



KENDRION INDUSTRIAL BRAKES

ACTIVE CLUTCH LINE

Electromagnetic single-face clutch

Operating Instructions 86 021..E00

Types: 86 02103E00 86 02104E00 86 02106E00
86 02107E00 86 02109E00 86 02111E00
86 02111E06 86 02114E00 86 02117E00
86 02121E00

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1. General

1.1 Introduction

These operating instructions describe the operating principle and features of the electromagnetic single-face clutch types 86 021..E00. 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 electromagnetic single-face clutch.

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 clutch. Electromagnetic single-face clutches are not ready-to-use products, but are intended to be incorporated into or assembled with machinery. Consequently, they will be referred to as **components** in the following sections.

1.2 Standards and directives

The state-of-the-art clutches 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”, electromagnetic single-face clutches 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 clutches 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: Electromagnetic single-face clutch

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Kendrion (Villingen) GmbH

Villingen
13/03/2020

Authorized signatory:


Dominik Hettich
(Head of Development)

1.4 EU Declaration of Conformity

This EU 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 placed on the market, 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 components in accordance with their intended use or by failure to observe safety information and other instructions provided in this document. 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 electromagnetic single-face clutch for flange mounting is designed to operate dry. The force generated by an electromagnetic field is utilized for torque transmission. The electromagnetic single-face clutch engages when DC voltage is applied. The clutch releases (opens) in unpowered condition when DC voltage is removed. The zero backlash connection between the armature and flange hub of the clutch (output side) ensures zero backlash transmission of the clutch torque to the output shaft of the machine and reliable disconnection of the single-face clutch with zero residual torque.

2.2 Clutch design

The magnet housing (1.1) with the flange (14) of the electromagnetic single-face clutch accommodates the firmly fitted field coil (1.2) with wire leads (1.3) that exit on the rear side of the clutch. The magnet body (2) with the front-side friction lining (3) is firmly connected with the drive shaft (12) of the machine (e.g. motor). The magnet housing (1.1) is fitted to the front face of the clutch and centred. Sufficient clearance is provided between the rotating magnet body (2) and the magnet housing (1.1) so that the components will not rub against each other. Depending on the specific clutch design, the armature (4) is mounted to the supplied Kendrion flange hub (5) or to a customer-specific flange hub version and thus connected directly to the output side of the machine by means of segment springs (7) and rivet fasteners (6) or socket head cap screws (6)²⁾ (if armature systems without Kendrion flange hub (5) are used). The armature connection thus established is axially movable, torsion-proof and friction-free. This ensures zero residual torque during horizontal or vertical clutch operation. The rated air gap 's' between the armature (4) and magnet body (2) of the electromagnetic single-face clutch is adjusted during clutch mounting (e.g. through mounting tolerances).

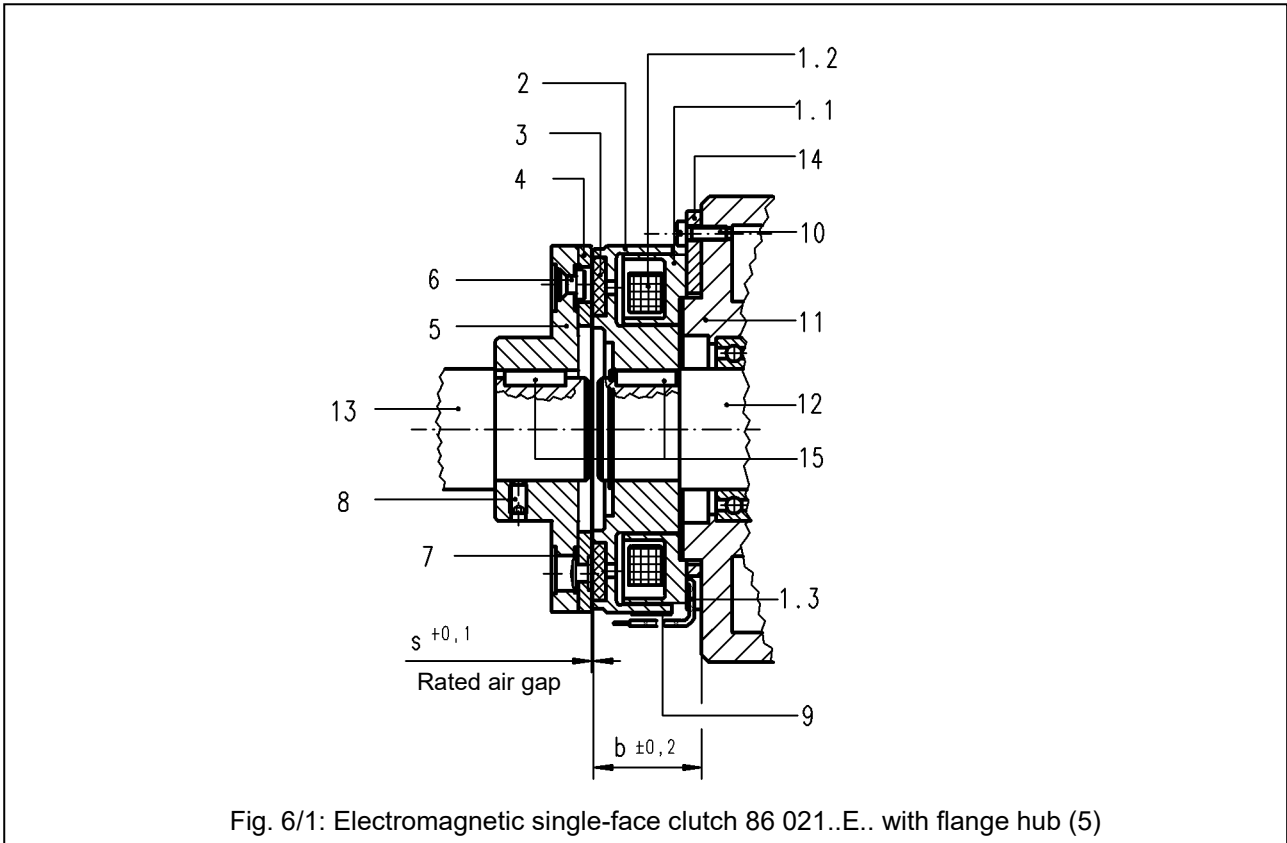
The electromagnetic field force generated when DC voltage is applied to the field coil (1.2) of the electromagnetic single-face clutch attracts the armature (4) and pulls it in frictional contact with the friction lining (3) or magnet body (2), causing the clutch to engage. Except for the minimal force exerted by the segment springs (7), the output shaft (13) and drive shaft (12) are not exposed to any other axial force.

List of reference numerals in Fig. 6/1:

1.1	Magnet housing	8	Set screw
1.2	Field coil	9	Rating plate
1.3	Wire leads	10	Mounting screw
2	Magnet body	11	Fixture for flange (14)
3	Friction lining	12	Drive shaft
4	Armature	13	Output shaft
5	Flange hub ¹⁾	14	Flange
6	Rivet fastener ²⁾ , socket head cap screw	15	Feather key
7	Segment spring		

Table 5/1: List of reference numerals of electromagnetic single-face clutch

- 1) Clutches with armature systems equipped with Kendrion flange hub (5) or customer-specific flange hub version
- 2) Only in armature systems equipped with Kendrion flange hub (5); rivet fasteners (6) for fixing the segment spring (7) on the armature (4) plus rivet fasteners (6) for fixing the segment spring (7) to the flange hub (5). If a customer-specific flange hub version is used, the segment spring (7) is fixed to the flange hub by means of socket head cap screws (6).



3. Installation

3.1 Mechanical installation

After having centred the magnet housing (1.1) with the fixture (11) of the machine (e.g. motor) over the inside or outside housing diameter, screw the entire assembly (without magnet body (2)) with the flange to the mounting surface of the fixture (11) provided on the machine (e.g. motor). Use the mounting screws (10) (e.g. socket head cap screws to ISO 1207, property class 5.8) for this purpose. Tighten the mounting screws (10) evenly in several steps. The M_A tightening torques specified for the mounting screws (10) (see Table 9/1) must be strictly observed. After completion of these operations, press the magnet body (2) onto the drive shaft (12) of the machine and secure it axially. The drive shaft (12) features a feather key (15). For uniform loads, the drive shaft should have a j6 tolerance, whereas a k6 tolerance is required for irregular loads. The maximum mismatch (see Table 9/1) between the magnet housing (1.1) and magnet body (2) must not be exceeded.

Armature system with Kendrion flange hub (5):

Slide the flange hub (5) with the armature (4) onto the output shaft (13) of the machine and secure it axially (e.g. by means of a set screw (8)). If a flange hub (5) without keyway is used, press the flange hub (5) onto the output shaft (13) without using a set screw (8). Ensure that the output shaft (13) of the machine is dimensioned in such a way that the rated air gap s_N (see Table 25/1) is achieved automatically when the flange hub (5) is mounted (e.g. output shaft (13) with stop shoulder for flange hub (5)). If there is no stop shoulder, use a feeler gauge or similar instrument for the axial adjustment of the rated air gap s_N (see Table 25/1).



Important!

When the flange hub (5) is in contact with a shaft stop shoulder, use shim rings for adjustment, if necessary.

Armature system without Kendrion flange hub (5) (customer-specific flange hub (5)):

Screw the armature (4) directly to the customer-specific flange hub (5) provided on the machine. Use socket head cap screws (6) to ISO 1207, property class 5.8, for this purpose. For size 07 clutches and over, use socket head cap screws (6) to DIN 7984, property class 8.8. The number of socket head cap screws (6) to be used and the M_A tightening torques are specified in Table 8/1. Apply Loctite 241 to the socket head cap screws (6). Ensure that the customer-specific flange hub (5) of the machine is dimensioned in such a way that correct operation of the armature system is achieved when the armature (4) has been installed. To this end, the customer-specific flange hub (5) must be provided with an undercut, clearing holes and fastening threads as shown in Fig. 7/1. The geometrical dimensions of the customer-specific flange hub (5) are specified in Table 8/1. Ensure that the output shaft (13) of the machine is dimensioned in such a way that the rated air gap s_N (see Table 25/1) is achieved automatically when the customer-specific flange hub (5) is mounted (e.g. output shaft (13) with stop shoulder for flange hub (5)). If there is no stop shoulder, use a feeler gauge or similar instrument for the axial adjustment of the rated air gap s_N (see Table 25/1).



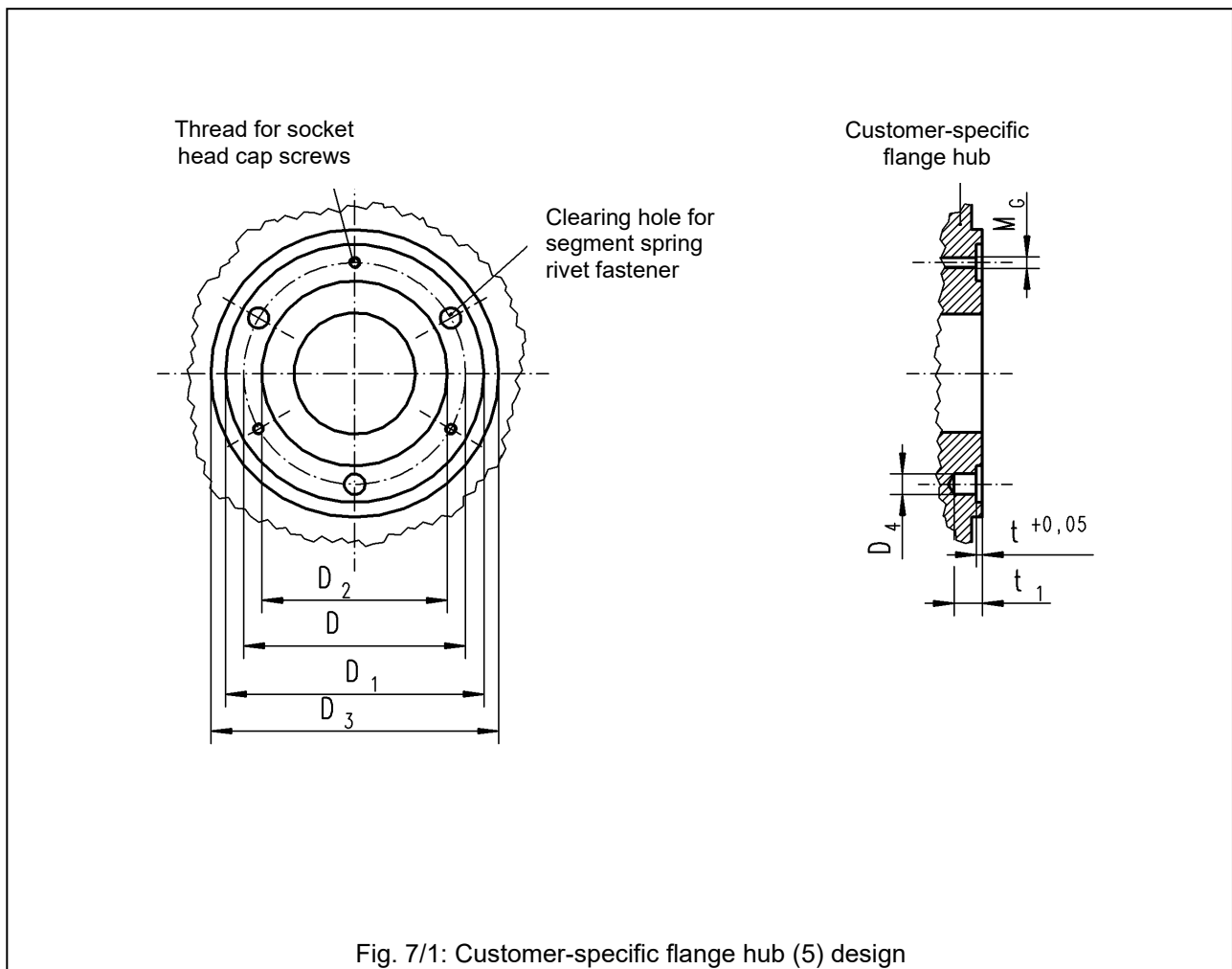
Important!

When the flange hub (5) is in contact with a shaft stop shoulder, use shim rings for adjustment, if necessary.



Important!

If an armature system without Kendrion flange hub (5) is used, make sure to apply Loctite 241 to the socket head cap screws (6) used to fix the armature (4). The depth of the undercut provided for the segment springs (7) must be strictly observed to ensure that the return force required by the segment springs (7) is achieved.



	Clutch size								
	03	04	06	07	09	11	14	17	21
Depth $t^{+0.05}$ of undercut [mm]	0.75	1.3	1	1.2	1.3	1.6	2.3	2.5	2.5
Outside diameter D_1 of undercut [mm]	26	37	54	68	88	108	136	161	186
Inside diameter D_2 of undercut [mm]	11	16	35	46	60	78	98	104	134
Min. diameter D_3 for armature (4) [mm]	28	39.5	56	70	90	110	140	170	202
Depth t_1 of clearing hole for rivet fastener (6) [mm]	2.2	2.2	2.8	2.8	4	5	6	6	7
Diameter D_4 of clearing hole for rivet fastener (6) [mm]	5	7	7	8.5	10.5	12	16	16	18
Number of clearing holes for rivet fastener (6)	2x180°	2x180°	3x120°	3x120°	3x120°	3x120°	3x120°	3x120°	3x120°
Pitch circle diameter D [mm]	19.5	29	46	60	76	95	120	135	158
Thread of socket head cap screws (6) M_G	M2	M3	M3	M4	M5	M6	M8	M8	M10
Number of socket head cap screws (6)	2	2	3	3	3	3	3	3	3
M_A tightening torque of socket head cap screws (6) [Nm]	0.23	0.9	0.9	3.3	6.5	11	27	27	53

Table 8/1: Customer-specific flange hub (5) design specifications for armature systems without Kendrion flange hub (5): thread size, number of socket head cap screws (6), M_A tightening torques of socket head cap screws (6)



Important!

The air gap must not be larger or smaller than the rated air gap s_N (see Table 25/1). The assembled components, especially the friction surface, must be free of oil and grease. The axial runout of the mounting surface relative to the drive shaft (12) must be less than 0.1 mm (measuring radius = pitch circle). During clutch installation, all parts must be axially secured and axial bearing play must be eliminated. During installation of the Kendrion or customer-specific flange hub (5) with armature (4), deformation of the segment springs (7) must be avoided.



Warning!

If a flange hub (5) without keyway is used, the output shaft (13) and flange hub (5) must be fitted together in such a way that reliable transmission of the generated clutch torques is ensured.



Notice!

The maximum axial offset between the drive shaft (12) and output shaft (13) must not exceed 0.05 mm. The maximum angular offset must not exceed 10 angular minutes. If greater deviations occur, an additional flexible coupling or compensating coupling will be required.



Important!

When the magnet body (2) is pressed in place, ensure that the pressure force is not transmitted to the magnet body (2) via the outer pole ring. Any impact of the magnet body (2) must be avoided to prevent potential deformation of the friction surfaces and damage to the machine bearings.

	Clutch size								
	03	04	06	07	09	11	14	17	21
Max. mismatch [mm]	0.04	0.04	0.04	0.04	0.04	0.08	0.08	0.08	0.08
Mounting height $b \pm 0.2$ of magnet body (2) [mm]	15	17.5	19	23	24.5	28	33.5	42.5	43
M_A tightening torque of mounting screws (10) [Nm]	0.23	0.23	0.9	0.9	0.9	2	4	7	16

Table 9/1: Max. mismatch between magnet body (2) and magnet housing (1.1), mounting height b of magnet body (2) and M_A tightening torques



Notice!

The M_A tightening torques specified for the mounting screws (10) (see Table 9/1) and socket head cap screws (6) (see Table 8/1 for customer-specific flange hub (5)) must be strictly observed. Tighten the mounting screws (10) and socket head cap screws (6) evenly in several steps.



Important!

Magnetic interference fields may adversely affect reliable clutch operation. Consequently, the clutch should always be installed outside the reach of magnetic interference fields.

3.2 Electrical connection and operation

The electromagnetic single-face clutch must be connected to a DC power source via the wire leads (1.3). Various rectifier versions are available (see examples in Table 9/2) to allow the clutch to be connected directly to an AC power source. Depending on the clutch size and torque, voltage ripple due to intermittent power supply may cause humming or incorrect clutch operation. Reliable operation must be ensured by the user or system manufacturer by providing suitable electrical controls.



Important!

During operation, any contact of the wire leads (1.3) with the rotating armature or other rotating parts must be avoided. Reduce the lead length, if necessary.

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 07.03B0.	bridge	0–500 ($\pm 10\%$)	$U_1 \cdot 0.890$	1.6	2.0
32 073.3B.0	bridge	0–500 ($\pm 10\%$)	$U_1 \cdot 0.890$	1.6	2.0

The relevant rectifier specification sheets must be observed!

Table 9/2: Recommended rectifiers for single-phase AC voltage supply

3.2.1 DC power supply

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



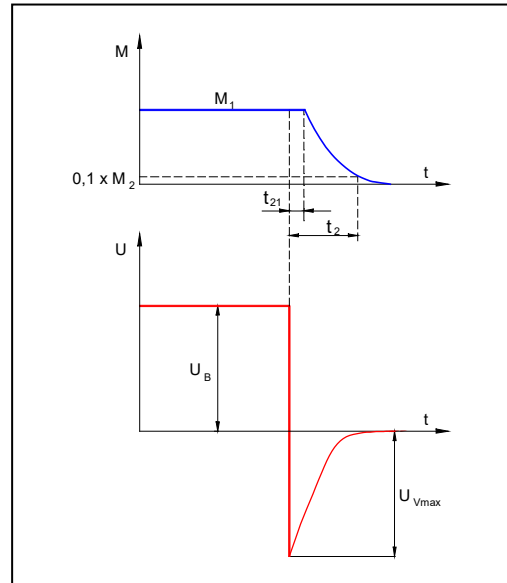
Notice!

The peak voltage U_{Vmax} during turn-off 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 turn-off. Consequently, a protective circuit must be provided to reduce the current during turn-off and to limit the voltage. The maximum permissible overvoltage during turn-off is 1500 V. If Kendrion rectifiers are used (see Table 9/2), 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.



Notice!

Sensitive electronic components (e.g. logical components) may also be damaged at a lower voltage.

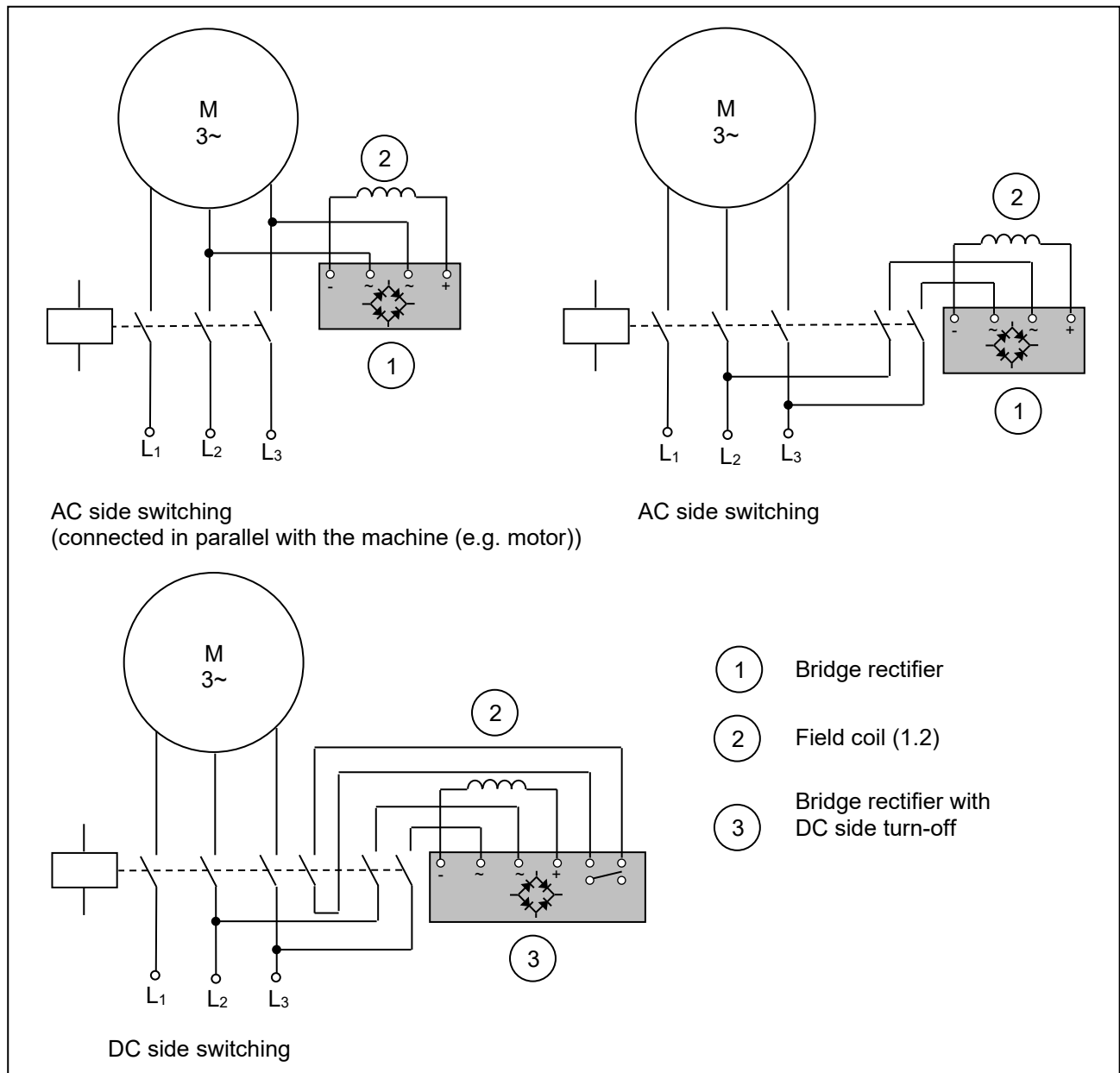


U_B operating voltage (coil voltage)

U_{Vmax} turn-off voltage

3.2.2 AC power supply

Direct clutch connection to an AC power source is only possible if a rectifier is used. Wiring of the clutch in case of single-phase AC power supply must be performed in the same way as with three-phase voltage. The coupling times vary depending on the switching type (DC side switching or AC side switching).



Bridge rectification:

Bridge rectifiers provide voltage with minimum residual ripple. This means that humming can be avoided even if small size clutches 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 clutch 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 clutch 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.



Notice!

In case of DC side switching, the clutch 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.



Warning!

All work must be performed by qualified specialist personnel only. Check that no voltage is present when connecting the component to the power supply. 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 clutch is a DC operated system. Permanent voltage variations on the power source of the electromagnetic clutch must be limited to +/-10% of the rated voltage.

Perform the following checks when connecting the clutch:

- Check that the connecting cables are suitable for the intended use and for the voltage and amperage requirements.
- 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 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 clutch operation must be minimized. Since the clutch 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 clutch. The electromagnetic single-face clutches in the 86 021..E00 series 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 installation. The requirements in terms of electromagnetic compatibility of devices and components are determined by basic standards derived from the generic standards. Wiring recommendations will be provided in the following sections to ensure compliance with the individual basic standards that are relevant for industrial 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 3.2.

Immunity according to EN 61000-4:

EN 61000-4-2 Electrostatic discharge:

The electromagnetic single-face clutches comply at least with severity level 3 without requiring additional measures. The recommended rectifiers specified in Section 3.2 conform to severity level 3 without additional measures.

EN 61000-4-3 Electromagnetic fields:

The clutches 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 clutches 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 clutches 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 clutches are stronger many times over than interference fields, the clutch function will remain unaffected. The clutches 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:

Clutches 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 is required to take adequate precautions to avoid consequential damage (e.g. slip of an electromagnetically engaged system due to torque drop). The functional reliability of the electromagnetic component 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 clutch 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 clutches 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 clutches comply with the limit values applicable to Class B equipment.

b) Conducted interference:
When connected to a DC power source, the electromagnetic clutches meet the limit values applicable to Class A equipment. If the clutches 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. 14/1 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 3.2 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 clutches are used with the specified rectifiers or with other types of rectifiers, the recommended values listed in Table 15/1 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, devices designed to limit the turn-off 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 clutch and increase the generated noise level. The rectifiers specified in Section 3.2 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 15/2.

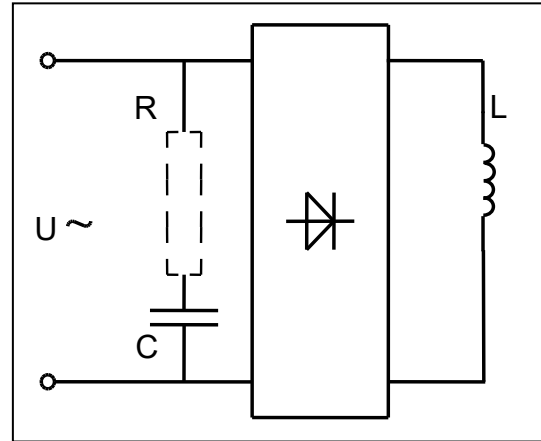


Fig. 14/1

If the clutch 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 will not relieve the user and manufacturer of the installation from their obligation to furnish proof of conformity of the installation with such standards.

Rectifier series	Rated input voltage range U ₁ /VAC (40–60 Hz)	DC at L-load (ADC)	Capacitor (nF/VAC)
Bridge rectifier 32 073.3B.0	up to 500 (±10%)	up to 2.0	no additional interference suppression measures required
Bridge rectifier 32 07.03B0.	up to 500 (±10%)	up to 2.0	no additional interference suppression measures required

Table 15/1

Max. rectifier operating voltage (VAC)	Recommended turn-off voltage for DC side switching (V)
250	700
440	1200
550	1500

Table 15/2

3.4 Putting into service



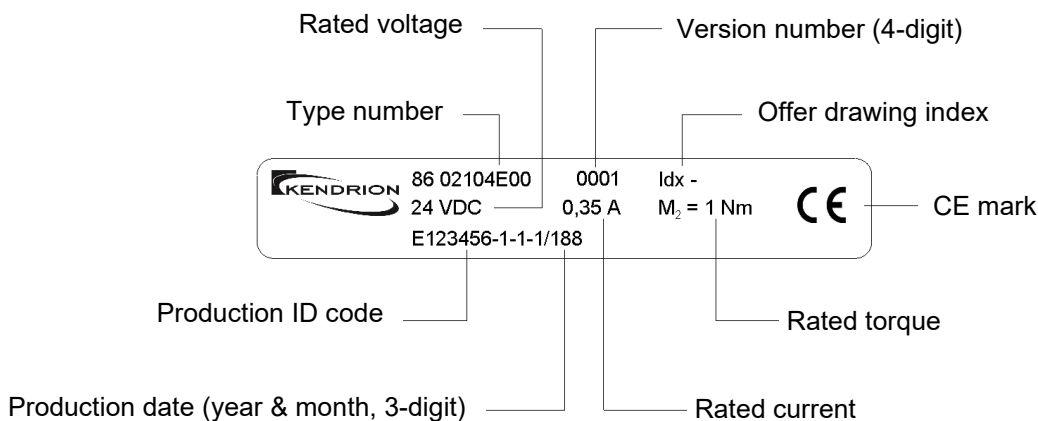
Warning!

Functional testing of the clutch must not be performed unless the machine (e.g. motor) has been turned off and secured so that it cannot be turned back on inadvertently or by unauthorized persons.

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 clutch, a functional test must be performed to check that the output shaft (13) rotates smoothly. For this purpose, turn the shaft (13) while the clutch and the machine (e.g. motor) are unpowered. After completion of assembly, all necessary covers and guards must be installed.

Specifications on the rating plate (subject to order, example clutch type 86 02104E00):



Note: The product number of the electromagnetic single-face clutch consists of the type number followed by the version number, e.g. 86 02104E00-0001.



Warning!

Before starting the test run of the machine (e.g. motor) without driven components, the feather key (if used) must be secured in such a way that it cannot be hurled out. The output shaft (13) must not be exposed to load torques. Before the machine is re-started, the clutch must be energized.



Caution!

The clutch 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 hot 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 clutch must be unpowered and disengaged.



Notice!

High-voltage tests performed when mounting the clutch in an installation or when putting the clutch into service 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.



Notice!

Check that the clutch has been connected to the power source in accordance with the specifications provided on the rating plate before it is put into service. Even short-term operation outside the specified supply voltage limits may cause irreversible damage to the clutch or electronic accessories. Such damage may not be apparent immediately. DC side switching of the clutch without protective circuit as described in Section 3.3 will cause damage to electronic rectifiers, electronic accessories, switching contacts and to the field coil (1.2).

4. Maintenance

4.1 Checks and service

The electromagnetic single-face clutch does not require any particular maintenance except that the air gap 's' must be measured at regular intervals. When the maximum air gap s_{max} (see Table 25/1) between the armature (4) and magnet body (2) of the electromagnetic single-face clutch has been reached, the clutch must be adjusted or replaced by a new one. Follow the instructions in Section 3.1 (Mechanical installation) to adjust or correct the air gap 's'. For information on the rated air gap, please refer to Table 25/1. If the clutch is not operated for a long period of time, the pole faces may corrode and reduce the torque. A short break-in process (see Table 25/2) will restore correct and reliable clutch operation.



Important!

Replace the clutch by a new one after the air gap 's' has been adjusted (corrected) twice.



Notice!

The M_A tightening torques specified for the mounting screws (10) (see Table 9/1) and socket head cap screws (6) (see Table 8/1 for customer-specific flange hub (5)) must be strictly observed. Tighten the mounting screws (10) and socket head cap screws (6) evenly in several steps.



Caution!

Depending on its operating condition, engagement of the electromagnetic single-face clutch may no longer be possible when the maximum air gap s_{max} (see Table 25/1) has been exceeded. This may affect the reliability of the clutch system.



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 of grease and oil. An oily or greasy friction surface cannot be cleaned.
- no swelling or glazing of the friction lining has occurred.

4.2 Spare parts and accessories

The electromagnetic single-face clutch does not require any maintenance, provided it is used in accordance with its intended use. If defects occur on the clutch or individual components, the entire clutch needs to be replaced. Individual spare parts or accessories are not available for the clutch.

5. Condition at delivery, transport and storage

Upon receipt of the shipment, the clutch must be checked for transit damage before storage. The electromagnetic single-face clutch is delivered ready for mounting. The air gap 's' (see Table 25/1 for rated air gap specification) must be adjusted during clutch installation. After the clutch has been mounted, it requires a break-in process using the break-in parameters specified in Table 25/2.



Important!

The excitation system of the clutch and the flange hub with armature (if a Kendrion flange hub is used) are factory-adjusted to ensure reliable clutch release (opening). Consequently, individual component parts cannot be replaced. If the clutch is not installed immediately upon delivery, it must be stored in a dry, dust-free and vibration-proof place.



Important!

The environmental conditions specified in Table 17/1 and in EN IEC 60721-3-2 / EN IEC 60721-3-1 must be considered during transport and storage of the clutch, especially when long-term storage is envisaged. The specified environmental conditions apply only if the clutch is stored in its original packaging.

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

Table 17/1: 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 electromagnetic single-face clutch 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 mounting position, operating conditions and state of the friction surfaces, audible vibrations (squealing) may be produced during clutch operation.

6.2 Heat

Clutch operation and gradual heating of the field coil cause the temperature of the magnet housing and magnet body 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
Clutch engagement failure	• Air gap too large	Check the air gap and adjust it, if necessary. Install a new clutch, if necessary.
	• No voltage applied to clutch	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.
	• Damaged rectifier	Check the rectifier and replace it, if necessary.
	• Damaged field coil	Check the resistance of the field coil. Install a new clutch, if necessary.
Delayed clutch engagement	• Air gap too large	Check the air gap and adjust it, if necessary. Install a new clutch, if necessary.
	• Voltage applied to field coil too low	Check the field coil supply voltage and correct faults, if found.
Clutch release 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 due to fusing of armature and magnet body	Separate the armature from the magnet body. Install a new clutch, if necessary.
Delayed clutch release	• Voltage applied to field coil too high	Check the field coil supply voltage and correct faults, if found.
Clutch torque too low	• Air gap too large	Check the air gap and adjust it, if necessary. Install a new clutch, if necessary.
	• Clutch operating temperature too high	Reduce the clutch switching work / switching power. Cool the clutch, if necessary.
	• Voltage applied to field coil too low	Check the field coil supply voltage and correct faults, if found.
	• Friction lining projects from pole faces	Install a new clutch, if necessary.
	• Friction surface thermally overloaded	Install a new clutch.
	• Oily or greasy friction surfaces	Check the friction surfaces. Install a new clutch, if necessary.

Table 19/1: Possible faults, causes and corrective actions (list not exhaustive)

8. Safety

The components 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 machine owner 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 monitor their implementation.

The machine owner is required to ensure that:

- the clutches are only used in accordance with their intended use (see Section 2).
- the components 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 components at all times.
- putting into service, maintenance and repair are only performed 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 components are not exposed to other strong magnetic fields.

8.1 Intended use

The components described in these operating instructions are intended to be assembled with electric machinery, specifically electric motors, for use in industrial installations. Operation in potentially explosive or firedamp atmospheres is strictly forbidden. The components must be used in accordance with the operating requirements detailed in these operating instructions. The specified rated power limits must not be exceeded.

8.2 General safety information

Clutches fitted to motors feature hazardous live components and rotating parts and may exhibit hot surfaces. Any work associated with the transport, connection, putting into service and periodical maintenance of the clutches must be carried out by authorized and suitably qualified specialist personnel in accordance with EN 50110-1, EN 501102 and IEC 60364-1. Failure to observe safety, operating and maintenance instructions may cause serious personal injury and property damage. Whenever special measures are required in accordance with the instructions contained herein, such measures should be agreed with the clutch manufacturer before setting up the machinery into which the clutch is to be incorporated. 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 clutch. Retrofitting or modification work to be carried out on the clutch is subject to the approval from Kendrion (Villingen). Accident prevention regulations applying to the specific field of application must be strictly observed. The clutches described in this manual are **not designed for use as “safety components”**. 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 permissible 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 machinery and installations (jog mode). Failure to observe these instructions may irreversibly affect reliable clutch operation and cause malfunctions. The rated 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. Bear in mind that the armature may freeze to the flange hub if ambient temperatures fall below -5°C or if the clutch remains unpowered for prolonged periods of time. In this case, special precautions must be taken after consultation with the manufacturer.

8.2.2 Putting into service

Do not put the components into service if:

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

8.2.3 Assembly

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

Adequate safety measures (to DIN VDE 0848-4; DIN 31000 / VDE 1000; DIN VDE 0100-420) must be taken by the clutch user to avoid hazards to persons or property damage caused by:

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

8.2.4 Operation and use

Ensure that live components such as plug contacts or the field coil are not exposed to water. The clutch 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 clutch wear (only with dynamic clutches) must be taken into consideration in the set-up of the machine or overall system. Due to the diverse ambient conditions in which the clutches may be used, always check that the clutch is in perfect working order before putting it into service. Torque reductions cannot be excluded if the clutch is used for applications where only minimum friction work is required. In such cases, the user should ensure that the clutch occasionally performs sufficient friction work.



Important!

The clutch must be operated at an ambient temperature of between -5°C and $+35^{\circ}\text{C}$ and at a relative humidity of between 30% and 80% within the ambient temperature range.



Notice!

During clutch 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 25/1). Fast cooling of the field coil with scavenging air is not allowed. Ensure that the permissible relative humidity range (see Table 26/1) is not exceeded.



Notice!

A maximum 6g continual shock load over a service life of 20,000 operating hours is permitted for the clutch. The armature connection, hub connection and power supply connections are subject to the user's approval. Vibration loads with a maximum excursion of 1.5 mm and a maximum 6g acceleration are permitted within a frequency band of 10 to 2000 Hz.



Important!

The clutch, and more specifically the armature, is not subject to specific requirements in terms of the balance quality grade to DIN ISO 21940-11. Consequently, the required balance quality must be agreed between the manufacturer and customer in each individual case.



Important!

The maximum air gap s_{max} (see Table 25/1) must not be exceeded throughout the entire clutch service life. Please refer to Section 4 (Maintenance) for details.



Important!

The M_2 rated torque (see Table 25/1) is not fully reached until the break-in process has been completed (burnishing of friction surfaces). The break-in parameters are specified in Table 25/2. Before the clutch is first used, the break-in process must be conducted by the product owner.

8.2.5 Maintenance, repair and replacement

Service, maintenance, repair or replacement of the components must only be carried out by qualified specialist personnel in accordance with EN 50110-1, EN 50110-2 and IEC 60364-1. Failure to perform repairs according to the relevant requirements may cause serious personal injury or property damage. Make sure that the components are unpowered when carrying out maintenance work.

8.3 Symbols, signs and signal words in safety messages

Personal injury and property damage			
	Symbol / Signal word	Indicates...	Potential consequences
	Danger	an imminent hazardous situation which, if not avoided, will result in death or serious injury	Death or serious injury
	Warning	a potentially hazardous situation which, if not avoided, could result in death or serious injury	Death or serious injury
	Caution	a potentially hazardous situation which, if not avoided, could result in minor or moderate injury	Minor or moderate injury
	Notice	potential property damage or environmental damage	Damage to the component or to the environment
Information			
	Symbol / Signal word	Provides...	
		Important information on the safe use and operation of the component	

9. 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 device or component. The rated torque M_2 is the mean value of at least three 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 permissible 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 coils 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 field coils.

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

10. Technical specifications

Product built and tested to DIN VDE 0580

	Clutch size								
	03	04	06	07	09	11	14	17	21
Rated torque M_2 [Nm]	0.2	1	2.2	5	11	21	60	80	150
Max. speed n_{max} [rpm]	16000	12000	10000	8000	6000	4800	3600	3000	2500
Max. switching power P_{max} [kJ/h]	65	100	160	250	350	500	700	1000	1300
Max. switching work W_{max} (Z=1) [kJ]	0.9	1.6	4.5	6	11	30	53	80	110
Rated power P_N [W]	6	8	10	12	17	22	35	40	45
Coupling time t_1 [ms]	13	15	15	25	45	70	110	110	150
Disconnection time t_2 [ms]	12	16	18	25	38	40	65	70	90
Moment of inertia J [kgcm ²] – armature (without flange hub)	0.01	0.05	0.22	0.65	2.1	5.7	20	48	97
Moment of inertia J [kgcm ²] – magnet body	0.06	0.17	0.55	2.45	7	20	36	85	217
Weight (without flange hub) m [kg]	0.06	0.15	0.35	0.65	1.15	2	4	7.4	11
Rated air gap $s_N^{+0.1}$ [mm]	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4
Max. air gap s_{max} [mm] (at 70% of rated current)	0.45	0.5	0.5	0.5	0.75	0.75	0.75	0.75	1.0
Duty cycle [%]	100								
Standard rated voltage [VDC]	24								
Thermal class	F								
Pollution degree	2								
Protection rating	IP00								
Duty type / Clutch type	dynamic clutch								

Table 25/1: Technical specifications

	Clutch size								
	03	04	06	07	09	11	14	17	21
Speed n [rpm]	1000	1000	1000	1000	1000	1000	1000	1000	1000
Coil ON time t_5 [s]	1	1	1	1	1	1	1	1	1
Coil OFF time t_6 [s]	0.8	0.8	1.5	2.5	5	6	17	17	21
Break-in period t_{total} [min]	approx. 0.75	approx. 0.75	approx. 1	approx. 1.5	approx. 2.5	approx. 3	approx. 7.5	approx. 7.5	approx. 9

Table 25/2: Break-in process parameters for the electromagnetic single-face clutch

Rated operating conditions	
Rated voltage tolerance	±10%
Frequency range	±1% of rated frequency
Ambient temperature ϑ_{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 26/1: Rated operating conditions for electromagnetic single-face clutch

Explanations of technical specifications:

W_{max} (maximum switching work) is the switching work that must not be exceeded during clutch operations at max. 1000 rpm. Clutch operations at speeds greater than 1000 rpm substantially reduce the maximum permitted switching work per switching operation. Such operation must be agreed with the manufacturer. The maximum switching power P_{max} is the switching work W that can be converted by the clutch per hour. In case of applications where the number of switching operations per hour is $Z > 1$, Fig. 26/1 applies. The P_{max} and W_{max} values are approximate values. The specified times apply to the following conditions: DC side clutch switching, operating temperature, rated voltage, and rated air gap. All values are mean values that are subject to variation. In case of AC side clutch switching, the disconnection time t_2 is substantially longer. The specified rated torques M_2 characterize the torque level. Depending on the application the clutch is used for, the switching torque M_1 and the transmissible torque M_4 may differ from the specified M_2 values. The switching torque M_1 depends on the speed (rpm). If the friction surfaces are contaminated with oil, grease or dirt, 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 25/2).

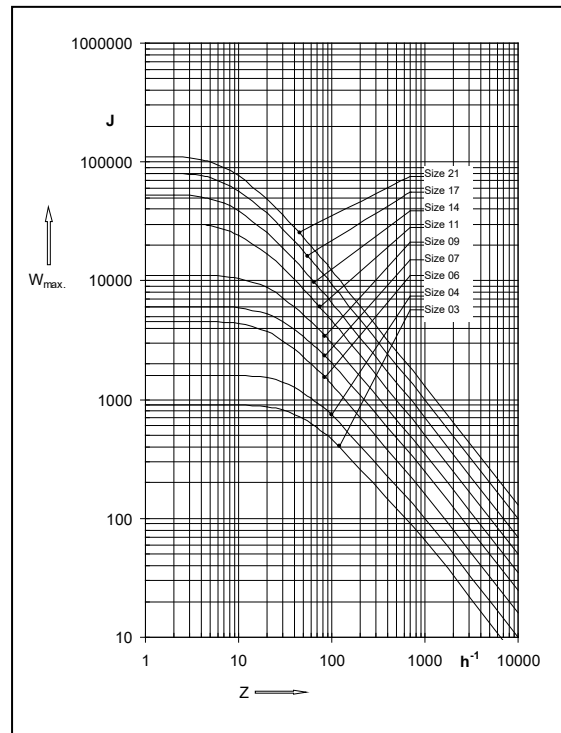


Fig. 26/1: Max. switching work W_{max} per switching operation as a function of the number of switching operations per hour Z (values based on $n = 1000$ rpm)

Note: A current level corresponding to 70% of the rated current is reached when the electromagnetic single-face clutch is operated at rated voltage and at a coil temperature of 130°C.

The rated operating conditions specified in Table 26/1 must be strictly observed during operation of the electromagnetic single-face clutch. The **ACTIVE CLUTCH LINE specification sheet** and offer drawing for the specific clutch types must be followed.

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 clutch version consists of the type number followed by the 4-digit version number. Individual clutch types may be available in different versions. So the version number identifies the relevant clutch model.

Example:

Type number: 86 02104E00

Version number: 0001

Product number: 86 02104E00-0001

12. Specialist repair shops

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13. Revision history

Date of issue	Changes
06/03/2002	First issue
03/03/2003	Text revisions
15/12/2004	Updated Section 2.2 (Clutch design) and Section 3.2 (Electrical connection) Service life specification deleted in Section 10 (Technical specifications) Text revisions
30/12/2009	Added ACTIVE CLUTCH LINE Revised EC Machinery Directive Text revisions
11/05/2010	Added device 86 02111E06 Added ambient temperature range (Technical specifications)
08/03/2016	Company name changed to Kendrion (Villingen) GmbH Added EC Declaration of Conformity Added Section 11 (Product number) Text revisions
28/02/2019	Added EU Declaration of Conformity with Low Voltage Directive 2014/35/EU and RoHS Directive 2011/65/EU Updated reference to standards and directives (EMC Directive 2014/30/EU etc.) Added example of rating plate Changed layout (design) of operating instructions Heading of Section 5 changed from "Condition at delivery" to "Condition at delivery, transport and storage"
13/03/2020	Text revisions Changed layout (design) of operating instructions

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