Rexroth
Bosch Group

Rexroth MKE synchronous motors for potentially hazardous areas

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Project Planning Manual

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The purpose of the documentation:

This document assists in

- familiarization with MKE AC motors
- mechanical integration into the machine
- planning of the electrical connections
- connecting the motor
- ordering or identifying a motor
- determining the required motor cables and connectors

Editing sequence

Document designations of previous editions	Status	Comments
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Contents

1 Introduction to MKE digital AC motors

1.1 General features

Applications

In conjunction with digital intelligent INDRAMAT drive controllers, MKE digital AC motors create cost-effective drive systems with a broad range of functionalities for use in potentially explosive areas.

Overview of performance

Motors with the following continuous standstill torques and nominal speeds are available:

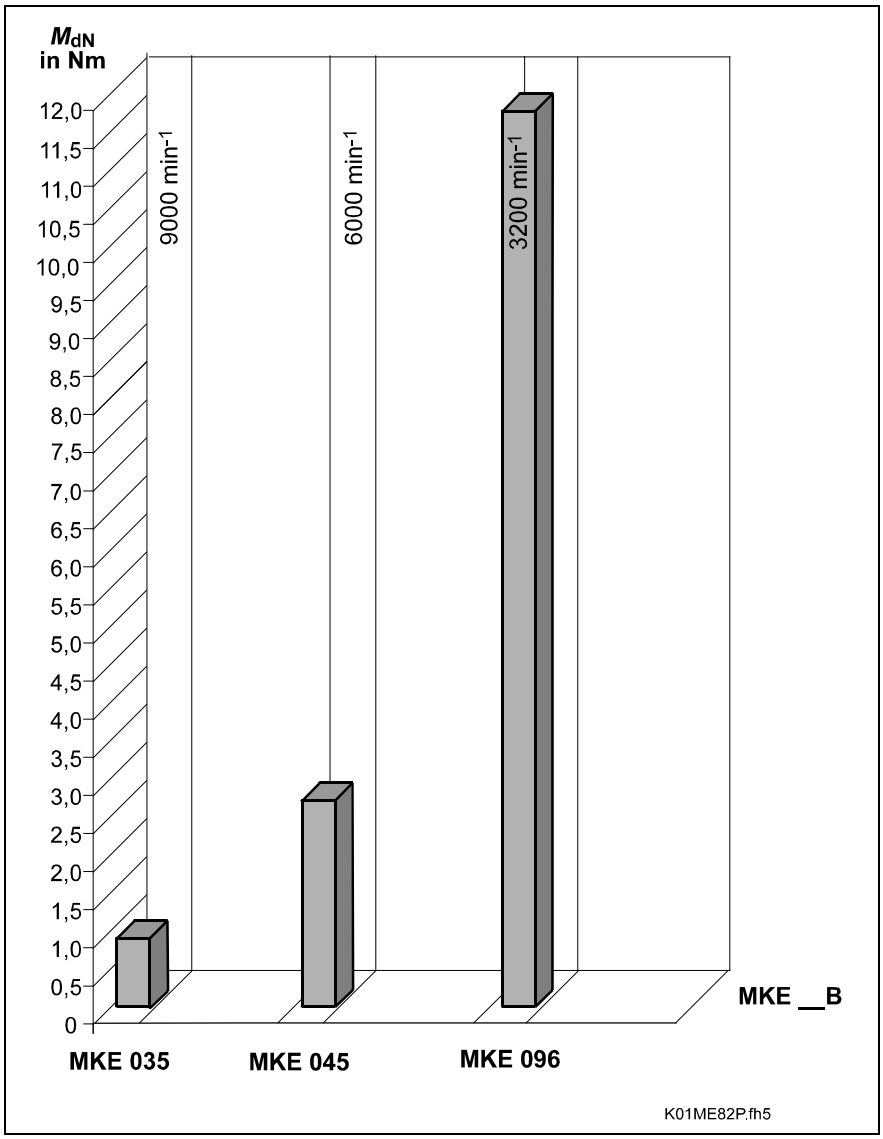


Fig. 1-1: Continuous torque at standstill of the available MKE motors

Advantages

The salient advantages of MKE motors are as follows:

- motors designed with „pressure-resistant housing“ as per EN 50014 ff
- extreme operating reliability
- maintenance-free operation (due to the brushless design and use of lifetime lubricated bearings)
- implementation even under adverse environmental conditions (due to the completely sealed motor design with protection category IP 65)
- overload protection (accomplished with motor temperature monitoring)
- high power data
- high dynamics (as a result of favorable power to weight ratio)
- high overload capacities (due to favorable heat conduction from the stator winding to the outside wall of the motor)
- peak torque which can be used over a broad rotational speed range (accomplished with electronic commutation)
- continuous start-stop operations with high repetitive frequencies is possible (accomplished with electronic commutation)
- easy mounting to the machine (with a flange as per DIN 42948)
- any mounting orientation
- pinions and belt pulleys can be directly mounted (the design of the bearing shaft accomodates high radial loads)
- simple cabling (accomplished with ready-made cables available in various designs)
- simple and rapid commissioning (as a result of data storage capabilities in the motor feedback)

Structure and components

MKE motors are permanent magnet-excited motors with electronic commutation. Special magnetic materials perwith a design with low inertia. The following illustrates the principle structure of MKE motors.

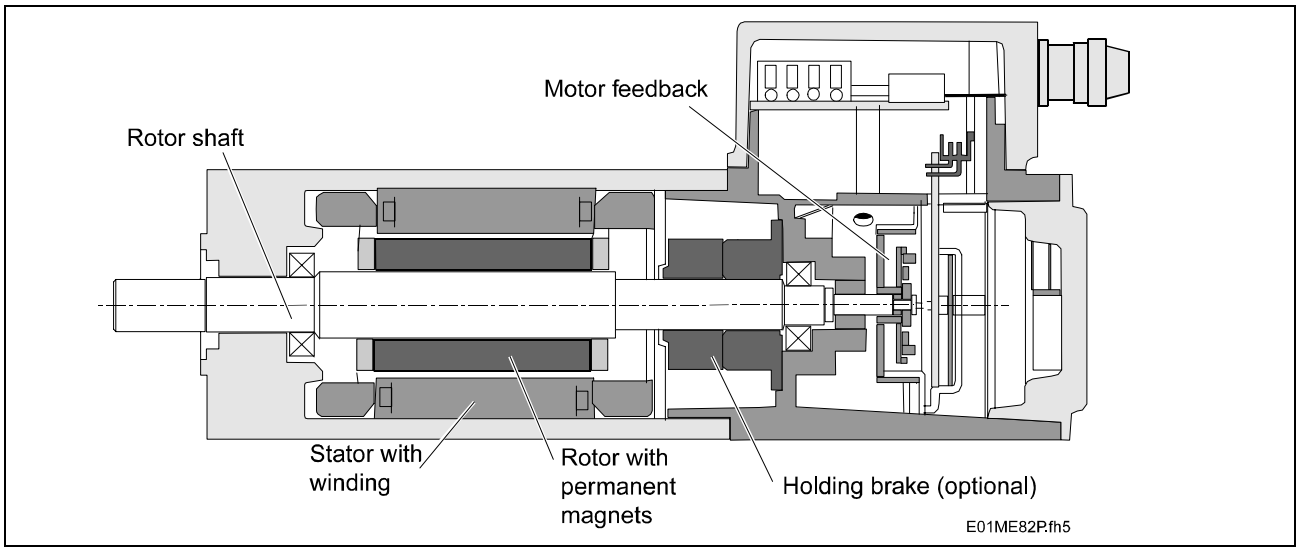


Fig. 1-2: The structure of MKE motors

MKE motors are intended for use with the following drive controllers:

Drive controller family	DIAX04	ECODRIVE
Drive controller	HDS HDD	DKC

Fig. 1-2: Drive controllers for MKE motors

1.2 Versions

MKE motors are available in different versions:

Motor feedback They are available with

- relative rotor position evaluation (standard) or
- absolute rotor position evaluation (optional).

For details see section 1.3.

Holding brakes Optional. For a safe holding of the axes at standstill when power to the motor is shutdown. See section 2.5 for details.

Output shaft They are available with

- plain shaft (standard) or
- shaft with keyway (optional).

For details see section 2.4.

Electrical connections These are motor-specific implementing either

- a terminal box

For details see section 11.4,,Connecting the motor“, Page 11-2.

1.3 Motor feedback

The drive controller requires the current position of the motor to regulate motor speed or when positioning the motor. The integrated motor feedback makes available to the drive controller such signals as are needed to perform this function. The drive controllers are, in turn, equipped to transmit the thus determined position value to a superordinate CNC or PLC.

Feedback data storage

Feedback electronics are equipped with data memory in which motor type designations, control loops and motor parameters are stored.

The digital intelligent drive controllers from INDRAMAT can read this data thus guaranteeing

- an easy and quick startup
- an automatic adjustment between motor and drive controllers, avoiding any damage to the motor.

MKE motors are available with two position evaluation options, viz.,

- relative position evaluation and
- absolute position evaluation.

Technical data of the motor feedback

Designation	Resolver feedback (RSF)	Resolver feedback (RSF) with integrated multiturn absolute encoder
measuring principle	inductive	
position resolution at the motor	MKE035, 045: 3 x 2^{13} = 24 576 MKE096: 4 x 2^{13} = 32 768 information/rotations	
system accuracy	±8 angle minutes	
position detection type	relative	absolute (within 4096 motor rotations)

Fig. 1-3: Technical data - motor feedback

Resolver feedback (RSF)

For relative indirect position evaluation. Replaces a separate incremental encoder on the motor.

Features of the digital resolver feedback: Given a power failure or after the initial POWER ON, it is necessary to first run the axis to its reference point before work can begin.

⇒ When placing the reference point switches and during the referencing procedure itself, it must be taken into account that during the course of a mechanical motor revolution, several zero pulses are generated. This is the result of the operating principle of the resolver. Therefore note:

- there are 3 zero pulses per revolution with the MKE 035 and MKE 045
- there are 4 zero pulses per revolution with the MKE 096

⇒ For this reason, avoid transmission ratios that are too large or feed constants that are too small.

Resolver feedback (RSF) with integrated multiturn absolute encoder

For absolute indirect position detection within a range of 4096 motor revolutions. Replaces a separate absolute encoder on the motor.

The absolute axis position of this feedback variant is retained even after power has been shutdown because of the battery backup it is equipped with. The battery has a lifespan of approximately ten years.

2 Mechanical integration into the machine

2.1 Using the drive in potentially explosive areas

The figure below illustrates how to mount the drive in potentially explosive areas. The following components must meet the demands made for explosion protection:

- motor with mountable components
- circuits which lead into the potentially explosive areas

Explosive area

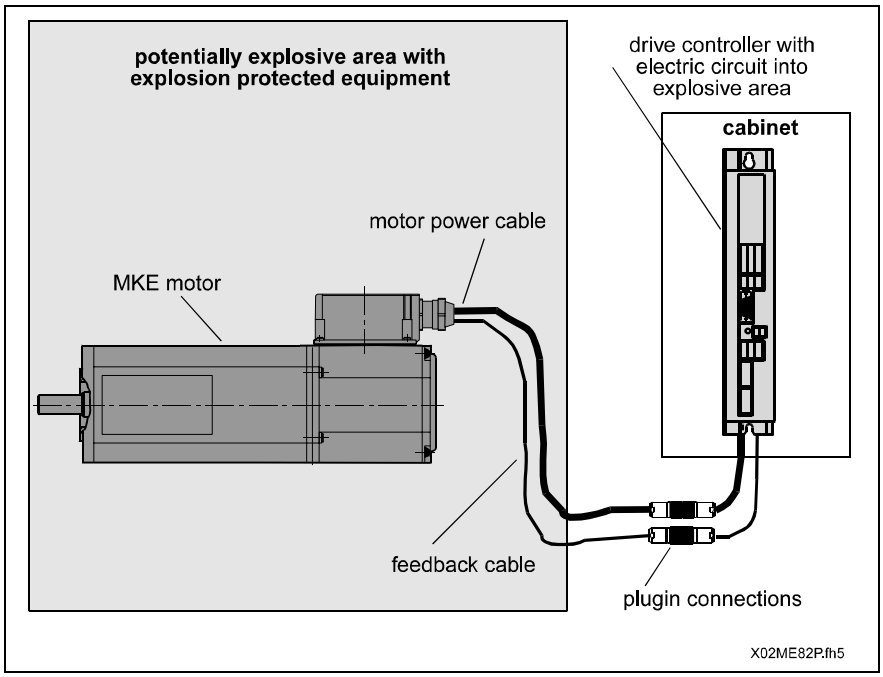


Fig. 2-1: Potentially explosive area

MKE motors are prototype tested as per EN 50014 ff (European standards) and have been released for use in potentially explosive areas. The relevant drive controllers and any plugin connectors for the lines (power and feedback connections) must be situated outside of the potentially dangerous area.

DANGER

Danger of explosion

Danger to life, severe injury and property damage

⇒ Do not install drive controllers and plugin connectors within the hazardous area.

⇒ Make sure that plugin connectors do not end up in the hazardous area.

⇒ Do not pull plugin connectors when machine is live!

⇒ Make sure that sparks cannot be generated in the hazardous area.

2.2 Conditions of Use

Maximum installation elevation and ambient temperature

Nominal data

The power data of the motor apply to

- an ambient temperature range of 0º to +40º C
- and an installation elevation of 0 to 1000 meters above sea level.

Exceeding nominal data

If the motor is to be used above this range, then the "load factors" must be taken into consideration. This derates the output data.

⇒ In cases like this, check whether the output data still suffice for your application. To determine the load factors, see Fig. 2-2. Values higher than those depicted are not permitted!

WARNING

Motor damage and forfeiture of guarantee!

Motors used outside of the specified conditions could be damaged. Such use also results in forfeiture of guarantee.

⇒ Please therefore note the following instructions!

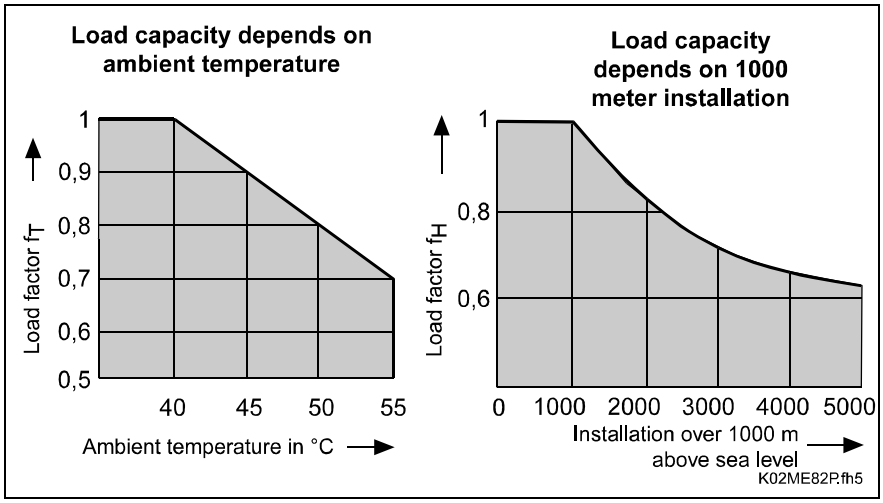


Fig. 2-2: Load factors as dependent on ambient temperature and installation elevation

If **either** ambient temperature **or** installation elevation exceed nominal ratings then:

⇒ Multiply the continuous standstill torque listed in the selection data with the determined load factor .

⇒ Make sure that the derated torque is not exceeded by your application.

If **both** ambient temperature **and** installation elevation exceed nominal ratings then:

⇒ Multiply the determined load factors f_T and f_H.

⇒ Multiple the determined value by the continuous standstill torque of the motor indicated in the selection data.

⇒ Make sure that the derated torque is not exceeded by your application.

Protection category

The design of MKE motors meets the protection category requirements as described in DIN VDE 0470, section 1, edition 11/1992:

Area of the motor	Protection category
Motor housing, drive shaft, power & feedback connections (only with proper mounting)	IP 65

Fig. 2-3: Protection category of MKE motors

The protection category is defined with the letters IP (**I**nternational **P**rotection) and two digits for the protection category.

The **first digit** denotes the protection level against contact and penetration of extrinsic objects. Thus,

a 6 means

- protection against penetration by dust (dust-proof)
- and complete contact protection.

The **second digit** denotes the protection level against water. Thus,

a 5 means

- protection against a jet of water ejected out of a nozzle, sprayed at the housing from all directions (jet of water).

WARNING

Danger to personnel or damage to property!
Improperly mounted power and feedback connections can injure personnel or damage the motor!

⇒ Make sure that the power and feedback connections are mounted by properly trained personnel.

⇒ Use MKE motors only in an environment where the indicated protection categories can be ensured.

Maximum vibration and shock requirements

Note: MKE motors may be used in areas with excessive vibrations and shocks as per IEC 721-3-3, edition 1987 or EN 60721-3-3, edition 06/1994 as per the following table. All mounting should be shock absorbent. The structure of mountable components depends on the application, whereby testing may be necessary.

WARNING

Motor damage and forfeiture of guarantee!
Motors operated outside of specified ambient conditions could be damaged. The guarantee is also forfeited.

⇒ Please therefore note the following instructions!

According to IEC 721-3-3, edition 1987 or EN 60721-3-3, edition 06/1994, MKE motors may be operated in a stationary and weather protected manner under the following conditions:

- longitundinal axis of the motor as per class 3M1
- lateral axis of the motor as per class 3M4

⇒ Make sure that, in terms of storage, transport and operation, MKE motors do not exceed values as depicted in Fig. 2-4: Limit data for sinusoidal oscillations and Fig. 2-5: Limit data of shock loads.

Influencing variable	**Unit**	**Maximum value of longitundinal axis**	**Maximum value in Lateral axis**
Amplitude of the displacemen at 2 to 9 Hz	mm	0.3	3.0
Amplitude of acceleration at 9 to 200 Hz	m/s²	1	10

Fig. 2-4: Limit data for sinusoidal oscillations

Influencing variable	**Unit**	**Maximum value of longitundinal axis**	**Maximum value of lateral axis**
Total shock-response spectrum (per IEC721-1 ed. 1990; table 1, section 6)		type L	type I
Reference accel (in IEC 721 peak acceleration given)	m/s²	40	100
Duration	ms	22	11

Fig. 2-5: Limit data of shock loads

Primary coat and housing finish

Condition at delivery: primary coat, black (RAL 9005)

Resistance: against weathering, yellowing, chalking, diluted acids and lyes.

An additional coat may be applied to the housing (maximum thickness equals 40 µm).

2.3 Type of construction and mounting orientation

Type of construction: B05 for flange mounting

Orientation: any

Per DIN IEC 34-7, edition 12/1992, the following orientations are permitted:

- IM B5 (horizontal)
- IM V1 (vertical, drive shaft downward)
- IM V3 (vertical, drive shaft upward)

CAUTION

Seeping of liquids!
Motors mounted as per IM V3 are susceptible to seeping liquids that collect over extended periods at the shaft and then penetrate the motor causing damage.

⇒ Make sure that liquids cannot collect at the drive shaft.

2.4 Drive shaft

Available versions

Plain drive shaft

For a backlash free and non-positive transmission of torque.

⇒ Use clamping sets, tension sleeves or other tension elements for coupling pinions, pulleys or other similar drive elements.

Drive shaft with keyway

(Per DIN 6885, sheet 1, edition 08/1968). For a form-fitting transmission of torque with low demands at the shaft/hub joint.

CAUTION

Damage to the shaft!
During powerful reverse operations, the bottom of the key can turn out and reduce the quality of concentricity. Ever-increasing deformations can cause fractures.

⇒ The use of plain shafts is thus recommended.

Shaft loads

Radial and axial forces affect the shaft:

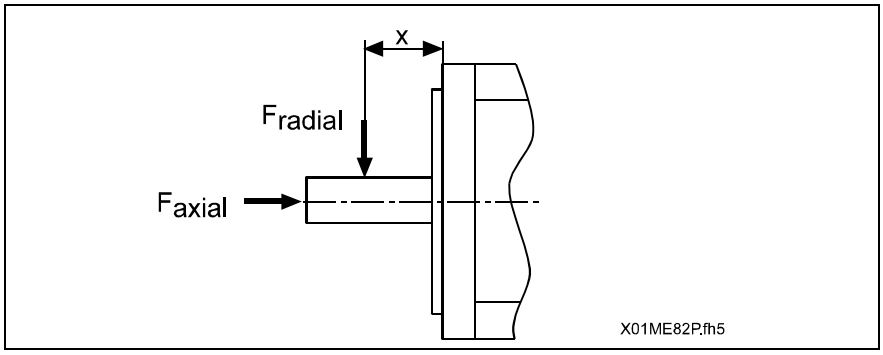


Fig. 2-6: Shaft load forces

WARNING

Motor damage and forfeiture of guarantee!
Excessive shaft loads can damage the motor and shorten bearing life span considerably. The guarantee is also forfeited.

⇒ Please therefore note the following instructions!

Maximum permissible radial force F_{radial}

Maximum permissible radial force F_{radial_max} depends on shaft/force load. It is determined in terms of distance x of the point of application of force and the design of the drive shaft (plain shaft or with keyway).

Sections 4 to 6 contain information on „Determining maximum shaft load".

⇒ Using the characteristics specified, determine the maximum permissible radial force F_{radial_max} for your application.

⇒ Make sure that the radial force thus determined is not exceeded during actual operations.

Permissible radial force F_{radial}

The permissible radial force F_{radial} depends on the bearing lifespan desired. It is dependent on the arithmetic average rotational speed of the motor n_{mittel} and distance x of application point of force (see Fig. 2-6: Shaft load forces).

Sections 4 to 6 contain information on „Determining maximum shaft load".

⇒ Using the characteristics specified, determine the permissible radial force F_{radial_max} for your application.

⇒ Make sure that the radial force thus determined is not exceeded during actual operations.

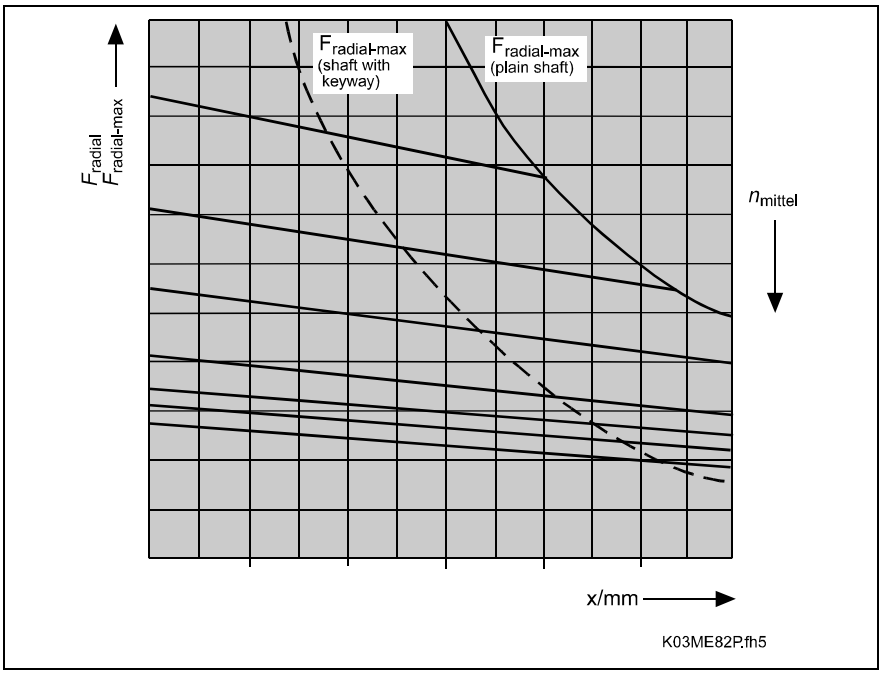


Fig. 2-7: Example to illustrate maximum permissible or permissible radial force

Permissible axial force F_{axial}

It is proportional to the permissible radial force F_{radial} .

The factor of proportionality can be found in sections 4 to 6 in section "Determining maximum shaft load".

⇒ Using the given formula, determine maximum permissible axial force F_{axial} for your application.

⇒ Make sure that the determined axial force is not exceeded during operations. Please note the following on this!

Note: Thermal effects can shift the flanged end of the drive shaft to the motor housing by up to 0.6 mm. If helical toothed drive pinions or bevel gear pinions are used and mounted directly to the output shaft, then these changes in the length can lead to the shifting

- of position of the axis, if the drive pinions are not axially fixed to the machine, or
- a thermally-dependent component of the axial force if the drive pinions are axially fixed machine side. There is the danger, in this case, that the maximum permissible axial force can be exceeded or that the clearance within the toothing is unacceptably increased.

The use of drive elements with bearings which are connected to the motor shaft via an axial compensating coupling is thus recommended.

Bearing lifespan L_{10h}

If permissible radial and axial forces are not exceeded, then the following applies to nominal bearnig lifespan:

L_{10h} = 30,000 operating hours (calculated per ISO 281, edition 12/1990).

Bearing lifespan otherwise drops to:

$$L_{10h} = \left(\frac{F_{radial}}{F_{radial\_ist}} \right)^3 \cdot 30000$$

L_{10h}: bearing lifespan (per ISO 281, edition 12/1990) in hours
F_{radial}: determined permissible radial force in N
F_{radial_ist}: actual effective radial force in N

Fig. 2-8: Calculating bearing lifespan L_{10h} if permissible radial force F_{radial} is exceeded

Note: The actually effective radial force F_{radial_ist} may at no time exceed maximum permissible radial force F_{radial_max}.

Mounting drive elements

Note: When mounting drive elements to the motor shaft, do not use fixed supported bearings, but rather bearings that are simply supported. The indispensable and existing tolerances generate the application of additional forces to the bearings of the motor shaft and possibly lead to a drop in service life. If a fixed type of mounting cannot be avoided, please contact INDRAMAT!

2.5 Holding brake

Optional. Holds the servo axis when no power is being supplied to the machine.

The holding brake works with the "electrically-released" principle. At zero current, a magnetic force acts on the brake armature disc. This means that the brake is locked and holding off the axis.

With the application of 24 V DC, the electrical field cancels the permanent magnetic field and the brake opens.

The drive controller regulates the holding brake. This ensures the correct on and off sequence in all operating states.

DANGER

Falling axes!

Danger to personnel. Body parts could be pinched or severed.

⇒ The holding brake itself does not guarantee personnel safety. Personnel safety must be secured by other measures such as protective bars or an additional brake in the machine.

CAUTION

Premature wear of the holding brake is possible!

The holding brake wears down after approximately 20,000 motor revolutions in a closed state.

⇒ Do not use the holding brake to stop a moving axis. This is only permitted in an emergency stop (E-stop) situation!

Note: If motors are stored for extended periods, then the transferrable torque of the holding brakes must be checked before the motor can be used. If the torque specified in the data sheets is not achieved, then it becomes necessary to refinish the holding brake prior to use.

⇒ Note the guidelines in section 11.5, Refinishing the holding brake, page 11-8.

2.6 Connection variants and cable output directions

A cable connection box is generally used for the MKE motor power and feedback connections. The desired cable output direction can be set at the time of mounting by turning the cable connection box.

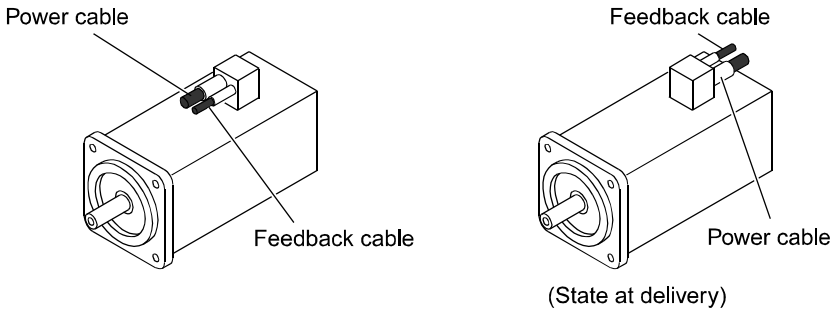
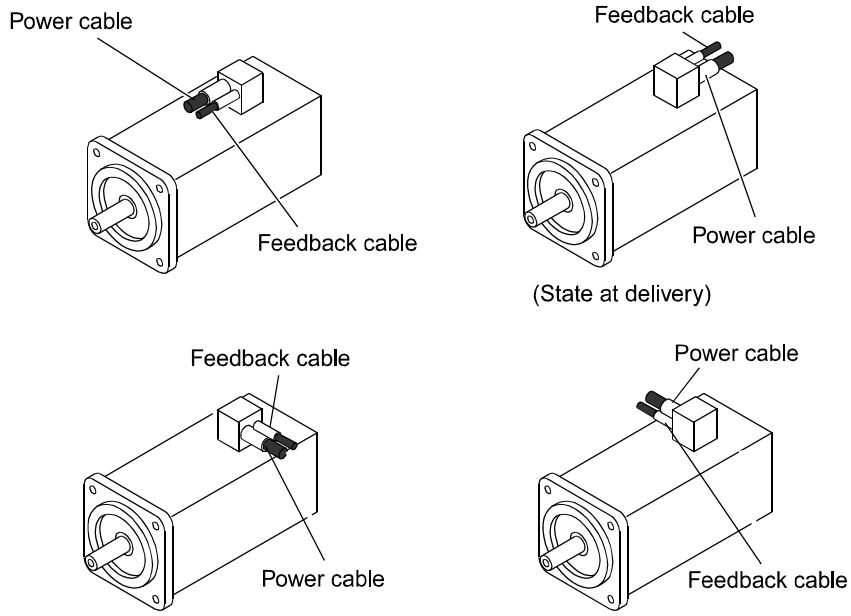
Connection options	Possible output directions
Terminal box (can be turned by 180°) MKE 035, MKE 045	
Terminal box (can be turned in 90° increments) MKE 096	

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Fig. 2-9: Possible cable output directions

Note: The cable output direction set at the factory can be altered at the time of mounting. Please see section, 11.4 „Connecting the motor“, page 11-2.

2.7 Speed and Torque

The rotational speed/torque characteristics depict

- the torque limit data
- the rotational speed limit data and
- operating characteristics

A diagram for each motor can be found in sections 4 to 6 under the topic „Speed/torque characteristics“.

⇒ Use this diagram to:

- Determine maximum usable speed with known torque requirements.
- Check whether the thermal limits of the motor are maintained. The RMS torque for a critical cycle must be below the S1 continuous operating curve (M_{dN}) of the averaged speed (arithmetic average).
- Record information from the selection documentation.

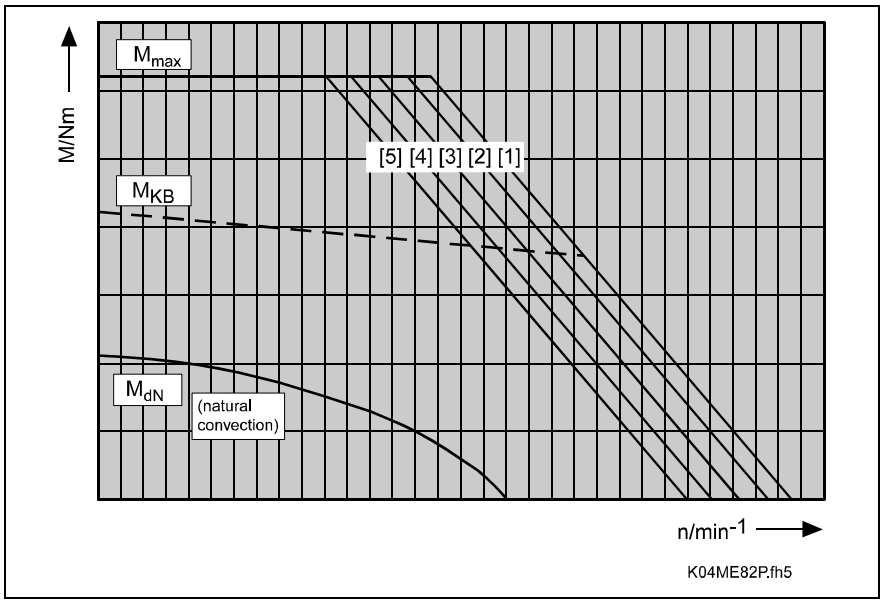


Fig. 2-10: Example diagram to illustrate speed/torque characteristics

M_{max} Corresponds to the theoretically possible maximum torque of the motor. The drive controller can limit it.

Note: The maximum torque of a motor/controller **combination** is always specified in the selection lists.

M_{KB} S6 intermittent operating curve with 25% ON time of the motor cooled with natural convection or 56% ON time of the motor with surface cooling as per DIN VDE 0530, edition 07/1991. Maximum duty cycle time for

- MKE 035: equals 10 minutes
- MKE 045 and 096: equals 15 minutes.

M_{dN} S1 continuous operating curve of the motor (as per DIN VDE 0530, edition 07/1991).

Characteristics (1) to (5)

As of "peak-torque" speed, maximum achievable, usable speed depends on the torque required. Since maximum motor speed is fixed by the DC bus voltage used, separate characteristics result for the individual drive controllers in terms of their supply voltage or the power supply unit used:

(1) **HDS** or **HDD attached to** supply units **HVR**

(2) **HDS** or **HDD** with power supply unit **HVE** with a mains connection of **3 x AC 480 V or- DKC....-...-7** with **3 x AC 480 V**

(3) **HDS** or **HDD** with power supply unit **HVE** with a mains connection of **3 x AC 440 V -or- DKC....-...-7** with **3 x AC 440 V**

(4) **HDS** or **HDD** with power supply unit **HVE** with a mains connection of **3 x AC 400 V -or- DKC....-...-7** with **3 x AC 400 V**

(5) **HDS** or **HDD** with power supply unit **HVE** with a mains connection of **3 x AC 380 V -or- DKC....-...-7** with **3 x AC 380 V**

3 Electrical connections

3.1 Overview of connections

The electrical connections of INDRAMAT drives are standardized. On MKE AC motors there are

- a power connection - includes connections for temperature sensors and holding brake - and
- a feedback connection.

Depending on the motor, both connections are conducted into the cable connection box with the use of EExd-cable leadthroughs, where they are mounted with a plug contact (see section 11.4 „Connecting the motor“, page11-2).

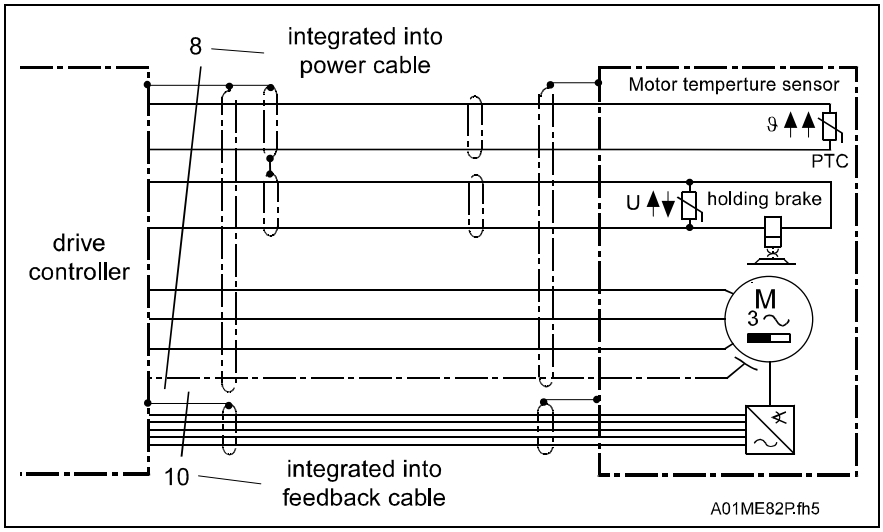


Fig. 3-1: Schematic terminal plan of MKE motors

3.2 Connections for motors with terminal boxes

Terminal diagram

Note: Only direct connections between motor and drive controller are depicted. The terminal diagrams, however, also apply to all other types, e.g., with intermediate connector, as the allocation of the connections of motor and drive controller never change.

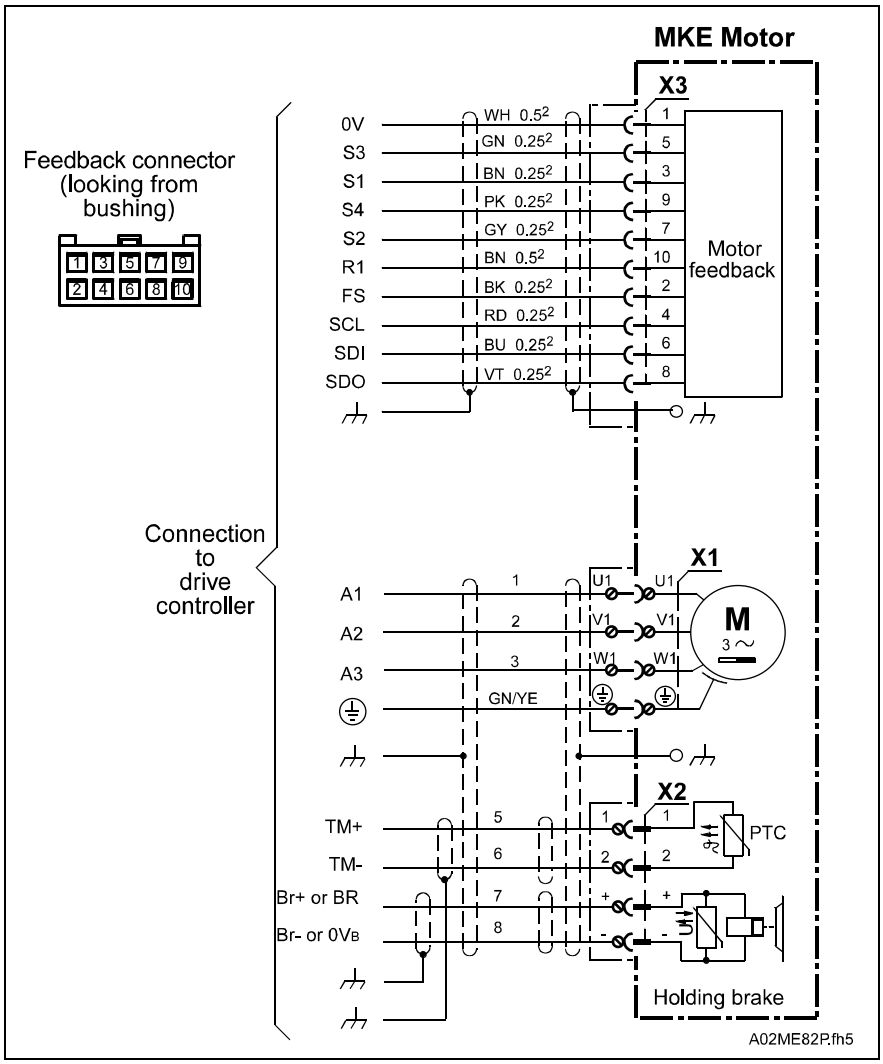


Fig. 3-2: Terminal diagram of MKE motor with terminal box

Thermal cutout connection

The use of an integrated motor temperature evaluation circuit in INDRAMAT drive controllers is urgently recommended to evaluate motor temperature in MKE motors used in areas where explosions represent a risk.

The PTC resistor connection for motor temperature evaluation is illustrated in the terminal diagram of the relevant drive controller.

Attention!

Temperature evaluation of the motors **must** implement INDRAMAT drive controllers!

⇒ Connections [1] and [2] of the PTC resistor must be connected with the temperature cutout circuit [TM+; TM-] of the drive controller!

The temperature class of INDRAMAT MKE motors is T4 as per EN 50014/ 3.77 (European standard). This makes a highly reliable surface temperature of the equipment with ≤ 135 °C possible. The PTC thermistor, made up of three thermistors, built into the MKE motors, guarantees, in conjunction with the evaluation circuits of the drive controller, a reliable and safe overtemperature cutout.

Power cable

Motors with terminal boxes are preferably equipped with ready-made power cables.

These power cables are available in various versions:

- direct connection of motor to drive controller
- direct connection of motor to terminal strip
- direct connection of motor to flanged socket
- motor connected via pluggable isolating point

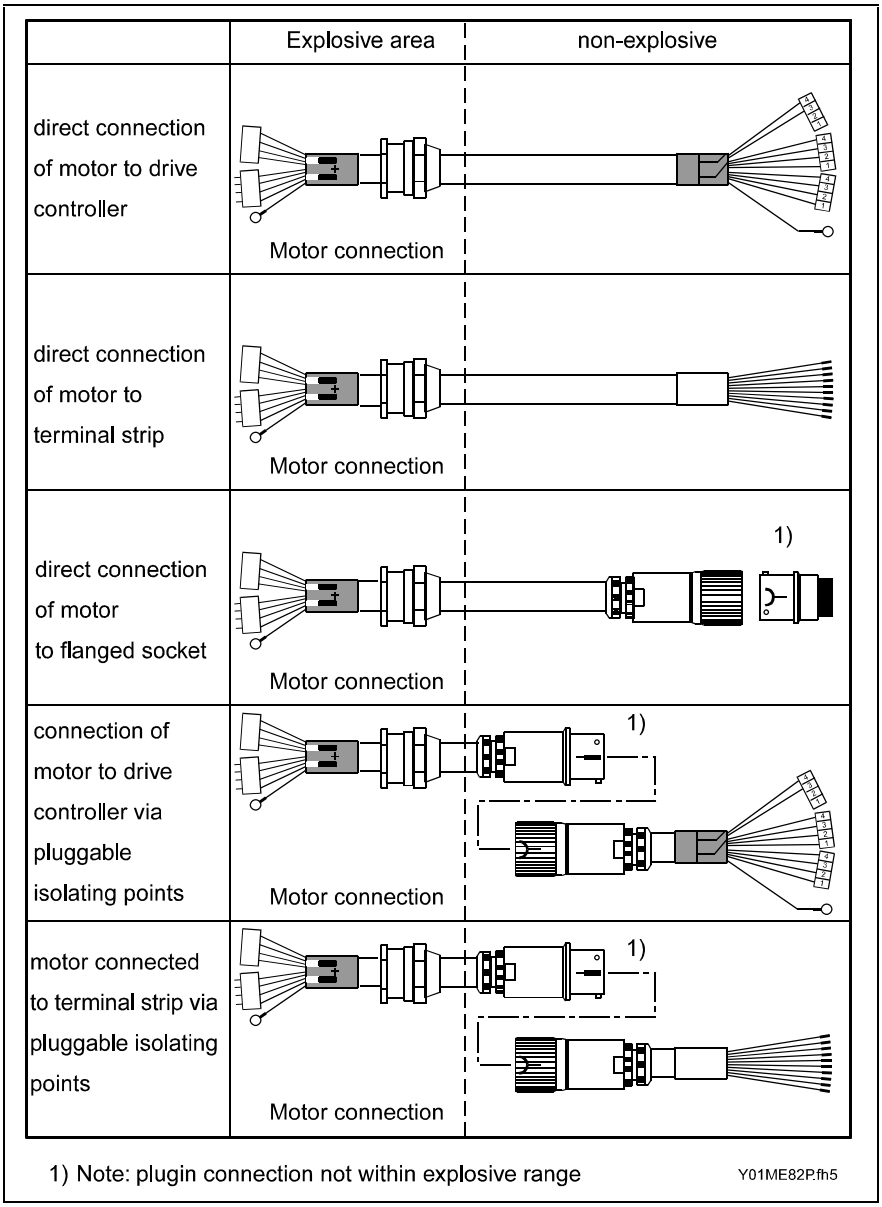


Fig. 3-3: Different types of connecting cables

⇒ Please find the type that suits your motor/controller combination in the table below.

⇒ If type designations are specified for two cables or a cable and a flanged socket, then order both.

Connecting drive controller DIAX04 or ECODRIVE

Motor type	Direct connection motor to						Connected via pluggable isolating point motor to				
MKE...	DKC 40A	DKC 100A	HDD/ HDS 40A	HDS 75/100A	Terminal strip	Flanged socket	DKC 40A	DKC 100A	HDD/ HDS 40A	HDS 75/10 0A	Terminal strip
035B-144	IKG-0307	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.
045B-144	IKG-0307	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.
096B-047	IKG-0307	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.	in prep.

Fig. 3-4: Ready-made power cables to connect MKE motors with terminal boxes to drive controller family DIAX 04 or ECODRIVE

Selecting the length

Available cable lengths: 5, 10, 15, 20, 30m. All other lengths available upon request.

⇒ When ordering, just enter the cable type and desired length. Example: IKG 0307 (= power cable for DKC, length 5m).

Note: Maximum total length of the cable connection from motor to drive controller with two intermediate plugin locations equals 75 m. With more plugin locations, the maximum total length drops. This may also necessitate testing.

Feedback cable

Motors with terminal boxes are generally preferably equipped with ready-made feedback cables.

These feedback cables are available in various versions:

- direct connection of motor to drive controller

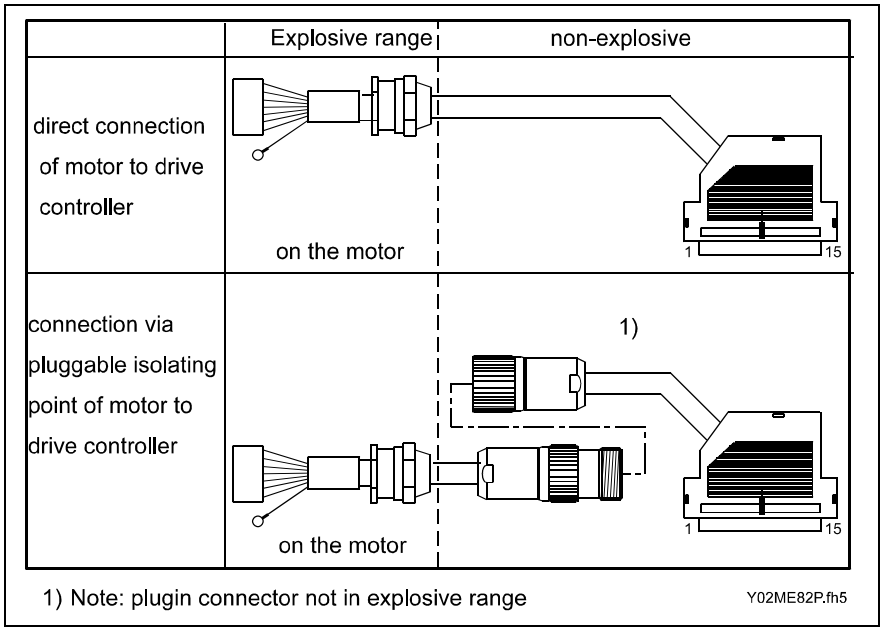


Fig. 3-5: Versions of connecting cables

⇒ Locate the cable which suits your motor/controller combination in the table below.

Motor type	Direct connection of motor to drive controller	Connected via pluggable isolating point motor to drive controller
all motor types with terminal box	IKS0203	in prep.

Fig. 3-6: Ready-made feedback cable to connect to MKE motors with terminal box

Selecting the length

Available cable length: 5, 10, 15, 20, 30m. Other lengths available upon request.

⇒ When ordering, just enter the cable type and desired length. Example: IKS 0203 / 5 (= feedback cable, length 5 meters).

Note: Maximum total length of the cable connection from motor to drive controller with two intermediate plugin locations equals 75 m. With more plugin locations, the maximum total length drops. This may also necessitate testing.

Technical data of the power and feedback cables

Name	Unit	Data		
		Power cables		Feedback cables
Ready-made cable type designation		IKG0307	IKG0308	IKS0203
Type designation of cable (cable parts)		INK0653	INK0650	INK0448
Diameter of power or supply strands	mm²	4 x 1.0	4 x 1.5	2 x 0.5
Control strand diameter (holding brake, temperature monitor or control voltage)	mm²	2 x (2 x 0.75)	2 x (2 x 0.75)	4 x (2 x 0.25)
Diameter	mm	12.5 ±0.3	12.2 ±0.4	8.5 ±0.3
Minimum bend radius fixed routing flexible routing (≥ 1 000 000 bend loads)	 mm mm	 75 120	 80 120	 50 90
Protection category (transition cable/terminal box) with expert mounting		IP 65		
Chemical features		absolute resistance to mineral oils and greases, hydrolysis resistant, silicone and halogen free		
Permissible ambient temperature for operation and storage	ºC	-30 to +80		
Cable surface		Poor adhesion, prevents sticking in drag chains		
Specific cable weight	kg/m	0.25	0.39	0.10

Fig. 3-7: Technical data of power and feedback cables for MKE motors with terminal box

Minimum temperature resistance of the connecting leads

To use MKE motors in potentially explosive areas, cables with a minimum temperature resistance of **80°C (176° F)** must be used. The cables listed in the INDRAMAT cable selection lists meet these requirements.

Individual parts

Note: INDRAMAT cables can be put together by the customer. The parts needed in this case are listed in the document „Connecting accessories for INDRAMAT drives“, doc. no. 209-0050-4399.

4 MKE 035

4.1 Technical data

Designation	Symbol	Unit	Data
Motor type			MKE035B-144
to run with drive controller family			DIAX04, ECODRIVE
drive controllers			HDS, HDD, DKC
nominal motor speed [1]	n	min^{-1}	9000
continuous torque at standstill	M_{dN}	Nm	0.9 (0.8) [8]
continuous current at standstill	I_{dN}	A	5.1 (4.5) [8]
theoretical maximum torque [2]	M_{max}	Nm	4.0
peak current	I_{max}	A	23.0
rotor inertia [3]	J_M	kgm^2	0.3×10^{-4}
torque constant at 20ºC	K_m	Nm/A	0.20
voltage constant at 20ºC [4]	K_{Eeff}	V/1000 min^{-1}	18.5
winding resistance at 20ºC	R_A	Ohm	2.7
winding inductance	L_A	mH	3.7
thermal time constant	T_{th}	min	15
mass [3]	m_M	kg	2.0
electrical connection			terminal box
permissible ambient temperature [5]	T_{um}	ºC	0 to +40
permissible storage and transport temperature	T_L	ºC	-20 to +80
maximum installation elevation [6]		m	1000 above sea level
Protection category [7]			IP 65
insulation class DIN VDE 0530 section 1			F
ignition protection category per EN 50014 / 3.77			EExd II C T4
PTB no.:			Ex - 97.D.1010
housing coat			black primary coat (RAL 9005)

1) Depends on torque requirements of the application. For standard applications see n_{max} in the selection lists of the motor/controller combination. For other applications, determine usable speed using the required torque as seen in the speed/torque characteristics.
2) Achievable maximum torque depends on drive controller used. **Only the** in the selection lists of the motor/controller combination specified maximum torques M_{max} are binding.
3) Without holding brake.
4) With 1000 min^{-1} .
5) With deviating ambient temperatures, see section 2.2.
6) With deviating installation elevations, see section 2.2.
7) With proper mounting of power and feedback cables.
8) Parenthetical value applies to motor with holding brake.

Fig. 4-1: Technical data MKE035

Designation	Symbol	Unit	Holding brake data
Holding torque	M_H	Nm	1.0
Nominal voltage	U_N	V	DC 24 ±10%
Nennstrom	I_N	A	0.4
Moment of inertia	J_B	kgm²	0.08×10^{-4}
Release delay	t_I	ms	4
Clamping delay	t_K	ms	3
Mass	m_B	kg	0.25

Fig. 4-2: Technical data - holding brake - MKE035 (Optional)

4.2 Speed/torque characteristics

For details see section 2.7, Speed and Torque, page 2-10.

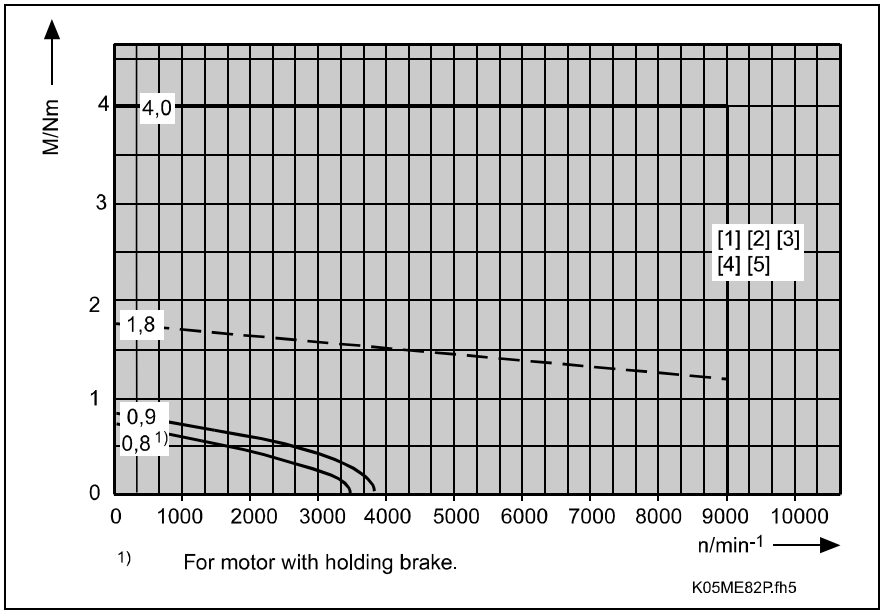


Fig. 4-3: Rotational speed - torque characteristics - MKE035B-144

4.3 Determining maximum shaft load

For details see section 2.4, section Shaft loads , page 2-5.

Permissible maximum radial force F_{radial_max} and permissible radial force F_{radial}

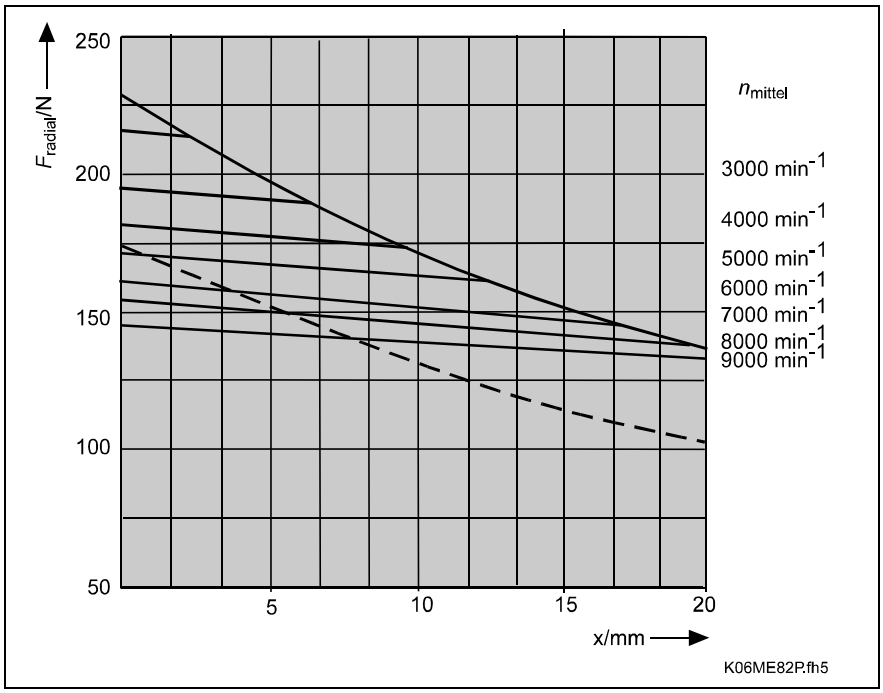


Fig. 4-4: MKE035: permissible maximum radial force F_{radial_max} and permissible radial force F_{radial}

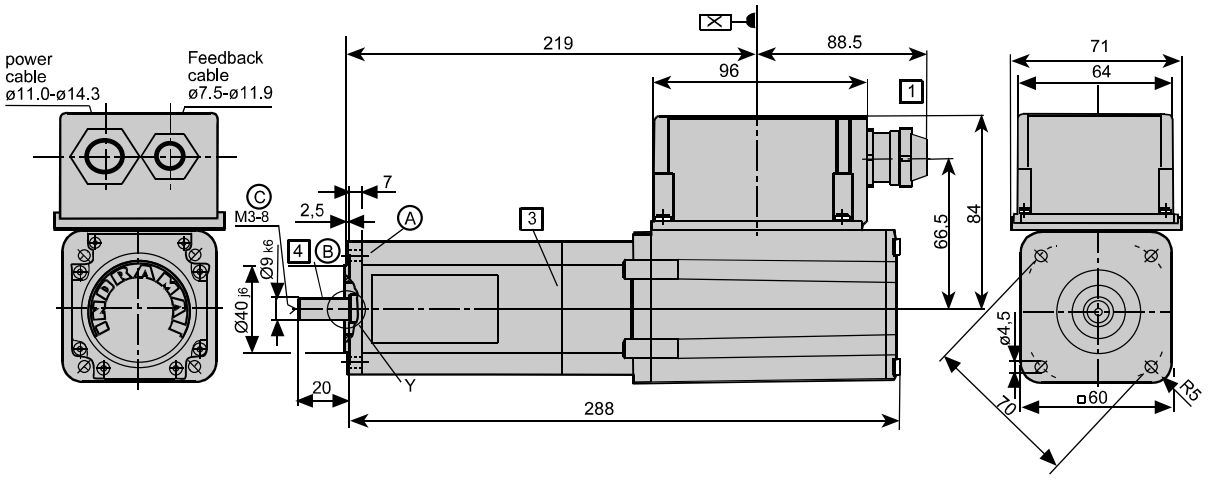
Permissible axial force F_{axial}

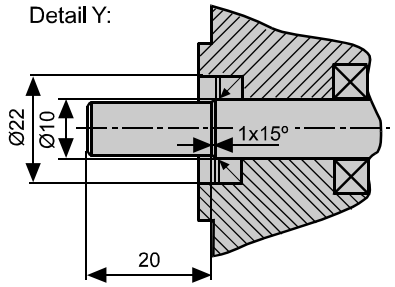
$$F_{axial} = 0{,}58 \cdot F_{radial}$$

F_{axial}: permissible axial force in N
F_{radial}: permissible radial force in N

Fig. 4-1: MKE035: permissible axial force

4.4 Dimensions





Ⓐ Motor construction per DIN 42950 sec. 1, ed. 08.77, B5 for all mounting orientations

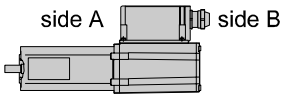
Ⓑ
- Flange per DIN 42948, ed. 11.65
- position accuracy of concentricity, excentricity and coaxiality to shaft as per DIN 42955, tolerance class N, ed. 12.81

Ⓒ
- shaft end per DIN 748, sec. 3, ed. 07.75, IEC 72,ed. 1971, cylindrical
- center drill hole DS M3 per DIN 332, sec. 2, ed. 05.83 max. screw tightening torque equals 1.3 Nm
- vibration severity level N as per DIN VDE 0530, sec.14, ed. 02.93

Options:

1 Output direction electrical connecting cable

Output direction of elec. connecting cable (power and feedback cables) is selected at time of mounting. Possible output directions are:
- towards side A
- towards side B



The drawing depicts side B as output direction, as delivered. The dimensions for side A as output direction can be obtained by turning connecting box around the X axis.

2 Motor feedback
- Resolver feedback (RSF)
- Resolver feedback (RSF) with integrated multiturn absolute encoder

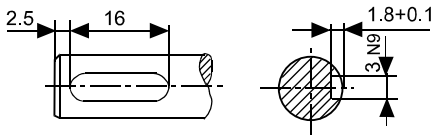
Dimensions are identical.

3 Holding brake:
- without holding brake
- 1.2 Nmwith holding brake

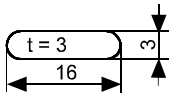
The dimensions are identical.

4 Driven shaft
- plain shaft (preferred)
- with keyway per DIN 6885, sh. 1, ed. 08.68

(Note: balanced with entire key!)



Matching key: DIN 6885-A 3 x 3 x 16, Must be ordered separately.



M01ME82.fh5

Fig. 4-5: Dimensional data MKE035

4.5 Available versions and type codes

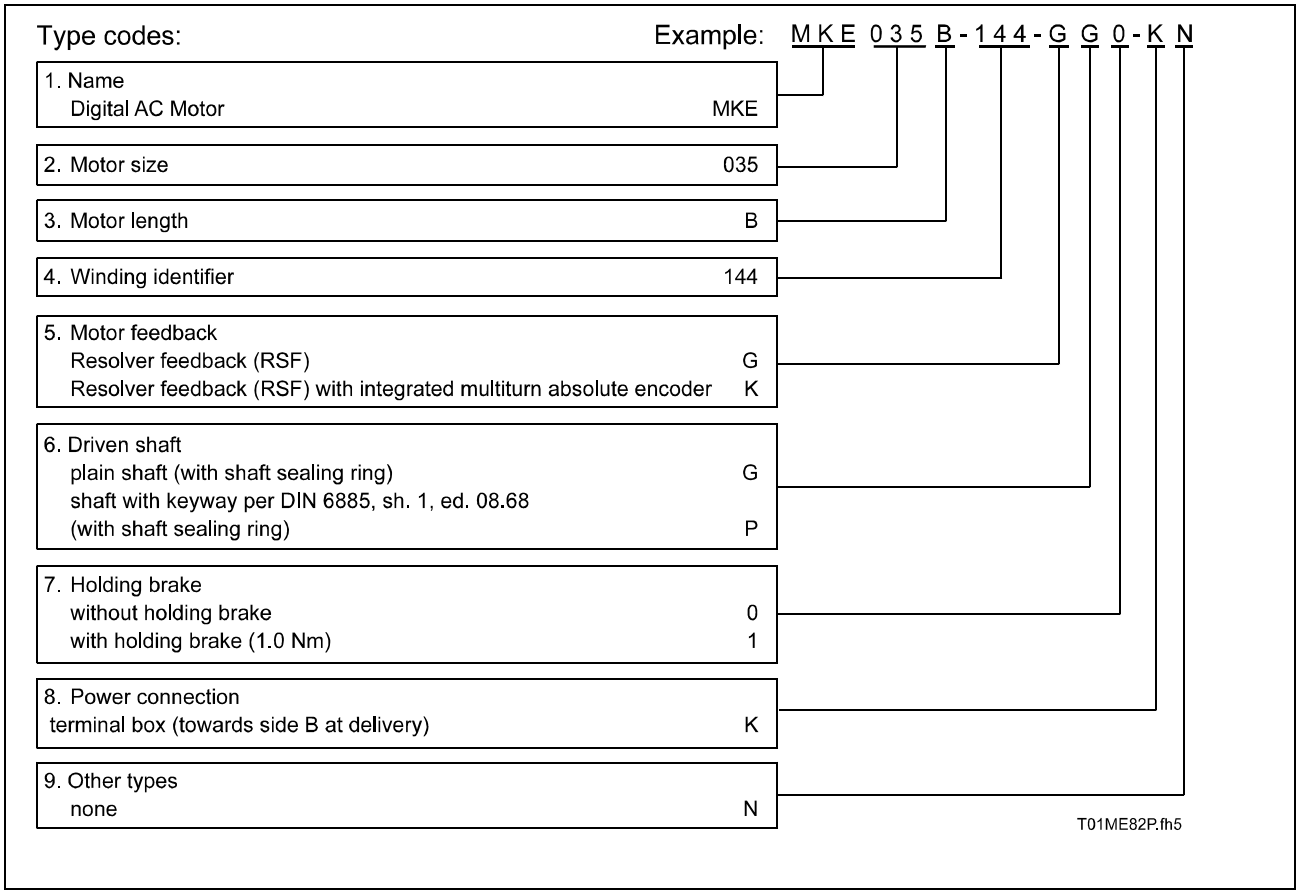


Fig. 4-6: Type codes MKE035

5 MKE 045

5.1 Technical data

Designation	Symbol	Unit	Data
Motor type			MKE045B-144
to run with drive controller family			DIAX04, ECODRIVE
drive controllers			HDS, HDD, DKC
nominal motor speed [1]	n	min^{-1}	6000
continuous torque at standstill	M_{dN}	Nm	2.7
continuous current at standstill	I_{dN}	A	7.5
theoretical maximum torque [2]	M_{max}	Nm	11.3
peak current	I_{max}	A	34.0
rotor inertia [3]	J_M	kgm^2	1.7×10^{-4}
torque constant at 20ºC	K_m	Nm/A	0.40
voltage constant at 20ºC [4]	K_{Eeff}	V/1000 min^{-1}	36.3
winding resistance at 20ºC	R_A	Ohm	1.8
winding inductance	L_A	mH	5.0
thermal time constant	T_{th}	min	30
mass [3]	m_M	kg	4.4
electrical connection			terminal box
permissible ambient temperature [5]	T_{um}	ºC	0 to +40
permissible storage and transport temperature	T_L	ºC	-20 to +80
maximum installation elevation [6]		m	1000 above sea level
Protection category [7]			IP 65
insulation class DIN VDE 0530 section 1			F
ignition protection category per EN 50014 / 3.77			EExd II B+H2 T4
PTB no.:			Ex - 97.D.1010
housing coat			black primary coat (RAL 9005)

1) Depends on torque requirements of the application. For standard applications see n_{max} in the selection lists of the motor/controller combination. For other applications, determine usable speed using the required torque as seen in the Speed/torque characteristics ermittelt werden.
2) Achievable maximum torque depends on drive controller used. **Only the** in the selection lists of the motor/controller combination specified maximum torques M_{max} are binding.
3) Without holding brake.
4) With 1000 min^{-1} .
5) With deviating ambient temperatures, see section 2.2.
6) With deviating installation elevations, see section 2.2.
7) With proper mounting of power and feedback cables.

Fig. 5-1: Technical data MKE045

Designation	Symbol	Unit	Holding brake data
Holding torque	M_H	Nm	2.2
Nominal voltage	U_N	V	DC 24 ±10%
Nominal current	I_N	A	0.35
Moment of inertia	J_B	kgm²	0.16×10^{-4}
Release delay	t_I	ms	28
Clamping delay	t_K	ms	14
mass	m_B	kg	0.25

Fig. 5-2: Technical data - holding brake - MKE045 (Optional)

5.2 Speed/torque characteristics

For details see section 2.7, Speed and Torque, page 2-10.

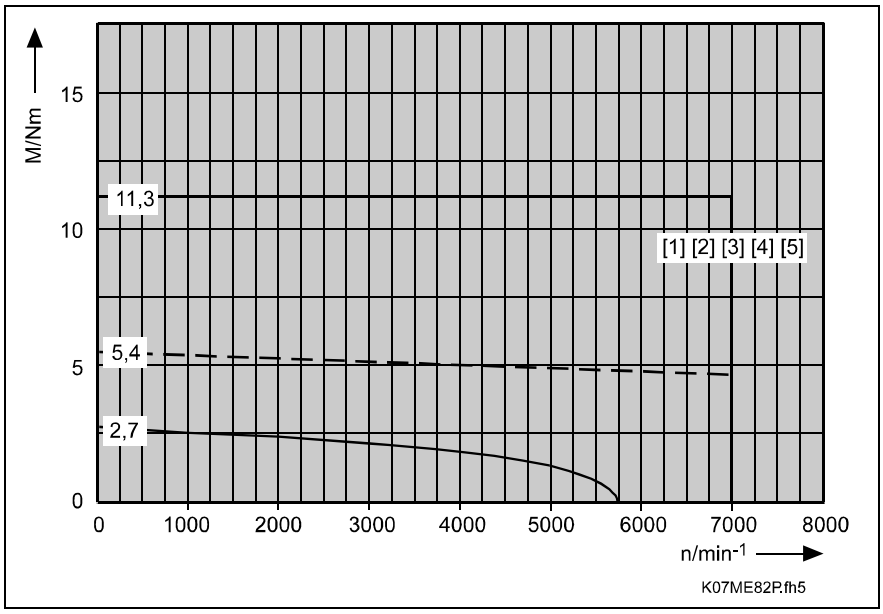


Fig. 5-3: Speed/torque characteristics MKE045B-144

5.3 Determining maximum shaft load

For details see section 2.4, Shaft loads , page 2-5.

Permissible maximum radial force F_{radial_max} and permissible radial force F_{radial}

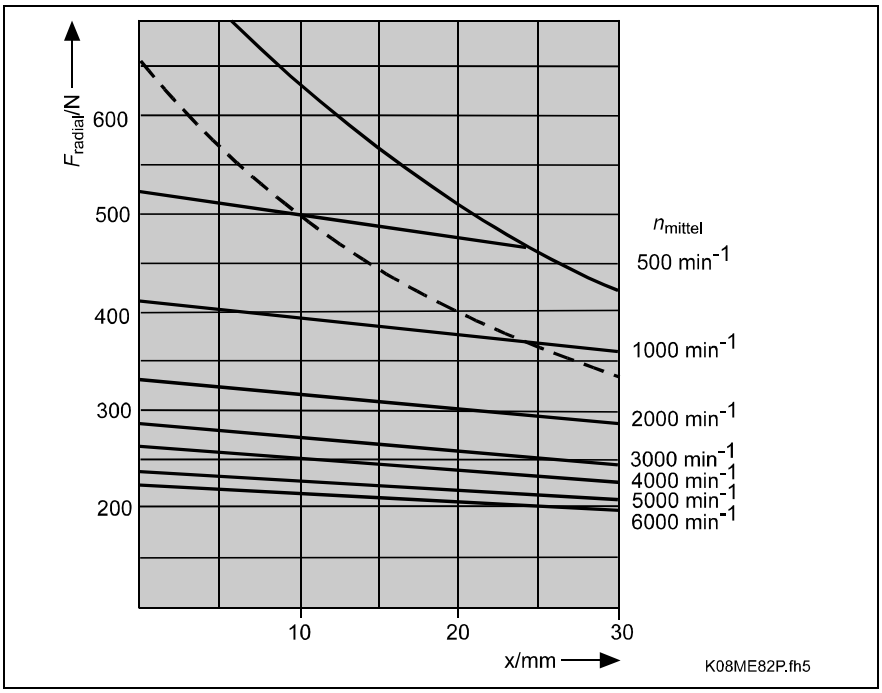


Fig. 5-4: MKE045: Permissible maximum radial force F_{radial_max} and permissible radial force F_{radial}

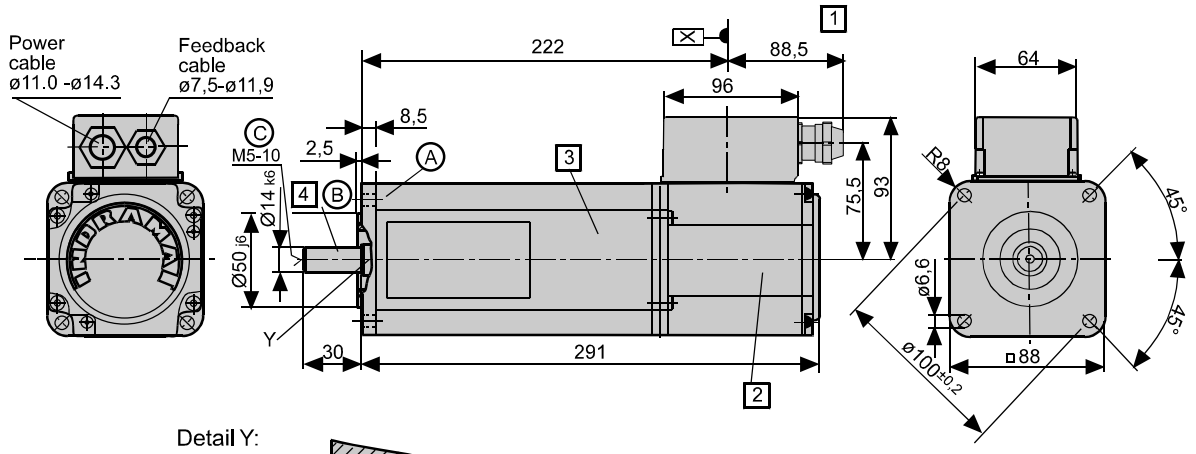
Permissible axial force F_{axial}

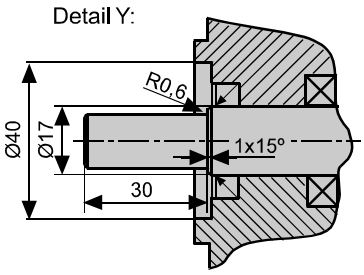
$$F_{axial} = 0{,}44 \cdot F_{radial}$$

F_{axial}: permissible axial force in N
F_{radial}: permissible radial force in N

Fig. 5-5: MKE045: permissible axial force F_{axial}

5.4 Dimensions





Ⓐ Motor construction per DIN 42950 sec. 1, ed. 08.77, B5 for all mounting orientations

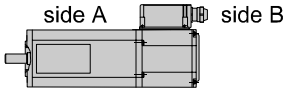
Ⓑ
- Flange per DIN 42948, ed. 11.65
- position accuracy of concentricity, excentricity and coaxiality to shaft as per DIN 42955, tolerance class N, ed. 12.81

Ⓒ
- shaft end per DIN 748, sec. 3, ed. 07.75, IEC 72,ed. 1971, cylindrical
- center drill hole DS M3 per DIN 332, sec. 2, ed. 05.83 max. screw tightening torque equals 5.0 Nm
- vibration severity level N as per DIN VDE 0530, sec.14, ed. 02.93

Options:

1 Output direction electrical connecting cable

Output direction of elec. connecting cable (power and feedback cables) is selected at time of mounting. Possible output directions are:
- towards side A
- towards side B



The drawing depicts side B as output direction, as delivered. The dimensions for side A as output direction can be obtained by turning connecting box around the X axis.

2 Motor feedback
- Resolver feedback (RSF)
- Resolver feedback (RSF) with integrated multiturn absolute encoder

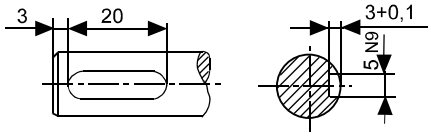
Dimensions are identical.

3 Holding brake:
- without holding brake
- 1.2 Nmwith holding brake

The dimensions are identical.

4 Driven shaft
- plain shaft (preferred)
- with keyway per DIN 6885, sh. 1, ed. 08.68

(Note: balanced with entire key!)



Matching key: DIN 6885-A 5 x 5 x 20, Must be ordered separately.

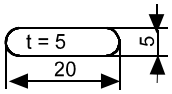


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Fig. 5-6: Dimensional data - MKE045

5.5 Available versions and type codes

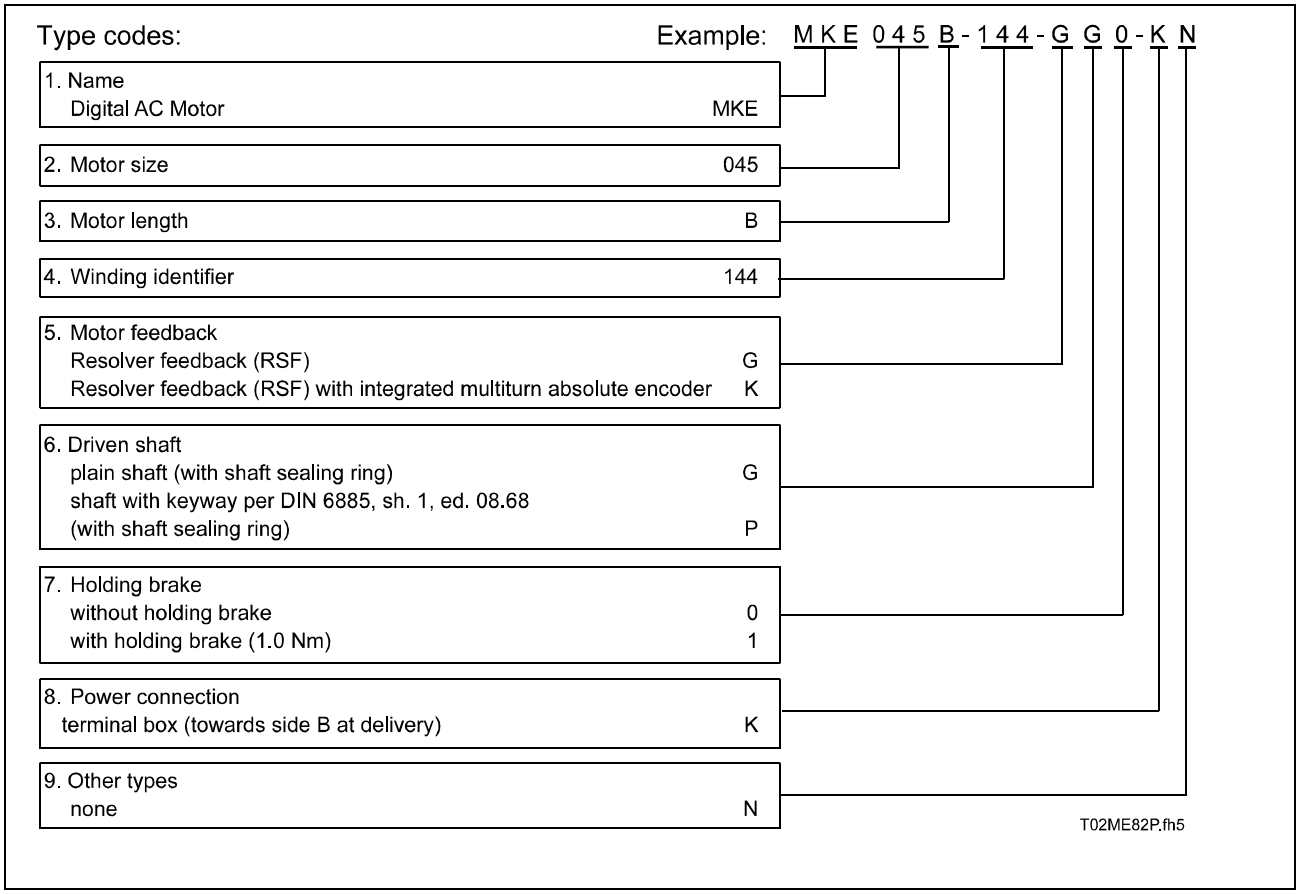


Fig. 5-7: Type codes MKE045

6 MKE 096

6.1 Technical data

Designation	Symbol	Unit	Data
Motor type			MKE096B-047
to run with drive controller family			DIAX04, ECODRIVE
drive controllers			HDS, HDD, DKC
nominal motor speed [1]	n	min^{-1}	3200
continuous torque at standstill	M_{dN}	Nm	12.0
continuous current at standstill	I_{dN}	A	13.2
theoretical maximum torque [2]	M_{max}	Nm	43.5
peak current	I_{max}	A	59.4
rotor inertia [3]	J_M	kgm^2	41.5×10^{-4}
torque constant at 20ºC	K_m	Nm/A	1.0
voltage constant at 20ºC [4]	K_{Eeff}	V/1000 min^{-1}	91.0
winding resistance at 20ºC	R_A	Ohm	1.2
winding inductance	L_A	mH	10.1
thermal time constant	T_{th}	min	60
mass [3]	m_M	kg	14
electrical connection			terminal box
permissible ambient temperature [5]	T_{um}	ºC	0 to +40
permissible storage and transport temperature	T_L	ºC	-20 to +80
maximum installation elevation [6]		m	1000 above sea level
Protection category [7]			IP 65
insulation class DIN VDE 0530 section 1			F
ignition protection category per EN 50014 / 3.77			EEx d IIB T4
PTB no.:			Ex-97.D.1036
housing coat			black primary coat (RAL 9005)

1) Depends on torque requirements of the application. For standard applications see n_{max} in the selection lists of the motor/controller combination. For other applications, determine usable speed using the required torque as seen in the Speed/torque characteristics ermittelt werden.
2) Achievable maximum torque depends on drive controller used. **Only the** in the selection lists of the motor/controller combination specified maximum torques M_{max} are binding.
3) Without holding brake.
4) With 1000 min^{-1} .
5) With deviating ambient temperatures, see section 2.2.
6) With deviating installation elevations, see section 2.2.
7) With proper mounting of power and feedback cables.

Fig. 6-1: Technical data MKE096

Designation	Symbol	Unit	Holding brake data
Holding torque	M_H	Nm	11.0
Nominal voltage	U_N	V	DC 24 ±10%
Nominal current	I_N	A	0.5
Moment of inertia	J_B	kgm²	1.1×10^{-4}
Release delay	t_I	ms	29
Clamping delay	t_K	ms	20
mass	m_B	kg	0.65

Fig. 6-2: Technical data - holding brake - MKE096 (Optional)

6.2 Speed/torque characteristics

For details see section 2.7, Speed and Torque, page 2-10.

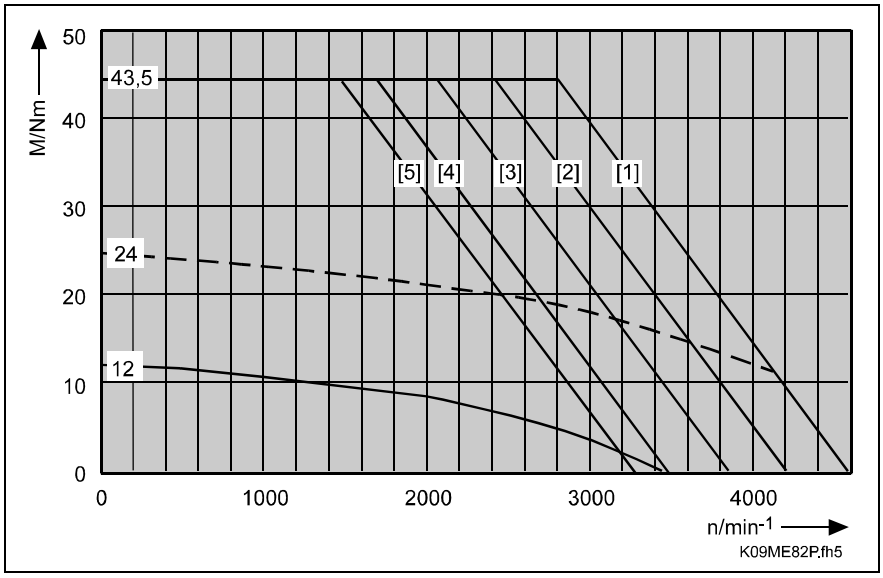


Fig. 6-3: Rotational speed - torque characteristics - MKE096B-047

6.3 Determining maximum shaft load

For details see section 2.4, Shaft loads , page 2-5.

Permissible maximum radial force F_{radial_max} and permissible radial force F_{radial}

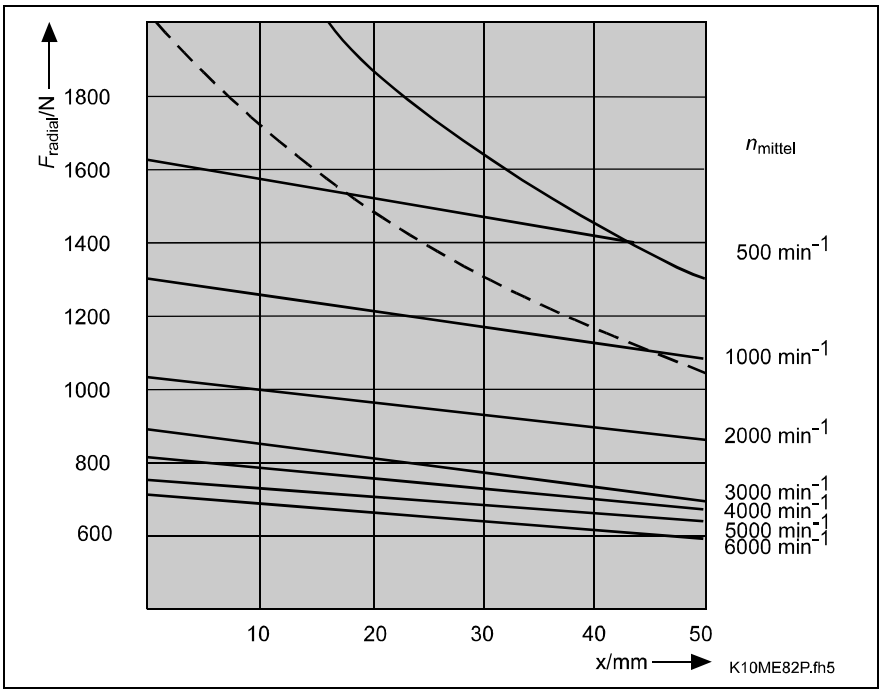


Fig. 6-4: MKE096: Permissible maximum radial force F_{radial_max} and permissible radial force F_{radial} .

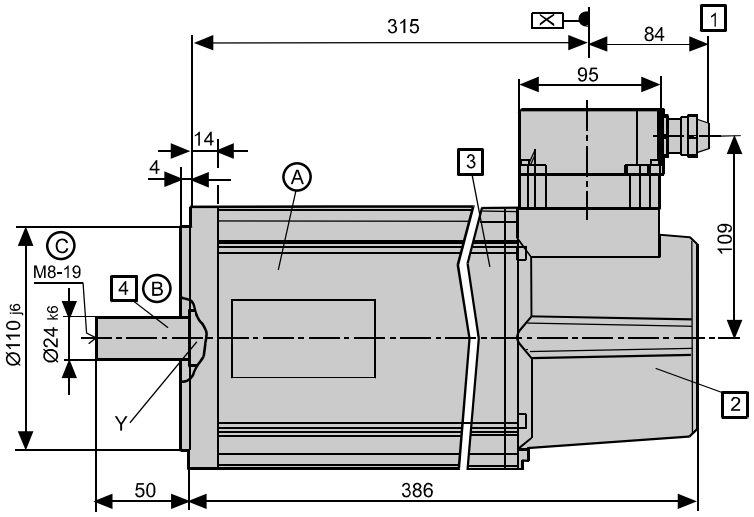
Permissible axial force F_{axial}

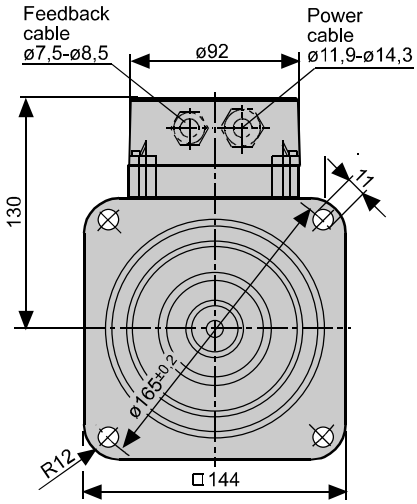
$$F_{axial} = 0{,}33 \cdot F_{radial}$$

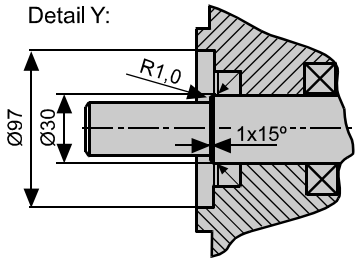
F_{axial}: permissible axial force in N
F_{radial}: permissible radial force in N

Fig. 6-5: MKE096: Permissible axial force F_{axial}

6.4 Dimensions







Ⓐ Motor construction per DIN 42950 sec. 1, ed. 08.77, B5 for all mounting orientations

Ⓑ • Flange per DIN 42948, ed. 11.65
• position accuracy of concentricity, excentricity and coaxiality to shaft as per DIN 42955, tolerance class N, ed. 12.81

Ⓒ • shaft end per DIN 748, sec. 3, ed. 07.75, IEC 72,ed. 1971, cylindrical
• center drill hole DS M3 per DIN 332, sec. 2, ed. 05.83 max. screw tightening torque equals 20 Nm
• vibration severity level N as per DIN VDE 0530, sec.14, ed. 02.93

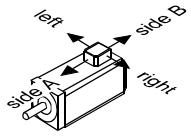
Options:

1

Output direction electrical connecting cable

Output direction of elec. connecting cable (power and feedback cables) is selected at time of mounting. Possible output directions are:

- towards side A
- towards side B
- to the right and
- to the left



The drawing depicts side B as output direction, as delivered. The dimensions for side A as output direction can be obtained by turning connecting box around the

2 **Motor feedback**

- Resolver feedback (RSF)
- Resolver feedback (RSF) with integrated multiturn absolute encoder

Dimensions are identical.

3 **Holding brake:**

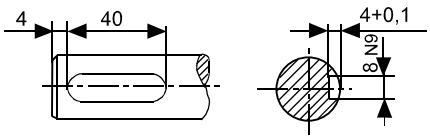
- without holding brake
- 1.2 Nmwith holding brake

The dimensions are identical.

4 **Driven shaft**

- plain shaft (preferred)
- with keyway per DIN 6885, sh. 1, ed. 08.68

(Note: balanced with entire key!)



Matching key: DIN 6885-A 8 x 7 x 40,
Must be ordered separately.

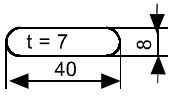


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Fig. 6-6: Dimensional data MKE096

6.5 Available versions and type codes

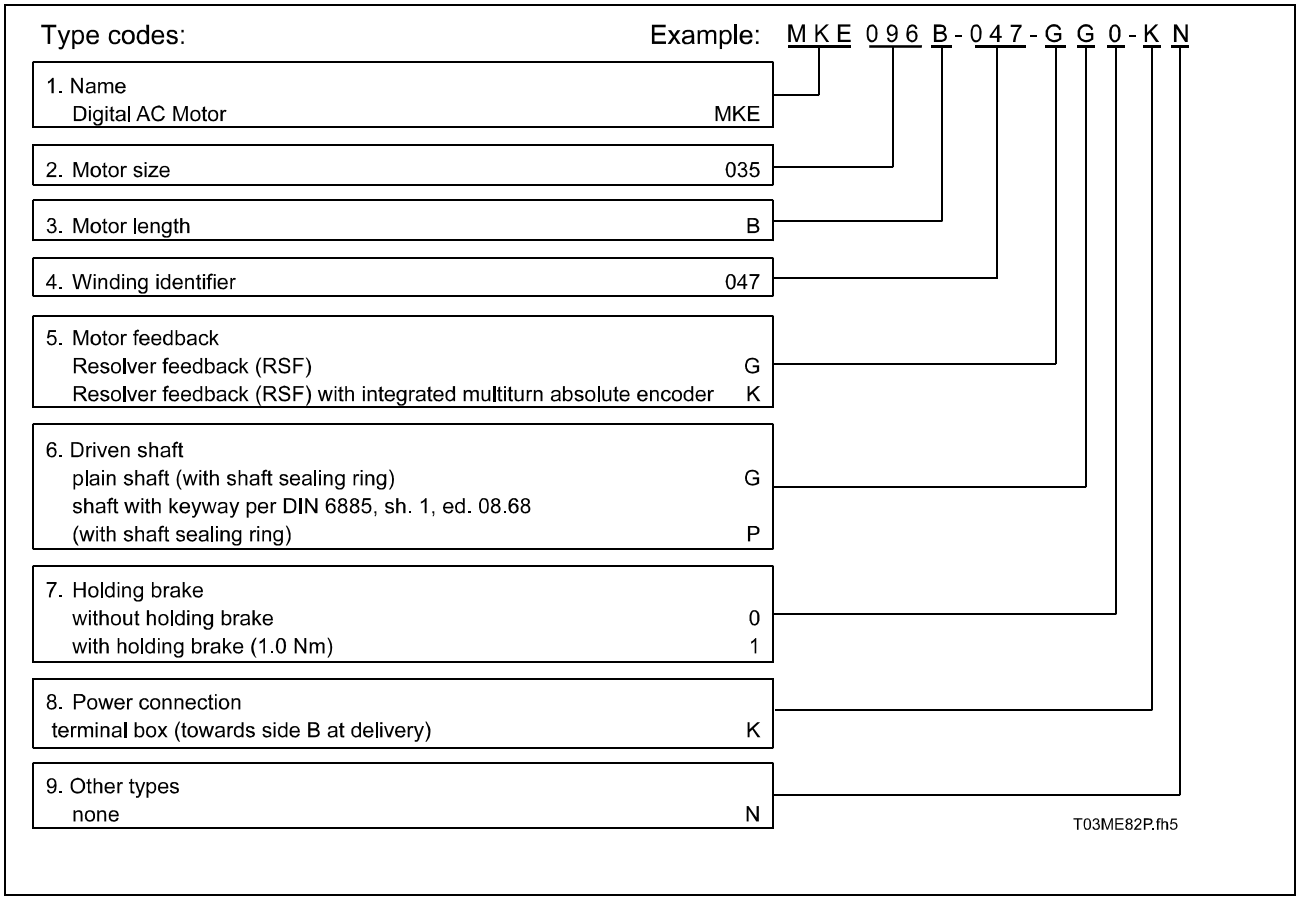


Fig. 6-7: Type codes MKE096

7 Condition at delivery

7.1 General information

The motor and accessories, such as cables, are loaded into cartons at delivery. Depending on number or size of these cartons, they may be loaded onto a pallet and then fixed into place with metal bands. For protection against adverse weather, an additional carton may be placed over the palette and affixed into place with metal bands attached to the pallett.

7.2 Removing the bands

CAUTION

Uncontrolled movements of the metal bands upon removal!

Mechanical injuries are possible.

⇒ Metal bands must be carefully removed!

⇒ Sufficient distance must be maintained!

7.3 Shipping papers

The entire delivery is accompanied by one copy of the shipping papers in an envelope. This lists merchandise by name and order designation. In the event that the listed contents are distributed over all cartons, (transport containers), such will be noted on the papers or freight papers.

The packaging on each motor lists the following information:

- type designation of the motor
- customer
- delivery slip number
- consignment
- freight company

(See section 8 “Identifying the merchandise“.)

8 Identifying the merchandise

8.1 Delivery slip

The entire delivery is acompanied by one slip in an envelope. The merchandise is listed here by name and order number. In the event that the contents are distributed over several cartons (transport containers), such will be noted in the delivery slip or the freight papers.

8.2 Barcode sticker

There is a barcode sticker on each motor package will lists the following information:

- type designation of the motor
- customer
- delivery slip number
- consignment
- freight company

The barcode sticker serves to identify the contents at the time of order completion.

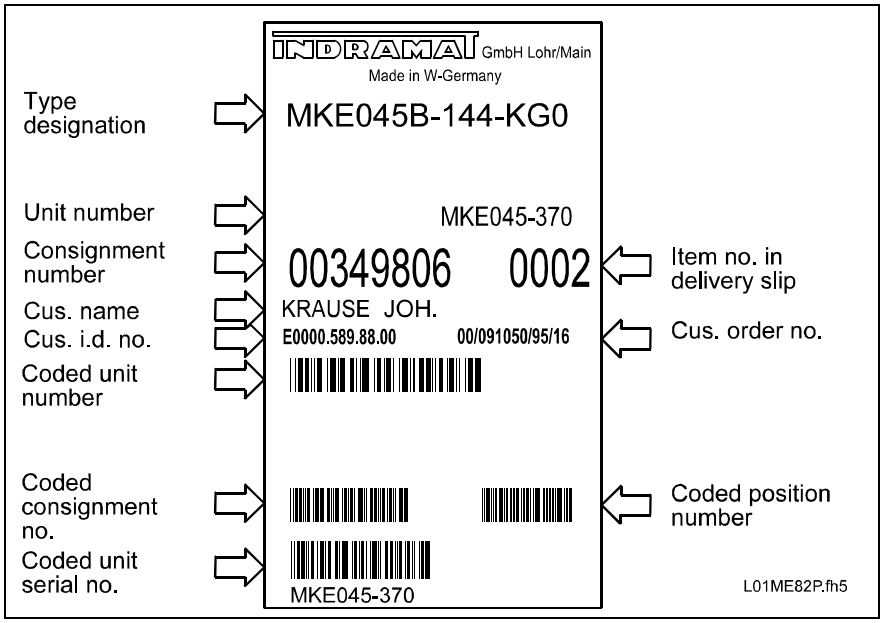


Fig. 8-1: Barcode sticker (Example)

8.3 Type plate

Motors

The motor is delivered with a type plate. It is attached to the motor housing. There is a second type plate placed over the original type plate with two-sided tape. This can be removed and placed elsewhere at a visible spot on the machine if the original type plate on the motor is somehow covered or not visible due to the contours of the machine.

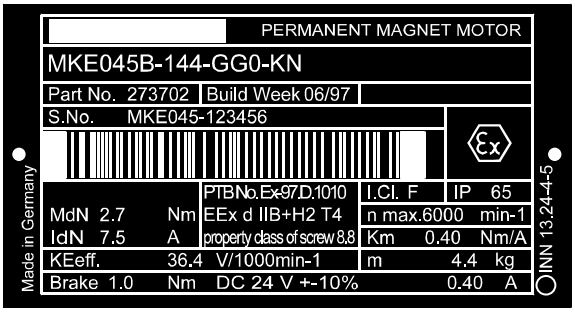


Fig. 8-2: Type plate (Example)

The type plate serves

- the identification of the motor
- to obtain replacement parts in the event of a breakdown
- service information, in general

Cable parts

Type designations are printed on the cable sheath.

Individual plugin connectors

Type designations are on the plastic bag.

Ready-made cables

Label (at cable end) with type designations.

Note: Type designations of the motor are also listed in the feedback data memory.

9 Storage , Transport and Handling

9.1 Notes on the packaging

Notes on storage, transport and handling are on the packaging. Please comply with the instructions.

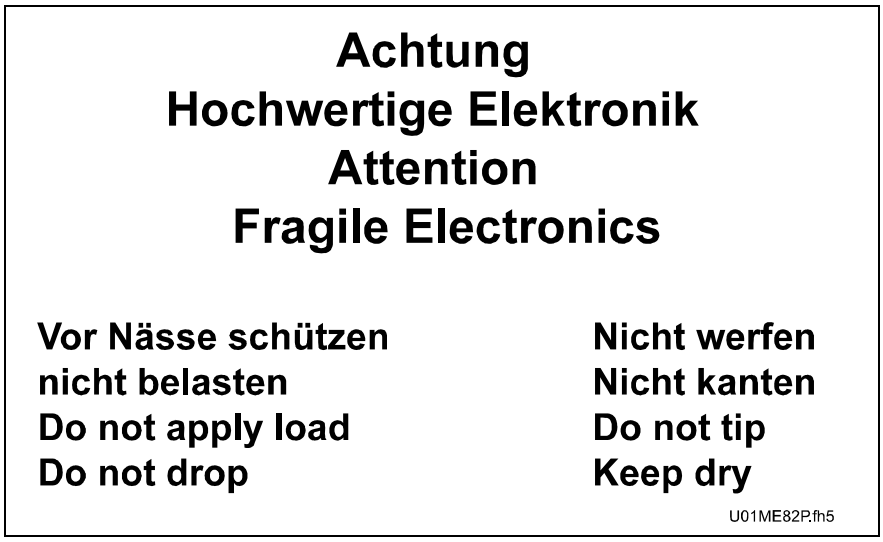


Fig. 9-1: Notes on storage, transport and handling on the packaging

9.2 Storage

WARNING

Motor damage and forfeiture of guarantee!
Motors not properly stored could be damaged. The guarantee is also forfeited in this case.
⇒ Please therefore note the following instructions.

Maintain the following conditions during storage:

⇒ permissible temperature range: -20° C to +80° C.

⇒ motors must be stored dry, dust-free and shock-free

⇒ motors must be stored horizontally

⇒ Protective cover of plastic on the drive shaft must not be removed. It protects against moisture and mechanical damage.

9.3 Transport and Handling

WARNING

Motor damage and forfeiture of guarantee!
Improper transport and handling can damage the motor.
The guarantee is also forfeited in this case.
⇒ Please therefore follow the instructions below.

Maintain the following conditions during transport and when handling:

⇒ Use suitable transport devices. Note the weight of the components (weights are listed in the individual sections with the technical data of the motor or on the type plates of the motor).

⇒ Shock damping should be used if excessive shocks are expected during transport. Note the limit data as outlined in section „2.2 Maximum vibration and shock requirements, page 2-3“.

⇒ Transport in horizontal position only.

⇒ When picking up the motor, use a crane or lifting belts

⇒ Motor flange and drive shaft must not be damaged!

⇒ Avoid impacts to drive shaft.

⇒ Protective cover made of plastic is on the drive shaft and must not be removed until shortly before the motor is mounted.

Note: If the motor is also equipped with a holding brake and, if prior to mounting the holding torque listed in the data sheets is not achieved, then refinish the holding brakes. Note the instructions in section 11.5 „Refinishing the holding brake“, page 11-8.

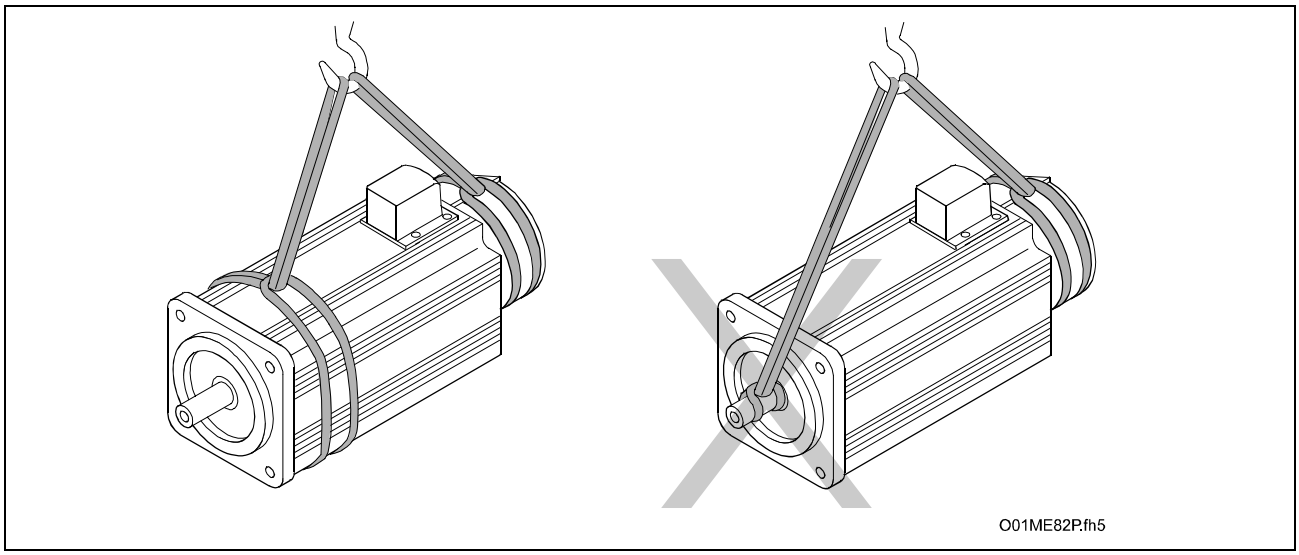


Fig. 9-2: Lifting and transporting the motors with the use of lifting belts

10 Safety Guidelines for electrical drives

10.1 General information

- The safety instructions outlined in this document must always be complied with. Improper handling of this machinery and non-compliance with the warnings can cause property damage, injury and possibly even death. INDRAMAT assumes no responsibility for deterimental conditions ensuing from non-compliance with the warnings.
- There can only be a safe and trouble-free operation of these drives if they have been correctly transported, stored, mounted and installed as well as if they are carefully operated and maintained.
- Only duly qualified personnel is permitted to work at, on or near them. Personnel is defined as qualified if it is familiar with mounting, installation and operation as well as with all warnings and precuationary measures as outlined in this document. Personnel is also trained if it has been instructed or if it may switch electric circuits on and off, ground and label them. Trained personnel must also have appropriate safety equipment and be instructed in first aid.
- Use only those replacement parts designated as acceptable.
- Safety guidelines and regulations must be complied with.
- The motors are intended for mounting into machines that will be used commercially.
- Commissioning is not permitted until it has been determined that the machine meets the EG directives 89/392/EWG for its application as per the corresponding machine guidelines.
- It may only be operated if it maintains the nawtional EMC reuirements for the particular application. The EMC guideline 89/336/EWG applies within the EU.

10.2 Note on protection against contact with live parts

If parts carrying in excess of 50 volts are touched, then this could be dangerous for human beings. When operating electrical components, they unavoidably become live and conduct dangerous voltage levels.

DANGER

High voltage!

DANGER to life or severe injury!

⇒ Comply with general setup and safety guidelines when working on high voltage facilities.

⇒ After installation, check the permanent connection of the protective conductor at all electrical components for compliance with the terminal diagram.

⇒ Operation, even for quick measuring and testing purposes, is only permitted with permanently attached protective conductors of all electrical components.

⇒ Prior to accessing electrical parts with voltages greater than 50 volts, remove them from the mains or the voltage source. Secure against being switche back on.

⇒ Wait the discharge time of five minutes after switching off before accessing the motor.

⇒ Points of electrical connections of the components are not to be touched when on.

⇒ Before switching the machine on, cover live parts ot prevent contact.

⇒ Make sure that there is also sufficient against indirect contact (as per DIN EN 50178/edition11.94, 5.3.2.3).

WARNING

High leakage current!

DANGER to life or severe injury!

⇒ Prior to switching on, connect the electrical devices of each drive controller, supply unit and the motor with the protective device to the grounding point.

⇒ The leakage current is greater than 3.5 mA. This necessitates a permanent connection to the power supply system (as per DIN EN 50178/edition 11.94, 5.3.2.3).

⇒ Before starting up, even for test purposes, always connect the protective conductor. High voltages could otherwise occur on the housing.

10.3 Notes on "safely-isolated low voltages

The connections and interfaces on the drive components intended for signal voltages range from 5 to 30 volts. These electrical circuits are part of the safely-isolated electrical circuits (safely-isolated low voltages).

WARNING

High electrical voltages from improper connections!

DANGER to life or severe injury!

⇒ Only those devices, electrical components or lines may be connected to the signal voltages of these components if they are sufficiently and safely isolated from the connected electrical circuits as complying with set standards (as per DIN EN 50178/edition 11.94, section 5.3.2.3).

10.4 Notes on handling and mounting

CAUTION

DANGER when handling!

Injury from pinching, shearing, cutting and poking!

⇒ Comply with the general setup and safety guidelines on handlnig and mounting.

⇒ Use suitable mounting and transport devices and special took, if necessary.

⇒ Squeezing and pinching can be prevented with the proper measures.

⇒ If necessary, wear suitable protective clothing (for example, protective eyewear, shoes and gloves).

⇒ Do not stand under hanging loads.

⇒ Spilled liquids must be wiped up immediately to avoid slipping.

10.5 Notes on protection against dangerous movements

The causes of dangerous motions can be various:

- faulty control
- software error
- component failure
- faulty wiring and cabling
- error in encoder for signals and measured values
- error causes by improper use of components

These errors can occur either directly after powering up or any time thereafter.

DANGER

Dangerous movements!

Danger to life, severe injury or property damage!

⇒ The monitoring devices within the drive components largely exclude malfunctions. This alone should not be relied upon for personnel safety. Until the built-in monitors are activated, it should be assumed that a faulty drive motion can occur, the extent of which depends on the nature of the problem and the oeprating mode. Personnel protection is therefore dependent on and must be secured with monitoring devices or measures that are superordinate in the machine. These are instituted in the machine by the manufacturer after a danger and error analysis has been complied with which takes the afety measures for the machine into consideration as well.

⇒ Personnel may not remain within the motional range of the machine. Possible measures against accidental accessing of personnel are:

- protective fences
- protective railings
- protective covers
- and photosensors.

⇒ Make sure that fencing and covers are strong enough to absorb maximum motional energy.

⇒ E-stop switches must be easily accessible and in close proximity to the user. Check the E-stop prior to commissioning to make sure it is operating properly.

⇒ Secure against unintentional startups of the drive via the E-stop loop or use a starting lockout mechanism.

⇒ Prior to accessing or entering the danger zone, bring the drives to a standstill.

⇒ Switch electrical equipment off via the main switch and secure it against being switched back on in the event of

- maintenance and service work
- when clearning
- prior to long operational breaks

⇒ The operation of high frequency, remote control and radio equipment in the proximity of the machine's electronics and leads is to be avoided. If such must be used, then check, prior to initial start, both system and machine for possible malfunctions in all situations. It may be necessary to run a special EMC check on the machine.

11 Mounting and Installation

11.1 Qualified personnel

All work on the machines and drives, or work within proximity of such, must be performed by trained and qualified personnel only. The user of machine or plant must ascertain that all personnel performing

- installation or
- maintenance work
- or those who operate them

are familiar with the contents, the warnings and the guidelines as specified in this documentation. Qualified personnel is trained, instructed and authorized to switch electric circuits and equipment on and off as per safety guidelines. They may also ground and label these. This personnel is equipped with appropriate safety equipment and is trained in first aid.

11.2 General notes on mounting

⇒ Comply with all the warnings and safety guidelines outlined in section 10 „Safety Guidelines for electrical drives“. This minimizes the risk of an accident and avoids damage to the plant or motor.

⇒ Follow all instructions carefully. This guarantees a problem-free assembly and disassembly of all components.

11.3 Mounting the motor

⇒ Obtain lifting devices, auxiliary aids, measuring and testing equipment.

⇒ Check the transferrable holding torque of the holding brake.
If the holding torque listed in the dimensional data sheets is not achieved, then go to section 11.5, page 11-7 first before taking the following steps.

⇒ Check all the components for cleanliness.

⇒ Check whether the components have visible damage. Do not mount damaged parts.

⇒ Make sure that the mounting procedure tiself takes place in a dry, dust-free environment.

⇒ Make sure that the motor flange is free of burrs.

⇒ Mount the motor. Maintain all dimensions and tolerances of the motor on the machine. For relevant data, see section "MKE ...", section „“.

⇒ If the motor is equipped with a "resolver feedback", then note, when allocating the reference point switches, that, due to the oeprating principle of the resolver, several zero pulses are generated during the course of an entire motor rotation (see section 1.3 "Motor feedback").

⇒ If the motor is equipped with a "resolver feedback with integrated multiturn absolute encoder", then make sure that the battery of the feedback electronics is in order. Empty or used batteries must be properly disposed of. If the battery needs to be replaced, then please follow the instructions outlined in section 12.1 „Changing the battery“.

Note: In the event the motor must be replaced, the connecting cable may remain in the lid of the terminal box. Only the motor needs to be replaced and attached to the connector on the new motor. This translates into a simple, service-friendly and quick replacement of MKE motors!

11.4 Connecting the motor

Once the motor has been properly mechanically mounted, then it can be connected.

DANGER

DANGER from electrical voltage!

Working in the area of live parts can be perilous. Thus:

⇒ All work on the electrical components may only be performed by trained electrical personnel. Electrical tools are absolutely necessary.

⇒ Before starting work, switch power to the machine off. Secure the power switch against being unintentionally and accidentally switched back on.

⇒ Prior to starting work, check, using suitable equipment, whether components are still under any residual voltage (e.g., from capacitors or similar). Wait until completely discharged.

WARNING

Injury to personnel or damage to property possible!

Interrupting or connecting live leads can cause unanticipated dangerous situations or property damage. Therefore:

⇒ Plugin connectors may only be connected or separated when these are dry and dead.

⇒ All plugin connectors must be firmly screwed into place while the machine is running.

WARNING

Danger of short-circuits from coolant or lubricants!

A short-circuit in live lines can cause unanticipated dangerous situations or property damage. Therefore:

⇒ Cover the exposed connector side of power plugin connectors both during installation or when replacing drive components, if the possibility exists that these could come into contact with either coolants or lubricants.

Indramat's terminal diagrams should be exclusively used for developing the wiring diagrams of the machine!

⇒ connect the motor as per the machine wiring diagrams of the manufacturer of the machine! Use the relevant terminal diagram as depicted in Fig. 3-2: Terminal diagram of MKE motor with terminal boxal box.

⇒ Note the instructions in the following section when mounting and routing the cables.

Connecting guidelines for MKE 035 and MKE 045

WARNING

Possible damage to terminal box or cables!

High tightening torques can damage screwed joints or pinch cables. If screwed joints are damaged, then the protection category IP 65 at the terminal box can no longer be guaranteed!

⇒ Do not, therefore, use automatic screwdrivers such as an electrical, pneumatic or hydraulic screwdriver!

MKE motors are equipped with a terminal box. Use ready-made INDRAMAT cables to mount them. Mount the cables as depicted below:

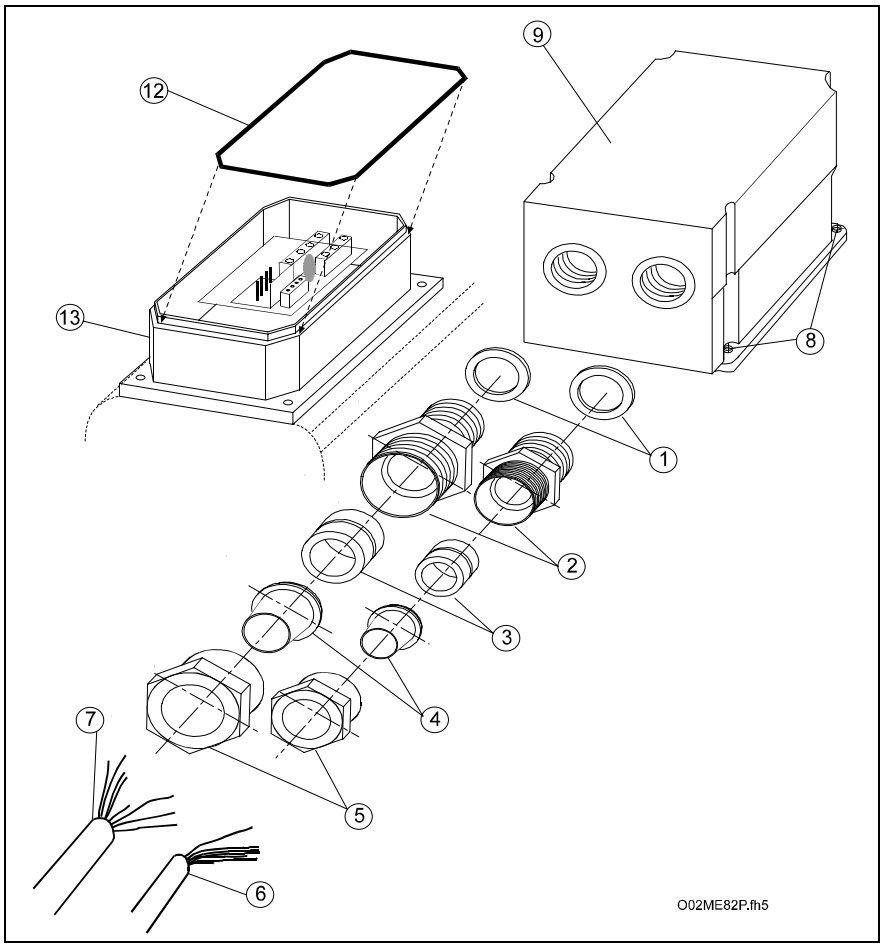


Fig. 11-1: Drawing of EExd screwed joint with terminal box

⇒ Release lid screws (8) and remove terminal box lid (9).

⇒ The EExd cable screwed jonts are mounted at the factory. Sealing ring (1) is screwed to the screwed joints (2) in the terminal box lid. Tightening torque equals 50 Nm.

⇒ Cap nut (5) and washer (4) must be removed.

⇒ Cap nut (5) and washer (4) must be guided over power cable (7) or feedback cable (6).

⇒ Check cable sealing ring (3) in screwed joint (2).

⇒ Feed cable end (6) and (7) through screwed joints (2) through terminal box lid (9).

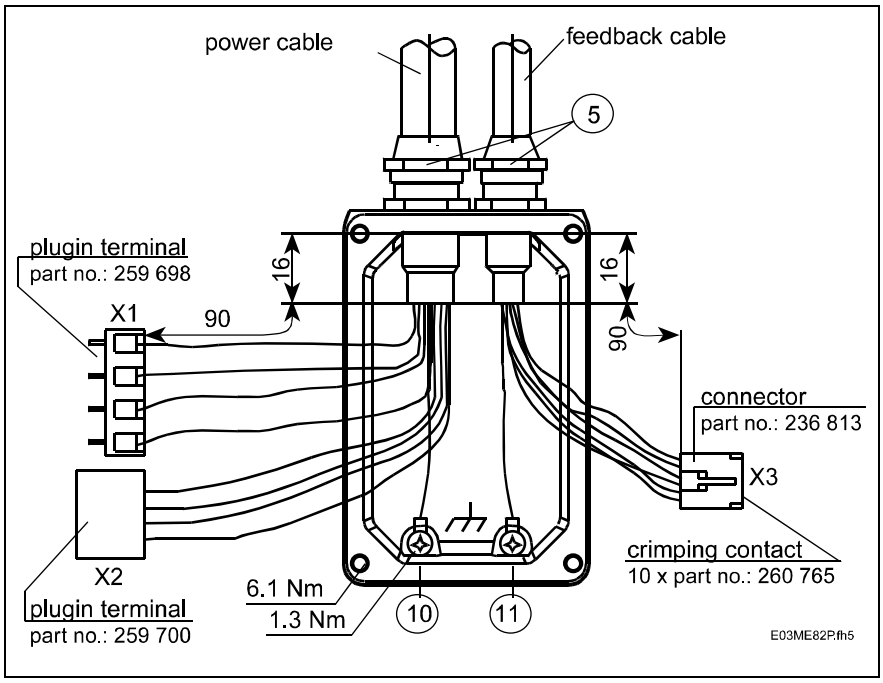


Fig. 11-2: Mounting power and feedback cables

⇒ Pull cable back to the point where the shrink sleeve extends into the inside of the terminal box by about 16 mm.

⇒ Screw down cap nut (5) onto screwed joint (2) with a tightening torque of about 15 Nm. This torque is achieved if the cable screwed joint is manually tightened and then turned twice using a suitable tool.

⇒ The connectig plugs X1, X2 and X3 must be mounted as per MKE motor plans (see Fig. 3-2: Terminal diagram of MKE motor with terminal box).

Note: Crimping pliers are available from INDRAMAT to mounting connector X3, part no. 262 293

⇒ The ground ring terminals (10) and (11) must be screwed to the terminal box lid (9) with 1.3 Nm.

⇒ X1, X2 and feedback connector X3 must be placed into position on the motor mounting panel.

⇒ The 4 connecting screws (plugin bushing of power cable connector part no.: 259698) of X1, must be firmly screwed into place.

⇒ The sealing ring (12) must be well greased, then inserted into nut on motor housing (13).

⇒ Make sure that no cable strands are pinched or damaged.

⇒ Tighten terminal box lid (9) into place with TFL coated lid screws (8) and 6.1 Nm.

If the lid screws (8) must be replaced, then only use screws, as per DIN 912 with a firmness of at least 8.8!

Note: If the terminal box must be repeatedly mounted, or has been repeatedly remounted, then it is recommended that the fastening screws (8) are additionally secured with Loctite 243.

Connecting guidelines for MKE 096

WARNING

Terminal box or cables could be damaged!

Excessive tightening torques could damage screwed joints or pinch cables. If screwed joints are damaged then the protection category IP 65 for the terminal box can no longer be guaranteed!

⇒ Therefore, do not use automatic screwdrivers such as electrical, pneumatic or hydraulic screwdrivers!

MKE motors are equipped with terminal boxes. Cables which correspond to ready-made INDRAMAT cables must be used for connections. Mount the cables in the following order:

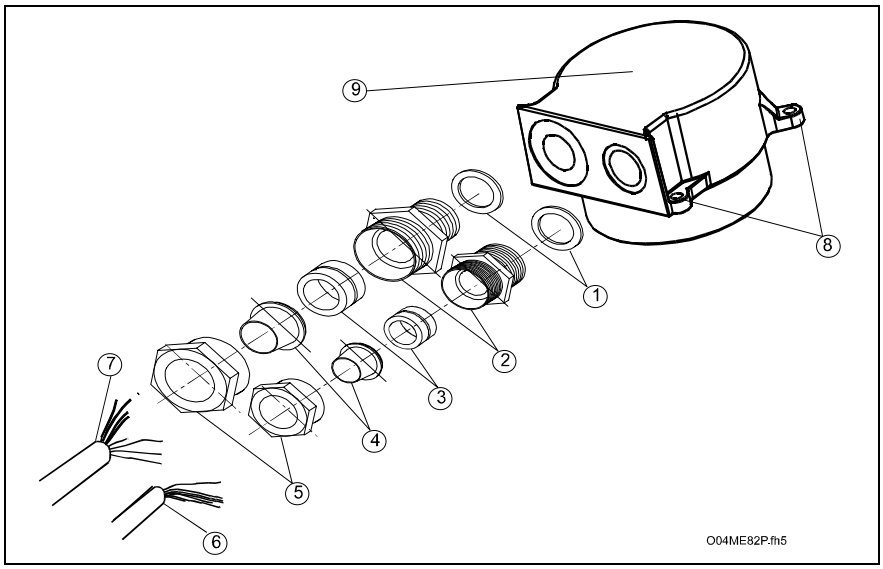


Fig. 11-3: EExd screwed joints with terminal box lid for MKE 096

⇒ Release lid screws (8) and remove terminal box lid (9).

⇒ The EExd cable screwed jonts are mounted at the factory. Sealing ring (1) is screwed to the screwed joints (2) in the terminal box lid. Tightening torque equals 50 Nm.

⇒ Cap nut (5) and washer (4) must be removed.

⇒ Cap nut (5) and washer (4) must be guided over power cable (7) or feedback cable (6).

⇒ Check cable sealing ring (3) in screwed joint (2).

⇒ Guide cable ends (6) and (7) through the screwed joints (2) into the terminal box lid (9).

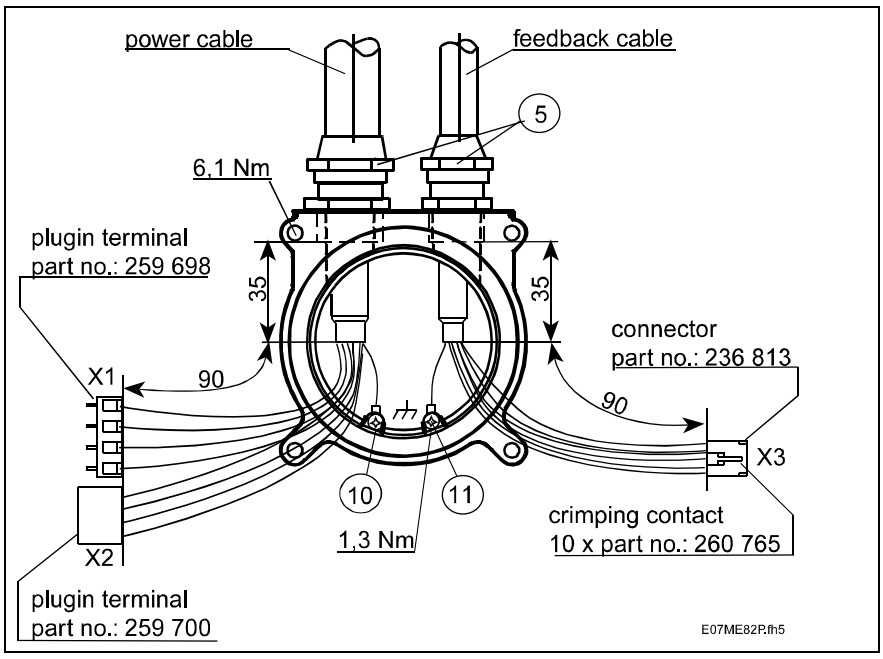


Fig. 11-4: Feeding in power and feedback cables of MKE 096

⇒ Pull cables back to the point where the shrink sleeve extends into the interior of the terminal box starting from the end of the screwed joint for a length of about 35 mm (up to about the middle of the terminal box lid) (see Fig. 11-4: Feeding in power and feedback cables of MKE 096).

⇒ Screw down cap nut (5) onto screwed joint (2) with a tightening torque of about 15 Nm. This torque is achieved if the cable screwed joint is manually tightened and then turned twice using a suitable tool.

⇒ The connectors X1, X2 and X3 must be mounted as per MKE motor plans (see Fig. 3-2: Terminal diagram of MKE motor with terminal box).

Note: Crimping pliers are available from INDRAMAT to mounting connector X3, part no. 262 293

⇒ The ground ring terminals (10) and (11) must be screwed to the terminal box lid (9) with 1.3 Nm.

⇒ X1, X2 and feedback connector X3 must be placed into position on the motor mounting panel.

⇒ The 4 connecting screws (plugin bushing of power cable connector part no.: 259698) of X1, must be firmly screwed into place.

⇒ The sealing ring (12) must be well greased and inserted into nut on motor housing (13).

⇒ Make sure that no cable strands are pinched or damaged.

⇒ Tighten terminal box lid (9) into place with TFL coated lid screws (8) and 6.1 Nm.

If the lid screws (8) must be replaced, then use only screws, as per DIN 912 with a firmness of at least 8.8!

Note: If the terminal box is repeatedly mount, then it is recommended that the screws (8) are additionally secured with Loctite 243.

EExd cable screwed joints

To meet the explosion requirements, it is necessary to tighten the cable screwed joints after power and feedback cables are in place.

Tightening torque: 15 Nm

A tightening torque of approximately 15 Nm is achieved if the cable screwed joints are manually tightenend and then followed by two more turns of a suitable tool (spanner or wrench).

The EExd screwed joints are only permitted with specific cable diameters. The table below specifies these diameters for screwed joints of the power and feedback cables.

EExd screwed joint	Screwed joint type	Permitted cable diameters in mm	
		Min.	Max.
Power cable	VERSCHR-M*20,0-GER-EX-11,0*14,3-MS-C4N-6	11.0	14.3
Feedback cable	VERSCHR-M*20,0-GER-EX-07,5*11,9-MS-C4N-6	7.5	11.9

Fig. 11-5: Permissible cable diameter of EExd screwed joints

If MKE motors are not mounted using the cable screwed joints supplied by INDRAMAT, then the following must be noted.

Note: MKE motors must be mounted with cable screwed joints that have a special test certificate complying with the B generation of EN 50014 and EN 50018.

11.5 Refinishing the holding brake

Check if the holding brake is functioning properly before mounting the motor. How to check the holding brake is described below as well as procedures to follow if any refinishing of such could be necessary.

CAUTION

Premature wear of the holding brake is possible!
The holding brake wears down after appropx. 20000 motor revolutions when closed.
⇒ Please therefore note the following instructions!

Prerequisite: The motor is equipped with a holding brake and has been stored for an extended period.

⇒ Check the transferrable holding torque of the holding brake.
If the holding torque listed in the dimensional data sheets is not achieved, then refinish the holding brake.

The following preconditions must be set before the holding brake can be refinished.

Prerequisite: No electrical connection of motor and drive controller.

⇒ Electrical connection between motor and drive controller must be separated.

⇒ Turn motor manually with holding brake closed approximately 50 times.
The holding brake is now refinished and ready to operate.

12 Service Notes

12.1 Changing the battery

If the motor is equipped "with integrated multiturn absolute encoder", then the battery must be included in regular maintenance scheduling. The nominal lifespan of the battery equals approximately 10 years.

How to change the battery

⇒ The following tools and aids must be handy:

- Allen screw driver for
  MKE 035 Size 2,5
  MKE 045 Size 3
  MKE 096 Size 4
- pointed pliers
- torque key with a range of 1.3 - 6.8 Nm
- New, ready-made batters for
  MKE 035 and MKE 045 INDRAMAT part no. 257 101
  MKE 096 INDRAMAT part no. 265 187

DANGER

Danger to life and limb from electrical voltage!

When changing the batter, the control voltage must be left on. Therefore:

⇒ only trained electricans must work on the machine.

⇒ switch power supply to machines off and secure them against being switched back on!

DANGER

Dangerous movements!

Danger to life and limb and serious property damage!

⇒ Switch power supply to drive controllers off and secure against being switched back on.

⇒ Replace batteries only with control voltage on. If control voltage is switched off with the battery removed, then the reference dimension will be lost and faulty movement could occur once the machine is switched back on.

Removing the battery

⇒ Allen screws (1) must be released and removed with Allen screwdriver size 2.5, 3 or 4

⇒ Remove motor feedback lid.

⇒ Pull battery connector (2) out.

⇒ Release screw (4) of the clamping device (3) of battery and remove it.

Mounting the battery

⇒ Insert ready-made battery as per motor type (part no. 257101 or 265187) and screw clamping device (3) with screws (4) back on (tightening torque max. 1.0 Nm).

Note: Do not pinch battery cable!

⇒ Place battery connector (2) back in place.

⇒ Close the motor feedback lid.

⇒ Allen screws (1) must be screwed back into place with toque key for MKE 035 with 3.1 Nm, MKE 045 with 1.3 Nm or 6.1 Nm with the MKE 096.

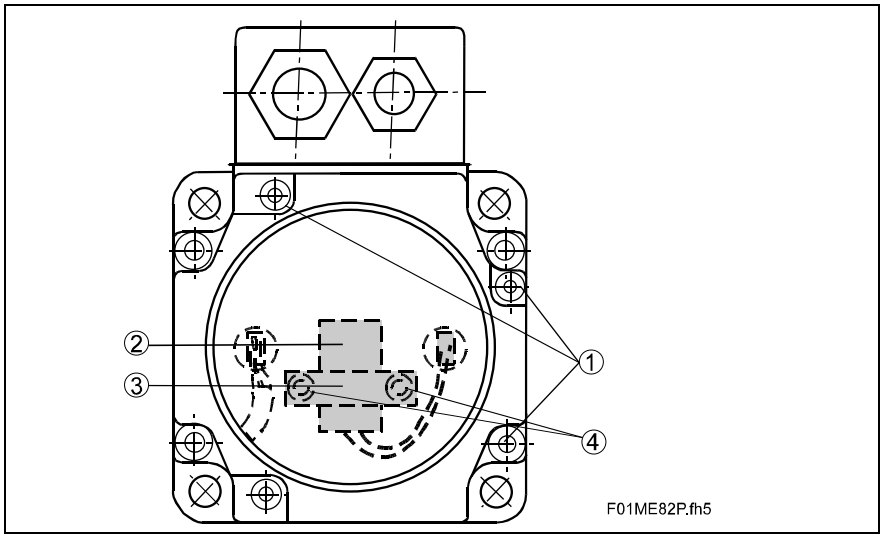


Fig. 12-1: Changing the battery

Powering machine/plant up

⇒ Switch power supply to drive controllers back on.

⇒ Run an axis test.

12.2 Maintenance work

The motors should be regularly cleaned (no later than one year after assuming operations)

- of dust, chips or similar dirt.

12.3 Contacting Customer Service

To rapidly and effectively eliminate and deal with all problems, our Service-Hotline is available.

⇒ Prior to calling, please note the following information

- type designations of drive controllers and motors not functioning
- the state of the problem
- disturbance or diagnostic displays (if machine is thus equipped)

Our Service-Hotline can be reached as follows:

Monday - Friday	7 - 23 CET
Saturday	8 - 20 CET
Sundays and holidays	9 - 19 CET

at the following telephone numbers

0171 - 333 882 6 **or** 0172 - 660 040 6.

⇒ If the decision has been made to return the motors, then please make a copy of the following fault report, fill it out and include it in the shipment.

⇒ Add a copy of the fault report to the machine documents for the user in the event such is needed.

This will facilitate processing of repairs and in determining application-specific problems.

INDRAMAT

Fault Report

for digital DKC and MKE AC servo drives

This fault report serves to clarify problems and their causes. It is absolutely necessary in order to detect and eliminate even hidden, sporadica or applicat-specific problems.

- Always include fault report when returning parts for repair.

- Otherwise send fault reports to relevant INDRAMAT office or the address of INDRAMAT's Quality Assurance department printed in the address field.

INDRAMAT appreciates your cooperation in this matter and will respond as quickly as possible.

Fault report dated:	Co.:	Loc	Date:
	Dept.:	Name:	Tel.:

Data on problem drive:

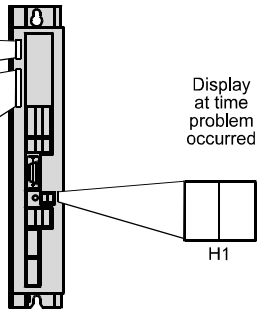
Data on type plate of basic unit

FWA _ _ _ _ _ _ _

DKC _._ - _ _ _ _ - _

SN: _ _ _ _ _ _

Mains connection:
single
three phase



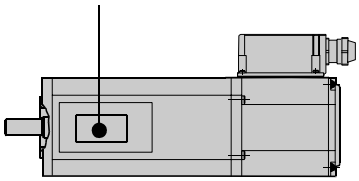
Display at time problem occurred

H1

Motor data

Motor _____

S. No.: _____



Data on machine with problem:

Manufacturer: _____ Type _____ Operating hours: _____

Machine number: _____ Startup date: _____

Manufacturer and machine control type: _____

Machine axis designation with problem: _____

Please explain the problem:

_____

_____

_____

Additional data:

Status:	Causes:	Accompanying
☐ is steady ☐ at startup ☐ occurs sporadically ☐ occurs after ☐ hours ☐ occurs with shocks ☐ is temperature dependent	☐ unknown ☐ faulty connection ☐ external causes ☐ mechanical damage ☐ loose cable connection ☐ moisture in unit ☐ extrinsic object in unit	☐ Problem in mechanics ☐ power section failure (24 $V_{ext.}$) ☐ control failure ☐ motor failure ☐ cable break ☐ blower defective ☐ feedback defective

☐ Additional comments: _____

_____

_____

Is there an air conditioner in the cabinet ?
Y / N ☐

Have there been similar problems previously ?

How often: _____

Did problems always occur in specific days or specific times of the day?

_____

_____

INDRAMAT GmbH
Bgm.-Dr.- Nebel- Straße 2
Abt. QSP

D-97816 Lohr am Main

U02ME82P.fh5

Fig. 12-2: MKE on DKC

Fault Report

for HDS and HDD digital AC drives

This fault report serves to clarify problems and their causes. It is absolutely necessary in order to detect and eliminate even hidden, sporadica or application-specific problems.

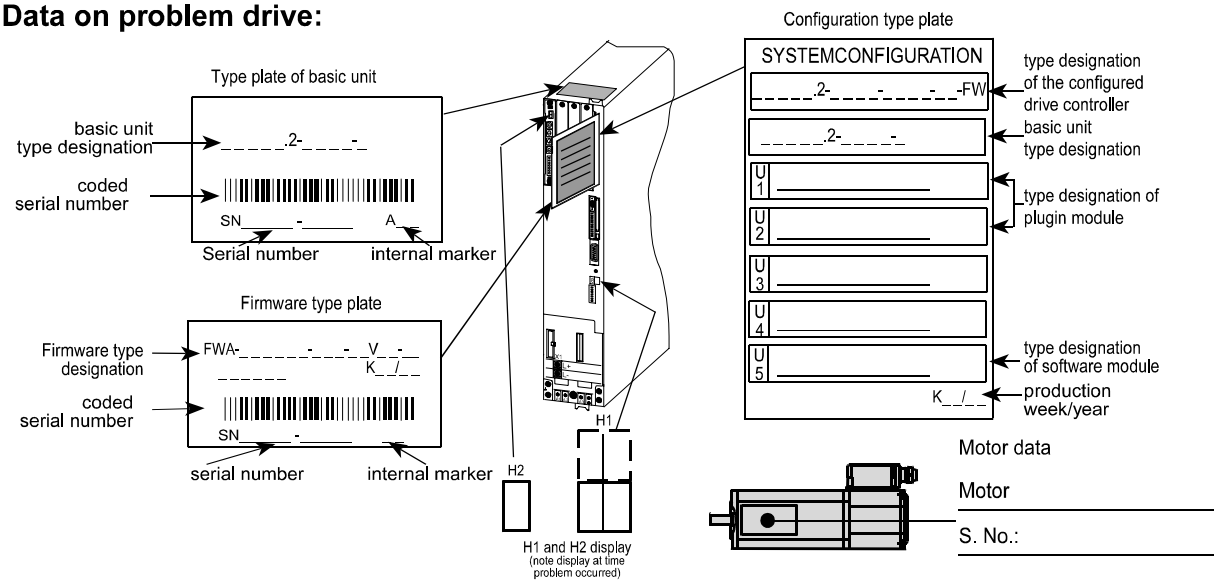
- Always include fault report when returning parts for repair.

- Otherwise send fault reports to relevant INDRAMAT office or the address of INDRAMAT's Quality Assurance department printed in the address field.

INDRAMAT appreciates your cooperation in this matter and will respond as quickly as possible.

Fault report dated:	Co.:	Loc	Date:
	Dept.:	Name:	Tel.:

Data on problem drive:



Data on machine with problem:

Manufacturer: _____ Type: _____ Operating hours: _____

Machine number: _____ Startup date: _____

Manufacturer and machine control type: _____

Machine axis designation with problem: _____

Please explain the problem:

_____

_____

_____

Additional data:

Status:	Causes:	Accompanying	
☐ is steady ☐ at startup ☐ occurs sporadically ☐ occurs after ☐ hours ☐ occurs with shocks ☐ is temperature dependent	☐ unknown ☐ faulty connection ☐ external causes ☐ mechanical damage ☐ loose cable connection ☐ moisture in unit ☐ extrinsic object in unit	☐ Problem in mechanics ☐ power section failure (24 $V_{ext.}$) ☐ control failure ☐ motor failure ☐ cable break ☐ blower defective ☐ feedback defective	Is there an air conditioner in the cabinet ? Y / N ☐ Have there been similar problems previously ? How often: _____ Did problems always occur in specific days or specific times of the day? _____ _____

☐ Additional comments: _____

_____

_____

U03ME82P.fh5

Fig. 12-3: MKE on HDS, HDD

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Directory of Customer Service Locations

Germany

Sales region central	Sales region east	Sales region west	Sales region north
INDRAMAT GmbH D-97816 Lohr am Main Bgm.-Dr.-Nebel-Str. 2 Telefon: 09352/40-0 Telefax: 09352/40-4885	INDRAMAT GmbH D-09120 Chemnitz Beckerstraße 31 Telefon: 0371/3555-0 Telefax: 0371/3555-230	INDRAMAT GmbH D-40849 Ratingen Hansastraße 25 Telefon: 02102/4318-0 Telefax: 02102/41315	INDRAMAT GmbH D-22085 Hamburg Fährhausstraße 11 Telefon: 040/227126-16 Telefax: 040/227126-15
Sales region south	**Sales region southwest**		**INDRAMAT Service-Hotline**
INDRAMAT GmbH D-80339 München Ridlerstraße 75 Telefon: 089/540138-30 Telefax: 089/540138-10	INDRAMAT GmbH D-71229 Leonberg Böblinger Straße 25 Telefon: 07152/972-6 Telefax: 07152/972-727		INDRAMAT GmbH Telefon: D-0172/660 040 6 -or- Telefon: D-0171/333 882 6

Customer service locations in Germany

Europe

Austria	Austria	Belgium	Denmark
G.L.Rexroth Ges.m.b.H. Geschäftsbereich INDRAMAT A-1140 Wien Hägelingasse 3 Telefon: 1/9852540-400 Telefax:1/9852540-93	G.L.Rexroth Ges.m.b.H. Geschäftsbereich INDRAMAT A-4061 Pasching Randlstraße 14 Telefon: 07229/64401-36 Telefax: 07229/64401-80	Mannesmann Rexroth N.V.-S.A. Geschäftsbereich INDRAMAT B-1740 Ternat Industrielaan 8 Telefon: 02/5823180 Telefax: 02/5824310	BEC Elektronik AS DK-8900 Randers Zinkvej 6 Telefon: 086/447866 Telefax: 086/447160
England	**Finnland**	**France**	**France**
Mannesmann Rexroth Ltd. INDRAMAT Division Cirencester, Glos GL7 1YG 4 Esland Place, Love Lane Telefon: 01285/658671 Telefax: 01285/654991	Rexroth Mecman OY SF-01720 Vantaa Riihimiehentie 3 Telefon: 0/848511 Telefax: 0/846387	Rexroth - Sigma S.A. Division INDRAMAT F-92632 Gennevilliers Cedex Parc des Barbanniers 4, Place du Village Telefon: 1/41475430 Telefax: 1/47946941	Rexroth - Sigma S.A. Division INDRAMAT F-69634 Venissieux - Cx 91, Bd 1 Joliot Curie Telefon: 78785256 Telefax: 78785231
France	**Italy**	**Italy**	**Netherlands**
Rexroth - Sigma S.A. Division INDRAMAT F-31100 Toulouse 270, Avenue de lardenne Telefon: 61499519 Telefax: 61310041	Rexroth S.p.A. Divisione INDRAMAT I-20063 Cernusco S/N.MI Via G. Di Vittoria, 1 Telefon: 02/92365-270 Telefax: 02/92108069	Rexroth S.p.A. Divisione INDRAMAT Via Borgomanero, 11 I-10145 Torino Telefon: 011/7712230 Telefax: 011/7710190	Hydraudyne Hydrauliek B.V. Kruisbroeksestraat 1a P.O. Box 32 NL-5280 AA Boxtel Telefon: 04116/51951 Telefax: 04116/51483
Spain	**Spain**	**Sweden**	**Switzerland**
Rexroth S.A. Centro Industrial Santiago Obradors s/n E-08130 Santa Perpetua de Mo-goda (Barcelona) Telefon: 03/718 68 51 Telex: 591 81 Telefax: 03/718 98 62	Goimendi S.A. División Indramat Jolastokieta (Herrera) Apartado 11 37 San Sebastion, 20017 Telefon: 043/40 01 63 Telex: 361 72 Telefax: 043/39 93 95	AB Rexroth Mecman INDRAMAT Division Varuvägen 7 S-125 81 Stockholm Telefon: 08/727 92 00 Telefax: 08/64 73 277	Rexroth SA Département INDRAMAT Chemin de l`Ecole 6 CH-1036 Sullens Telefon: 021/731 43 77 Telefax: 021/731 46 78
Switzerland	**Russia**		
Rexroth AG Geeschäftsbereich INDRAMAT Gewerbestraße 3 CH-8500 Frauenfeld Telefon: 052/720 21 00 Telefax: 052/720 21 11	Tschudnenko E.B. Arsenia 22 153000 Ivanovo Rußland Telefon: 093/22 39 633		

European customer service locations without Germany

Outside of Europe

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Canada Basic Technologies Corporation Burlington Division 3426 Mainway Drive Burlington, Ontario Canada L7M 1A8 Telefon: 905/335-55 11 Telefax: 905/335-41 84	China Rexroth (China) Ldt. Shanghai Office Room 206 Shanghai Intern. Trade Centre 2200 Yanan Xi Lu Shanghai 200335 P.R. China Telefon: 021/627 55 333 Telefax: 021/627 55 666	China Rexroth (China) Ldt. Shanghai Parts & Service Centre 199 Wu Cao Road, Hua Cao Minhang District Shanghai 201 103 P.R. China Telefon: 021/622 00 058 Telefax: 021/622 00 068	China Rexroth (China) Ldt. 1430 China World Trade Centre 1, Jianguomenwai Avenue Withjing 100004 P.R. China Telefon: 010/50 50 380 Telefax: 010/50 50 379
China Rexroth (China) Ldt. A-5F., 123 Lian Shan Street Sha He Kou District Dalian 116 023 P.R. China Telefon: 0411/46 78 930 Telefax: 0411/46 78 932	Honkong Rexroth (China) Ldt. 19 Cheung Shun Street 1st Floor, Cheung Sha Wan, Kowloon, Honkong Telefon: 741 13 51/-54 and 741 14 30 Telex: 3346 17 GL REX HX Telefax: 786 40 19 786 07 33	India Mannesmann Rexroth (India) Ltd. INDRAMAT Division Plot. 96, Phase III Peenya Industrial Area Bangalore - 560058 Telefon: 80/839 21 01 80/839 73 74 Telex: 845 5028 RexB Telefax: 80/839 43 45	Japan Rexroth Co., Ltd. INDRAMAT Division I.R. Building Nakamachidai 4-26-44 Tsuzuki-ku, Yokohama 226 Japan Telefon: 045/942-72 10 Telefax: 045/942-03 41
Korea Rexroth-Seki Co Ltd. 1500-12 Da-Dae-Dong Saha-Gu, Pusan, 604-050 Telefon: 051/264 90 01 Telefax: 051/264 90 10	Korea Seo Chang Corporation Ltd. Room 903, Jeail Building 44-35 Yoido-Dong Youngdeungpo-Ku Seoul, Korea Telefon: 02/780-82 07 ~9 Telefax: 02/784-54 08	Mexico Motorización y Diseño de Controles, S.A. de C.V. Av. Dr. Gustavo Baz No. 288 Col. Parque Industrial la Ioma Apartado Postal No. 318 54060 Tlalnepantla Estado de Mexico Telefon: 5/397 86 44 Telefax: 5/398 98 88	
USA Rexroth Corporation INDRAMAT Division 5150 Prairie Stone Parkway Hoffman Estates, Illinois 60192 Telefon: 847/645-36 00 Telefax: 857/645-62 01	USA Rexroth Corporation INDRAMAT Division 2110 Austin Avenue Rochester Hills, Michigan 48309 Telefon: 810/853-82 90 Telefax: 810/853-82 90		

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Bosch Group

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