sub>z</sub>16
- Surface hardness min. 100HB
- Material: steel, aluminium, cast iron – with excellent thermal conductivity
- Absence of oil and grease
- Permitted mismatch of centring diameter (fixing surface (18)) relative to shaft <0.2mm

The spring-applied single-disc brake must be screwed to the fixing surface (18) by tightening the fixing screws (22) to the M<sub>A</sub> tightening torques specified in Table 8/1. The factory-adjusted rated air gap 's' cannot be changed.



#### Note!

If the friction disc (5) and/or hub (13) are equipped with rubber buffers for noise reduction, the buffers must be slightly greased before installation to reduce fitting forces during brake mounting. Check that the friction disc (5) can be easily moved along the hub (13) by hand. The fitted components (especially the friction surfaces) must be free from grease.



#### Attention!

The M<sub>A</sub> tightening torque specified for the fixing screws (22) must be strictly observed. The screws (22) must be tightened evenly in diametrically opposite sequence.



#### Note!

The centring diameter  $d_7$  (see Fig. 6/1) is factory-aligned relative to the centring diameter  $d_2$  on the flange (11) with a maximum 0.2mm radial runout. This enables easy attachment of a tachometer generator to the solenoid housing (1.1).

## 3.2 Installation of accessories

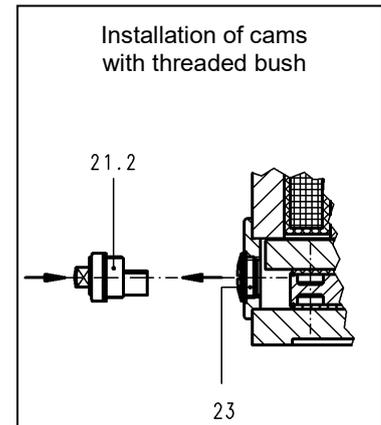
### Hand release (21):

The two screw plugs (23) fitted opposite each other to the circumference of the intermediate ring (6) must be screwed out. The cams (21.2) with threaded bush must be screwed into the bores provided in the screw plugs (23) making sure that they are in the right position (see figure). Secure the cams with Loctite 601. The hand release lever (21.1) must be fixed to the square socket provided in the cams (21.2). The release forces  $F$  and the maximum permitted release forces (actuation forces)  $F_{max}$  are specified in Table 7/1.



### Note!

Machinery-specific regulations and requirements (e.g. for hoists, cranes and elevators) must be observed when using brakes with hand release (21).



	Size					
	10	11	13	16	19	24
$M_A$ tightening torque of threaded bush [Nm]	20	20	20	26	26	35
Release force $F$ <sup>2)</sup> [N]	8	13	32	100	110	165
Max. permitted release force (actuation force) $F_{max}$ [N]	11	18	50	150	155	230

Table 9/1: Release force  $F$  and maximum permitted release force (actuation force)  $F_{max}$  of hand release (21);  $M_A$  tightening torque of threaded bush of cams (21.2)



### Note!

When installing the cams (21.2) make sure that the cam surface points towards the armature (2).



### Caution!

The brake torque can be neutralised manually by means of the hand release (21). Consequently, the brake must be installed in such a way that any unintentional actuation of the hand release (21) is excluded.



### Warning!

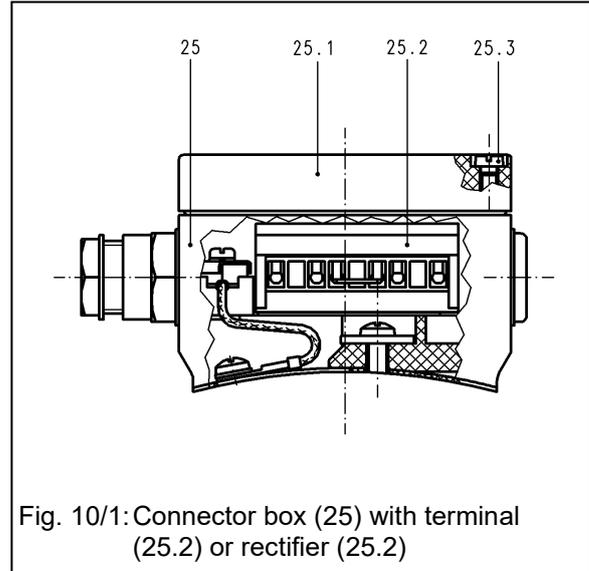
Check that the mechanical hand release (21) is in a central position (see Fig. 6/1) when not in use. This is crucial to ensure reliable brake engagement. Otherwise, the full braking effect of the spring-applied single-disc brake may not be reached. In this case, the machine (e.g. motor) must be stopped immediately and must not be restarted until correct operation of the hand release (21) and automatic return of the hand release lever in its central position (see Fig. 6/1) has been ensured.

<sup>2)</sup> Release force  $F$  (approx.) at the highest rated (standard) torque.

### 3.3 Electrical connection and operation

The spring-applied single-disc brake must be supplied with DC voltage. Connection to an AC power source is via a half-wave, bridge or overexcitation rectifier (25.2). Brakes with connector box (25) and built-in rectifier (25.2) can be connected directly to the AC mains. The contact assignment is shown in Fig. 11/1. Brakes equipped with connector box (25) and connecting terminal (25.2) resp. connecting cable must be connected directly to DC voltage. The customer-specific connecting cable must be connected to the terminals (25.2) or built-in rectifier (25.2) by means of a cable gland (14) (PG 11, clamping range 7.5 to 10 mm). Remove the cover (25.1) of the connector box (25) so that the individual strands of the connecting cable can be connected to the terminals (25.2) or to the contacts of the built-in rectifier (25.2).

Brake versions with flying leads or connecting cable do not have a connector box (25). The wire ends of the flying leads or cable must be connected directly to the DC power source.



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	L-load I/ADC
32 07.22B.0	half-wave	0-500 ( $\pm 10\%$ )	$U_1 \cdot 0.445$	1.6	2.0
32 07.23B.0	bridge	0-400 ( $\pm 10\%$ )	$U_1 \cdot 0.890$	1.6	2.0
32 17350E..	overexcitation bridge $\Rightarrow$ half-wave	48-120 ( $\pm 10\%$ ) 220-415 ( $\pm 10\%$ ) 480-525 ( $\pm 10\%$ )	$U_1 \cdot 0.890 / U_1 \cdot 0.445$	2.3	3
32 17.2.B..	overexcitation bridge $\Rightarrow$ half-wave	110-230 ( $\pm 10\%$ ) 220-415 ( $\pm 10\%$ )	$U_1 \cdot 0.890 / U_1 \cdot 0.445$	1.2 0.8	1.5 1.0

Specific rectifier specification sheets must be observed!

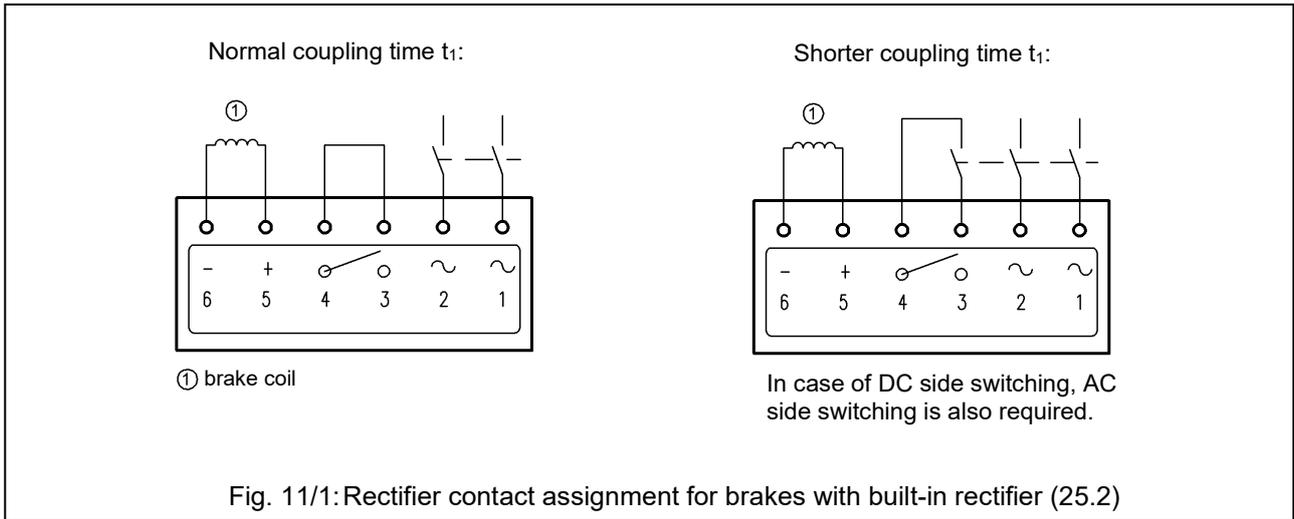
Table 10/1: Recommended rectifiers for single-phase AC voltage supply and for connection via terminal (25.2)



#### Attention!

When fixing the cover (25.1) to the connector box (25), the  $M_A$  tightening torques of the machine screws specified in Table 14/1 must be strictly observed. Damage to the flat seal between the connector box (25) and cover (25.1) must be avoided.

When using brakes with built-in rectifier (25.2), the supply voltage is rectified by means of a half-wave rectifier (25.2). The built-in rectifier (25.2) 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. 11/1). Various Kendrion rectifiers are available (see Table 8/1, list not exhaustive) for direct brake connection to an AC power source via the built-in connecting terminal (25.2). 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.



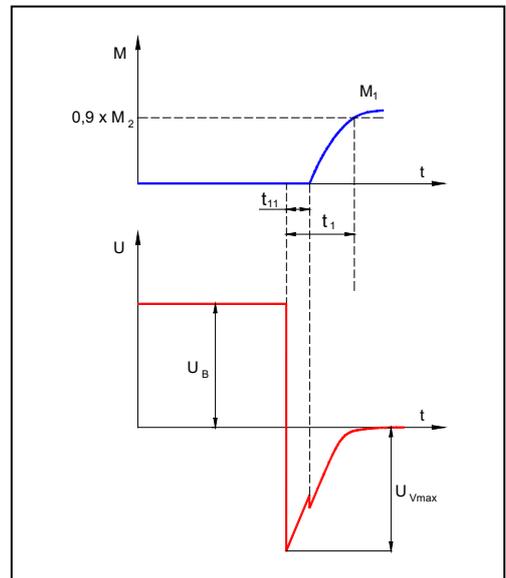
**3.3.1 DC power supply**

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

**Attention!**

The peak voltage  $U_{Vmax}$  during disconnection without protective circuit may reach **several thousand V** 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 10/1), the protective circuit required for the built-in electronic components and field coil (1.2) is included in the rectifier. This does not apply to the external contacts required for DC side switching as there would be no galvanic isolation of the external contact.

**Attention!**



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

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

**3.3.2 AC power supply**

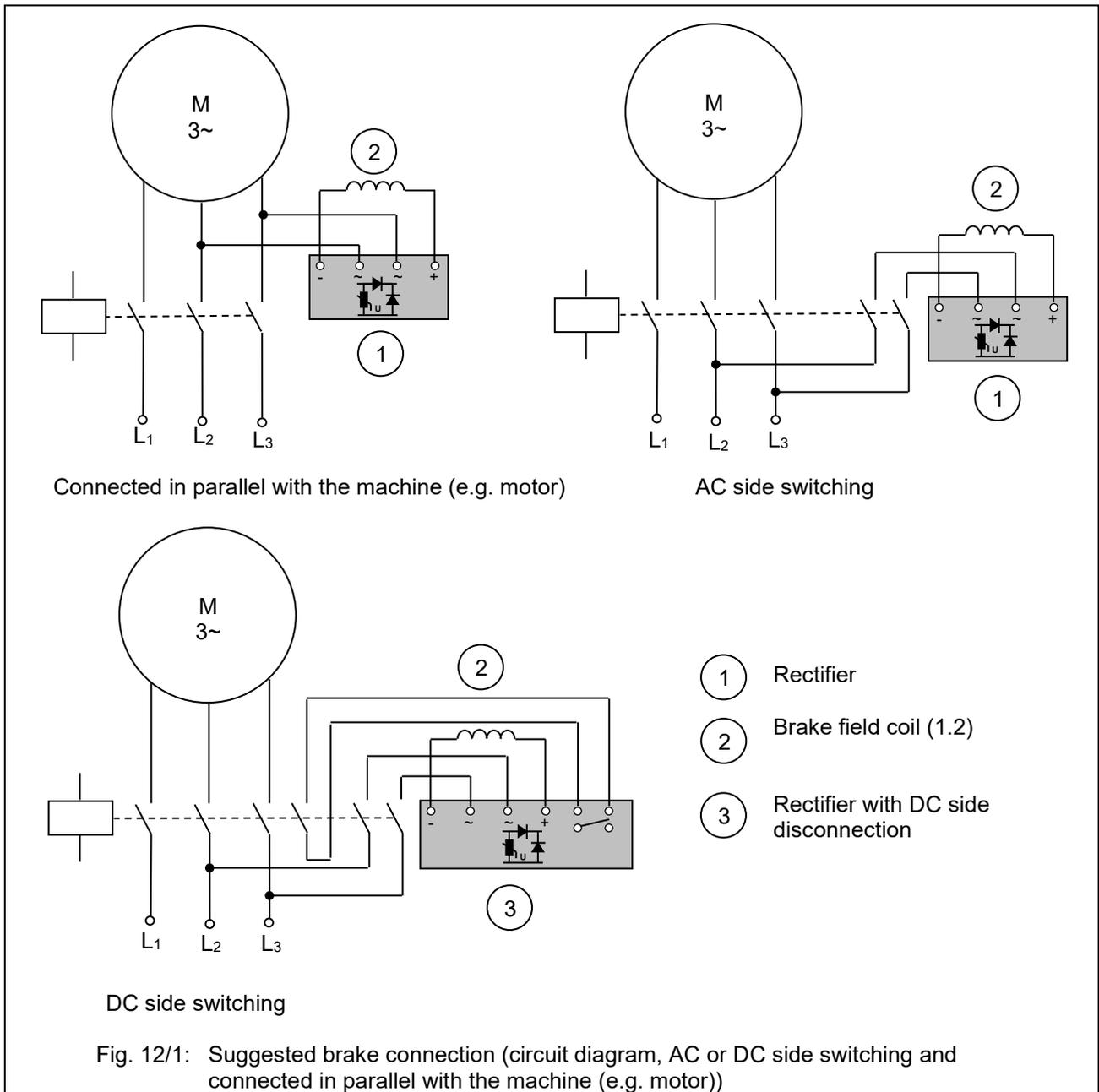
Direct connection of the spring-applied single-disc brake to an AC power source is only possible if a rectifier is used. The coupling times vary depending on the switching type (DC side switching or AC side switching).

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 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 allows brake humming to be avoided even if small size brakes 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 5 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.

**Attention!**

In case of DC side switching, the brake 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 welded contacts.

**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.

**Warning!**

The brake 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.

### 3.3.3 Microswitch (19) connection

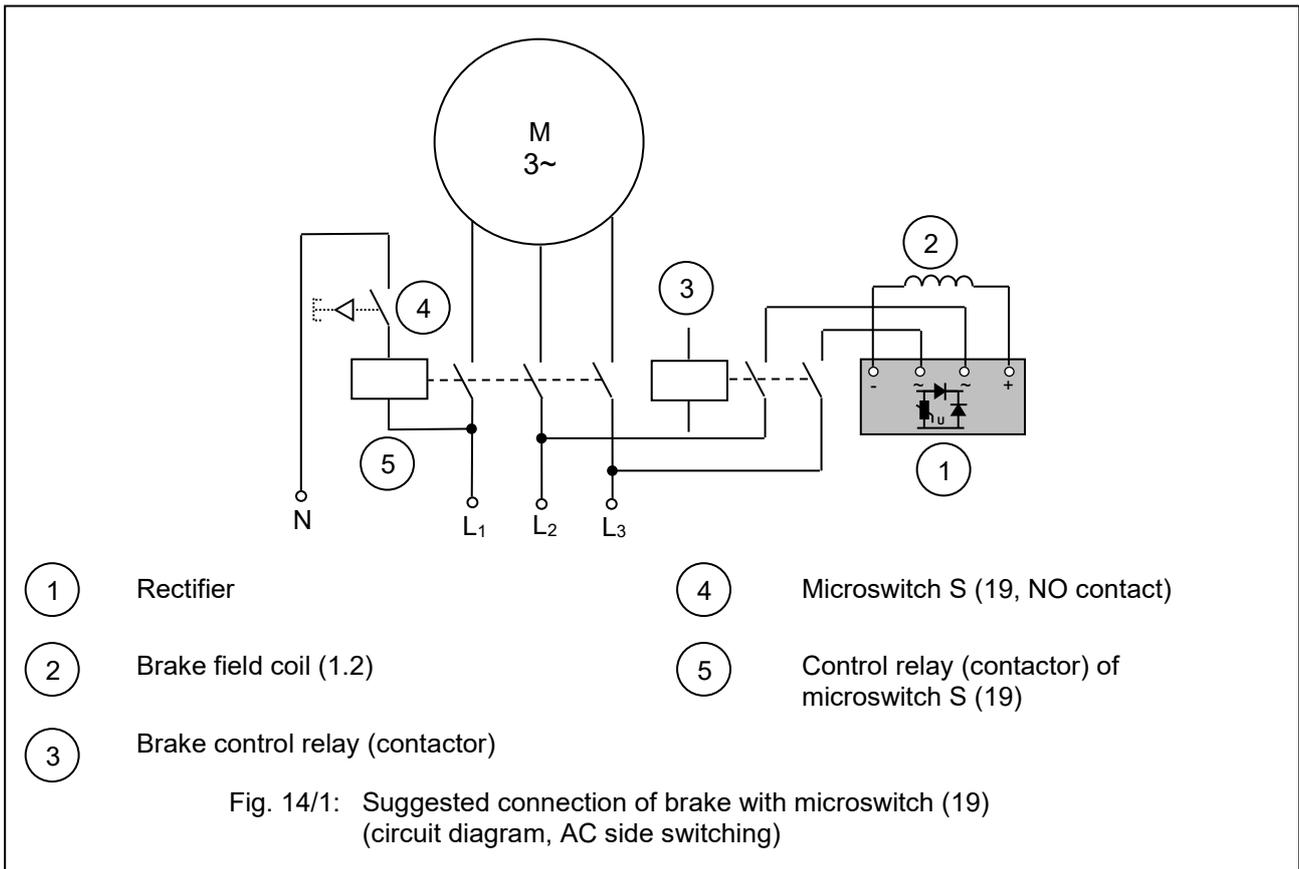
If brakes are equipped with a microswitch (19) to control the release status (released/engaged) of the spring-applied single-disc brake, the microswitch (19) must be tied into the control circuit of the machine (e.g. motor) (see suggested brake and microswitch (19) connection in Fig. 12/1). This is to ensure that the microswitch (19) prevents any start-up of the machine (e.g. motor) before the spring-applied single-disc brake has been released. If the brake has a protective microswitch cover (20), the cover (20) must be removed to allow the microswitch connecting cable to be installed. After removal of the cover (20), the microswitch cap (19.2) can be loosened and taken off. The customer-specific connecting cable for the microswitch (19) can be fed into the microswitch connector box through the cable gland (19.1) (PG 9). The cable strands must be connected with the NO (normally open) and C (common) contacts by means of the microswitch connecting terminals. After completion of connection, the cap (19.2) and protective cover (20) must be reinstalled. The optional microswitch (19) must be ordered together with the brake as it cannot be retrofitted to the brake at a later date. The microswitch (19) is factory-adjusted prior to shipment of the spring-applied single-disc brake.

**Attention!**

When installing the protective cover (20) and cap (19.2) of the microswitch (19) and the cover (25.1) provided for the connector box (25), the machine screws must be tightened to the  $M_A$  tightening torques specified in Table 14/1.

	Size					
	10	11	13	16	19	24
M <sub>A</sub> tightening torque [Nm] of machine screws (20.1) for protective cover (20)	-	-	-	5	5	5
M <sub>A</sub> tightening torque [Nm] of machine screws (19.5) for microswitch cap (19.2)	-	-	0.75	0.75	0.75	0.75
M <sub>A</sub> tightening torque [Nm] of machine screws (25.3) for connector box cover (25.1)	1.6	1.6	1.6	1.6	1.6	1.6

Table 14/1: Tightening torques of machine screws for protective cover (20), microswitch cap (19.2) and connector box cover (25.1)



**Note!**

Machinery-specific regulations and requirements (e.g. for hoists, cranes and elevators) must be observed when using brakes with microswitches (19).



**Warning!**

The motor circuit must be protected in such a way that no accidental motor start-up can occur when the microswitch (19) contact closes.



**Note!**

The suggested wiring of the spring-applied single-disc brake with microswitch (19) shown in Fig. 12/1 is based on the general recommendations for the connection of electromagnetic components used in electric 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 (19) and brake.

### 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 minimised. 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 spring-applied single-disc brakes are designed for industrial applications to which the following EMC standards apply: Generic Immunity Standard EN 61000-6-2 and Generic Emission Standard EN 61000-6-3 / EN 61000-6-4. 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 brakes series 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. When using brakes with built-in rectifier, the rectifier conforms to severity level 3 without requiring additional measures.

##### **EN 61000-4-3 Electromagnetic fields:**

The brakes comply at least with severity level 3 without requiring additional measures. The recommended rectifiers conform to severity level 3 without additional measures. When using brakes with built-in rectifier, the rectifier conforms to severity level 3 without requiring additional measures.

##### **EN 61000-4-4 Fast transients (burst):**

The brakes comply at least with severity level 3 without requiring additional measures. The recommended rectifiers conform to severity level 3. When using rectifiers of the 32 17.2.B.. series, which conform to severity level 3, a temporary slight voltage increase may occur which, however, will not interfere with the rectifier function. When using brakes with built-in rectifier, the rectifier conforms to severity level 3 without requiring additional measures.

##### **EN 61000-4-5 Surge:**

The brakes comply at least with severity level 3 without requiring additional measures. The recommended rectifiers conform to severity level 3 without additional measures. When using brakes with built-in rectifier, the rectifier conforms to severity level 3 without requiring additional measures.

##### **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 brakes comply at least with severity level 4. The recommended rectifiers conform to severity level 3 without additional measures. When using brakes with built-in rectifier, the rectifier conforms to severity level 3 without requiring additional measures.

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

- a) Voltage interruptions:  
 Brakes that comply with the requirements of DIN VDE 0580 are de-energised 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 damage is avoided (e.g. motor start-up before the brake has been released caused by phase failure in the case of two-phase energised 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 provided that any 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-energised temporarily. 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 brakes 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 50/60 Hz AC voltage, all brakes comply with the limit values applicable to Class B equipment.

- 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 50/60 Hz AC power source and equipped with electronic rectifiers or other electronic controls, interference suppression measures as shown in Fig. 16/1 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 17/2 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 17/2.

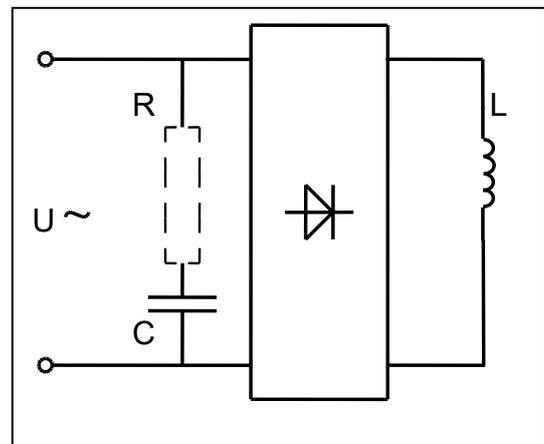


Fig. 16/1

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 type	Rated input voltage range $U_1/VAC$ (40-60 Hz)	DC at L-load (ADC)	Capacitor (nF(VAC))
Bridge rectifier 32 07.23B.0	up to 400 (+10%)	up to 2.0	no additional interference suppression measures required
Half-wave rectifier 32 07.22B.0	up to 500 (+10%)	up to 2.0	no additional interference suppression measures required
Overexcitation rectifier 32 17350E..	48-120 ( $\pm 10\%$ ) 220-415 ( $\pm 10\%$ ) 480-525 ( $\pm 10\%$ )	up to 3	no additional interference suppression measures required
Overexcitation rectifier 32 17.2.B..	110-230 220-415	up to 1.5 up to 1.0	no additional interference suppression measures required

Table 17/1

Rectifier input voltage (max.) (VAC)	Recommended disconnection voltage for DC side switching (V)
250	700
440	1200
550	1500

Table 17/2

## 3.5 Set-up and start-up



### Warning!

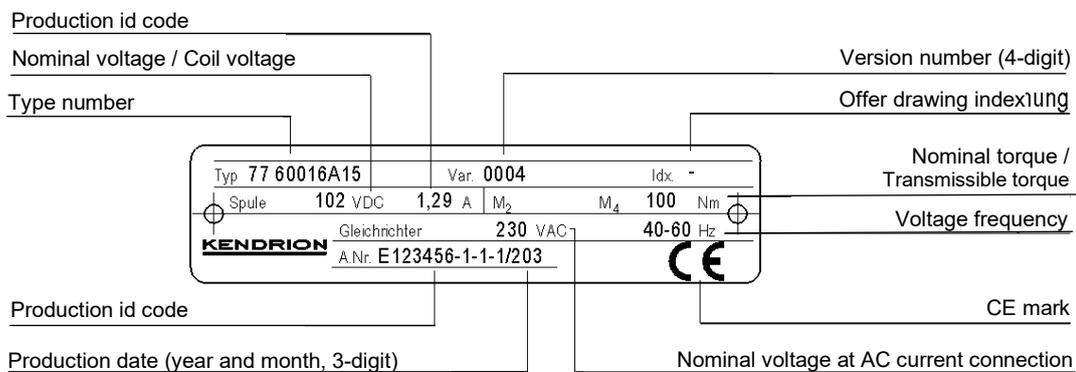
The functional check of the brake must not be performed unless the machine (e.g. motor) has been switched off and secured against accidental or unintentional start-up.

### 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 connection of the brake, an operational test must be performed to check that the friction disc (5) runs smoothly. For this purpose, turn the shaft (while the brake is energised and the machine (e.g. motor) is unpowered). Install the required guards and protections after completion of installation.

Specifications on the rating plate (subject to order, example type 77 60016A15)



Note: The product number of the brake consists of the type number followed by the version number of the spring-applied multiple-disc brake, e.g. 77 60016A15-0004.



### 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 (e.g. motor) is re-started, the brake must be de-energised.



### Caution!

The brake surface temperature may rise to over 60°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 must be released electromagnetically or by means of the hand release lever (21).



### Caution!

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 brake switching 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 brake release

The spring-applied single-disc brake can be released "manually" by means of a mechanical hand release (21) (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. For this purpose, the brake user is required to install a UPS system that complies with the voltage specifications given on the brake rating plate.



### Warning!

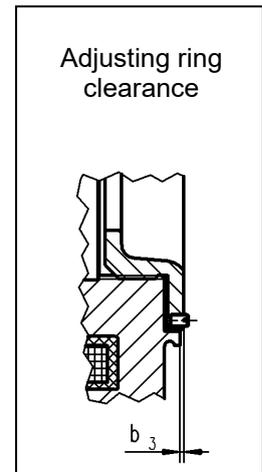
Manual release (inching mode) of the spring-applied single-disc brake (e.g. for maintenance operations on the machine (e.g. motor) or in case of failure of the regular power supply and use of a UPS system) must be performed with extreme caution. If the drive system is unbalanced, the load torque may 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 is released and engaged in inching mode.

### 3.6 M<sub>4</sub> transmissible torque adjustments

The brakes are factory-adjusted to the M<sub>4</sub> transmissible torque (as specified in the purchase order). The M<sub>4</sub> transmissible torque is specified on the rating plate (16) of the brake. The adjusting ring clearance  $b_3$  is marked on the collar of the brake back near the set screw (8). It can be changed by tightening or loosening the adjusting ring (7) by means of a pin spanner. The corresponding changes in the M<sub>4</sub> transmissible torque are specified in Table 19/1. The adjusting ring clearance  $b_3$  must remain within the specified minimum and maximum values (see Table 19/1).

	Size					
	10	11	13	16	19	24
$\Delta M_2/\text{mm}$ [Nm]	3.8	3.3	11.5	9.25	12	49
$b_{3\text{min}}$ [mm]	2	3.6	3	4.7	4.5	2.7
$b_{3\text{max}}$ [mm]	3.3	6.2	4.7	8.6	11	5.6

Table 19/1: Change in the M<sub>4</sub> transmissible torque from 1 mm axial adjustment of the adjusting ring (7); adjusting ring clearance  $b_3$  limit values



### Attention!

After having tightened or loosened the adjusting ring (7), the ring (7) must be locked with the set screw (8). The tightening torque to be applied is  $M_A = 3\text{Nm}$ . The adjusting ring (7) must be turned in such a way that the set screw (8) can be inserted between the studs (4).

## 4. Maintenance

### 4.1 Checks and service

The spring-applied single-disc brake does not require any particular maintenance except that the air gap 's' must be measured at regular intervals. After the screw plugs (23) have been removed from the intermediate ring (6), the air gap 's' (see Table 29/1 for rated air gap specification) between the armature (2) and the friction disc (5) can be checked by means of a feeler gauge while the brake is energised. When the maximum air gap  $s_{max}$  has been reached (see Table 29/1), the friction disc (5) must be replaced as follows: Loosen the fixing screws (22) and remove the brake from the hub (17). Remove the cover hood (9) and screw out the adjusting ring (7) after having loosened the set screw (8). Loosen the machine screws (13) and sealing rings (12), and remove the flange (11) and friction plate <sup>3)</sup> (10) from the intermediate ring (6). Remove the worn friction disc (5) and replace it by a new one. Before reassembling the brake components, clean all parts (flange (11), friction plate <sup>3)</sup> (10), armature (2) and intermediate ring (6)) with grease-free cleaners. Install the friction plate <sup>3)</sup> (10) in such a way that the convex surface is in contact with the flange (11). Screw the flange (11) with the intermediate ring (6) to the core element of the spring-applied single-disc brake by means of the machine screws (13) and sealing rings (12). Screw in the adjusting ring (7) until the  $b_3$  clearance (marked on the collar of the brake back) has been reached and secure it with the set screw (8). Install the cover hood (9) as shown in Fig. 6/1. Install and connect the spring-applied single-disc brake as described in Sections 3.2 and 3.3.



#### Attention!

When installing the spring-applied single-disc brake, it is crucial that the fixing screws (22) be tightened applying the  $M_A$  tightening torque specified in Table 8/1. The machine screws (13) must be tightened to the  $M_{AZ}$  torque specified in Table 8/1. The set screw (8) of the adjusting ring (7) must be tightened to  $M_A = 3Nm$ . After the friction disc (5) has been replaced, the air gap 's' must be checked (see Table 29/1 for information on the rated air gap).



#### Attention!

After the adjusting ring (7) has been screwed in, the set screw (8) must be located directly beside the marking of the adjusting ring clearance  $b_3$ . Check that the set screw is not positioned on a stud (4).



#### Attention!

Depending on its operating condition, it may no longer be possible to release the spring-applied single-disc brake when the maximum air gap  $s_{max}$  (see "Technical specifications" in Table 29/1) has been exceeded. In this case, the braking effect cannot be neutralised. This may cause thermal overloading of and irreversible damage to the brake 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.



#### Caution!

If a hand release lever (21) is fitted to the brake and the maximum air gap  $s_{max}$  (see "Technical specifications" in Table 29/1) has been exceeded, the hand release lever (21) will limit the axial movement of the armature (2). This will cause the torque to be reduced down to zero. Whenever carrying out maintenance work, check the degree of wear of the friction disc (5) and the air gap 's' and replace the friction disc (5) well before the maximum air gap  $s_{max}$  (see "Technical specifications" in Table 29/1) is reached.

<sup>3)</sup> Size 10 to 16 brakes.

## 4.2 Microswitch (19) adjustment (only applicable to brakes with microswitch (19))

The spring-applied single-disc brake must be released electrically to allow the microswitch (19) to be adjusted. Unscrew the locknut (19.3) and turn the hexagon head cap screw (19.4) clockwise until the microswitch (19) switches (slight audible click or contact closure between the NO and C contacts). If the microswitch (19) is in ON position, it must be turned anticlockwise to OFF. After the changeover position has been reached, continue to turn the hexagon head cap screw (19.4) as follows:

Size 13 brakes: by 50° / Size 16 – 24 brakes: by 70°

Tighten the locknut (19.3). Make sure the position of the hexagon head cap screw (19.4) remains unchanged when tightening the locknut. Switch the brake on and off to check that the microswitch is in perfect working order.

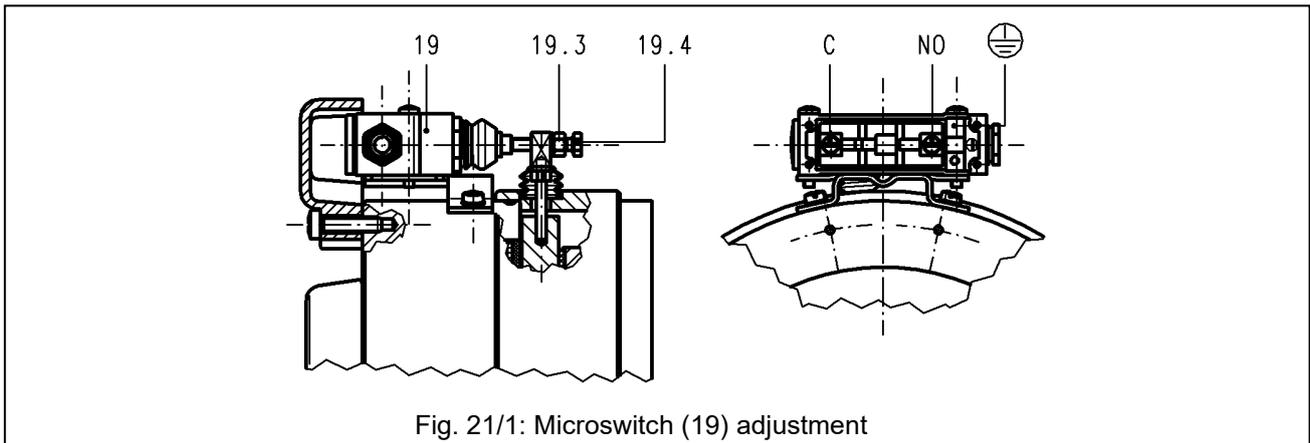


Fig. 21/1: Microswitch (19) adjustment



### Warning!

The motor circuit must be protected in such a way that no accidental motor start-up can occur when the microswitch (19) contact closes.



### Warning!

Whenever inspection and maintenance work is carried out, check that

- the machine (e.g. motor) is secured against accidental or unintentional start-up.
- no load torque is applied to 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 (5) cannot be cleaned.
- the friction lining has not swollen or turned vitreous.

## 4.3 Spare parts and accessories

Size	Designation, order number		
	Hand release (21) A	Fixing screw (22) A	Friction disc (5) <sup>4)</sup> S
10	76 14110B00940	304028	73 24110E00400
11	76 14111B00940	304030	76 14511E15400
13	76 14113B00940	304035	73 24113E00400
16	76 14116B00940	304060	73 24116E00400
19	76 14119B00940	304061	76 14119E00400
24	76 14124B00940	304088	76 14124E00400

Table 22/1: Spare parts (S) and accessories (A)

## 5. Condition at delivery

Upon receipt of the shipment, the spring-applied brake must be checked for transit damage before storage. Ordered accessories (e.g. hand release, fixing screws) are delivered together with the brake. The spring-applied single-disc brake is delivered ready for mounting with factory-adjusted M<sub>4</sub> transmissible torque and factory-adjusted air gap 's' (adjustment with sleeves and tooth ring).



### Note!

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 22/1 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. The permissible ambient conditions only apply if the component is stored in the original packaging.

	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 22/1: Environmental conditions for storage and transport as specified in EN IEC 60721-3-1 and EN IEC 60721-3-2

## 6. Emissions

### 6.1 Noise

The spring-applied single-disc brake produces switching noise during engagement and release. The noise level is determined by the installation conditions, circuitry (e.g. with overexcitation) and air gap. Depending on the installation position, operating conditions and quality of the friction surfaces, clearly audible vibrations (squeaking) may be produced during braking.

<sup>4)</sup> Friction discs can be supplied with special friction material for increased switching work (W).

## 6.2 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.

## 7. 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	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.
	• Damaged rectifier	Check the rectifier and replace it, if necessary.
	• Damaged field coil	Check the field coil resistance. Install a new brake, if necessary.
	• Friction disc thermally overloaded	Install a new friction disc. Install a new brake, if necessary.
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.
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 surface	Check the friction surface. Install a new friction disc, if necessary.
	• Axial armature movement blocked by hand release	Check the air gap. Install a new friction disc, if necessary.
	• Broken compression spring	Check the spring force. Install a new brake, if necessary.
Microswitch failure (only brake types with microswitch)	• Damaged microswitch	Install a new microswitch.
	• Adjustment error of microswitch switching point	Readjust the microswitch switching point.

Table 23/1: Possible faults, causes and corrective actions (list not exhaustive)

## 8. 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 harmonised 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 the safety instructions are strictly adhered to.

The user 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.
- start-up, maintenance and repair work is only done by authorised 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.

### 8.1 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 atmospheres or locations requiring flame-proofing 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.

### 8.2 General safety information

Brakes 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 authorised 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 (Villingen) 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 (Villingen). 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.

### 8.2.1 Set-up

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. The operating conditions at normal rating specified in these Operating Instructions refer to DIN VDE 0580. The protection type is based on EN 60529. In case of deviations from these requirements, special precautions may have to be taken after consultation with the brake 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  $-5^{\circ}\text{C}$  or if the brake remains unpowered for prolonged periods of time. In this case, special precautions must be taken after consultation with the manufacturer.

### 8.2.2 Set-up and start-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.

### 8.2.3 Installation

The voltage 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 (DIN 31000; DIN VDE 0100-420) must be taken by the brake user to avoid hazards to persons and animals or damage to equipment caused by:

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

### 8.2.4 Operation

Make sure 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 liquids 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 liquids. The gradual brake wear and the resulting torque reduction of spring-applied brakes must be taken into consideration during set-up. 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 is used for applications where only minimum friction work is required. In such cases, the user should ensure that the brake occasionally performs sufficient friction work. Operation of the brake as pure holding brake without friction work is only allowed after prior consultation with the manufacturer. If brakes equipped with hand release lever are used, the lever must only be moved up to the release position in order to avoid deformation or breaks.



**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 29/1 "Technical specifications"). Fast cooling of the field coil with scavenging air is not allowed. Ensure that the permissible relative humidity range (see Table 31/1) is not exceeded.



**Note!**

The maximum air gap  $s_{max}$  (see Table 29/1 "Technical specifications") must not be exceeded throughout the entire brake service life. (Please refer to Section 4 "Maintenance" for details.)

## 8.2.5 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.

## 8.3 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 the components or other equipment
Information			
Symbol / Term	Provides information on ...		
	Note	the safe use and operation of the product	

## 9. Definitions

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

<b>Switching torque <math>M_1</math></b>	torque acting on the shaft during brake or clutch slip
<b>Rated torque <math>M_2</math></b>	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.
<b>Transmissible torque <math>M_4</math></b>	highest torque that can be applied to the engaged brake or clutch without causing the brake/clutch to slip
<b>Residual torque <math>M_5</math></b>	torque transmitted by the released brake or clutch
<b>Load torque <math>M_6</math></b>	torque acting on the drive of the engaged brake or clutch; determined by the power requirement of the driven machine at a given speed
<b>Switching work <math>W</math></b>	heat generated by friction inside the brake or clutch as a result of the switching operation
<b>Maximum switching work <math>W_{max}</math></b>	maximum switching work to which the brake or clutch may be exposed
<b>Switching power <math>P</math></b>	switching work converted into heat per unit of time
<b>Maximum switching power <math>P_{max}</math></b>	maximum permitted switching work converted into heat per unit of time
<b>Coil ON time <math>t_5</math></b>	time between power on and power off
<b>Coil OFF time <math>t_6</math></b>	time between power off and power on
<b>Total cycle time <math>t_7</math></b>	coil ON time plus coil OFF time
<b>Duty cycle</b>	percentage relationship of coil ON time to total cycle time
<b>Switching operation</b>	one complete switching on and off operation
<b>Switching frequency <math>Z</math></b>	number of regular switching operations per hour
<b>Response delay during coupling <math>t_{11}</math></b>	time between power off (releasing systems) or power on (engaging systems) and beginning of torque increase
<b>Rise time <math>t_{12}</math></b>	time it takes to reach 90% of the $M_2$ rated torque from the beginning of the torque increase
<b>Coupling time <math>t_1</math></b>	response delay $t_{11}$ plus rise time $t_{12}$
<b>Response delay during disconnection <math>t_{21}</math></b>	time between power on (releasing systems) or power off (engaging systems) and beginning of torque decrease
<b>Fall time <math>t_{22}</math></b>	time it takes for the torque from the beginning of the torque decrease to fall to 10% of the $M_2$ rated torque
<b>Disconnection time <math>t_2</math></b>	response delay $t_{21}$ plus fall time $t_{22}$
<b>Slip time <math>t_3</math></b>	time from the beginning of the torque increase up to the end of the braking process (brakes) or until the synchronisation torque $M_3$ has been reached (clutches)
<b>Making time <math>t_4</math></b>	response delay $t_{11}$ plus slip time $t_3$ (braking or acceleration time)
<b>Operating condition at operating temperature</b>	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.

<b>Overtemperature <math>\Delta\vartheta_{31}</math></b>	difference between the temperature of the electromagnetic device or a part thereof and the ambient temperature
<b>Limit temperatures of coil insulating materials</b>	in accordance with DIN VDE 0580. The individual insulating materials are classified by insulation classes to DIN IEC 60085.
<b>Rated voltage <math>U_N</math></b>	supply voltage specified by the manufacturer for voltage windings to identify the device or component
<b>Rated current <math>I_B</math></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.
<b>Rated power <math>P_N</math></b>	power value to identify the device or component
<b>Rated power at 20°C winding temperature <math>P_B</math></b>	determined from the rated current of voltage-controlled devices and components and the $R_{20}$ resistance at 20°C winding temperature

## 10. Technical specifications

Product built and tested to DIN VDE 0580

	Size					
	10	11	13	16	19	24
Transmissible (standard) torque range $M_4$ [Nm]	7.5-15	15-25	35-50	50-100	120-200	180-360
Max. reachable transmissible torque $M_{4max}$ [Nm]	15	25	55	110	200	360
Max. speed $n_{max}$ [rpm]	5400	5000	4000	3500	3000	3000
Max. switching power (attached brakes) $P_{max}$ [kJ/h]	90	125	150	175	195	240
Max. switching power (built-in brakes) $P_{max}$ [kJ/h]	190	285	410	535	645	730
Rated power $P_N$ [W]	68	79	130	155	215	167
Coupling time $t_1$ [ms]	15 ( $M_4=15Nm$ )	20 ( $M_4=25Nm$ )	30 ( $M_4=50Nm$ )	50 ( $M_4=100Nm$ )	65 ( $M_4=200Nm$ )	110 ( $M_4=360Nm$ )
Disconnection time $t_2$ [ms]	45 ( $M_4=15Nm$ )	60 ( $M_4=25Nm$ )	80 ( $M_4=50Nm$ )	120 ( $M_4=100Nm$ )	155 ( $M_4=200Nm$ )	205 ( $M_4=360Nm$ )
Moment of inertia – hub and friction disc $J$ [kgcm <sup>2</sup> ]	1.22	1.75	5	14	37.5	87
Weight $m$ [kg]	1.8	2.9	4.3	8.6	13.4	26.5
Rated air gap $s$ [mm]	0.28 <sup>+0.2</sup>	0.28 <sup>+0.2</sup>	0.33 <sup>+0.2</sup>	0.35 <sup>+0.2</sup>	0.4 <sup>+0.2</sup>	0.4 <sup>+0.25</sup>
Max. air gap $s_{max}^{5)}$ [mm]	0.65	0.75	0.85	0.95	1.05	1.1
Standard rated voltage [VDC]	24, 102, 178					
Insulation class	F					
Pollution degree	2					
Protection	IP 54 IP 55 (when installed under motor fan cover)					
Brake type	holding brake with emergency stop function					

Table 29/1: Technical specifications



### Note!

Additional resp. different information to the technical specifications in accordance to Table 29/1, refer to the respective offer drawing.

	Size					
	10	11	13	16	19	24
Speed $n$ [rpm]	250	250	250	250	125	125
Coil ON time $t_5$ [s]	2	2	6	6	6	6
Coil OFF time $t_6$ [s]	1	1	1	1	1	1
Break-in period $t_{tot}$ [min]	approx. 2					

Table 29/2: Break-in process parameters for the spring-applied single-disc brake

<sup>5)</sup> Max. air gap  $s_{max}$  at maximum (standard) transmissible torque and at 70% of rated current. Information on max. air gap  $s_{max}$  at maximum reachable transmissible torque  $M_{2max}$  to be requested from manufacturer.

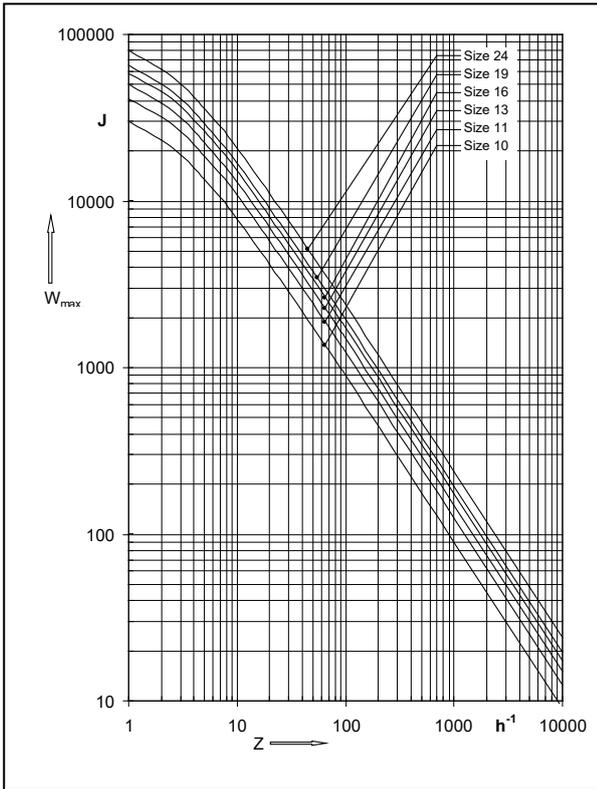


Fig. 30/1: Max. switching work  $W_{max}$  per switching operation as a function of the number of switching operations per hour  $Z$  (attached brakes; values based on  $n=1500$  rpm)

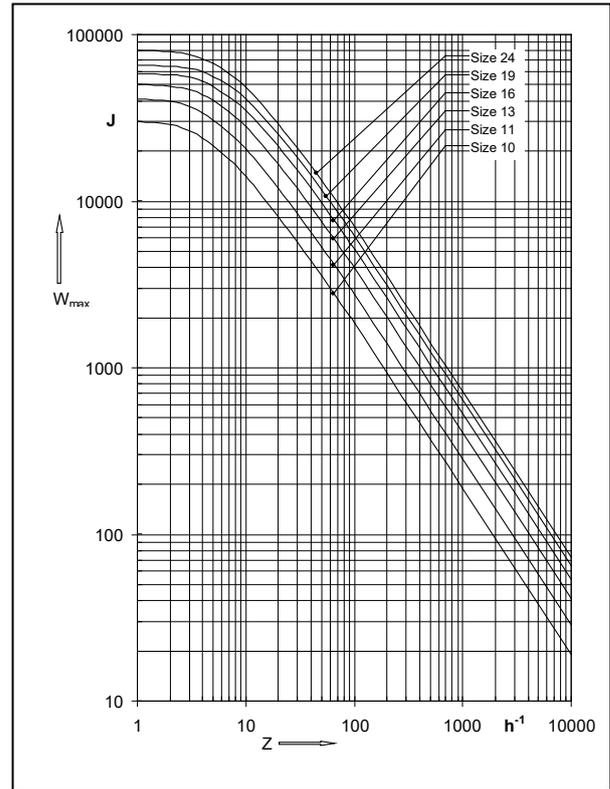


Fig. 30/2: Max. switching work  $W_{max}$  per switching operation as a function of the number of switching operations per hour  $Z$  (built-in brakes; values based on  $n=1500$  rpm)

Technical specifications	
Switching capacity	250 VAC, 25 A (resistive load)
	250 VAC, 8 A (inductive load, $\cos \varphi = 0.6$ )
	24 VDC, 10 A (resistive load)
	24 VDC, 6 A ( $L/R = 50$ ms)
Min. switching power	12 VDC, 10 mA
Mechanical service life [switching operations]	$3 \times 10^7$
Contact type	normally open contact
Temperature range [°C]	-20 to +80
Protection	IP 67

Table 30/1: Microswitch specifications (only for brakes with microswitch)

	Größe																	
	10			11			13			16			19			24		
Schaltungen (Notstopps) $Z$ [h <sup>-1</sup> ]	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4
Höchst-Schaltarbeit $W_{max}$ [kJ]	23	19	15	32	26	21	38	31	26	45	36	30	50	41	34	62	50	42

Table 30/2: Maximum switching work  $W_{max}$  depending of number switching's (emergency stops)  $Z$  (Value valid for  $n = 1500$ min<sup>-1</sup>)

<sup>6)</sup> Typs 77 600..A15, 77 600..K15 und 77 600..K16

Rated operating conditions	
Rated voltage tolerance	+10%, -15%
Frequency range	±1% of rated frequency
Ambient temperature $\vartheta_{13}$ [°C]	-5 to +35
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 31/1: Rated operating conditions for spring-applied multiple-disc brake

Explanations on the technical specifications:

$W_{max}$  (maximum switching energy) is the switching work that must not be exceeded during braking operations at max. 1500 rpm. Braking operations at >1500 rpm substantially reduce the maximum permitted switching work per switching operation. Such operation is only allowed after prior consultation with the manufacturer. The maximum switching power  $P_{max}$  is the switching work  $W$  that can be converted by the brake per hour. The permissible number of switching operations (emergency stops)  $Z$  per hour and the resulting max. permissible switching work  $W_{max}$  can take from Table 30/2. In case of applications e.g. as service brake where the number of switching operations per hour is  $Z > 1$ , Fig. 30/1 or Fig. 30/2 ( $W_{max}$  as a function of the number of switching operations per hour  $Z$ ) applies. The  $P_{max}$  and  $W_{max}$  values are approximate values; they apply to applications where the brake is mounted between the B-face end shield of the motor and the motor fan or attached to the motor and in case of 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  $M_4$  characterise the torque level of the brakes. Depending on the application the brake is used for, the switching torque  $M_1$  and the 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 29/2). Vertical brake operation is only allowed after prior consultation with the manufacturer.

**Note:** A current level corresponding to 70% of the rated current is reached if the brake is operated at rated voltage and at a coil temperature of 130°C.

The required operating conditions specified in Table 31/1 and the information provided in the **CLASSIC LINE specification sheet** and offer drawing must be observed during operation of the spring-applied single-disc brake.



**Note!**

At different information in the respective offer drawing compared to the information in the operation instructions the information and explanations in the offer drawing are valid.

**Specifications subject to change without notice!**

## 11. 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 60016A15

Version number: 0004

Product number: 77 60016A15-0004

## 12. Specialist repair shops

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## 13. Revision history

Ausgabedatum	Änderungen
11/04/2002	New issue.
14/04/2003	Operating instructions revised in content.
13/01/2004	Operating instructions revised in content.
14/12/2004	Operating instructions revised in content.
30/12/2009	Operating instructions revised in content.
13/03/2020	Operating instructions revised in content. Updated layout (design) of operating instructions.

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