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Digital AC Motors
MKD

Project Planning Manual

SYSTEM200

DOK-MOTOR*-MKD********-PR05-EN-P

Rexroth
Indramat

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What is the purpose of this document?

The following documentation helps...

- in the familiarization with digital MKD AC Motors
- to plan the mechanical integration into the installation
- to plan the electrical connections
- to connect the motor
- to order or identify a motor
- to determine the required motor cable and connector

Course of modifications

Document identification of previous and present output	Release Date	Comments
DOK-MOTOR*-MKD********-PRJ2-EN-P	Sept 96	1st edition (not printed)
DOK-MOTOR*-MKD********-PRJ2-EN-P	Jan 97	Motor feedback: digital Servo feedback (MSF) - obsolete
DOK-MOTOR*-MKD********-PR05-EN-P	Mai 99	3rd edition

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Contents

1 Introducing the MKD Digital AC Servo Motors

1.1 General Features

Applications

In conjunction with digital intelligent INDRAMAT drives, MKD AC servo motors create cost-effective automatization systems for a broad range of industrial applications in such areas as

- machine tools
- transfer machines
- handling systems
- printing presses
- packaging machines
- textile machines
- the food processing industries (specific motor types that are required "*without painted coating*")
- ...

Advantages

The salient advantages of MKD motors are:

- high operating reliability
- maintenance-free operations (due to the brushless design and the 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 performance data
- high dynamics (favorable power to weight ratio)
- high overload capacities (as a result of favorable heat conduction from the stator windings to the outside wall of the motor)
- peak torque which can be used over a broad speed range (accomplished with electronic commutation)
- continuous start-stop operations with high repetitive frequencies are 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)

Power overview Motors with the following continuous torques at standstill and rated speeds are available:

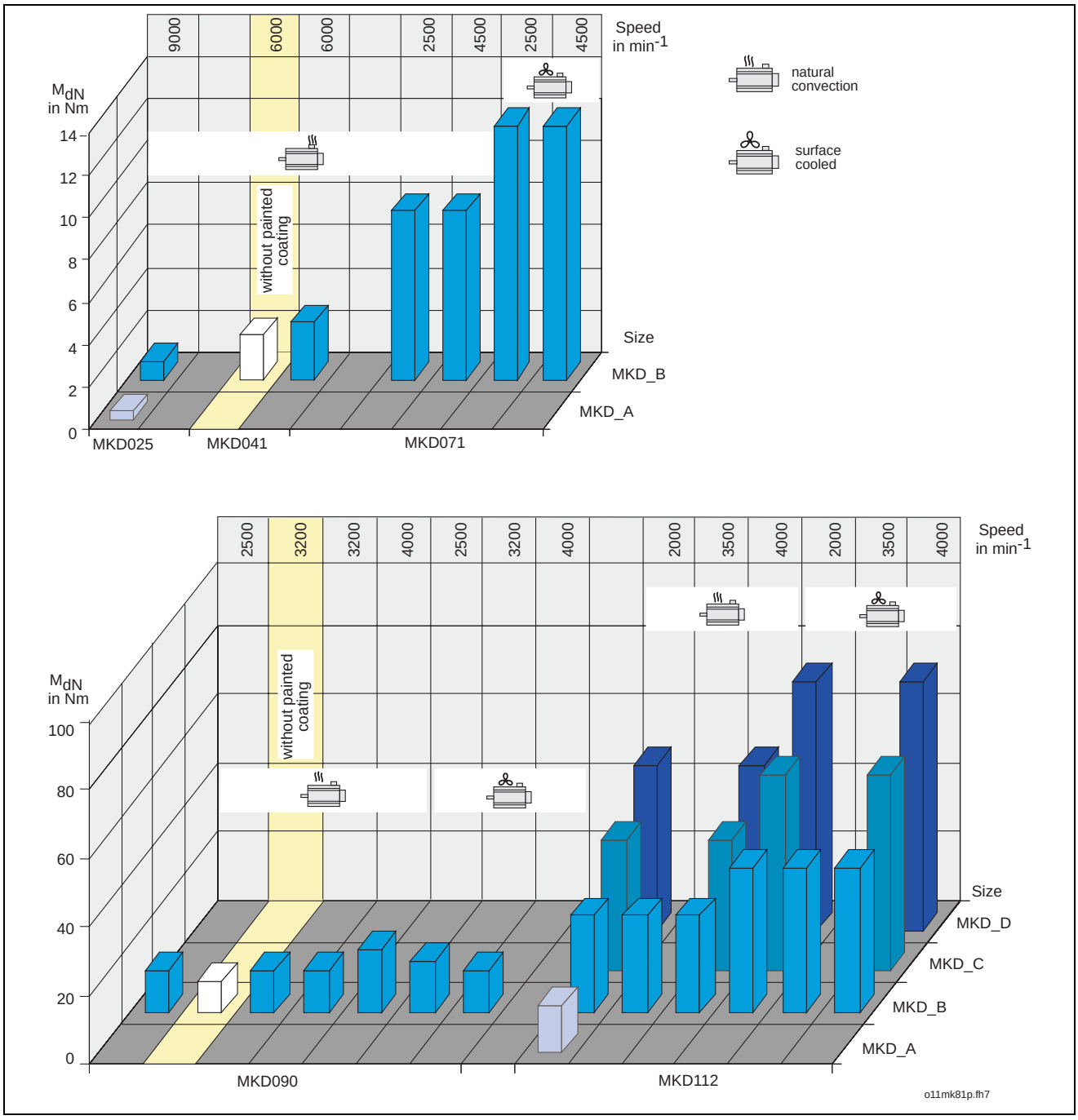


Fig. 1-1: Continuous torque at standstill for the available MHD motors

Structure and components MKD motors are permanent magnet-excited motors with electronic commutation. Special magnetic materials permit a design with low inertia. The following illustrates the principle structure of MKD motors.

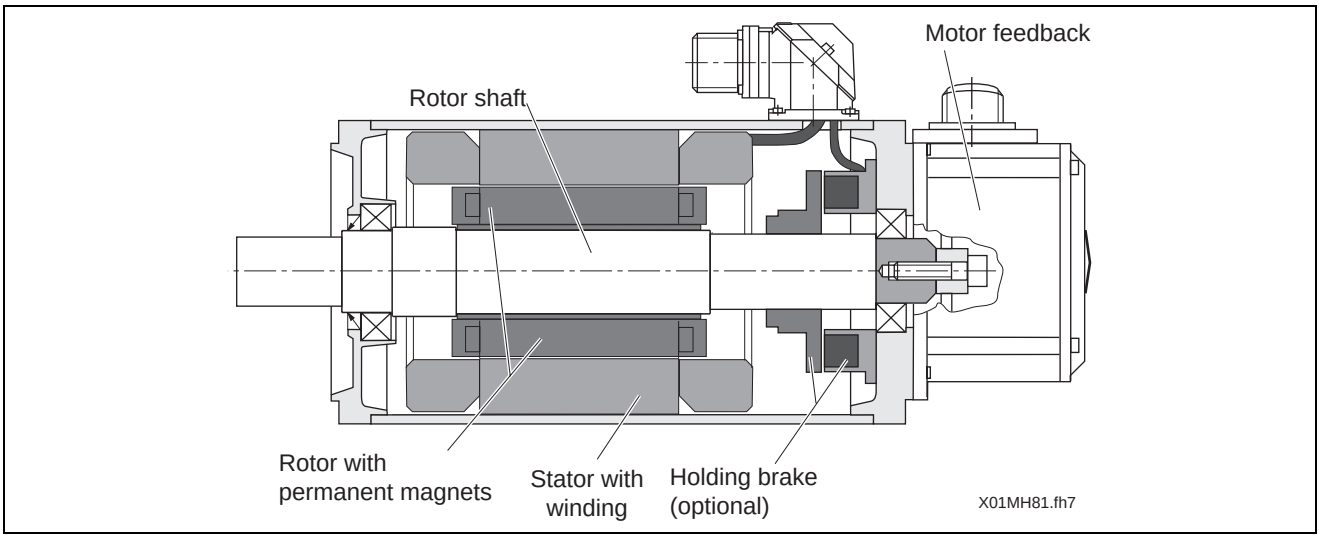


Fig. 1-2: The structure of an MKD motor

1.2 Versions

MKD 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 brake Optional. For a safe holding of the axes at standstill when power to the motor is shutdown. For details see section

Output shaft They are available as

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

For details see section 3.3.

Electrical connections These are motor-specific and use either

- a terminal box or
- plugin connectors.

For details see section 3.6.

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 determined position value to a superordinate CNC or PLC.

Feedback data storage The 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 commissioning

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

MKD motors are available with two position-evaluation principles, 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	MKD025, 041: 3 x 2^{13} = 24 576 MKD071, 090, 112: 4 x 2^{13} = 32 768 information / rotations	
system accuracy	±8 angle minutes	
position detection type	relative	absolute (within range of 4096 motor rotations)

Fig. 1-3: Technical data of the motor feedback

Note: The MDD or MHD lines of motors are available if higher performance levels are required.

Resolver feedback (RSF)

For relative indirect position detection. 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, or home, 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 that

- there are three (3) zero pulses per revolution with the MKD 025 and MKD 041
- and four (4) zero pulses per revolution with the MKD 071, 090 and 112.

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

Resolver feedback (RSF) with integral 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 (10) years.

2 Safety Instructions for Electrical Drives

2.1 Introduction

These instructions must be read and understood before the equipment is used to minimize the risk of injury to personnel and / or property damage. Follow these safety instructions at all times.

Do not attempt to install, use or service this equipment without first reading all documentation provided with the product. Please read and understand these safety instructions, and all user documentation of the equipment, prior to working with the equipment at any time. You must contact your local INDRAMAT representative if you cannot locate the documentation for your equipment. A listing of INDRAMAT offices is supplied in the back of this manual. Request that your representative send this documentation immediately to the person or persons responsible for the safe operation of this equipment.

If the product is resold, rented or lent out and/or otherwise transferred or passed on to others, then these safety instructions must accompany it.

WARNING

Improper use of this equipment, failure to follow the attached safety instructions, or tampering with the product, including disabling or disconnecting the safety device, may result in injury, severe electrical shock or death and property damage!

2.2 Hazards due to Improper Use

DANGER

High voltage and high discharge current!

Danger to life, risk of severe electrical shock and risk of injury!

DANGER

Dangerous movements!

Danger to life and risk of injury or equipment damage by unintentional motor movements!

WARNING

High electrical voltages due to incorrect connections!

Danger to life, severe electrical shock and serious bodily injury!

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids when in proximity to electrical equipment!

CAUTION

Surface of machine housing could be extremely hot!
Danger of injury!

Danger of burns!

CAUTION

Risk of injury due to incorrect handling!

Bodily injury caused by crushing, shearing, cutting and thrusting movements!

CAUTION

Risk of injury due to incorrect handling of batteries!

2.3 General Information

- INDRAMAT GmbH is not liable for damages resulting from failure to observe the warnings given in these instructions.
- Order operating, maintenance and safety instructions in your language before starting up the machine. If your language is not available, then numerous other languages are. Please select one that you understand perfectly.
- Proper and correct transport, storage, assembly and installation as well as care in operation and maintenance are prerequisites for optimal and safe operation of this equipment.
- Personnel trained and qualified to handle electrical equipment:

Only trained and qualified personnel may work on this equipment or within its proximity. Personnel are qualified if they have sufficient knowledge of the assembly, installation, and operation of the product as well as an understanding of all warnings and precautionary measures noted in these instructions.

Furthermore, they should be trained, instructed, and qualified to switch electrical circuits and equipment on and off, to ground them, and to identify and mark them according to the requirements of safe work practices and common sense. They must be adequately equipped and trained in first aid.

- Use only spare parts approved by the manufacturer.
- All safety regulations and requirements for the specific application must be followed as practiced in the country of use.
- The equipment is designed for installation on commercial machinery.
- Start-up is only permitted once it is sure that the machine in which the product is installed complies with the requirements of national safety regulations and safety specifications of the application.

European countries: see Directive 89/392/EEC (Machine Guideline).

- Operation is only permitted if the national EMC regulations for the application are met.

The instructions for installation in accordance with EMC requirements can be found in the INDRAMAT document "EMC in Drive and Control Systems“.

The machine builder is responsible for compliance with the limiting values as prescribed in the national regulations and specific EMC regulations for the application.

European countries: see Directive 89/336/EEC (EMC Guideline).

U.S.A.: See National Electrical Codes (NEC), National Electrical Manufacturers Association (NEMA), and local building codes. The user of this equipment must consult the above noted items at all times.

- Technical data, connections and operational conditions are specified in the product documentation and must be followed.

2.4 Protection against contact with electrical parts and enclosures not grounded

Note: This section pertains to equipment and drive components that conduct voltages exceeding 50 volts.

Touching live parts with potentials of 50 volts and higher applied to them or touching not grounded enclosures can be dangerous and cause severe electrical shock. In order for electrical equipment to be operated, certain parts must have dangerous voltages applied to them.

DANGER

High Voltage!
Danger to life, severe electrical shock and risk of injury!

⇒ Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain and / or repair this equipment.

⇒ Follow general construction and safety regulations when working on electrical installations.

⇒ Before switching on power, the ground wire must be permanently connected to all electrical units according to the connection diagram.

⇒ At no time may electrical equipment be operated if the ground wire is not permanently connected, even for brief measurements or tests.

⇒ Before beginning any work, disconnect mains or the voltage source from the equipment. Lock the equipment against being switched on while work is being performed.

⇒ Wait five (5) minutes after switching off power to allow capacitors to discharge before beginning work. Measure the voltage on the capacitors before beginning work to make sure that the equipment is safe to touch.

⇒ Never touch the electrical connection points of a component while power is turned on.

⇒ Before switching the equipment on, install those covers and guards provided with the equipment to prevent contact with live parts. Before operating, cover and secure live parts properly so they cannot be touched.

⇒ A residual-current-operated protective device (r.c.d.) must not be used on an AC drive! Indirect contact must be prevented by other means, for example, by an overcurrent protective device.

European countries: according to EN 50178/ 1994.

⇒ Electrical components with exposed live parts must be installed in a control cabinet to prevent direct contact.

European countries: according to EN 50178/ 1994.

U.S.A: See National Electrical Codes (NEC), National Electrical Manufacturers Association (NEMA), and local building codes. The user of this equipment must consult the above noted items at all times.

DANGER

High housing voltage! High leakage current!
Danger to life and limb, danger of injury from electric shock!

⇒ Prior to powering up, connect the electrical equipment, the housing of all electrical units and motors to the protective conductor at the grounding points or ground them. This applies even to brief tests.

⇒ The protective conductor of the electrical equipment and units must always be connected to the supply network. Leakage current exceeds 3.5 mA.

⇒ Use at least a 10 mm^2 copper conductor cross section for this protective connection over its entire course!

⇒ Prior to startups, even for brief tests, always connect the protective conductor or connect to ground wire. High voltage levels can occur on the housing that could lead to severe electrical shock and personal injury.

European countries: EN 50178 / 1994, section 5.3.2.3.

USA: See National Electrical Codes (NEC), National Electrical Manufacturers Association (NEMA) and local building codes. The user of this equipment must consult the above noted at all times.

2.5 Protection by protective low voltage (PELV) against electrical shock

All connections and terminals with voltages ranging between 5 and 50 volts on INDRAMAT products are protective low voltages designed in accordance with the following standards on contact safety:

- International: IEC 364-4-411.1.5
- EU countries: see EN 50178/1994, section 5.2.8.1.

WARNING

High electrical voltages due to incorrect connections!
Danger to life, severe electrical shock and/or serious bodily injury!

⇒ Only that equipment or those electrical components and cables may be connected to all terminals and clamps with 0 to 50 volts that are of the protective low voltage type (PELV = Protective Extra Low Voltage).

⇒ Only connect those voltages and electrical circuits that are safely isolated. Safe isolation is achieved, for example, with an isolating transformer, an optoelectronic coupler or when battery-operated.

2.6 Protection against dangerous movements

Dangerous movements can be caused when units have bad interfaces or motors are connected incorrectly.

There are various causes of dangerous movements:

- Improper or incorrect wiring or cable connections
- equipment is operated incorrectly
- probe parameters or encoder parameters are set incorrectly
- malfunctioning components
- errors in software or firmware

Dangerous movements can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.

Although the monitoring circuits in the drive components make improper operation almost impossible, personnel safety requires that proper safety precautions be taken to minimize the risk of personal injury and/or property damage. This means that unexpected motion must be anticipated since the safety monitoring devices built into the equipment might be nullified or incapacitated by incorrect wiring or other faults.

DANGER

Dangerous movements!
Danger to life and risk of injury or equipment damage!

⇒ In the drive component monitoring units, every effort is made to avoid the possibility of faulty operation in connected drives. Unintended machine motion or other malfunctions are possible if monitoring units are disabled, bypassed or not activated.

⇒ Safe requirements of each individual drive application must be considered on a case-by-case basis by users and machine builders.

Avoiding accidents, injury and/or property damage:

⇒ Keep free and clear of the machine's range of motion and moving parts. Prevent people from accidentally entering the machine's range of movement:

- use protective fences
- use protective railings
- install protective coverings
- install light curtains / barriers

⇒ Fences should be strong enough to withstand the maximum possible momentum.

⇒ Mount the emergency stop (E-stop) switch within the immediate reach of the operator. Verify that the emergency stop works before starting up. Do not operate the machine if this device is not working.

⇒ Isolate the drive power connection by means of an emergency stop circuit or use a start inhibit system to prevent unintentional start-up.

⇒ Make sure that the drives are standing still before accessing or entering the danger zone.

⇒ Disconnect electrical power to the equipment using a master lock-out and secure against reconnection for:

- maintenance and repair work
- cleaning of equipment
- long periods of discontinued equipment use

⇒ Avoid operating high-frequencies, remote controls and radio equipment near electronics and supply leads. If use of such equipment cannot be avoided, check the system and the plant for possible malfunctions at all possible positions of normal use before the first start-up. If necessary, perform a special electromagnetic compatibility (EMC) test on the plant.

2.7 Protection against magnetic and electromagnetic fields during operation and when mounting

Magnetic and electromagnetic fields in the vicinity of current-carrying conductors and permanent motor magnets represent a serious health hazard to persons with heart pacemakers, metal implants and hearing aids.

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

⇒ Persons with pacemakers and metal implants are not permitted to have access to the following areas:

- Areas in which electrical equipment and parts are mounted, being operated or started up.
- Areas in which parts of motors with permanent magnets are being stored, repaired or mounted.

⇒ If it is necessary for a person with a pacemaker to enter into such an area, then a physician must be consulted prior to doing so.

⇒ Persons with metal implants or hearing aids must use caution when entering the areas described above. It is assumed that metal implants or hearing aids will be affected by such areas: A physician must be consulted prior to working in and/or entering such areas.

2.8 Protection against contact with hot parts

CAUTION

Surface of machine housing can be extremely hot! Danger of injury! Danger of burns!

⇒ Do not touch housing surface near the source of heat! Danger of burns!

⇒ Prior to accessing a unit, wait ten (10) minutes to allow the unit to cool off.

⇒ If hot parts of the equipment are touched, such as the unit housing in which heatsink and resistor are located, then this can cause burns.

2.9 Protection during handling and installation

All INDRAMAT products should be handled and assembled according to the instructions in the documentation.

CAUTION

Risk of injury due to incorrect handling!
Bodily injury caused by crushing, shearing, cutting, and thrusting movements!

⇒ Observe installation instructions and safety regulations before handling and working on the product.

⇒ Use suitable lifting or moving equipment during installation. Refer to the user manual for the product.

⇒ Take precautions to avoid pinching and crushing.

⇒ Only use suitable tools specified in the user manuals and use them according the instructions.

⇒ Use lifting devices and tools correctly and safely.

⇒ Wear appropriate protective clothing, e.g., protective goggles, safety shoes, protective gloves.

⇒ Never stand under suspended loads.

⇒ Wipe up all spills immediately to prevent slipping.

3 Mechanical Integration Into the Machine

3.1 Environmental Conditions

Maximum Installation Elevation and Ambient Temperature

Rated data

The power data of the motor apply to:

- Ambient temperatures of 0º up to +45º C
- Installation elevations of 0 up to 1000 m above sea level

Exceeding rated data

If the motors are to be used above this range, then the "Load capacity factors" must be taken into account. This derates power data.

⇒ In cases like this, check whether the power data still suffice for your application. To determine the load capacity factor, see Fig. 3-1. Values exceeding those illustrated for temperature or installation elevations are basically not permitted!

Note: **Possible motor damage and forfeiture of guarantee!**

Motors operated outside the specified range could be damaged. The guarantee is also forfeited. Therefore, please note the following instructions!

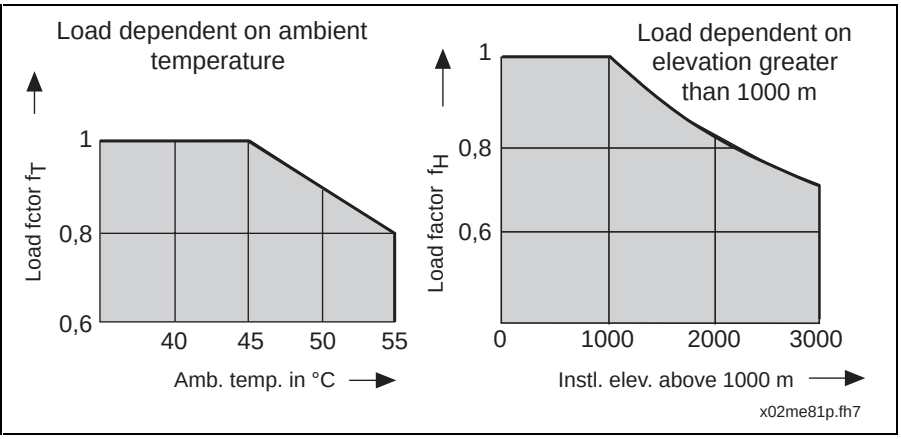


Fig. 3-1: Load capacity factor as dependent on ambient temperature and installation elevation

Should **either** the ambient temperature **or** the installation elevation exceed rated data:

⇒ Multiply the continuous torque at standstill data specified in the selection lists with the load capacity factor which was determined.

⇒ Make sure that the application does not exceed derated torque.

If **both** ambient temperature **and** installation elevation exceed rated data:

⇒ Multiply the determined load capacity factors f_T and f_H.

⇒ Multiply the determined value with the continuous torque data at standstill listed in the selection lists of the motor.

Make sure that the derated torque data are not exceeded by your application.

Protection Category

The construction of the MKD motors meets the protection category demands as outlined in DIN VDE 0470, sec. 1, edition dated 11/1992 (EN 60 529):

The area of the motor	Protection Category
Motor housing, output shaft, power and feedback connections (only with correct mounting)	IP 65
blower motor	IP 44
surface cooling (blower grids) and blower connections	IP 24

Fig. 3-2: Areas of protection of MKD motors

The protection category is identified by the abbreviation **IP** (**I**nternational **P**rotection) and two numbers for the level of protection.

The **first number** specifies the level of protection against contact and penetration of extrinsic objects. The **second number** specifies the protection level against water.

First number	Protection level against contact and extrinsic objects
6	Protection against penetration by dust (dust proof); complete contact protection
4	Protection against penetration by solid objects with a diameter exceeding 1mm
2	Protection against penetration by solid objects with a diameter exceeding 12 mm ⇒ Keep fingers or similar sized objects away!
Second number	**Protection level against water**
5	Protection against a jet of water from a nozzle coming from all directions against the housing (jet of water).
4	Protection against water coming from all directions against the housing (jet of water).

Fig. 3-3: IP protection categories

Note: The tests for the second number are conducted with fresh water. If any cleansing processes are conducted at high pressures or using solvents, lubricants or such, then higher protection categories may be needed.

WARNING

Danger to personnel or damage to property!
Incorrectly connected power and feedback connections could endanger personnel or damage motors!

⇒ Make sure that the power and feedback connections have been properly connected.

⇒ Use the MKD motors only in that environment which is covered by the specified category.

Maximum Vibration and Shock Demands

Note: MKD motors are suited for demands made by pressing, punching or press feed operations if they are mounted in a shock-damped or shock-decoupled manner. The construction of such mounts depends on their use and should be tested.

Note: Motor damage and loss of the guarantee!

- Motors operated outside of the specified range could be damaged. Doing so also means that the guarantee is forfeited. Please note the following instructions!

In accordance with IEC 721-3-3, ed. 1987 or EN 60721-3-3, ed. 6/1994 MKD motors may only be operated in a stationary, weather-protected manner under the following conditions:

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

⇒ Make sure that the limit values for storage, transport and operation of MKD motors as specified in Fig. 3-4 and Fig. 3-5 are not exceeded.

Variable	Unit	Maximum value in longitudinal axis	Maximum vaue in lateral axis
Amplitude of displacement at 2 to 9 Hz	mm	0.3	3.0
Amplitude of acceleration at 9 to 200 Hz	m/s^2	1	10

Fig. 3-4: Limit data for sinusoidal oscillations

Variable	Unit	Maximum value in longitudinal axis	Maximum value in lateral axis
Total shock response spectrum (per IEC721-1 edition 1990; table 1, section 6)		type L	type I
Reference accel (in IEC 721 peak accel specified)	m/s^2	40	100
Duration	ms	22	11

Fig. 3-5: Limit data for shock loads

Note: MDD and MHD motors have higher maximum values.

Note: Motors with mounted blowers are not suited for applications with shock loads such as occur with:
- Punching,
- Pressing
- or gantry axes.

In these cases, use motors without surface cooling that have higher torques

Base Coat and Housing Finish

Delivery state: Base coat black (RAL 9005)

Resistance: against weathering, yellowing, chalking, diluted acids and caustic substances.

An additional coat may be applied. Its thickness should not exceed 40µm.

Special designs For special applications, e.g., within the food industry, MKD motors without housing finishes are available.

Note: In the case of motors *without painted coating* the torque data is derated by about 15 to 20%. The technical data and the speed/torque characteristics of such motors are specified in sections „6 “ and „8 “!

3.2 Construction and Mounting Orientation

Construction: B05 for flange mounting

Mounting orientation: any

The following mounting orientations are allowed and meet the requirements specified in DIN IEC 34-7, ed. dtd. 12/1992:

- IM B5 (horizontal)
- IM V1 (vertical, output shaft downward)
- IM V3 (vertical, output shaft upwards)

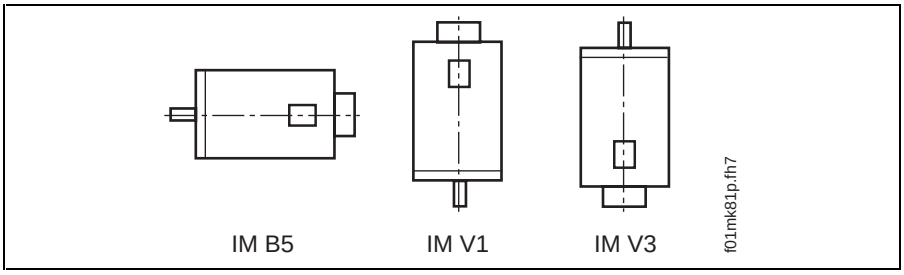


Fig. 3-6: Mounting orientations

CAUTION

Penetration by liquids!
With IM V3 mounted motors it is possible that liquids can collect at the output shaft over an extended period of time and then ultimately damage the motor.
⇒ Therefore make sure that this cannot happen.

3.3 Output Shafts

Available Designs

Plain output shafts

For a backlash-free and non-postive torque transmission.

⇒ Use clamping sets, pressure sleeves or similar clamping components for coupling pinions, belt pulleys or similar drive elements.

Output shaft with keyway

(Per DIN 6885, sh. 1; ed. dtd. 08/1968). For the form-fitting transmission of torque with low demands at the shaft-hub connection.

CAUTION

Damage to the shaft
During powerful reverse operations the bottom of the key can turn out. Ever-increasing deformations can cause the shaft to break.
⇒ The use of plain output shafts is thus recommended.

Shaft loads

Radial and axial forces effect the output shaft:

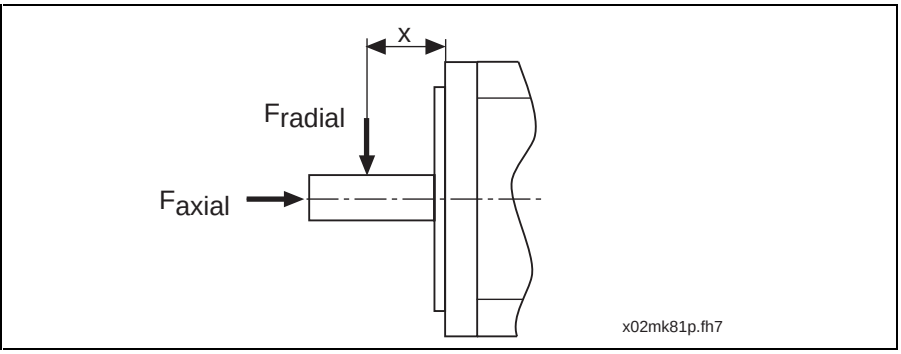


Fig. 3-7: Shaft loads

Note: **Damage to motor and loss of guarantee!**
The motors could be damaged by excessive shaft loads which shortens the service life. The guarantee is also forfeited in this case. It is therefore advisable to note the following instructions!

Maximum allowable radial force F_{radial_max}

The maximum allowable radial force F_{radial_max} depends on the shaft load. It is determined in terms of distance x of the point of application of force and the design of the output shaft (plain shaft or shaft with keyway .

Sections 5 through 9 contain "Speed and Torque".

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

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

Allowable radial force F_{radial}

The allowable radial force F_{radial} depends on the service life desired. It is fixed by the arithmetically calculated speed of the motor n_{mittel} and the distance x of the point of application of force (see Fig. 3-7).

Sections 5 through 9 contain **"Speed and Torque"**.

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

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

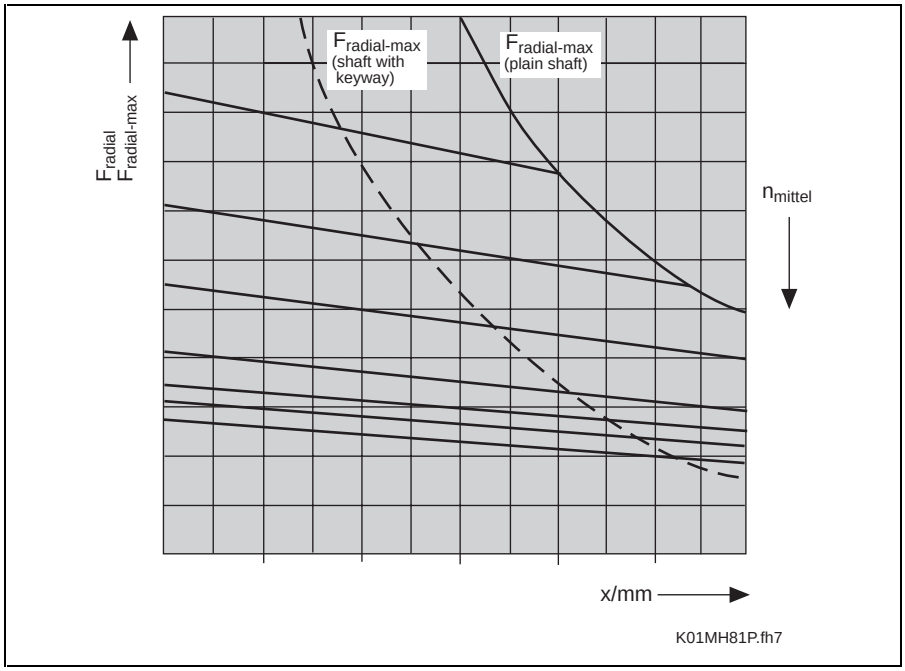


Fig. 3-8: Diagram on maximum allowable radial force - example

Allowable axial force F_{axial}

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

The proportionality factor is also specified in sections 5 to 9 "Data on determining maximum shaft load“.

⇒ Using the specified formula determine the maximum allowable axial force F_{axial} for your application.

⇒ Make sure that the determined axial force is not exceeded during operations. Relative to this, please note the following!

Note: As a result of thermal effects, the flanged end of the output shaft can shift up to 0.6 mm with respect to the motor housing. If drive pinions or bevel gear pinions with helical teeth are used and directly mounted to the output shaft, then this could cause deformation in length. In other words:

- there can be a shifting – of position of the axis if the drive pinion is not permanently axially fixed or
- of a thermally dependent component of the axial force if the drive pinion is permanently axially affixed to the machine. The danger exists, in this case, that the maximum allowable axial force is exceeded or the backlash within the teeth rises to unacceptably high levels.

  It is therefore advisable, in such cases, to use drive elements with bearings that are connected to the motor shaft via axially compensating coupling units.

Bearing service life L_{10h}

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

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

Bearing service life otherwise drops as follows:

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

L_{10h}: bearing service life (per ISO 281, ed. dtd. 12/1990) in hours
F_{radial}: determined allowable radial force in N
F_{radial_ist}: actual radial force in N

Fig. 3-9: Calculating bearing service life L_{10h} if allowable radial force F_{radial} is exceeded

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

Mounting drive elements

Note: When mounting drive elements to the output shaft avoid redundant bearings. The inevitable tolerances generate additional forces that affect the bearings of the motor shaft which, in turn, could reduce service life. If redundant bearings must be used, then please consult Indramat!

3.4 Surface Cooling

For extreme loads such as continuous start/stop operations with high repetitive frequencies, it is possible to mount a radial surface cooling device to MKD071, MKD090 and MKD112 motors.

Blower motors to operate supply voltages 1xAC230 V and 1xAC115 V are available.

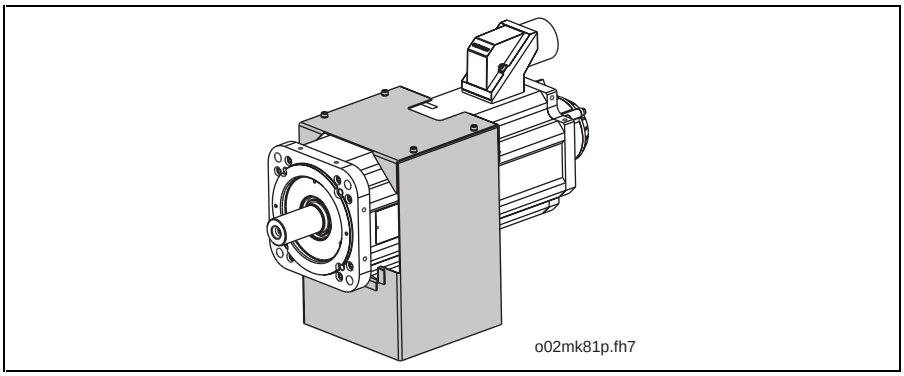


Fig. 3-10: Example of an MKD motor with radial surface cooling

The radial surface cooling device is delivered mounted to the motor and is specified in the order as a subitem of the motor. For detailed information on how to order, see section 7 to 9 .

3.5 Holding Brake

Option For holding the servo axis when power to the machine is off.

The holding brake uses the "electrical release" principle. If the power is off, then the magnetic force acts on the brake disc. This clamps the brake and holds the axis.

Applying the 24 VDC compensates the magnetic field of the continuous magnet by means of the electrially generated magnetic field which causes the brake to open.

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

DANGER

Falling axes!

Danger to personnel by pinching or severing body parts.

⇒ The holding brake alone does not guarantee personnel safety. Using superordinate structural measures such as protective fences or a second brake mean that personnel safety can be better secured.

CAUTION

Premature wear of holding brake is possible!
The holding brake wears down after about 20000 motor revolutions when closed.
⇒ Therefore, do not use the holding brake as if it were a brake that stops moving axes. It should only be used in an emergency situation.

Note: If motors have been stored for extended periods then the transmittable torque of the holding brake must be checked before the motor is used. If the torque as specified in the data sheets is not achieved, then it is necessary to adjust the holding brake.

⇒ Please note the data specified in section 13.5 „Refinishing the holding brake“.

3.6 Connecting Variants and Cable Output Directions

Depending on the motor, different connections are possible (such as terminal box or plug-in connections). The table below outlines possible variants as dependent on motor types.

Motor type	Terminal box	Plug-in connections
MKD025	MKD025A MKD025B	MKD025B
MKD041	all types	---
MKD071	MKD071B-035 MKD071B-061	---
MKD090	MKD090B-035 MKD090B-047 MKD090B-058	---
MKD112	-	all types

Fig. 3-11: Allocating connections to motor types

As shown in Fig. 3-12 it is possible to determine the output direction of the cable if the terminal box variant is selected. It is fixed at the time of mounting. The desired cable output direction of motors that use plug-in connectors has to be specified in the order.

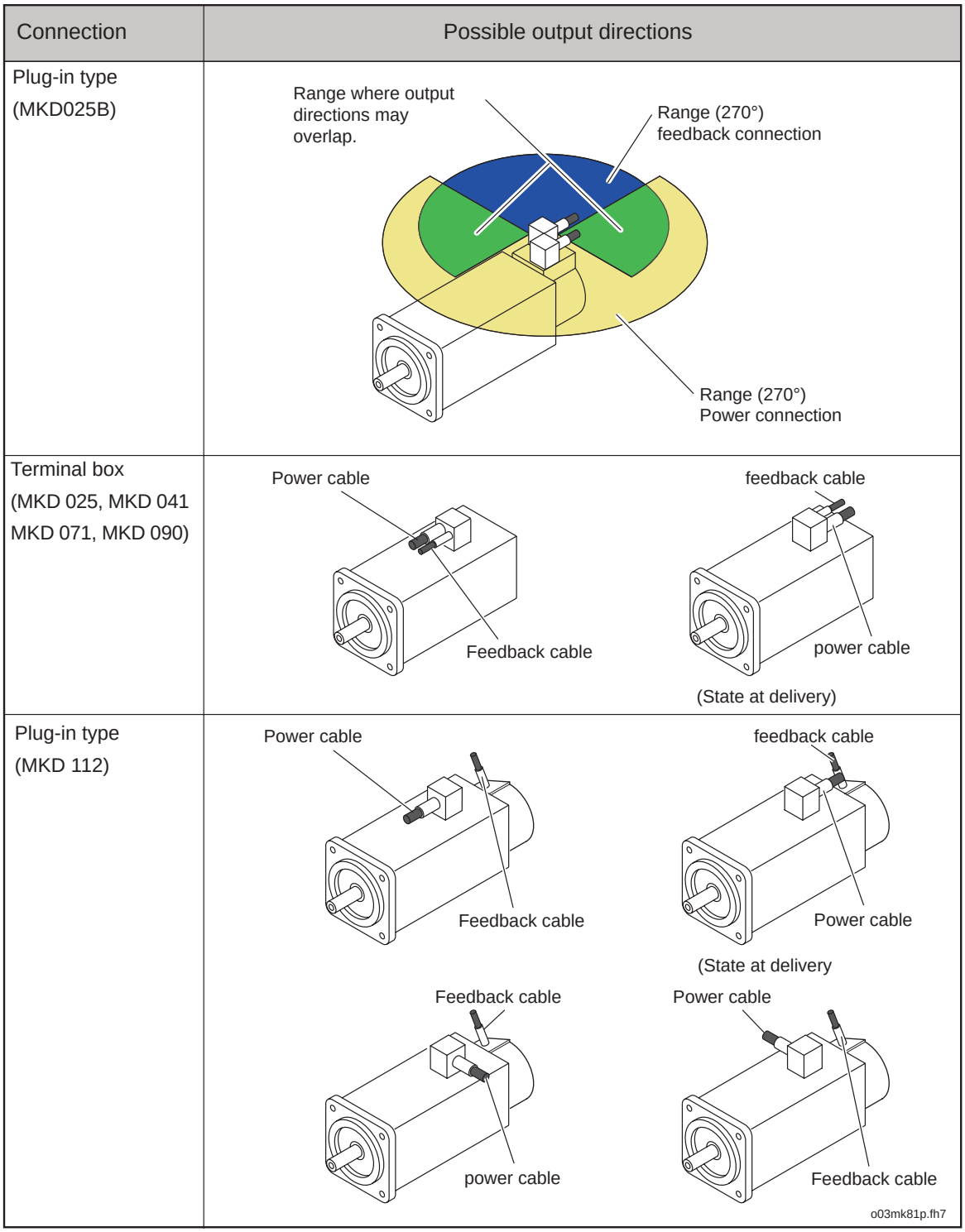


Fig. 3-12: Possible cable output directions

Note: The output direction specified at the time that the order is placed can be changed at the time of mounting should this be necessary. See section 13 for details on this.

If feedback cables with angle feedback connectors are used in motors with plug-in connectors, then the output direction of the feedback cable is set at the factory and is side B of the motor.

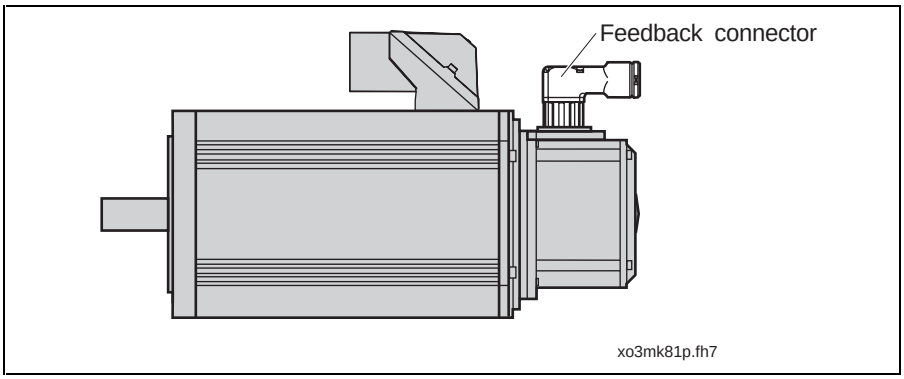


Fig. 3-13: MKD motor with angle feedback connector

Note: The cable output direction of the angle feedback connector can be altered at the time of mounting. See section 13 for details.

3.7 Speed and Torque

The speed/torque curves illustrate

- torque limit data
- speed limit data and
- operating curves.

Sections 5 to9, contain a diagram for each motor.

Use this diagram in order to

- determine maximum usable speeds with known torque requirements;
- check whether the thermal limits of the motors are maintained. This means that the root-mean-square torque achieved with a limit cycle with the arithmetically determined speed (arithmetic average) must lie below the S1 continuous operating characteristic curve (M_{dN}).
- Enter the data from the selection lists in the selection documentation.

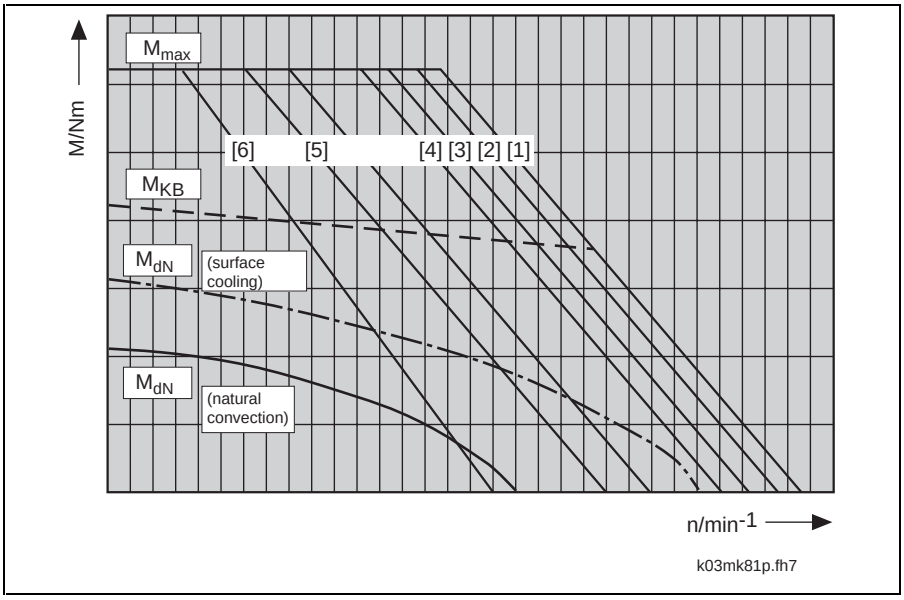


Fig. 3-14: Diagram for determining speed/torque curves - an example

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

Note: The selection lists of the selection documents always specify the maximum torque of a **motor/controller combination.**

M_{KB} S6 intermittent operating curve at 25% ON time of a motor with natural convection cooling or 56% ON time if the motor has surface cooling (as per DIN VDE 0530, ed. dtd. 07/1991). The maximum duty cycles time for

- the MKD 025 is ten (10) minutes
- and 15 minutes for the MKD 041, 071, 090 and 112.

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

Curves (1) to (8) At the peak or "knee" speed, maximum achievable usable speed depends on the available torque. As this maximum speed is determined by the DC bus voltage, separate curves result for each individual drive controller in terms of the supply unit used and possibly its supply voltage.

1. **HDS** or **HDD** on an **HVR power supply unit.**
2. **HDS** or **HDD** on an **HVE power supply unit** connected to a mains of **3 x AC 480 V -or- DKC....-...-7** with a mains of **3 x AC 480 V.**
3. **HDS** or **HDD** on an **HVE power supply unit** connected to a mains of **3 x AC 440 V -or- DKC....-...-7** connected to **3 x AC 440 V.**
4. **HDS** or **HDD** on an **HVE power supply unit** connected to a mains of **3 x AC 400 V -or- DKC....-...-7** conneted to **3 x AC 400 V.**
5. **DKC ...-...-3** with a mains connection of **3 x AC 230 V**.
6. **DKC ...-...-3** with a mains connection of **1 x AC 230 V.**

4 Electrical Connections

4.1 Terminal Overview

The electrical connections of INDRAMAT drives have been standardized. MHD AC motors are equipped with:

- power connections which include temperature sensor and holding brake and
- a feedback connection.

Depending on the motor, the connections are either a terminal box or a separate connector. For details on this see section 3.6 .

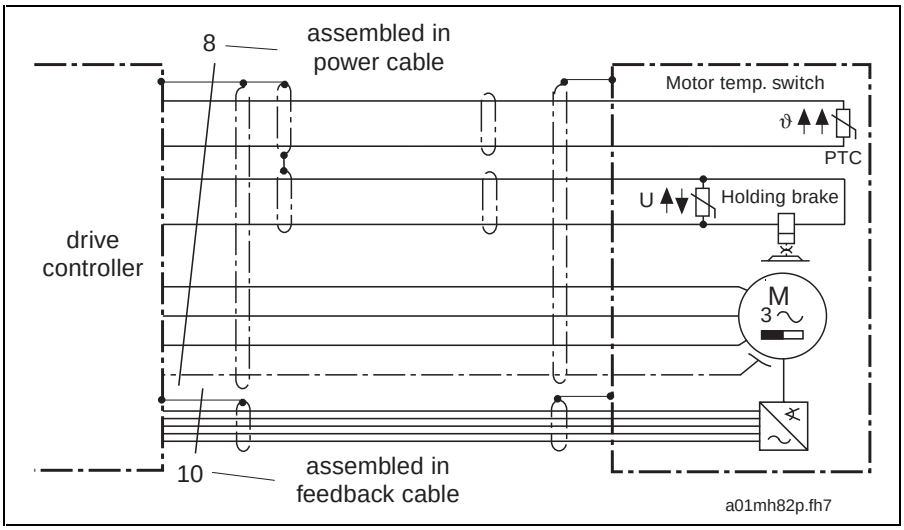


Fig. 4-1: Schematic terminal diagram of an MKD motor

Indramat does not supply the cables for the blowers of surface-cooled.

For detailed connection and mounting instructions of the blower connector see Section 13.4 .

4.2 Connecting Motors with Terminal Boxes

Terminal diagram

Note: Only the direct connection between motor and drive controller is illustrated. The terminal diagrams can, however, be used for all other types of connection such as with intermediate connector, as the allocation of the motor and drive controller connections does not change.

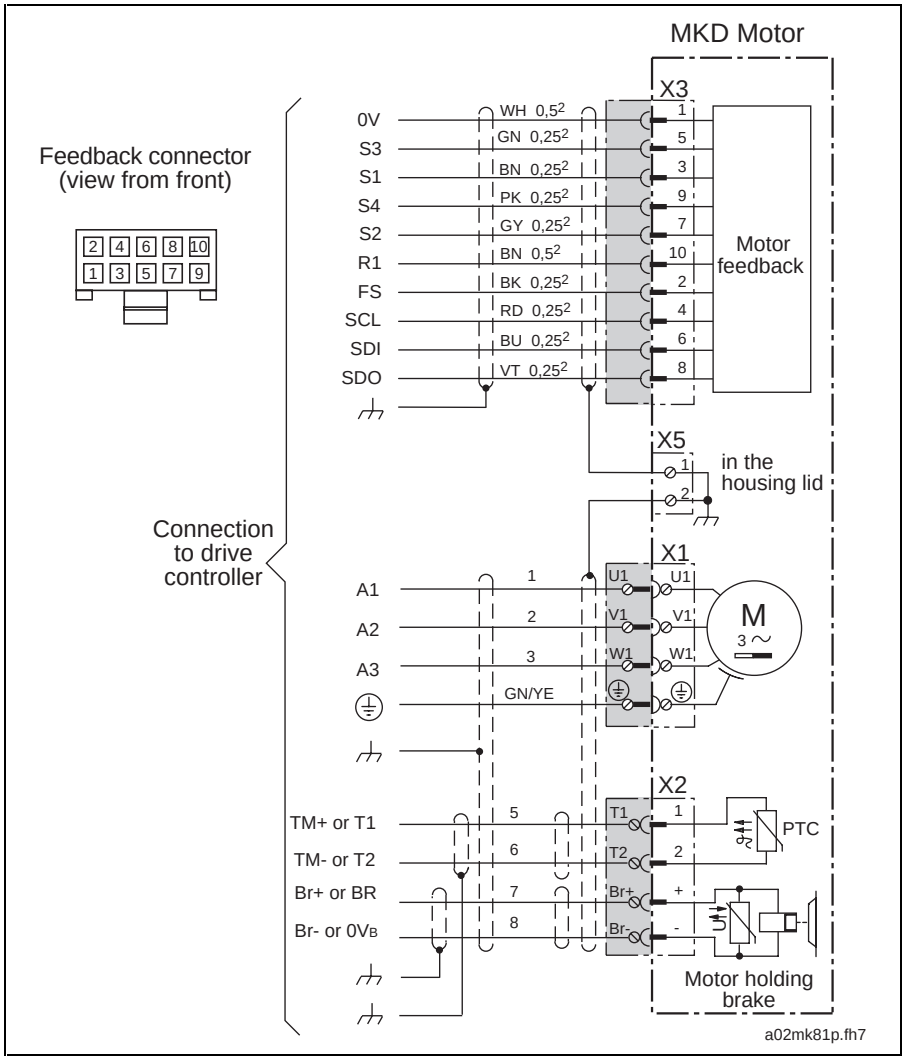


Fig. 4-2: Diagram for MKD motor with terminal box

Power Cables

It is better to equip motors with terminal boxes with standard, ready-made power cables. These power cables are available as

- direct connections or
- connections with intermediate plugs

⇒ Find that cable type designation suitable to your motor/controller combination in the table below.

Selecting the length

Available cable lengths: 2 to 75 meters.

⇒ When ordering, just specify the cable type and the desired length. Example: IKG4020 / 10.5 (= power cables for DKC, length 10.5 meters).

Note: The maximum total length of the cable connection of the motor to the drive controller with two intermediate connections equals 75 meters. In the event that more than two intermediate connections should be required, then the maximum total length could be reduced. This change should be tested.

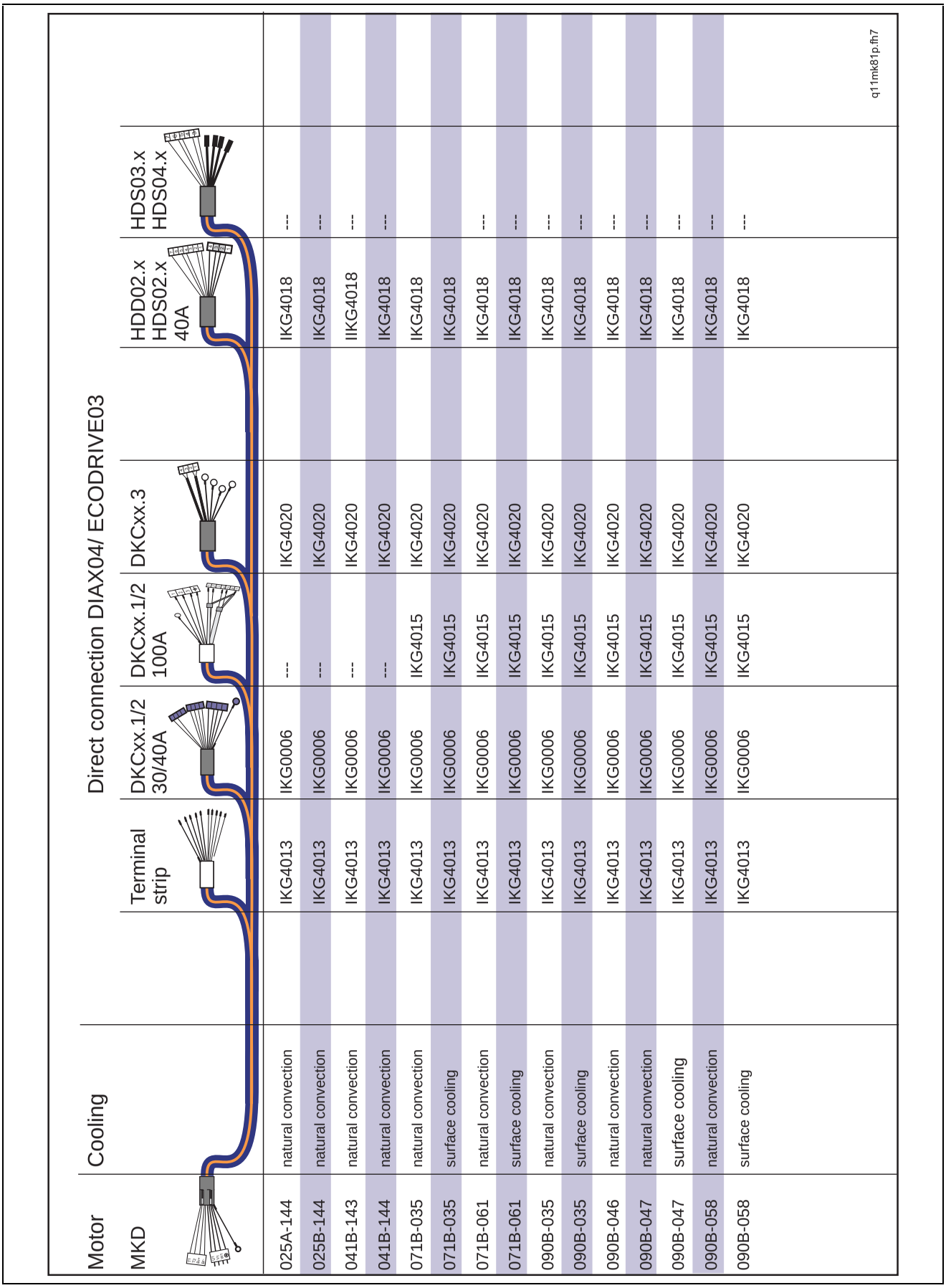


Fig. 4-3: Power cable - terminal box - Table 1

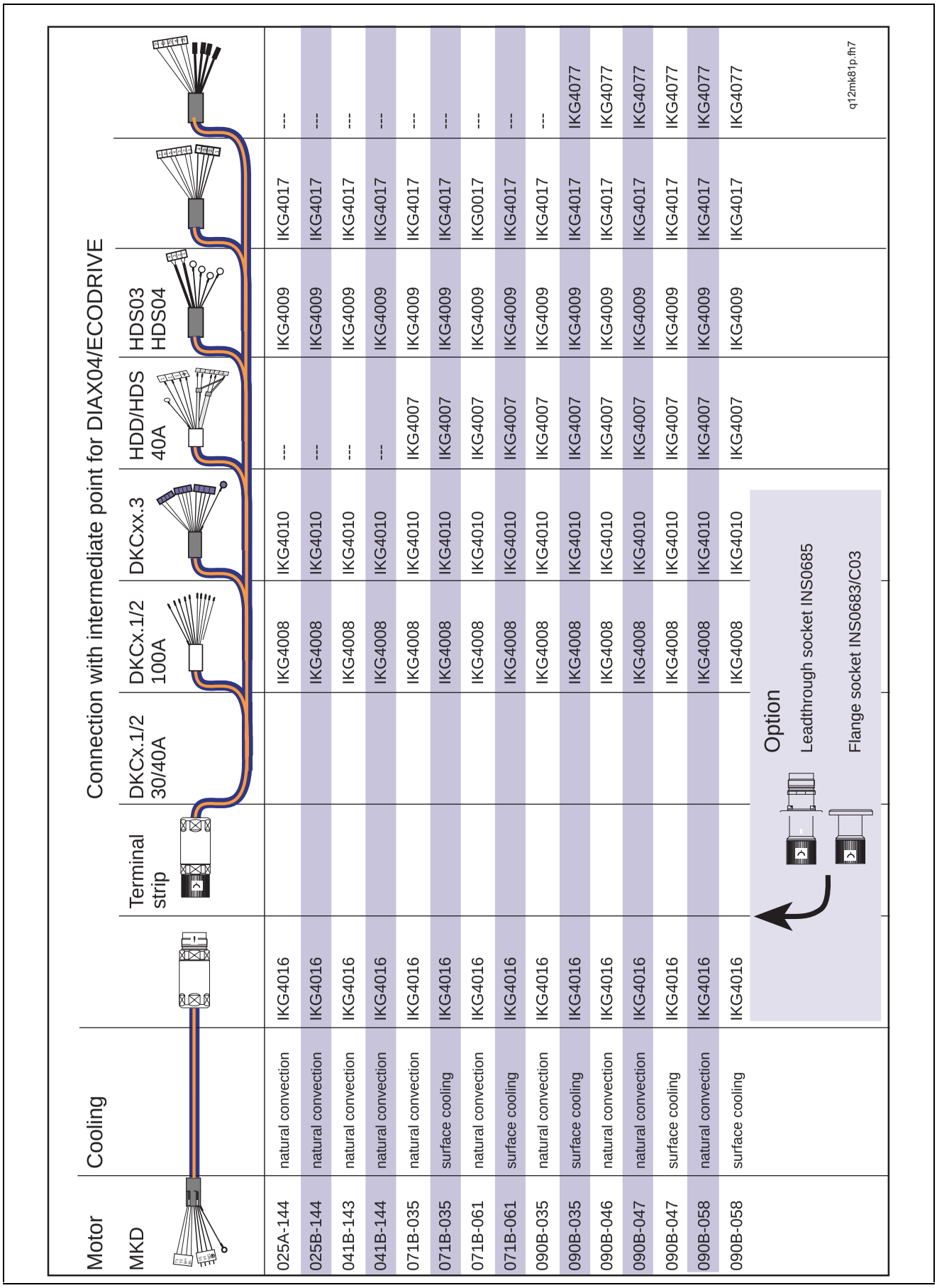


Fig. 4-4: Power cable - terminal box - Table 2

Feedback Cables

Motors with terminal boxes are generally and preferrably equipped with standard, ready-made feedback cables.

These cables are available as:

- direct connections or
- connections with intermediate plugs

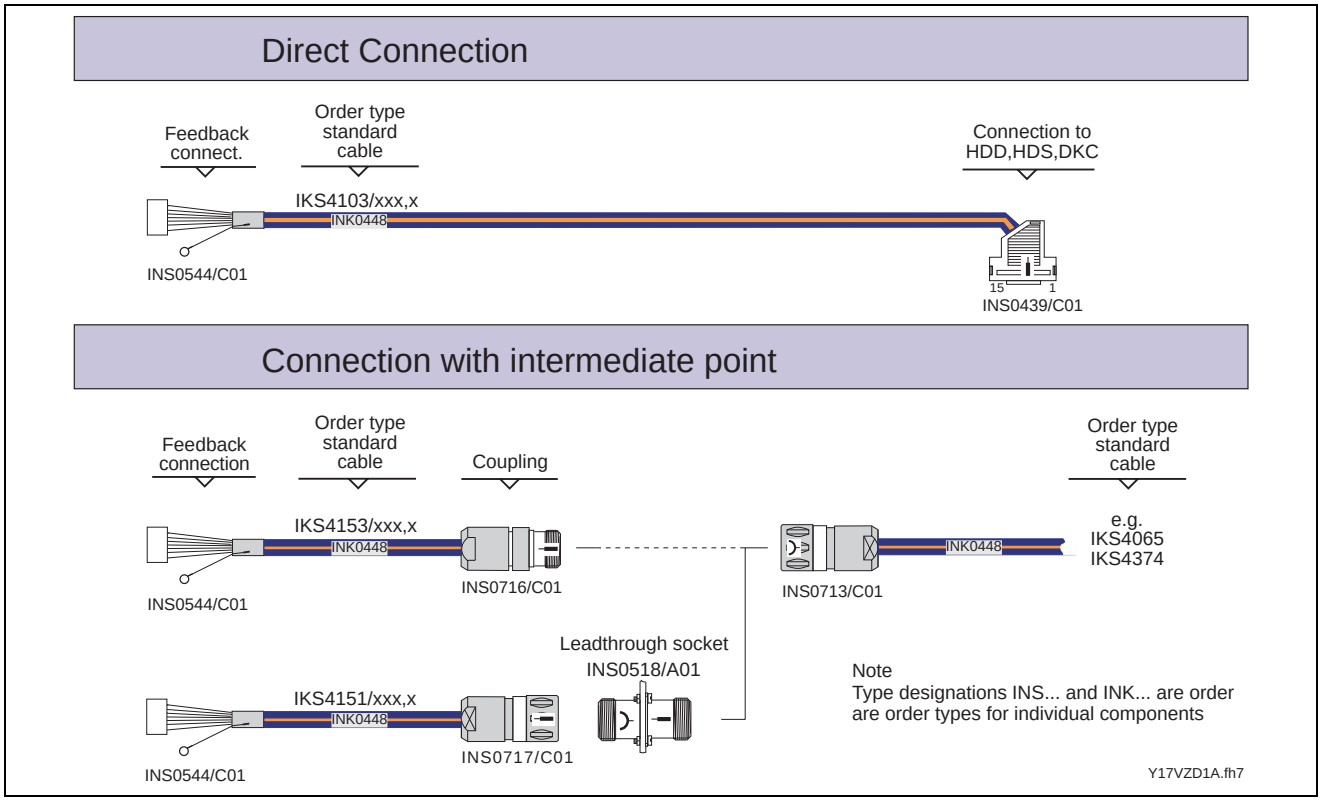


Fig. 4-5: Standard feedback cable for connecting MKD motors with terminal box

Selecting the length

Available cable lengths: two (2) to 75 meters.

⇒ When ordering, specify cable type and desired length. Example: IKS0103 / 10.5 (= feedback cable, length 10.5 m).

Note: The maximum total length of the cable connection of the motor to the drive controller with two intermediate connections equals 75 meters. In the event that more than two intermediate connections should be required, then the maximum total length could be reduced. This change should be tested.

Technical Data of the Power and Feedback Cables

Name	Unit	Data	
		IKG	IKS
Type designations for standard cables IKG... or IKS...		0006 4008 4009 4013 4015 4016 4017 4018 4020	4065 4103 4151 4153 4374
Type designations for cables (non-standard)		INK0653	INK0448
Cross sections of power and supply strands	mm²	4 x 1.0	2 x 0.5
Control strand cross section (Holding brake, temperature monitor or control voltage)	mm²	2 x (2 x 0.75)	4 x (2 x 0.25)
Diameter	mm	12.0 ±0.5	8.5 ±0.3
Minimum bend radius with fixed routing with flexible routing (≥ 2 000 000 bends)	 mm mm	 75 120	 50 90
Specific cable weight	kg/m	0.25	0.10
Protection category (transition from cable to terminal box) when correctly mounted		IP 65	
Chemical features		absolute resistance to mineral oils and greases; hydrolysis resistant, silicone and halogen free	
Allowable storage temperature	ºC	-30 to +80	
Allowable operating temperature	ºC	-30 to +40	
Cable surface		poor adhesion that prevents sticking in drag chains	

Fig. 4-6: Technical data of power and feedback cables for MKD motors with terminal box

Individual Components

Note: It is possible to make INDRAMAT cables. Detailed instructions on how to customize cables are available with the document designated DOK-CONNEC-CABLE*INSTR-MA01-EN-P.

The type designation of the required cable is specified in Fig. 4-6. The connecting accessories (packaging insert in terminal box) of MKD motors with terminal box is part of the overall delivery.

Note: The accessories needed to connect the motor cables to INDRAMAT drive controllers is part of the general drive controller delivery.

4.3 Connections for Motors with Plug-In Connections

Terminal diagram

Note: Only the direct connection between motor and drive controller is illustrated. The terminal diagrams can, however, be used for all other types of connection such as intermediate connectors as the allocation of the motor and drive controller connections does not change.

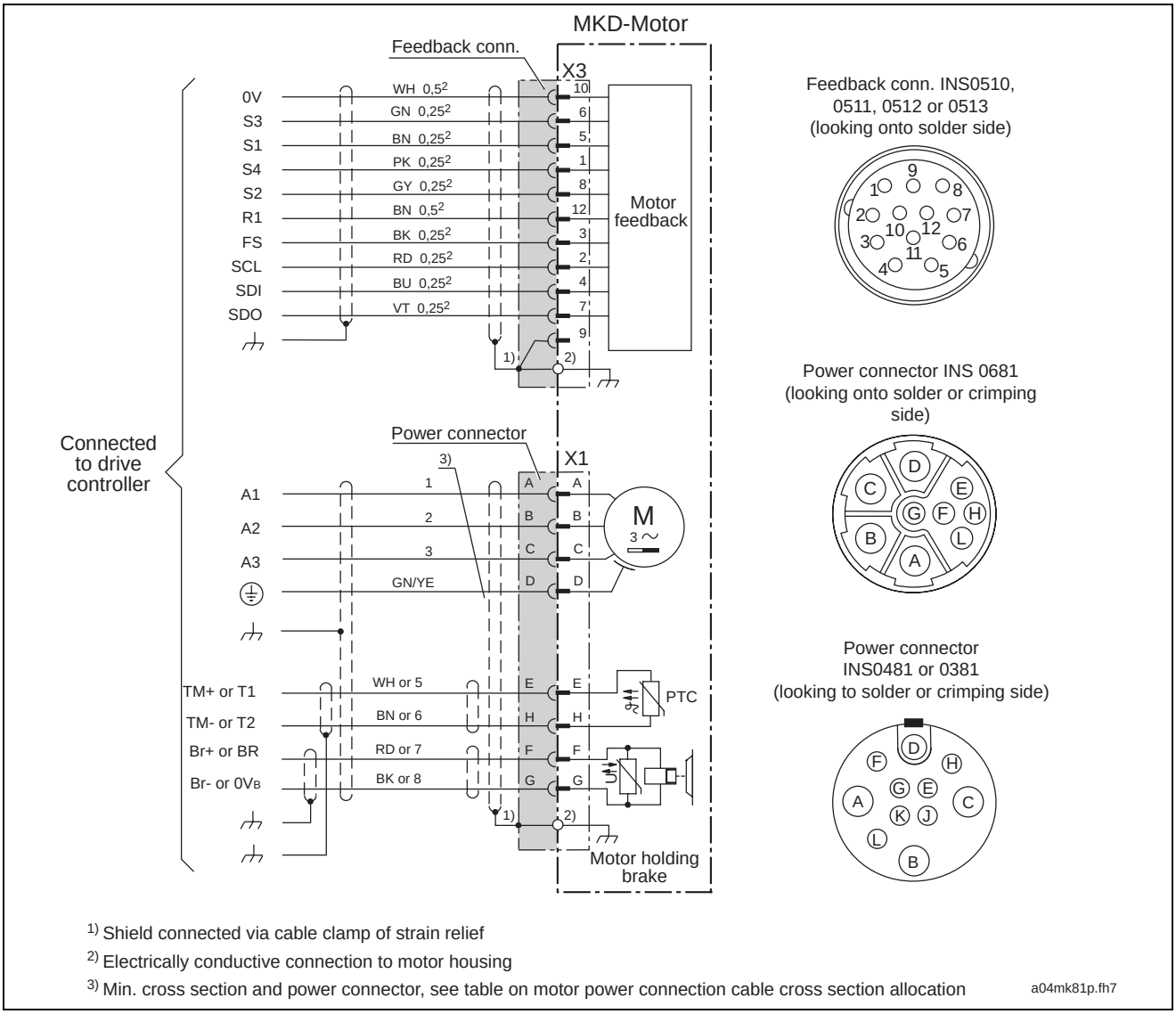


Fig. 4-7: Terminal diagram of and MKD AC motor with plug-in connector

Power Cables

Motors with terminal boxes are generally and preferrably equipped with standard, ready-made power cables.

Standard power cables are available with:

- direct connections
- connections with intermediate plugs

⇒ Use the following tables to select the cable designation suitable for your motor/controller combination.

Selecting the length

Available cable lengths: two (2) to 75 meters.

⇒ When ordering, specify cable type and desired length. Example: IKG4020 / 10.5 (= power cables for DKC, length 10.5 m).

Note: The maximum total length of the cable connection of the motor to the drive controller with two intermediate connections equals 75 meters. In the event that more than two intermediate connections should be required, then the maximum total length could be reduced. This change should be tested.

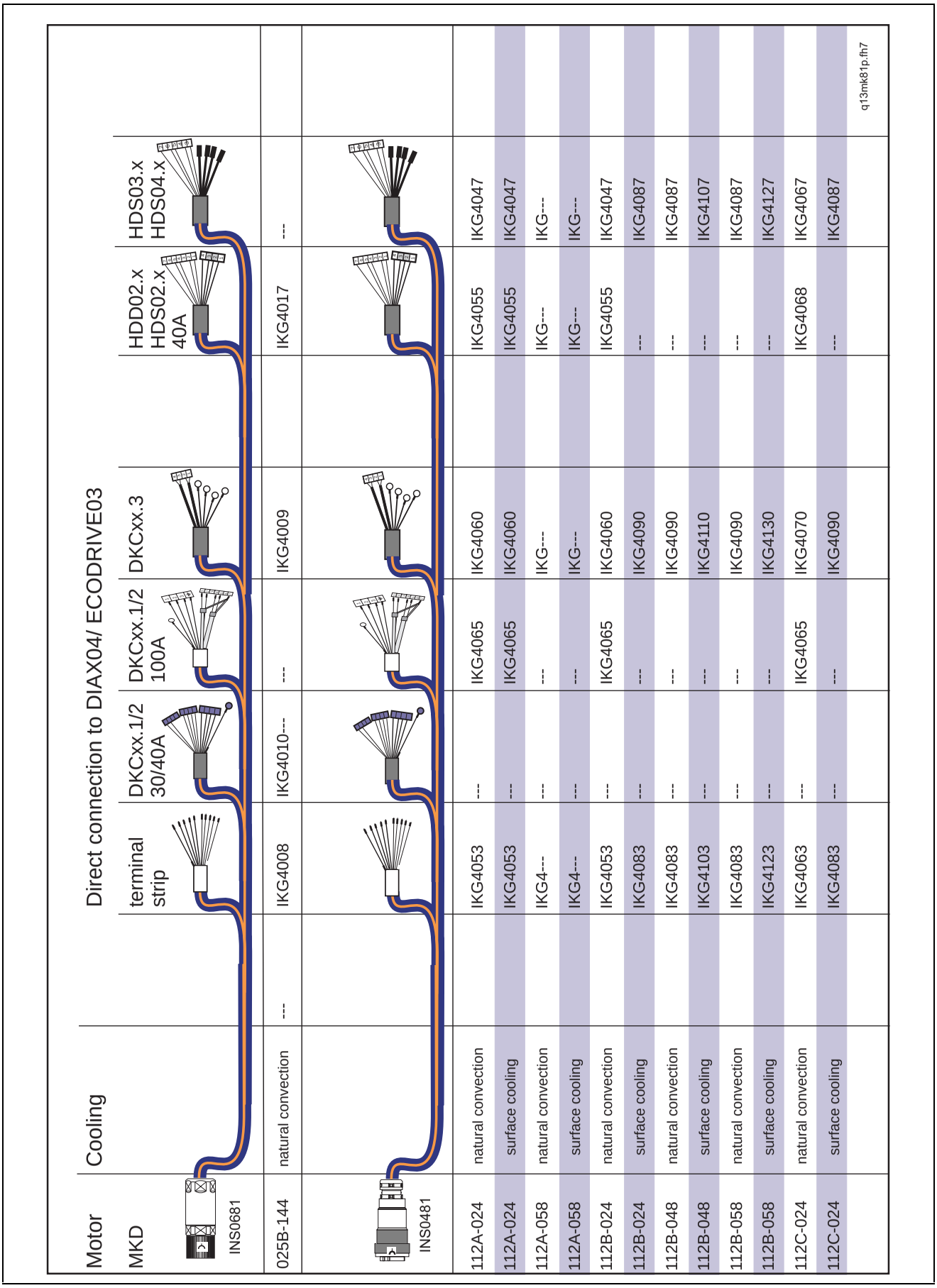


Fig. 4-8: Power cables - plug-in connection - Table 1

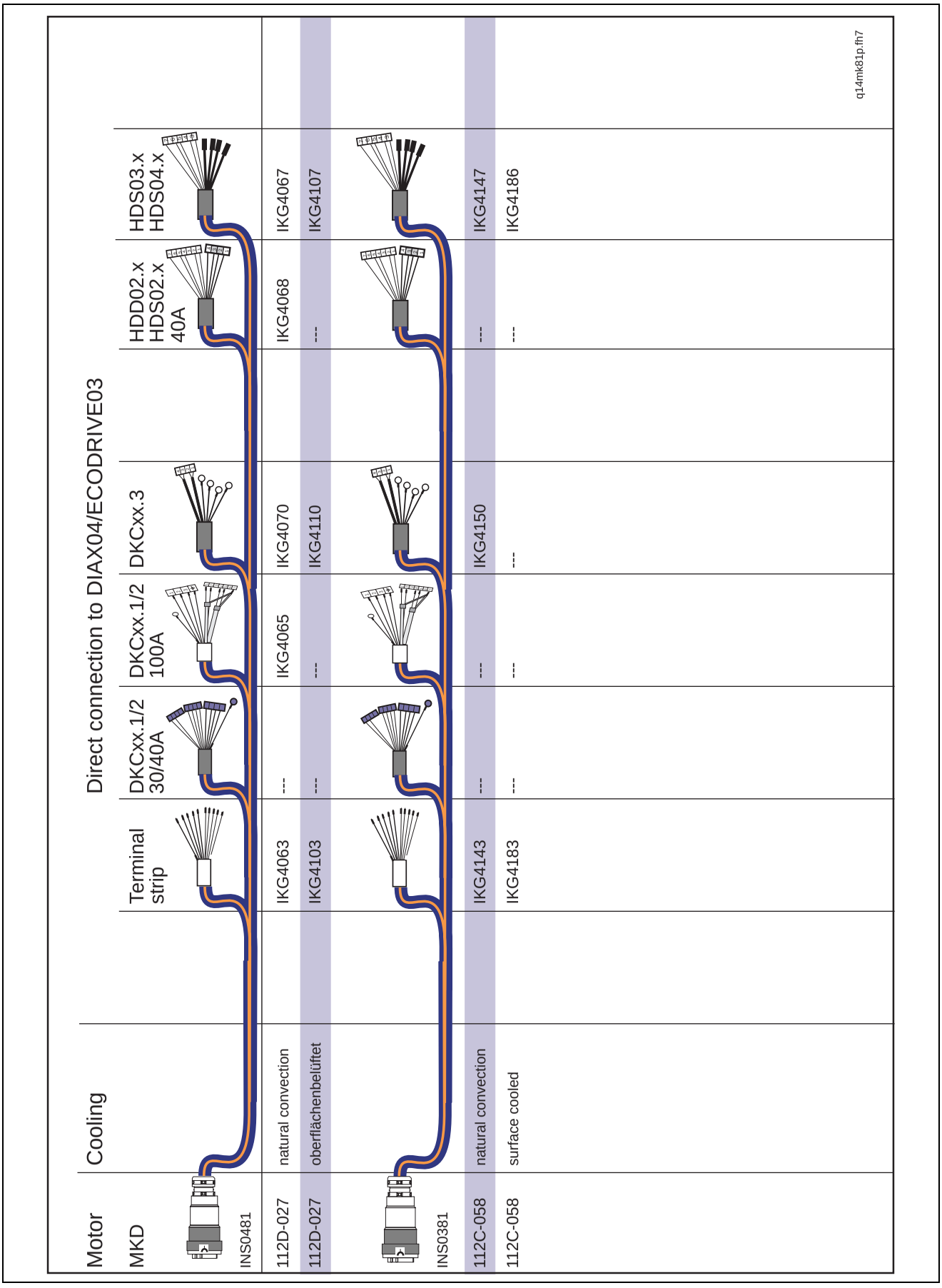


Fig. 4-9: Power cables - plug-in connection - Table 2

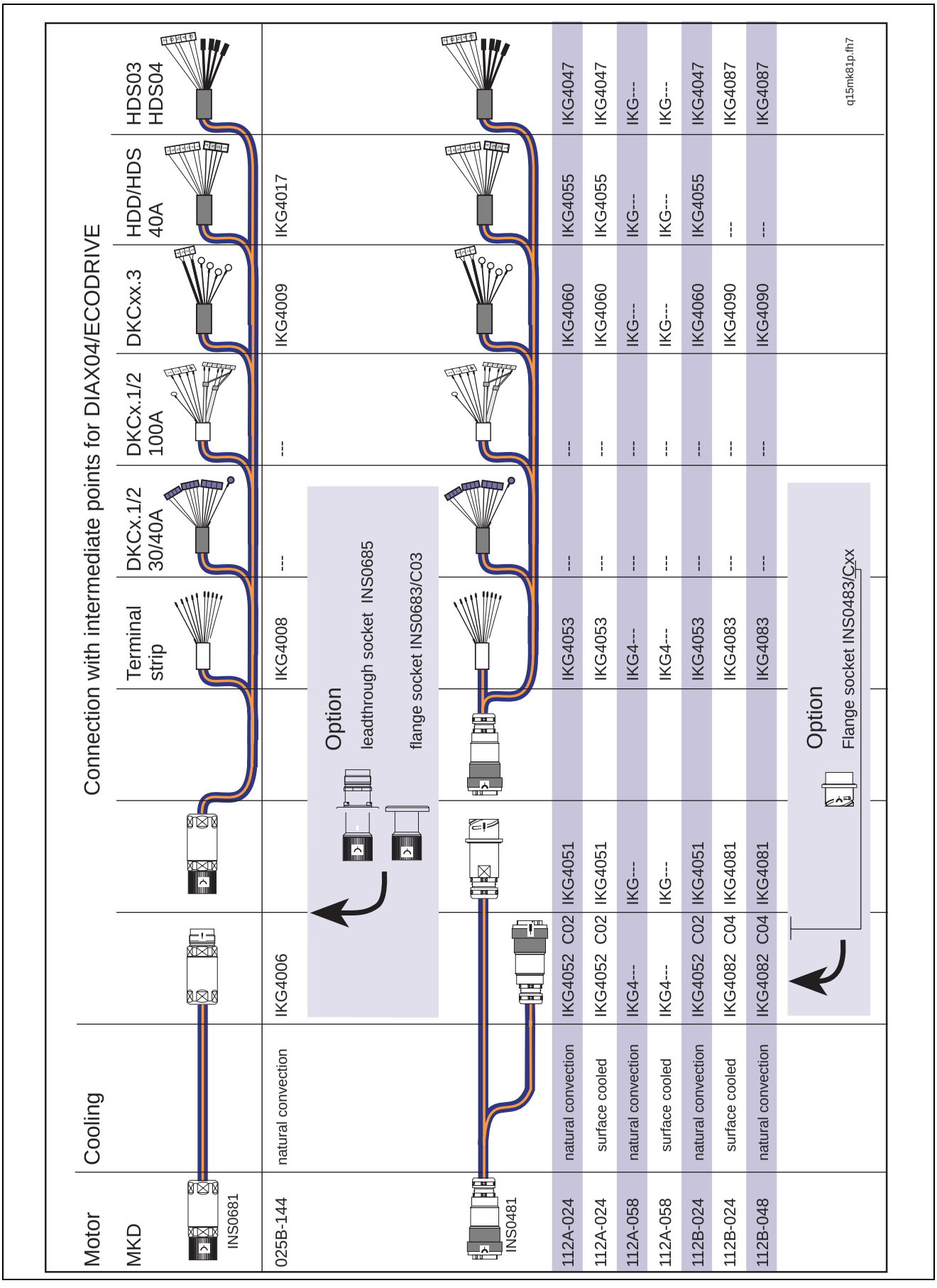


Fig. 4-10: Power cables - plug-in connection - Table 3

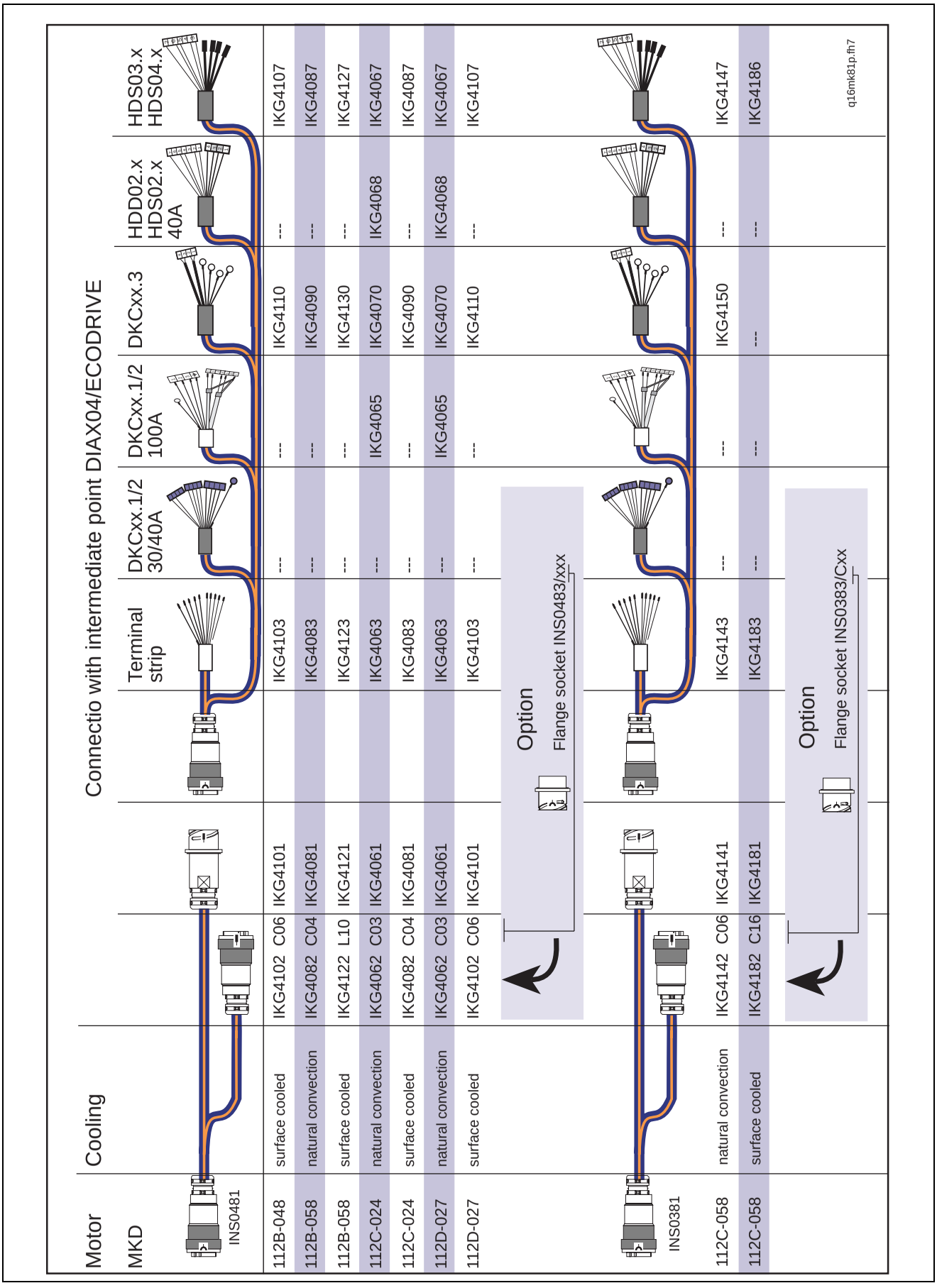


Fig. 4-11: Power cables - plug-in connection - Table 4

Feedback cable

Standard, ready-made cables can be used in motors with plug-in connections.

These feedback cables are, like the power cables, available for „Direct connection„ or „Connection with intermediate points„ as follows:

- as a „straight“ version
- or an „angled“ one.

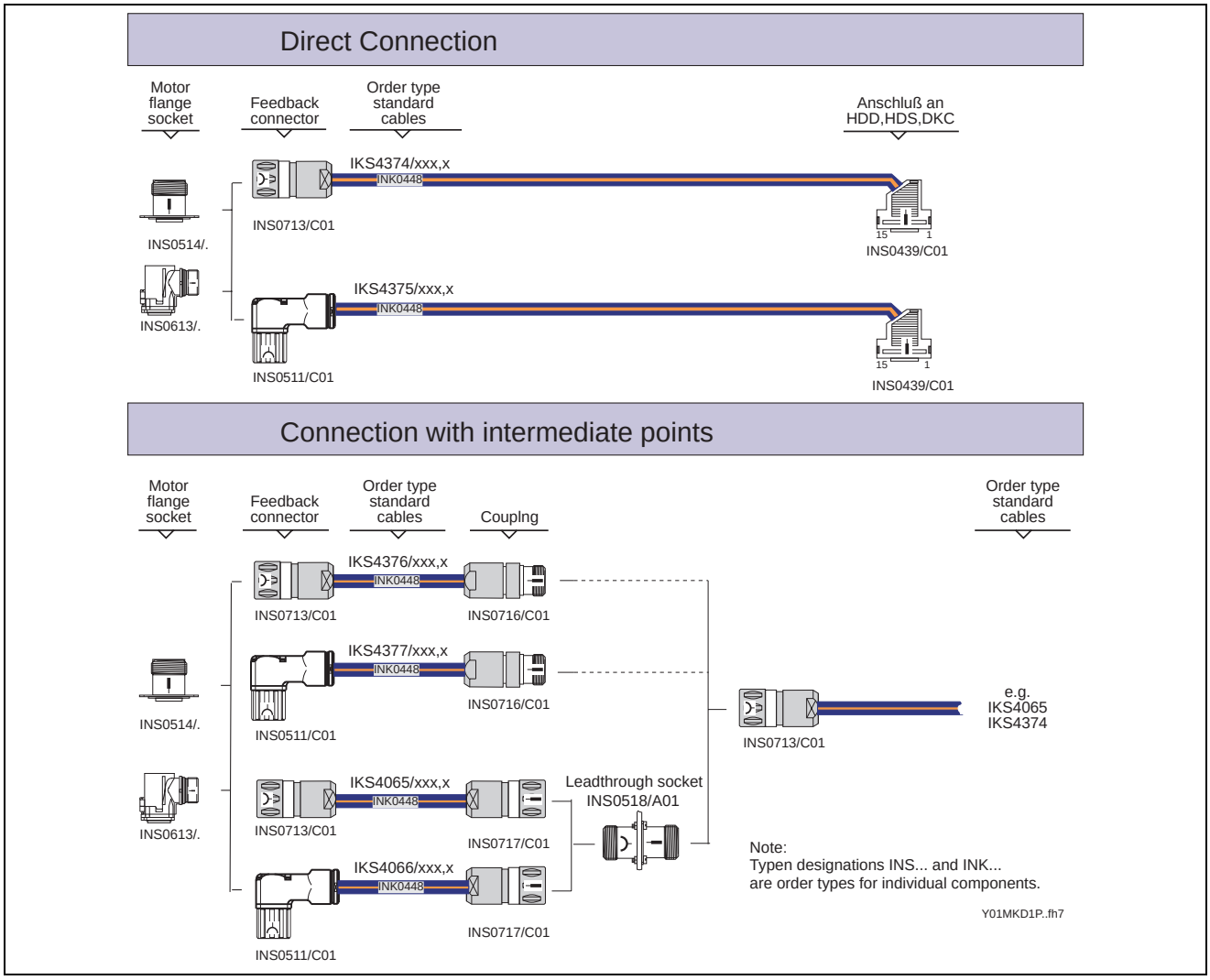


Fig. 4-12: Feedback cable - plug-in connection - (straight type)

Selecting the length

Available cable lengths: two (2) to 75 meters.

⇒ When ordering, specify cable type and desired length. Example: IKS4374 / 10.5 (= Feedback cable for DKC and HDD/HDS, length 10.5 m).

Note: The maximum total length of the cable connection of the motor to the drive controller with two intermediate connections equals 75 meters. In the event that more than two intermediate connections should be required, then the maximum total length could be reduced. This change should be tested.

Technical Data of the Power and Feedback Cables

Name	Unit	Data							
		IKG	IKG	IKG	IKG	IKG	IKG	IKG	IKS
Type designations of standard, ready-made cables		4006 4008 4009 4017	4047 4051 4052 4053 4055 4060	4061 4062 4063 4065 4067 4068 4070	4081 4082 4083 4087 4090	4101 4102 4103 4107 4110 4141 4142 4143 4147 4150	4121 4122 4123 4127 4130	4181 4182 4183 4186	4065 4066 4374 4375 4376 4377
Type designations for cables (non-standard)		0653	0650	0602	0603	0604	0605	0606	0448
Cross sections of power and supply strands	mm²	4x 1.0	4x 1.5	4x 2.5	4x 4.0	4x 6.0	4x 10.0	4x 16.0	2x 1.0
Control strand cross section (Holding brake, temperature sensor or control voltage)	mm²	2 x (2 x 0.75)	2 x (2 x 0.75)	2 x (2 x 1.0)	(2 x 1.0) + (2 x 1.5)	(2 x 1.0) + (2 x 1.5)	(2 x 1.0) + (2 x 1.5)	2 x (2 x 1.5)	4 x (2 x 0.25)
Diameter	mm	12.0 ±0.5	12.2 ±0.5	12.2 ±0.8	17.8 ±0.6	18.6 ±0.8	22.5 ±1.0	27.6 ±0.8	8.8 ±0.3
Minimum bend radius with fixed routing with flexible routing (≥2 000 000 bends)	 mm mm	 75 120	 85 140	 95 160	 100 180	 140 190	 170 230	 190 280	 45 90
Specific cable weight	kg/m	0.25	0.39	0.59	0.60	0.81	1.10	1.40	0.10
Protection category (transition from cable to terminal box) when correctly mounted		IP 65							
Chemical features		absolute resistance to mineral oils and greases; hydrolysis resistant, silicone and halogen free							
Allowable storage temperature	ºC	-30 to +80							
Allowable operating temperature	ºC	-30 to +40							
Cable surface		poor adhesion, prevents sticking in drag chains							

Fig. 4-13: Technical data of power and feedback cables for MKD motors with plug-in connector

Individual Components

Note: INDRAMAT cables can be made. Detailed customizing instructions for motor connectors is available from Indramat in the document DOK-CONNEC-CABLE*INSTR-MA01-EN-P. Indramat connectors must, however, be used even if the cables are not. When selecting the plug-in connector and when determining cable cross sections, please note the following information.

WARNING

Forfeiture of guarantee!
If Indramat cables **are not used**, then the guarantee for the entire drive system is forfeited.
⇒ The use of Indramat cables is recommendedl!

Selecting power connectors and cables

⇒ Using the following selection lists, find the motor power connector and cable cross sections required for the individual MKD motors.

⇒ Motor power cables are available either crimped or soldered.

⇒ Strain reliefs must be mounted in the conduit threads of the motor power cables. This strain relief is not a part of the connector. The dimensions of the conduit threads are listed in sections 5 to 9 „Dimensional data„.

Note: The accessories needed to mount motor cables to INDRAMAT drive controllers are included in the overall delivery of the drive controllers.

Motortyp	Cooling	Motor phase curr.	Min. cross section power conn. [1]			Conn. Access.		
						Crimping		Soldering
			Indramat cable [2]	Standard PVC cable [3]		Indramat cable	Standard PVC cable	
MKD...		A	mm²	mm²	AWG [4]	INS...	INS...	INS...
025B-144	natural convection	3,6	1,0	1,0	18	0680/C03	0680/C03	---
112A-024	natural convection	9,9	1,5	1,5	16	0481/C02	0481/C02	0481/L10
112A-058	natural convection	i.V.	i.V.	i.V.	i.V.	i.V.	i.V.	i.V.
112B-024	natural convection	15,5	1,5	2,5	14	0481/C02	0481/C03	0481/L10
112B-024	surface	23,3	4,0	6,0	10	0481/C04	0481/C06	0481/L10
112B-048	natural convection	23,2	4,0	6,0	10	0481/C04	0481/C06	0481/L10
112B-048	surface	34,8	6,0	10,0	8	0481/C06	---	0481/L10
112B-058	natural convection	28,8	4,0	6,0	10	0481/C04	0481/C06	0481/L10
112B-058	surface	43,2	10,0	---	---	---	---	0481/L10
112C-024	natural convection	18,8	2,5	4,0	12	0481/C03	0481/C04	0481/L10
112C-024	surface	28,2	4,0	6,0	10	0481/C04	0481/C06	0481/L10
112C-058	natural convection	37,6	6,0	10,0	8	0381/C06	0381/C10	0381/L35
112C-058	surface	56,4	16,0	25,0	4	0381/C16	0381/C25	0381/L35
112D-027	natural convection	22,3	2,5	4,0	12	0481/C03	0481/C04	0481/L10
112D-027	surface	33,5	6,0	10,0	8	0481/C06	---	0481/L10

1) Min. cross section power conn. as per EN 60204, sec. 1, table 5, col. B2, ed. 1992 or UL 508 table 50.2, ed.1989 at max. 40°C ambient temp.
2) with Indramat cables
3) with standard PVC cable per DIN EN 60204, ed. 1993
4) cable per UL 508 may only be connected by soldering to motor power cables

Fig. 4-14: Allocation of motor to power connector to cable diameter

Feedback connector

⇒ Using the following selection lists, select that feedback connector which is suited to your application. Feedback connectors are available either crimped or soldered.

Note: We recommend the use of a feedback connector with plastic sheathing and integrated cable clamp with your Indramat cable INK0448 (preferred) or INK0209. These feedback connectors are best matched to Indramat cables and meet all EMC guidelines.

If non-Indramat cables are used, then use feedback connectors in metal with conduit threads (clamping range for cable diameter from six (6) to ten (10) mm).

Name	**Feedback connector for INDRAMAT-cable INK0209 / INK0448**		**Feedback connetor for cable with an outside diameter of six (6) to ten (10) mm**	
	Crimping	Soldering	Crimping	Soldering
Connector (straight)	INS0713/C [1)]	INS0713/L [1)]	---	INS0512/L
Connector (angled)	INS0511/C	INS0511/L	INS0510/C	INS0510/L
1) Feedback connector with plastic sheathing				

Fig. 4-15: Feedback connector

Note: The cable output direction of an angled feedback connector can be altered at the time of mounting depending on the conditions at the machine. See section 13.

5 MKD025

5.1 Technical data

Designation	Symbol	Unit	Data	
Motor type			MKD025A-144	MKD025B-144
Nominal motor speed [1]	n	min^{-1}	9000	9000
Torque at standstill [2]	M_{dN}	Nm	0.4	0.9 (0.8) [9]
Current at standstill	I_{dN}	A	2.2	5.1 (4.5) [9]
Theoretical maximum torque [3]	M_{max}	Nm	1.8	4.0
Peak current	I_{max}	A	10.0	23.0
Moment of inertia of rotor [4]	J_M	kgm²	$0.19x10^{-4}$ ($0.27x10^{-4}$) [10]	0.3×10^{-4}
Torque constant at 20ºC	K_m	Nm/A	0.2	0.20
Voltage constant at 20ºC [5]	K_{Eeff}	V/1000 min^{-1}	18.2	18.2
Windings resistance at 20ºC	R_A	Ohm	7.3	2.7
Windings inductance	L_A	mH	8.1	3.7
Thermal time constant	T_{th}	min	15	15
Mass	m_M	kg	1.5	2.0 [4]
Electrical connections			terminal box	terminal box or plug-in connector
Allowable ambient temperatures [6]	T_{um}	ºC	0 to +45	
Allowable storage and transport temperature	T_L	ºC	-20 to +80	
Maximum installation elevation [7]		m	1000 above sea level	
Protection category [8]			IP 65	
Insulation class as per DIN VDE 0530, part 1			F	
Housing finish			Basic black coat (RAL 9005)	

1) Depends on torque requirements of application. For standard applications see n_{max} in the selection lists of the motor/controller combination. The usable speed for other applications is determined using the required torque as specified in the speed/torque characteristics.
2) Given 60 Kelvin overtemperature at the housing of the motor.
3) The achievable maximum torque depends on the drive controller used. **Only** the maximum torque M_{max} specified in the selection lists of the motor/controller combination are binding.
4) Without holding brake.
5) At 1,000 min^{-1} .
6) Given deviating ambient temperatures, see Section 3.1 .
7) Given deviating installation elevations, see Section 3.1 .
8) With correct mounting of power and feedback cables.
9) Value in brackets applies to motor with holding brake.
10) Moment of inertia of rotor applies to motor with resolver feedback; bracketed values apply to motor with resolver feedback with integral multiturn absolute encoder

Fig. 5-1: Technical data MKD025

Designation	Symbol	Unit	Data Holding brake
Holding torque	M_H	Nm	1.0
Nominal voltage	U_N	V	DC 24 ±10%
Nominal current	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. 5-2: Technical data holding brake MKD025 (Option)

5.2 Speed/torque characteristics

For details see Section 3.7 Speed and Torque, Page 3-12.

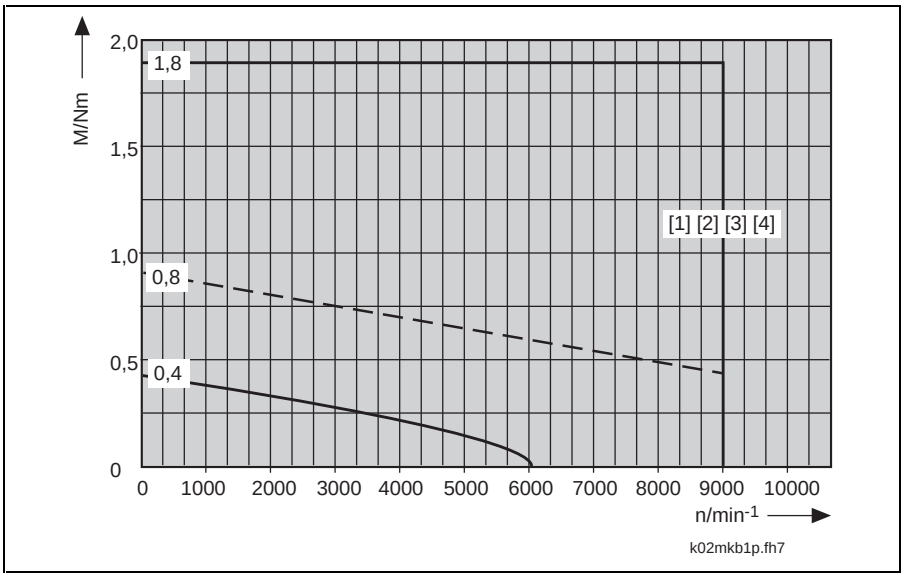


Fig. 5-3: Speed/torque characteristics MKD025A-144

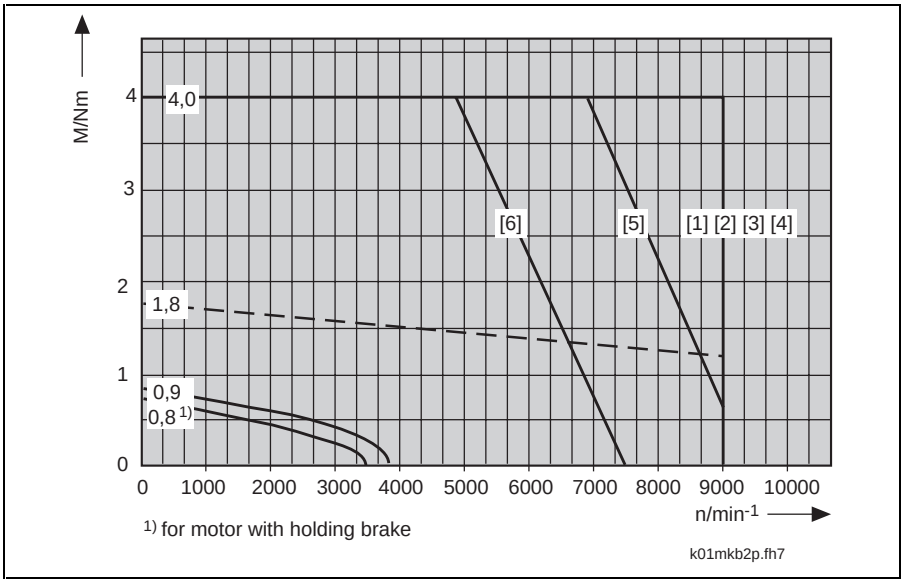


Fig. 5-4: Speed/torque characteristics MKD025B-144

5.3 Data on determining maximum shaft load

For details see Section 3.3 Output Shafts, Page 3-6.

Allowable maximum radial force F_{radial_max} and allowable radial force F_{radial}

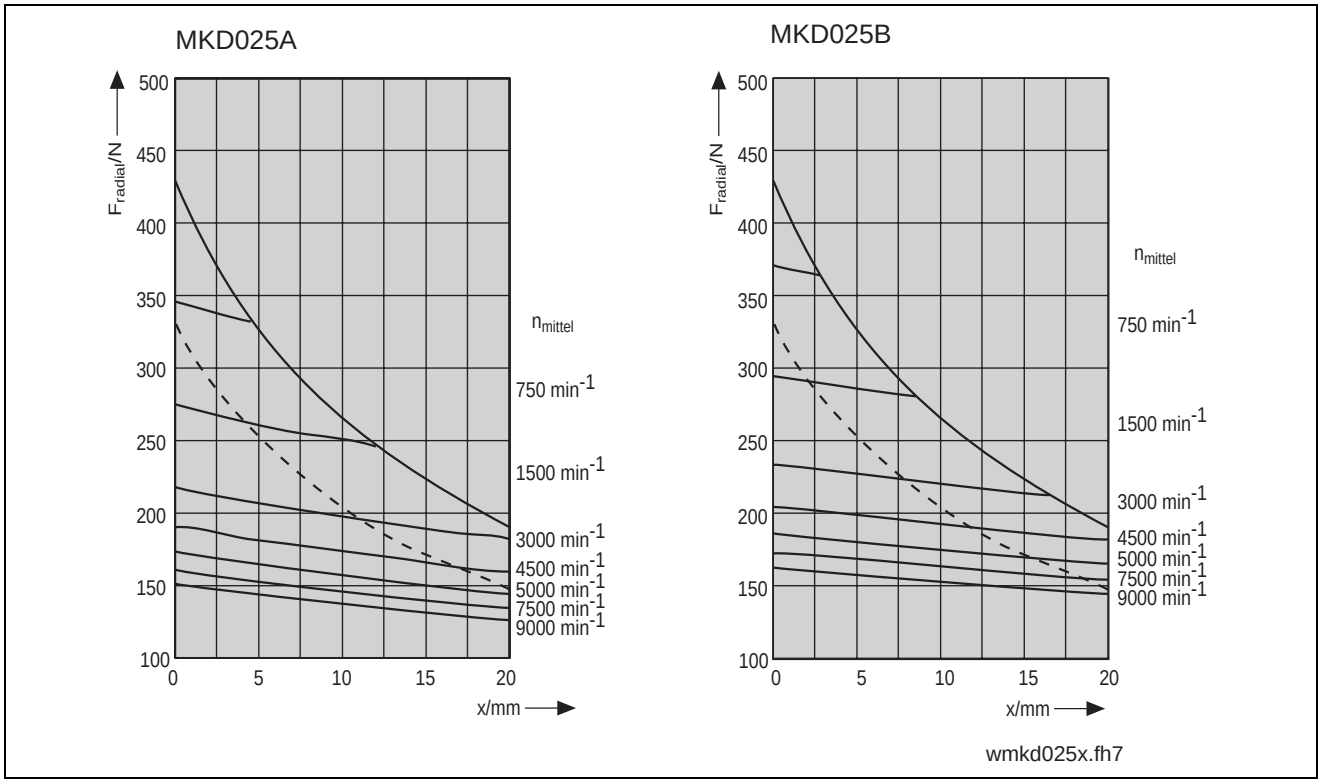


Fig. 5-5: MKD025: Allowable maximum radial force F_{radial_max} and allowable radial force F_{radial}

Allowable axial force F_{axial}

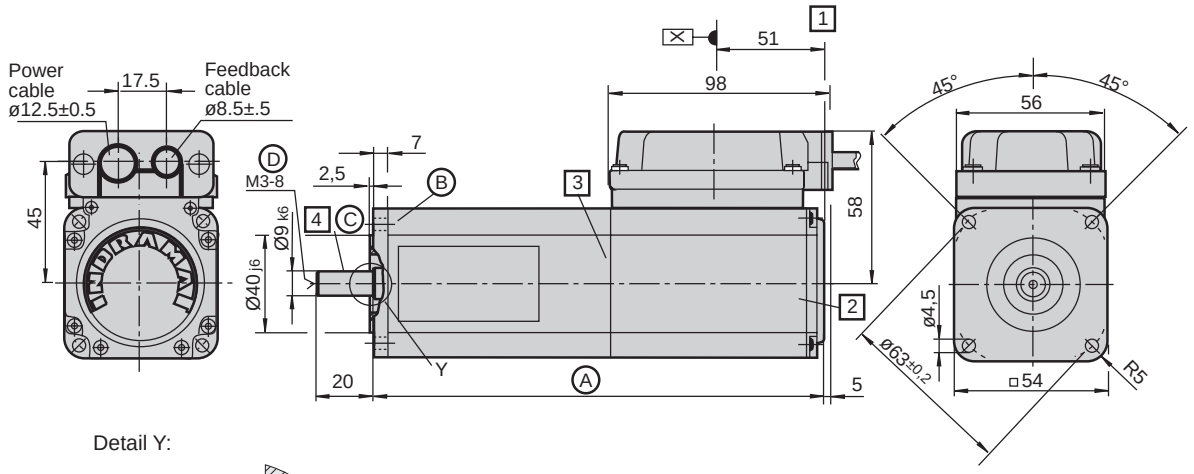
$$F_{axial} = x \cdot F_{radial}$$

x: **0.59** for MKD025A
0.55 for MKD025B

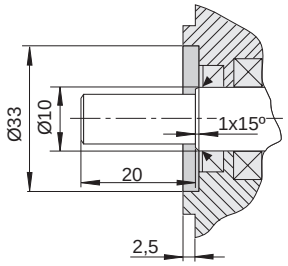
F_{axial}: allowable axial force in N
F_{radial}: allowable radial force in N

Fig. 5-6: MKD025: Allowable axial force F_{axial}

5.4 Dimensional data



Detail Y:

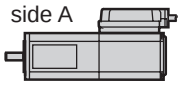


Options:

1 Output direction of electrical terminal box

The output direction of this box (power and feedback cables) is selected at the time of mounting. Possible directins are:

- to side A
- to side B



Side B is the output direction illustrated. The dimensions for side A as output direction can be obtained by turning the terminal box around the X axis.

Ⓐ Dimensional table:

Size	Dim. A
MKD 025 A	183 only without brake
MKD 025 B	236 with an without brake

Ⓑ Motor as per DIN 42950, sec. 1, ed. 08.77, B5 for all mounting orientations

Ⓒ
- Flange as per DIN 42948,ed. 11.65
- Position accuracy per concentricity, excentriciy and coaxility 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 0.7 Nm
- vibration severity level N per DIN VDE 0530 sec. 14, ed. 02.93

2 Motor feedback

- Resolver feedback (RSF) with integral multiturn absolute encoder

The dimensions are identical.

3 Holding brake:

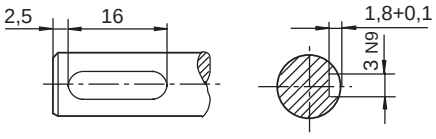
- without
- with

The dimensions are identical.

4 Output shaft

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

(Note! balanced with entire key!)



Matching keyway: DIN 6885-A 3 x 3 x 16, not part of delivery.

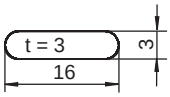


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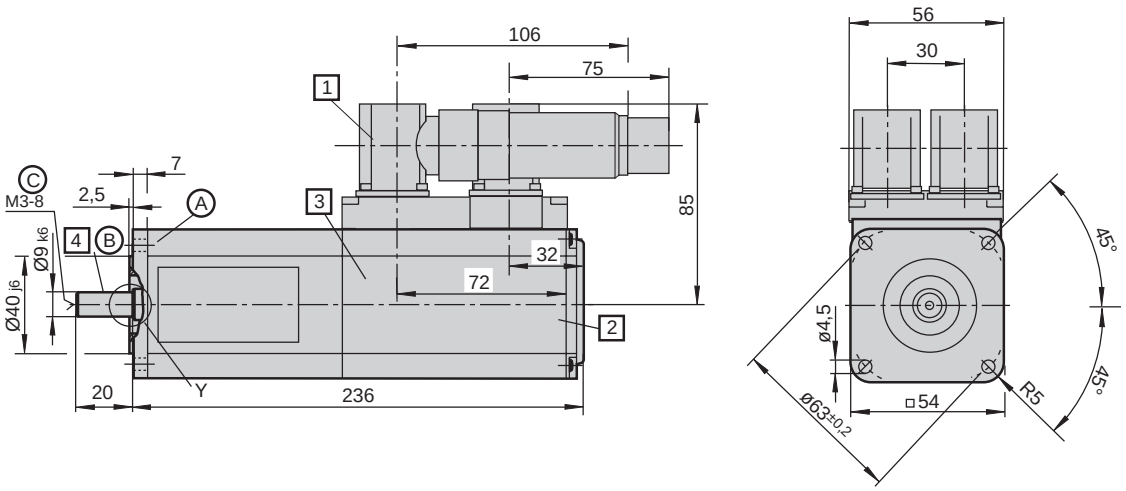
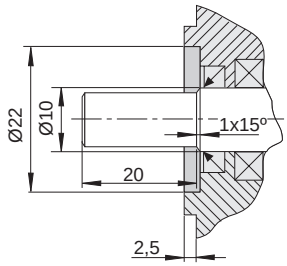
Fig. 5-7: Dimensions sheet MKD025A, MKD025B



Detail Y:



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

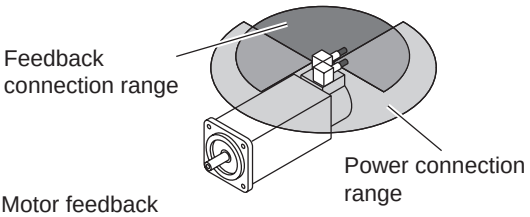
Ⓑ • Flange as per DIN 42948,ed. 11.65
• Position accuracy per concentricity, excentriciy and coaxility to shaft as per DIN 42955 tolerance class N, ed. 12.81

Ⓒ • 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 0.7 Nm
• vibration severity level N per DIN VDE 0530 sec. 14, ed. 02.93

Options:

1 Output directions of power and feedback connections

These output directions are selected at the time of mounting. The direction can be set within a range of 270°. Make sure that the outputs do not overlap.



2 Motor feedback

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

The dimensions are identical.

3 Holding brake:

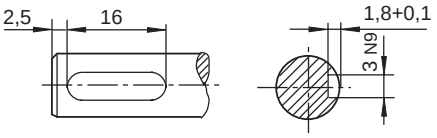
- without
- with

The dimensions are identical.

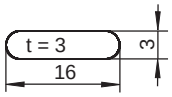
4 Output shaft

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

(Note! balanced with entire key!)



Matching keyway DIN 6885-A 3 x 3 x 16, not part of delivery



m02mkb1p.fh7

Fig. 5-8: Dimensions sheet MKD025B (plug-in connection)

5.5 Available Versions and Type Codes

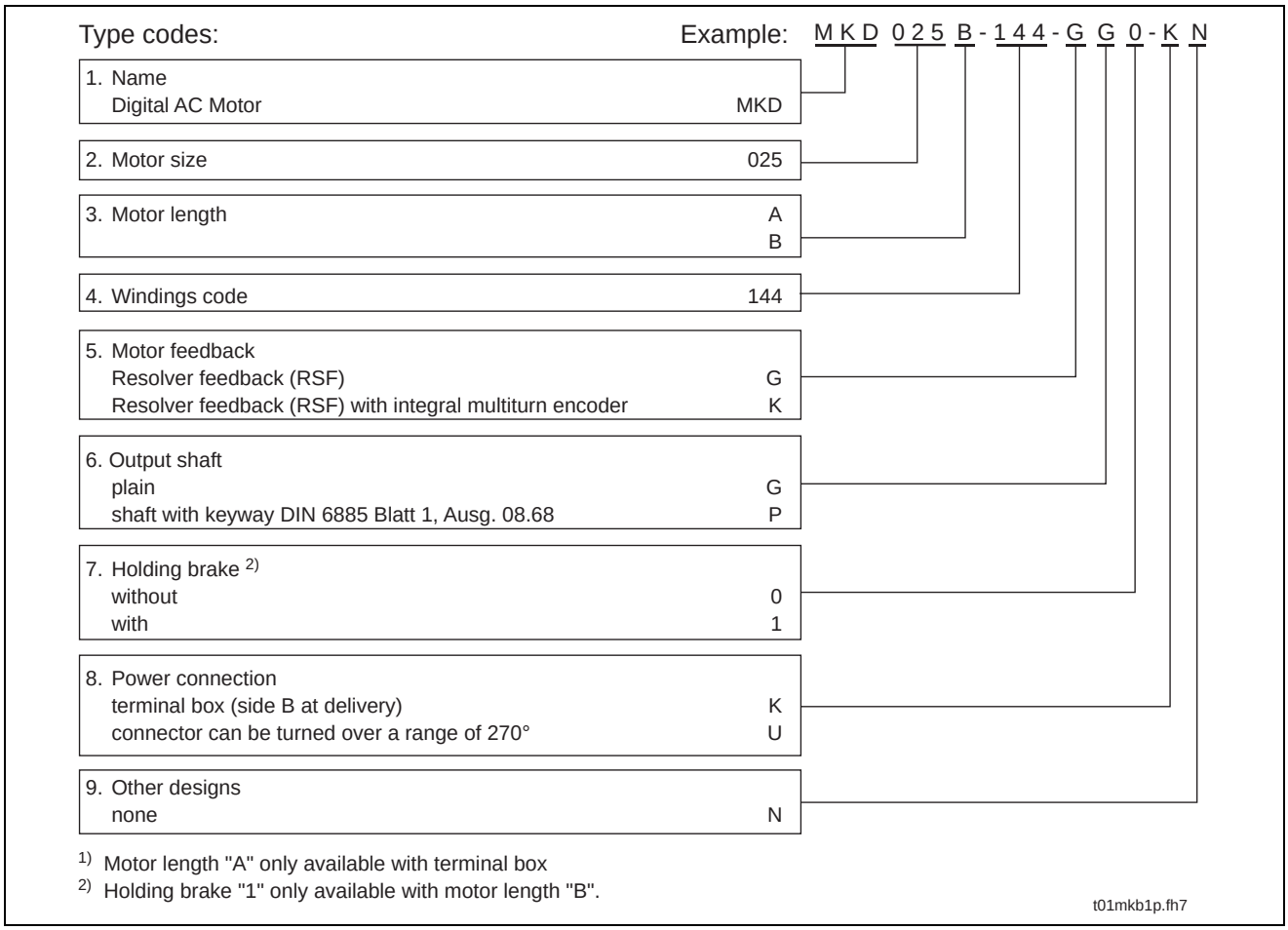


Fig. 5-9: Type codes MKD025

6 MKD041

6.1 Technical data MKD041

Designation	Symbol	Unit	Data
Motor type			MKD041B-144
Nominal motor speed [1]	n	min^{-1}	6000
Torque at standstill [2] Cooling mode natural convection	M_{dN}	Nm	2.7
Current at standstill Cooling mode natural convection	I_{dN}	A	7.5
Theoretical maximum torque [3]	M_{max}	Nm	11.3
Peak current	I_{max}	A	34.0
Moment of inertia of rotor [4]	J_M	kgm^2	1.7×10^{-4}
Torque constant at 20ºC	K_m	Nm/A	0.40
Voltage constant at 20ºC [5]	K_{Eeff}	V/1000 min^{-1}	36.4
Windings resistance at 20ºC	R_A	Ohm	1.8
Windings inductance	L_A	mH	5.0
Thermal time constant	T_{th}	min	30
Mass [4]	m_M	kg	4.4
Electrical connections			terminal box
Allowable ambient temperatures [6]	T_{um}	ºC	0 to +45
Allowable storage and transport temperature	T_L	ºC	-20 to +80
Maximum installation elevation [7]		m	1000 above sea level
Protection category [8]			IP 65
Insulation class as per DIN VDE 0530, part 1			F
Housing finish			Basic black coat (RAL 9005)

1) Depends on torque requirements of application. For standard applications see n_{max} in the selection lists of the motor/controller combination. The usable speed for other applications is determined using the required torque as specified in the speed/torque curves.
2) Given 60 Kelvin overtemperature at the housing of the motor.
3) The achievable maximum torque depends on the drive controller used. **Only** the maximum torque Mmax specified in the selection lists of the motor/controller combination are binding.
4) Without holding brake.
5) At 1000 min^{-1} .
6) Given deviating ambient temperatures, see Section 3.1 .
7) Given deviating installation elevations, see Section 3.1 .
8) With correct mounting of power and feedback cables.

Fig. 6-1: Technical data MKD041

Designation	Symbol	Unit	Data Holding brake
Holding torque	M_H	Nm	2.2
Nominal voltage	U_N	V	DC 24 ±10%
Nominal current	I_N	A	0.34
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. 6-2: Technical data holding brake MKD041 (Option)

6.2 Technical data MKD041 „*without painted coating*“

Designation	Symbol	Unit	Data
Motor type			MKD041B-143
Nominal motor speed [1]	n	min^{-1}	6000
Torque at standstill [2] Cooling mode natural convection	M_{dN}	Nm	2.1
Current at standstill Cooling mode natural convection	I_{dN}	A	5.9
Theoretical maximum torque [3]	M_{max}	Nm	11.3
Peak current	I_{max}	A	34.0
Moment of inertia of rotor [4]	J_M	kgm^2	1.7×10^{-4}
Torque constant at 20ºC	K_m	Nm/A	0.40
Voltage constant at 20ºC [5]	K_{Eeff}	V/1000 min^{-1}	36.4
Windings resistance at 20ºC	R_A	Ohm	1.8
Windings inductance	L_A	mH	5.0
Thermal time constant	T_{th}	min	30
Mass [4]	m_M	kg	4.4
Electrical connections			terminal box
Allowable ambient temperatures [6]	T_{um}	ºC	0 to +45
Allowable storage and transport temperature	T_L	ºC	-20 to +80
Maximum installation elevation [7]		m	1000 above sea level
Protection category [8]			IP 65
Insulation class as per DIN VDE 0530, part 1			F
Housing finish			without

1) Depends on torque requirements of application. For standard applications see n_{max} in the selection lists of the motor/controller combination. The usable speed for other applications is determined using the required torque as specified in the speed/torque characteristics.
2) Given 60 Kelvin overtemperature at the housing of the motor.
3) The achievable maximum torque depends on the drive controller used. **Only** the maximum torque Mmax specified in the selection lists of the motor/controller combination are binding.
4) Without holding brake.
5) At 1000 min^{-1} .
6) Given deviating ambient temperatures, see Section 3.1 .
7) Given deviating installation elevations, see Section 3.1 .
8) With correct mounting of power and feedback cables.

Fig. 6-3: Technical data MKD041

Designation	Symbol	Unit	Data Holding brake
Holding torque	M_H	Nm	2.2
Nominal voltage	U_N	V	DC 24 ±10%
Nominal current	I_N	A	0.34
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. 6-4: Technical data holding brake MKD041 (Option)Speed/torque characteristics

6.3 Speed/torque characteristics MKD041

For details see Section 3.7 „Speed and Torque“, Page 3-12.

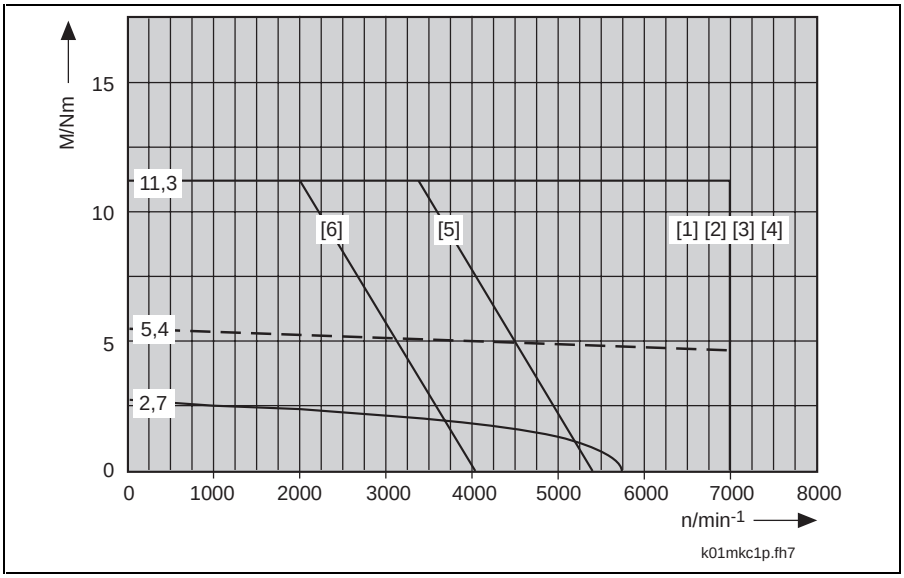


Fig. 6-5: Speed/torque characteristics MKD041B-144

6.4 Speed/torque characteristics MKD041 „*without painted coating*“

For details see Section 3.7 Speed and Torque, Page 3-12 .

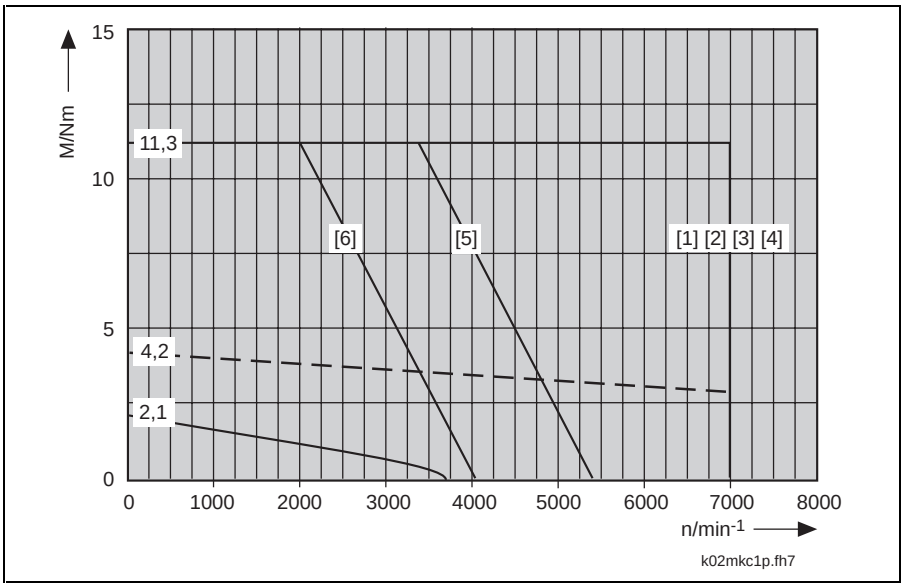


Fig. 6-6: Speed/torque characteristics MKD041B-143

6.5 Data on determining maximum shaft load

For details see Section 3.3 „Output Shafts, Page 3-5.

Allowable maximum radial force F_{radial_max} and allowable radial force F_{radial}

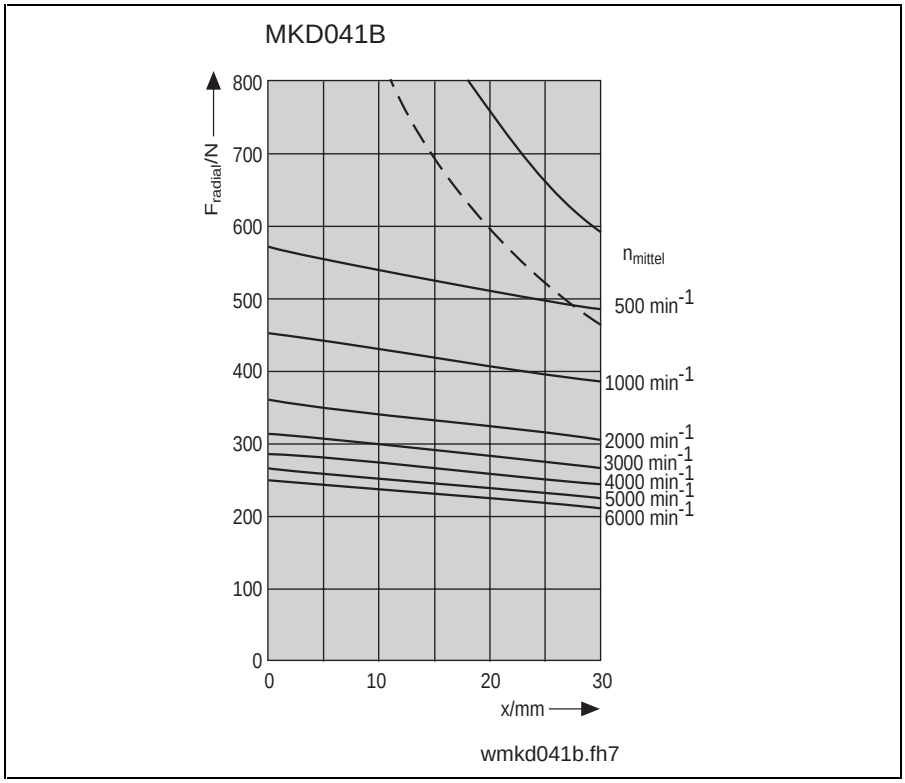


Fig. 6-7: MKD041: Allowable maximum radial force F_{radial_max} and allowable radial force F_{radial}

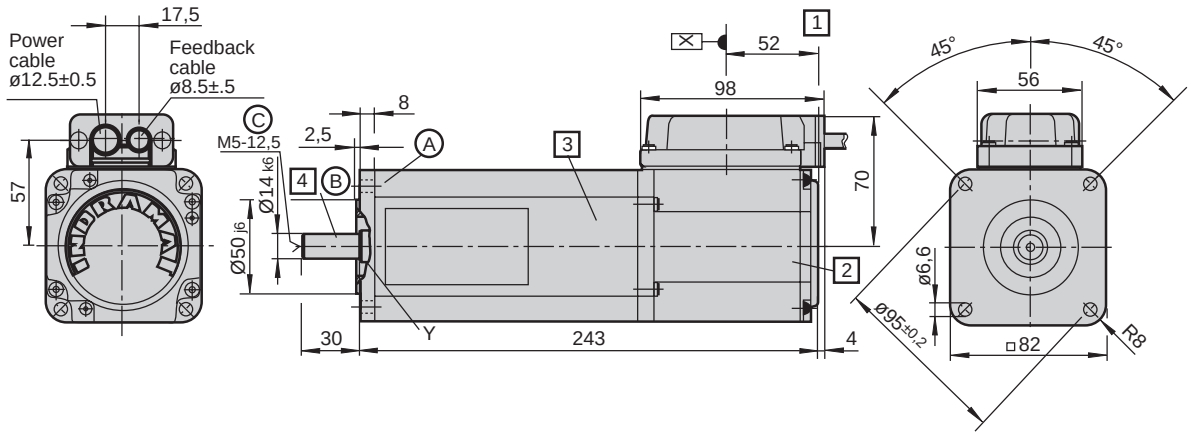
Allowable axial force F_{axial}

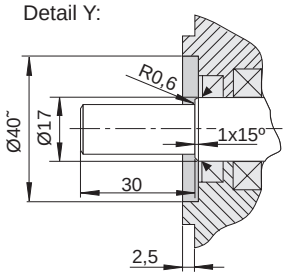
$$F_{axial} = 0{,}45 \cdot F_{radial}$$

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

Fig. 6-8: MKD041: Allowable axial force F_{axial}

6.6 Dimensional data





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

Ⓑ
- Flange as per DIN 42948,ed. 11.65
- Position accuracy per concentricity, excentriciy and coaxility 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 M5 per DIN 332 sec. 2, ed. 05.83 max. screw tightening torque 3.0 Nm
- vibration severity level N per DIN VDE 0530 sec. 14, ed. 02.93

Options:

1 Output direction of electrical terminal box

The output direction of this box (power and feedback cables) is selected at the time of mounting. Possible directins are:
- to side A
- to side B

Side B is the output direction illustrated. The dimensions for side A as output direction can be obtained by turning the terminal box around the X axis.

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

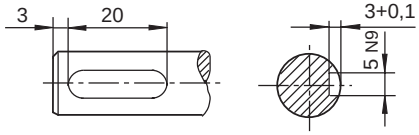
The dimensions are identical.

3 Holding brake:
- without
- with

The dimensions are identical.

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

(Note! balanced with entire key!)



Matching keyway: DIN 6885-A 5 x 5 x 20, not part of delivery.

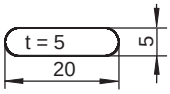


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Fig. 6-9: Dimensions sheet MKD041

6.7 Available Versions and Type Codes

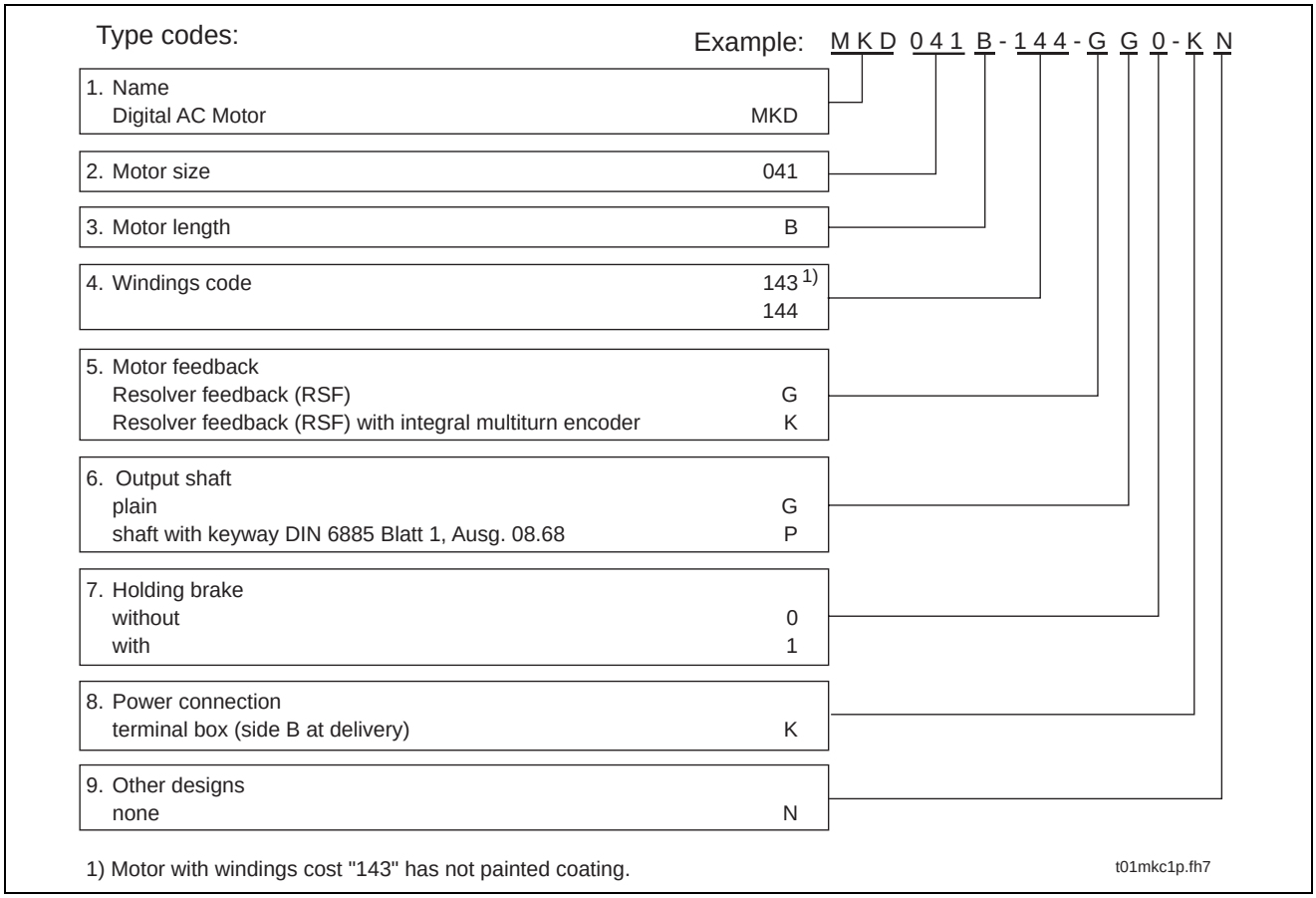


Fig. 6-10: Type codes MKD041

7 MKD071

7.1 Technical data

Designation	Symbol	Unit	Data	
Motor type			MKD071B-035	MKD071B-061
Nominal motor speed [1]	n	min^{-1}	2500	4500
Torque at standstill [2]				
Cooling natural convection	M_{dN}	Nm	8.0	8.0
mode surface cooled	M_{dN}	Nm	12.0	12.0
Current at standstill				
Cooling natural convection	I_{dN}	A	6.3	11.2
mode surface cooled	I_{dN}	A	9.5	16.8
Theoretical maximum torque [3]	M_{max}	Nm	32.0	32.0
Peak current	I_{max}	A	28.3	50.0
Moment of inertia of rotor [4]	J_M	kgm^2	8.7×10^{-4}	8.7×10^{-4}
Torque constant at 20ºC	K_m	Nm/A	1.38	0.77
Voltage constant at 20ºC [5]	K_{Eeff}	$V/1000\ min^{-1}$	125.5	70.0
Windings resistance at 20ºC	R_A	Ohm	4.55	1.45
Windings inductance	L_A	mH	23.0	7.2
Thermal time constant	T_{th}	min	45	45
Mass [4]	m_M	kg	8.8	8.8
Electrical connections			terminal box	terminal box
Allowable amb. temperatures[6]	T_{um}	ºC	0 to +45	
Allowable Storage and transport temperature	T_L	ºC	-20 to +80	
Max. installation elevation [7]		m	1000 above sea level	
Protection category [8]			IP 65	
Insulation class as per DIN VDE 0530, part 1			F	
Housing finish			Basic black coat (RAL 9005)	

1) Depends on torque requirements of application. For standard applications see n_{max} in the selection lists of the motor/controller combination. The usable speed for other applications is determined using the required torque as specified in the speed/torque characteristics.
2) Given 60 Kelvin overtemperature at the housing of the motor.
3) The achievable maximum torque depends on the drive controller used. **Only** the maximum torque Mmax specified in the selection lists of the motor/controller combination are binding.
4) Without holding brake und blower unit.
5) At 1,000 min^{-1} .
6) Given deviating ambient temperatures, see Section 3.1 .
7) Given deviating installation elevations, see Section 3.1 .
8) With correct mounting of power and feedback cables.

Fig. 7-1: Technical data MKD071

Designation	Symbol	Unit	Data Holding brake
Holding torque	M_H	Nm	5.0
Nominal voltage	U_N	V	DC 24 ±10%
Nominal current	I_N	A	0.56
Moment of inertia	J_B	kgm²	0.72×10^{-4}
Release delay	t_I	ms	38
Clamping delay	t_K	ms	20
Mass	m_B	kg	0.62

Fig. 7-2: Technical data holding brake MKD071 (Option)

Designation	Symbol	Unit	Surface cooling data	
Nominal voltage	U_N	V	1 x AC 230 ±10%	1 x AC 115 ±10%
Nominal current	I_N	A	0.1	0.2
Power consumption	S_N	VA	18	17
Frequency	f	Hz	50	60

Fig. 7-3: Technical data on surface cooling MKD071 (Option)

7.2 Speed/torque characteristics

For details see Section 3.7 Speed and Torque, Page 3-12 .

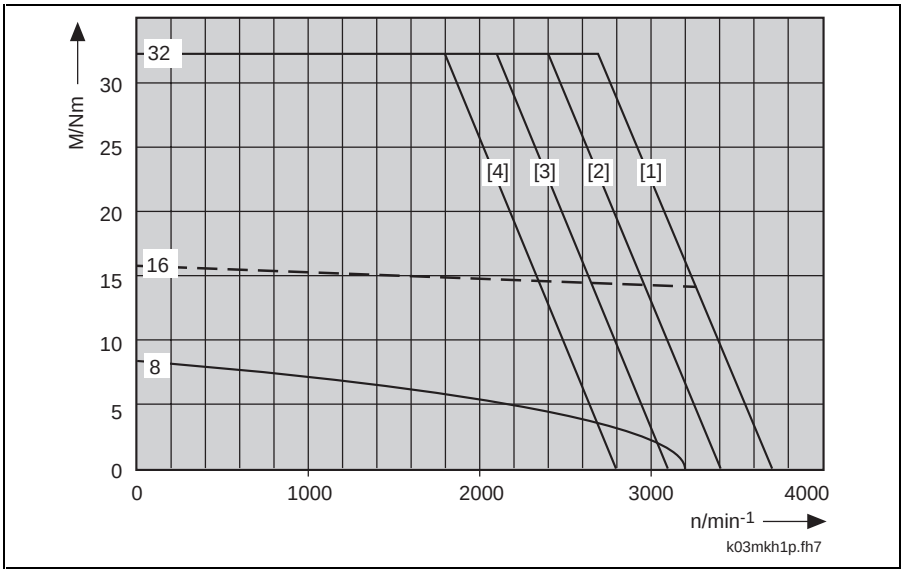


Fig. 7-4: Speed/torque characteristics MKD071B-035

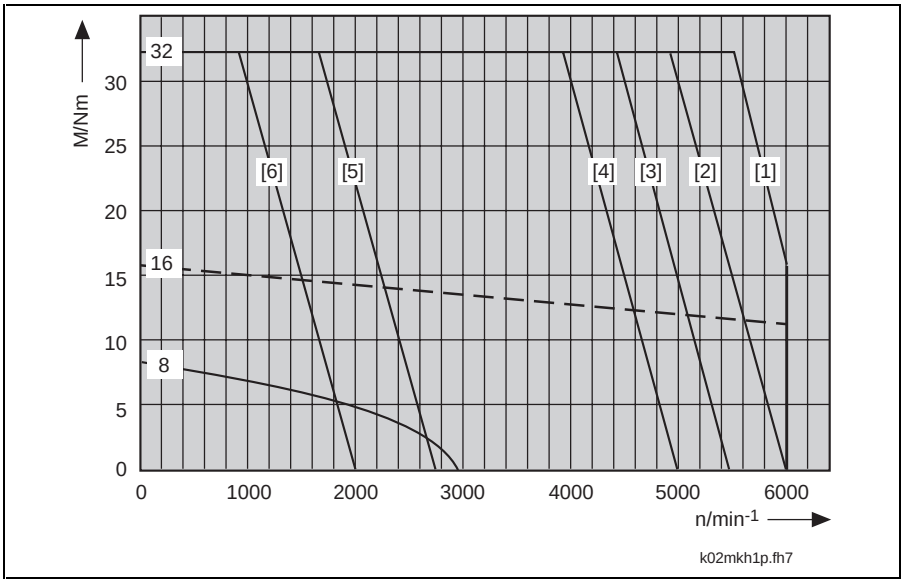


Fig. 7-5: Speed/torque characteristics MKD071B-061

7.3 Data on determining maximum shaft load

For details see Section 3.3 Output Shafts, Page 3-6.

Allowable maximum radial force F_{radial_max} and allowable radial force F_{radial}

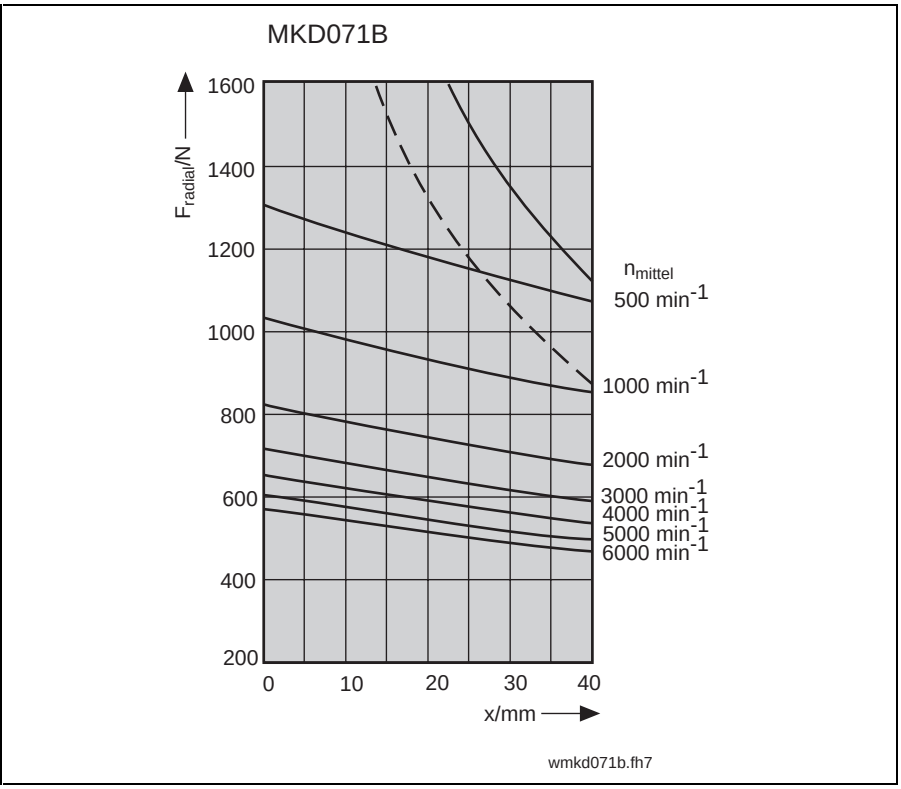


Fig. 7-6: MKD071: Allowable maximum radial force F_{radial_max} and allowable radial force F_{radial}

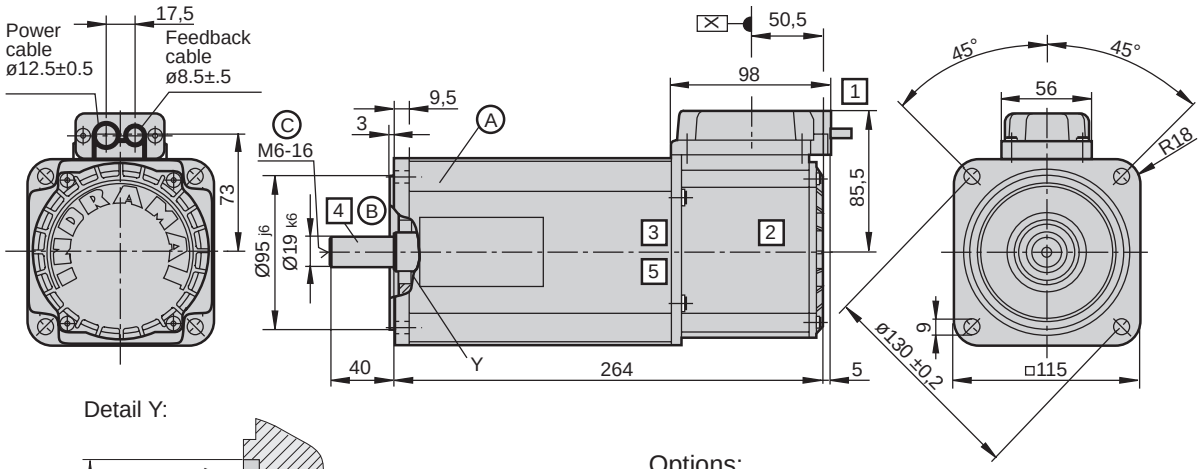
Allowable axial force F_{axial}

$$F_{axial} = 0{,}5 \cdot F_{radial}$$

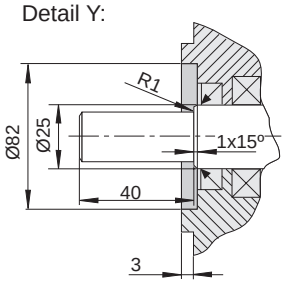
F_{axial}: allowable axial force in N
F_{radial}: allowable radial force in N

Fig. 7-7: MKD071: Allowable axial force F_{axial}

7.4 Dimensional data



Detail Y:

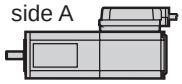


Options:

1 Output direction of electrical terminal box

The output direction of this box (power and feedback cables) is selected at the time of mounting. Possible directins are:

- to side A
- to side B



Side B is the output direction illustrated. The dimensions for side A as output direction can be obtained by turning the terminal box around the X axis.

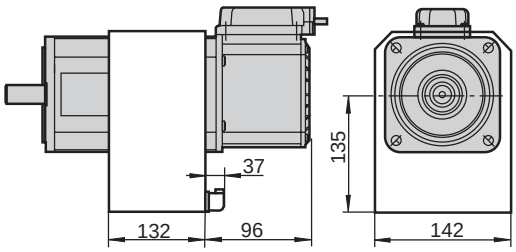
Ⓐ Motor as per DIN 42950, sec. 1, ed. 08.77, B5 for all mounting orientations

Ⓑ
- Flange as per DIN 42948,ed. 11.65
- Position accuracy per concentricity, excentriciy and coaxility to shaft as per DIN 42955 tolerance class N, ed. 12.81

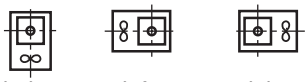
Ⓒ
- Shaft end per DIN 748, sec. 3, ed. 07.75, IEC 72, ed. 1971, cylindrical
- center drill hole DS M6 per DIN 332 sec. 2, ed. 05.83 max. screw tightening torque 5.0 Nm
- vibration severity level N per DIN VDE 0530 sec. 14, ed. 02.93

5 Cooling mode:

- natural convection (dim. see above)
- radial surface cooling



Possible arrangements:



below left right

(looking from front onto motor shaft)

2 Motor feedback

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

The dimensions are identical.

3 Holding brake:

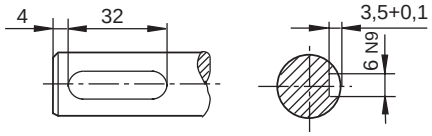
- without
- with

The dimensions are identical.

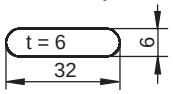
4 Output shaft

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

(Note! balanced with entire key!)



Matching keyway: DIN 6885-A 6 x 6 x 32 not part of delivery.



m01mkh1p.fh7

Fig. 7-8: Dimensions sheet MKD071B-035, MKD071B-061 (with terminal box)

7.5 Available Versions and Type Codes

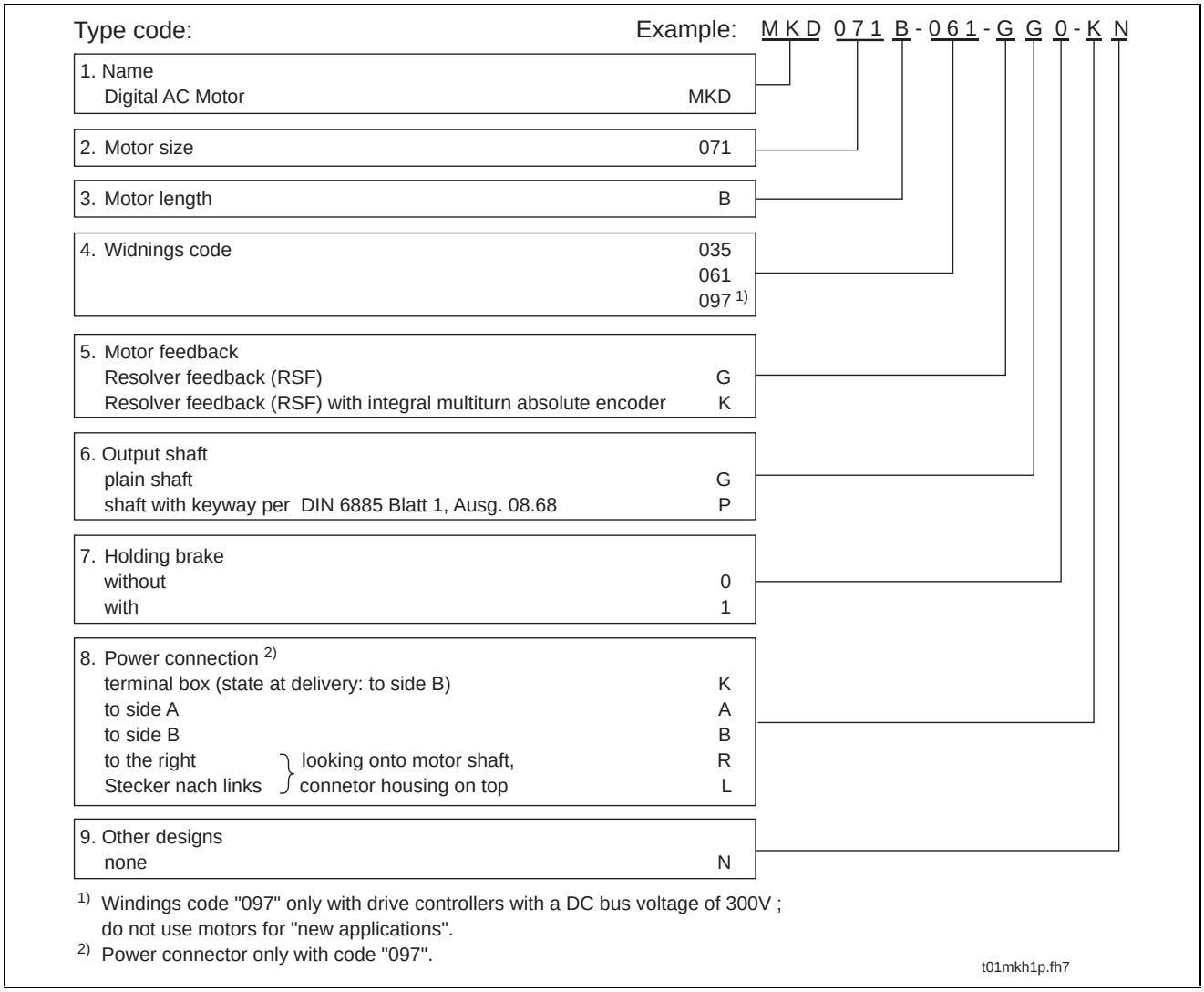


Fig. 7-9: Type codes MKD071

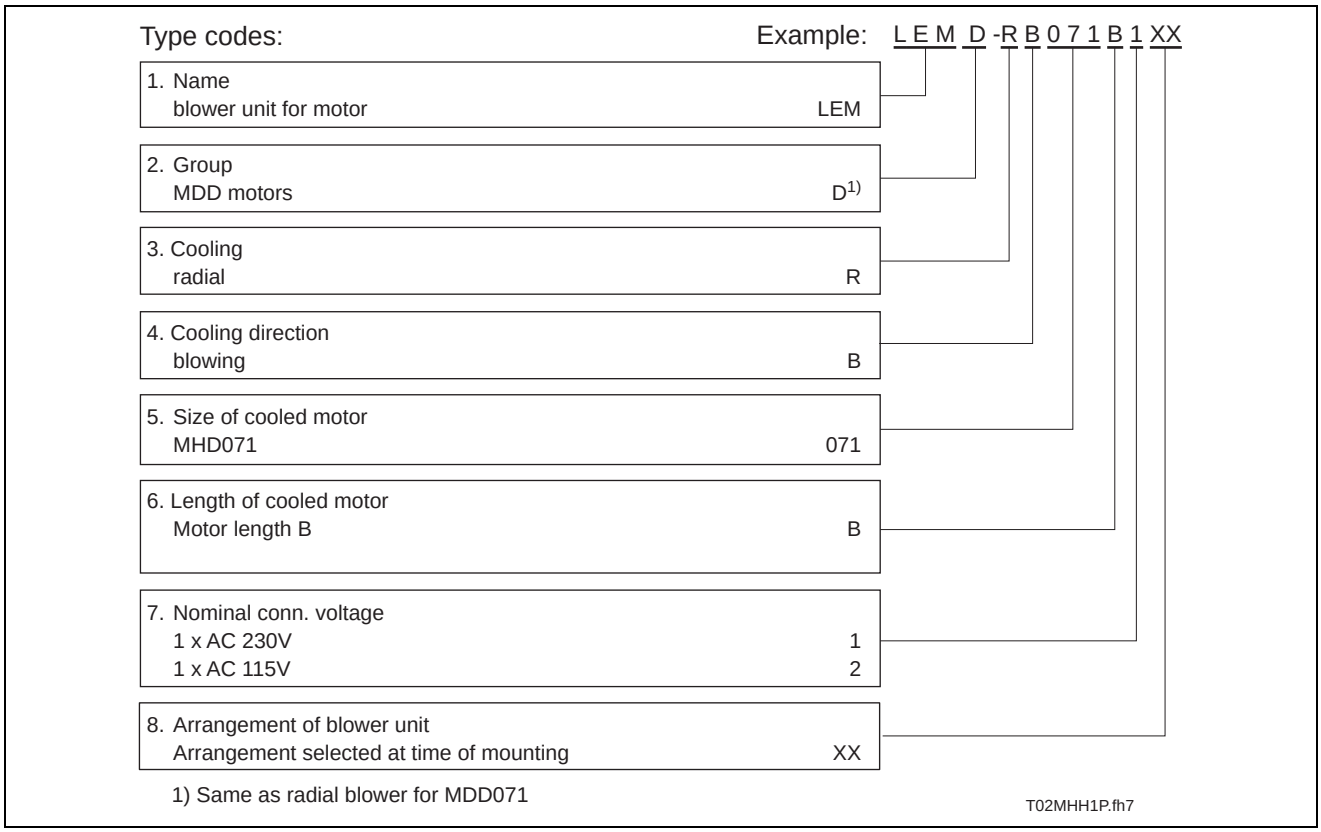


Fig. 7-10: Type codes radial blower unit

To purchase a motor with surface cooling device mounted it is necessary to enter the relevant, above-referenced type designations of the radial blower unit onto the order as a subitem of the MKD motor noting the desired blower orientation. If the bower unit is specified as a separate order item, then it will be delivered separate of the motor, in other words, not mounted.

Order position	Designation	
1	1	digital AC motor MKD071B-035-GG0-KN
1.1	1	blower unit LEMD -RB071B1-XX mounted to pos. 1 blower arranged left

Fig. 7-11: Order info for an MKD motor with attached blower unit

Order position	Designation	
1	1	digital AC motor MKD071B-035-GG0-KN
2	1	blower unit LEMD -RB071B1-XX

Fig. 7-12: Order info for an MKD motor with separate blower unit

8 MKD090

8.1 Technical data MKD090

Designation		**Symbol**	**Unit**	**Data**		
Motor type				MKD090B-035	MKD090B-047	MKD090B-058
Nominal motor speed [1]		n	min^{-1}	2500	3200	4000
Torque at standstill [2]						
Cooling	natural convection	M_{dN}	Nm	12.0	12.0	12.0
mode	surface cooled	M_{dN}	Nm	18	15.0	12.0
Current at standstill						
Cooling	natural convection	I_{dN}	A	11.0	13.2	17.5
mode	surface cooled	I_{dN}	A	16.5	16.5	17.5
Theoretical maximum torque [3]		M_{max}	Nm	43.5	43.5	43.5
Peak current		I_{max}	A	49.5	59.4	79.0
Moment of inertia of rotor [4]		J_M	kgm²	43×10^{-4}	43×10^{-4}	43×10^{-4}
Torque constant at 20ºC		K_m	Nm/A	1.22	1.0	0.77
Voltage constant at 20ºC [5]		K_{Eeff}	V/1000 min^{-1}	111.0	91.0	70.0
Windings resistance at 20ºC		R_A	Ohm	1.90	1.2	0.74
Windings inductance		L_A	mH	17.2	10.1	5.8
Thermal time constant		T_{th}	min	60	60	60
Mass [4]		m_M	kg	14	14	14
Electrical connections				terminal box	terminal box	terminal box
Allowable amb. temperatures[6]		T_{um}	ºC	0 to +45		
Allowable Storage and transport temperature		T_L	ºC	-20 to +80		
Max. installation elevation [7]			m	1000 above sea level		
Protection category [8]				IP 65		
Insulation class as per DIN VDE 0530, part 1				F		
Housing finish				Basic black coat (RAL 9005)		

1) Depends on torque requirements of application. For standard applications see n_{max} in the selection lists of the motor/controller combination. The usable speed for other applications is determined using the required torque as specified in the speed/torque characteristics.
2) Given 60 Kelvin overtemperature at the housing of the motor.
3) The achievable maximum torque depends on the drive controller used. **Only** the maximum torque Mmax specified in the selection lists of the motor/controller combination are binding.
4) Without holding brake und LüfertUnit.
5) At 1,000 min^{-1} .
6) Given deviating ambient temperatures, see Section 3.1.
7) Given deviating installation elevations, see Section 3.1 .
8) With correct mounting of power and feedback cables.

Fig. 8-1: Technical data MKD090

Designation	Symbol	Unit	Data Holding brake
Holding torque	M_H	Nm	11.0
Nominal voltage	U_N	V	DC 24 ±10%
Nominal current	I_N	A	0.71
Moment of inertia	J_B	kgm²	3.6×10^{-4}
Link time	t_1	ms	13
Separation time	t_2	ms	30
Mass	m_B	kg	1.1

Fig. 8-2: Technical data holding brake MKD090 (Option)

Designation	Symbol	Unit	Surface cooling data	
Motor type			MKD090B-035 MKD090B-047 MKD090B-058	
Nominal voltage	U_N	V	1 x AC 230 ±10%	1 x AC 115 ±10%
Nominal current	I_N	A	0.2	0.4
Power consumption	S_N	VA	40	39
Frequency	f	Hz	50	60

Fig. 8-3: Technical data on surface cooling MKD090 (Option)

8.2 Technical data MKD090 „*without painted coating*“

Designation	Symbol	Unit	Data
Motor type			MKD090B-046
Nominal motor speed [1]	n	min^{-1}	3200
Torque at standstill [2] Cooling mode natural convection	M_{dN}	Nm	9.3
Current at standstill Cooling mode natural convection	I_{dN}	A	10.4
Theoretical maximum torque [3]	M_{max}	Nm	43.5
Peak current	I_{max}	A	59.4
Moment of inertia of rotor [4]	J_M	kgm^2	$43.0x10^{-4}$
Torque constant at 20ºC	K_m	Nm/A	1.0
Voltage constant at 20ºC [5]	K_{Eeff}	V/1000 min^{-1}	91.0
Windings resistance at 20ºC	R_A	Ohm	1.2
Windings inductance	L_A	mH	10.1
Thermal time constant	T_{th}	min	60
Mass [4]	m_M	kg	14.0
Electrical connections			terminal box
Allowable ambient temperatures [6]	T_{um}	ºC	0 to +45
Allowable Storage and transport temperature	T_L	ºC	-20 to +80
Maximum installation elevation [7]		m	1000 above sea level
Protection category [8]			IP 65
Insulation class as per DIN VDE 0530, part 1			F
Housing finish			without

1) Depends on torque requirements of application. For standard applications see n_{max} in the selection lists of the motor/controller combination. The usable speed for other applications is determined using the required torque as specified in the speed/torque characteristics.
2) Given 60 Kelvin overtemperature at the housing of the motor.
3) The achievable maximum torque depends on the drive controller used. **Only** the maximum torque Mmax specified in the selection lists of the motor/controller combination are binding.
4) Without holding brake und LüfertUnit.
5) At 1,000 min^{-1} .
6) Given deviating ambient temperatures, see Section 3.1 .
7) Given deviating installation elevations, see Section 3.1 .
8) With correct mounting of power and feedback cables.

Fig. 8-4: Technical data MKD090

Designation	Symbol	Unit	Data Holding brake
Holding torque	M_H	Nm	11,0
Nominal voltage	U_N	V	DC 24 ±10%
Nominal current	I_N	A	0,71
Moment of inertia	J_B	kgm²	$3{,}6 \times 10^{-4}$
Link time	t_1	ms	13
Separation time	t_2	ms	30
Mass	m_B	kg	1,1

Fig. 8-5: Technical data holding brake MKD090 (Option)

Note: The option of surface cooling *„without painted coating“* is not available with MKD motors.

8.3 Speed/torque characteristics MKD090

For details see Section 3.7 „Speed and Torque", Page 3-12 .

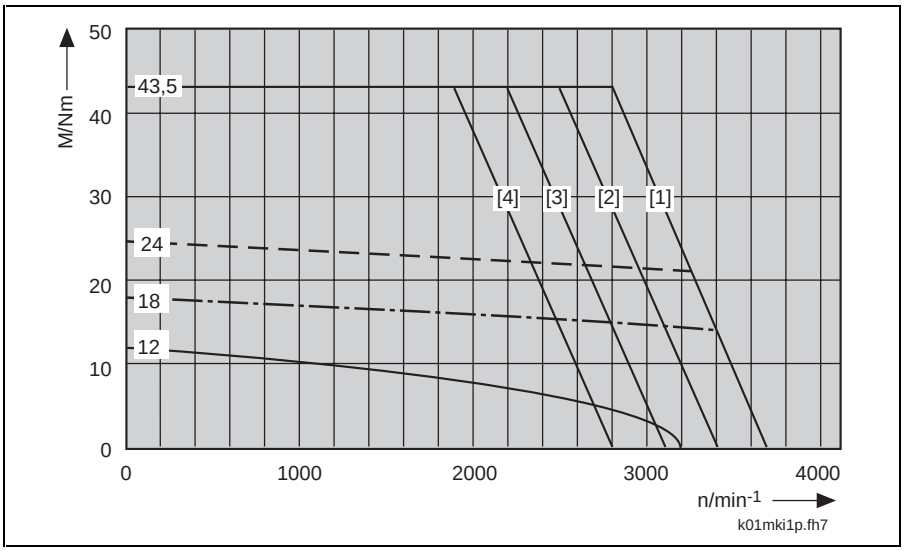


Fig. 8-6: Speed/torque characteristics MKD090B-035

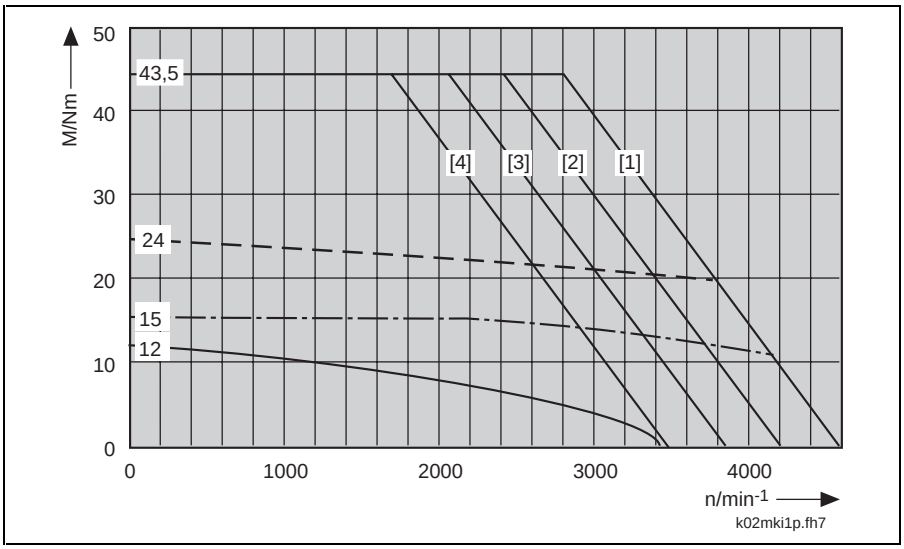


Fig. 8-7: Speed/torque characteristics MKD090B-047

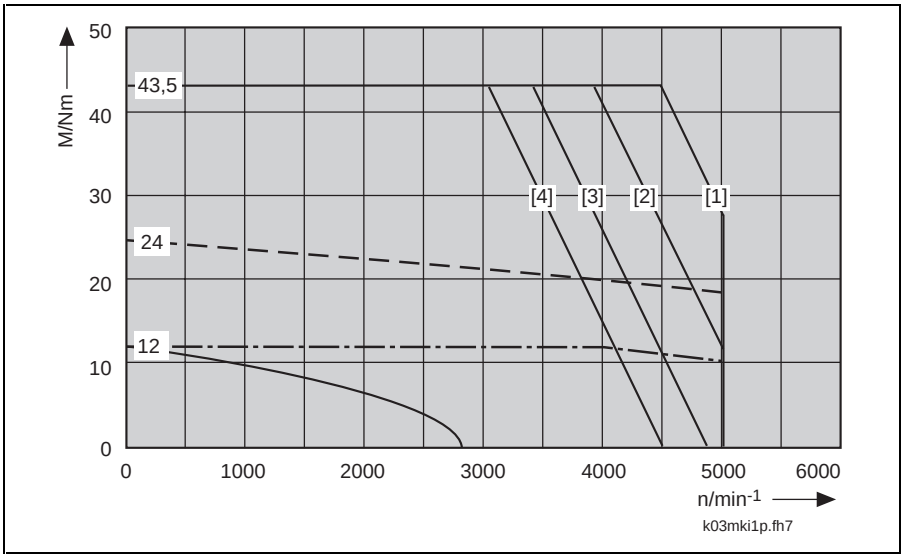


Fig. 8-8: Speed/torque characteristics MKD090B-058

8.4 Speed/Torque Characteristics - MKD090 „*without painted coating*“

For details see Section 3.7 „Speed and Torque ";Page 3-12 .

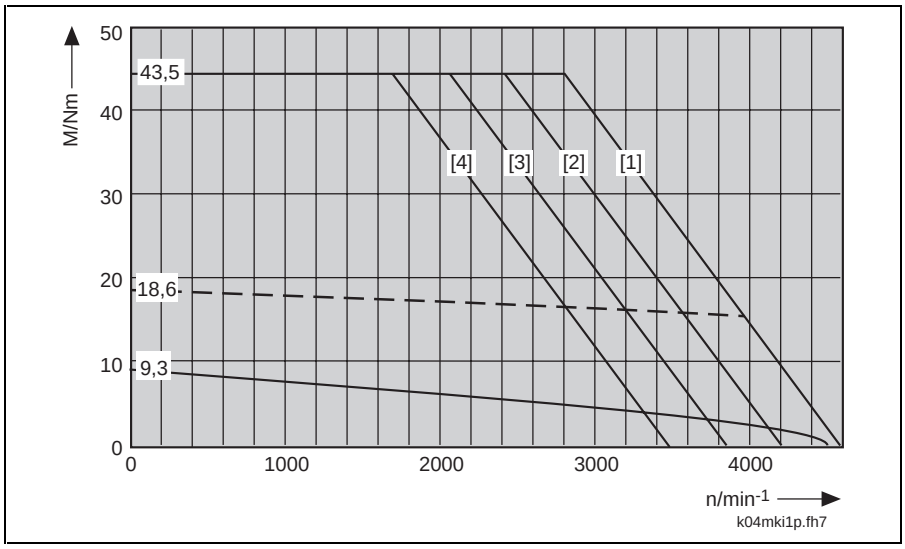


Fig. 8-9: Speed/torque characteristics MKD090B-046

8.5 Data on determining maximum shaft load

For details see Section,3.3 Output Shafts, Page 3-6.

Allowable maximum radial force F_{radial_max} und allowable radial force F_{radial}

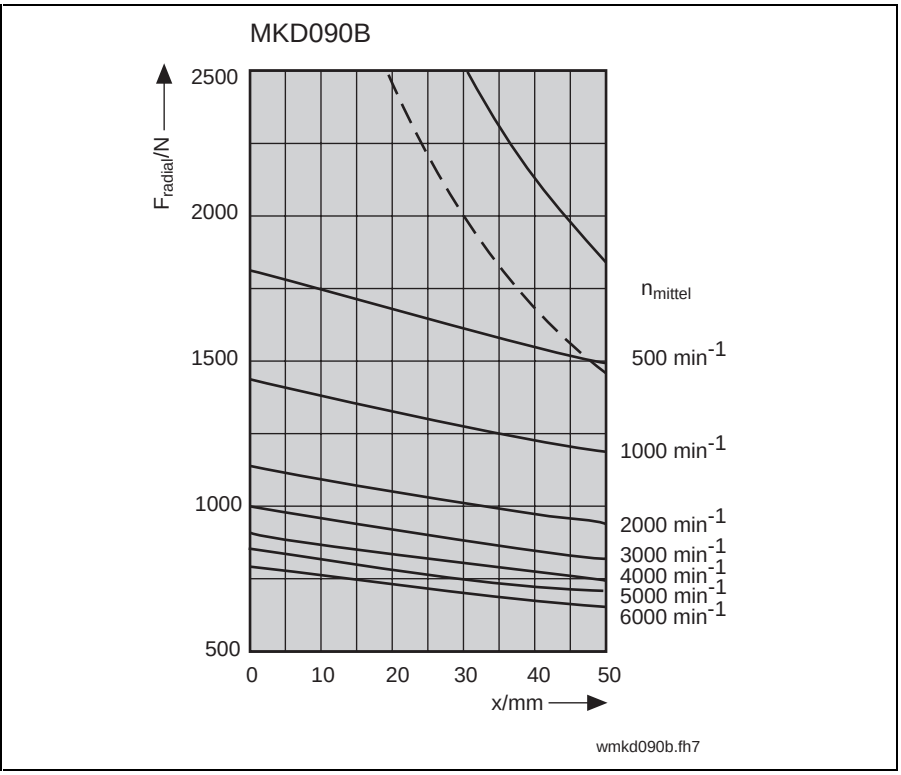


Fig. 8-10: MKD090: Allowable maximum radial force F_{radial_max} and allowable radial force F_{radial}

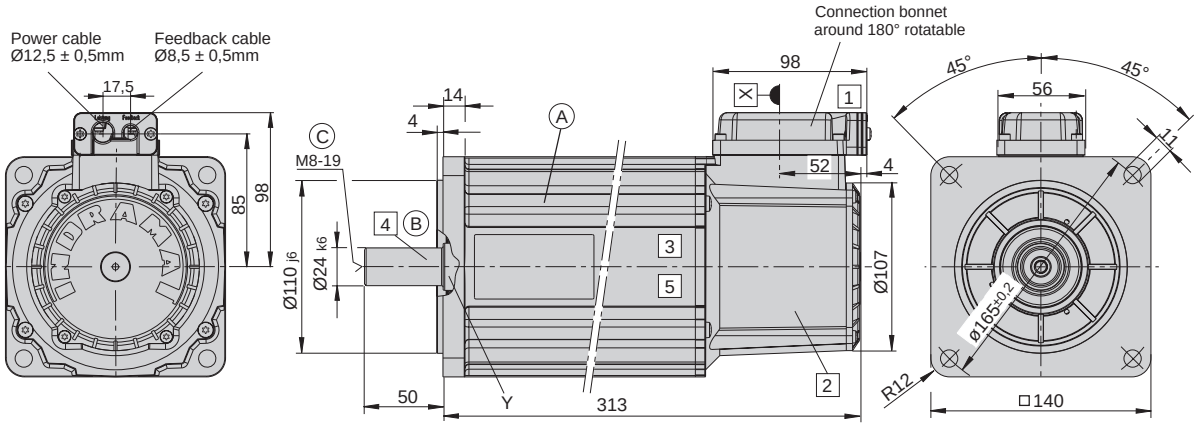
Allowable axial force F_{axial}

$$F_{axial} = 0{,}34 \cdot F_{radial}$$

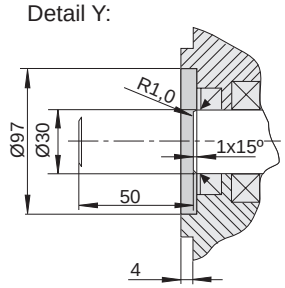
F_{axial}: allowable axial force in N
F_{radial}: allowable radial force in N

Fig. 8-11: MKD090: Allowable axial force F_{axial}

8.6 Dimensional data



Detail Y:

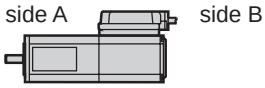


Options:

1 Output direction of electrical terminal box

The output direction of this box (power and feedback cables) is selected at the time of mounting. Possible directins are:

- to side A
- to side B



Side B is the output direction illustrated. The dimensions for side A as output direction can be obtained by turning the terminal box around the X axis.

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

Ⓑ
- Flange as per DIN 42948,ed. 11.65
- Position accuracy per concentricity, excentriciy and coaxility 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 M8 per DIN 332 sec. 2, ed. 05.83 max. screw tightening torque 12.0 Nm
- vibration severity level N per DIN VDE 0530 sec. 14, ed. 02.93

5 Cooling mode:

- natural convection (dim. see above)
- radial surface cooling not with MKD090B-046

2 Motor feedback

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

The dimensions are identical.

3 Holding brake:

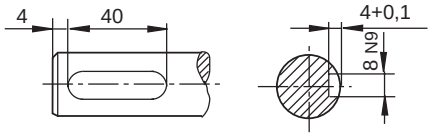
- without
- with

The dimensions are identical.

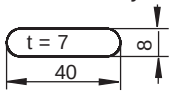
4 Output shaft

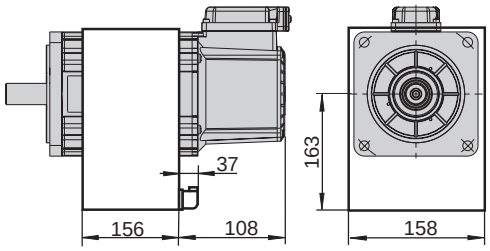
- plain shaft (preferred type)
- with keyway per DIN 6885 sh.1, ed. 08.68

(Note! balanced with entire key!)

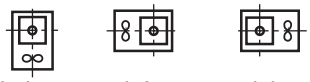


Matching keyway DIN 6885-A 8 x 7 x 40, not part of delivery





Possible arrangement:



below left right

(looking onto motor shaft) from front

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Fig. 8-12: Dimensions sheet MKD090B-035, -046, -047, -058

8.7 Available Versions and Type Codes

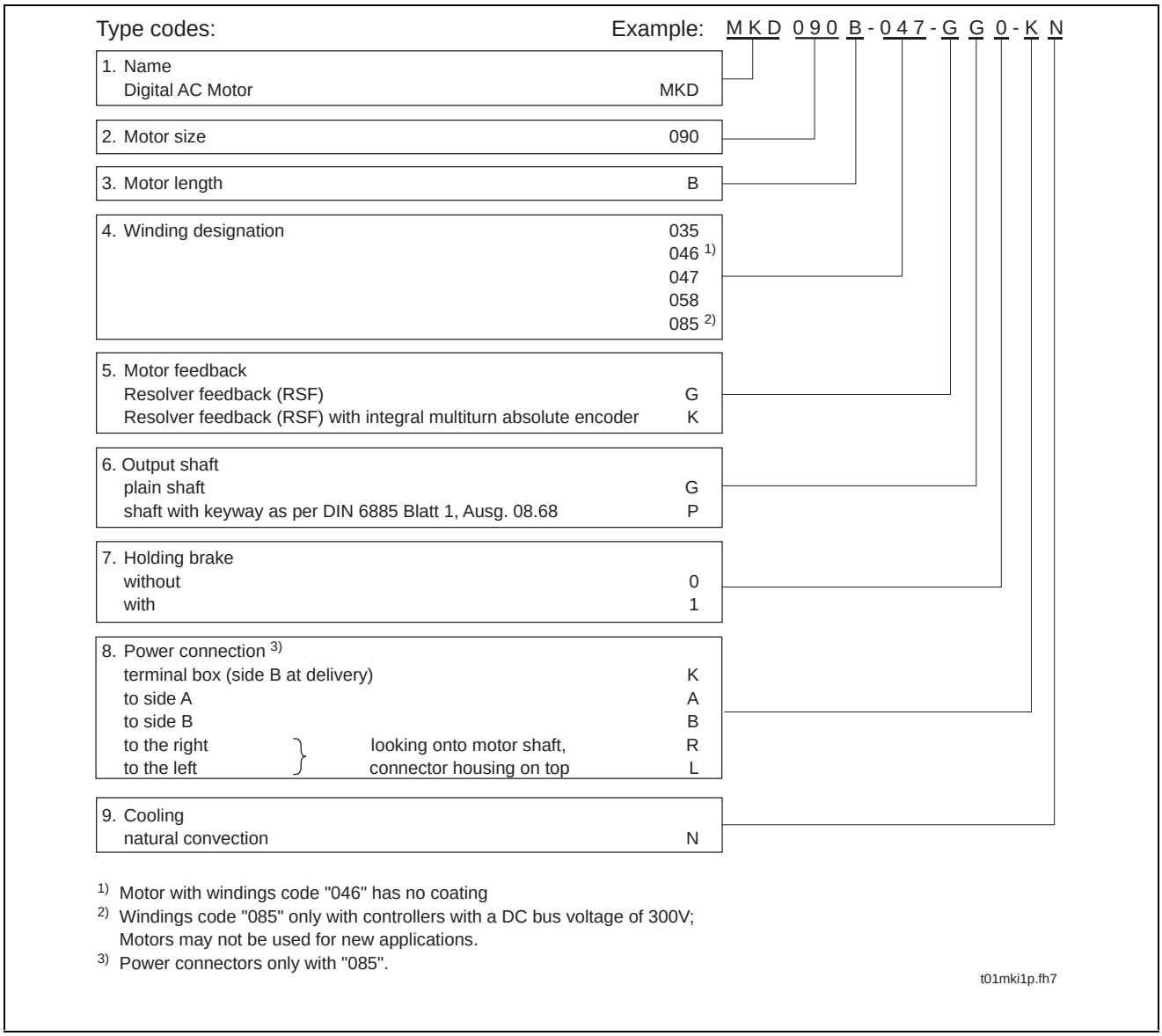


Fig. 8-13: Type codes MKD090

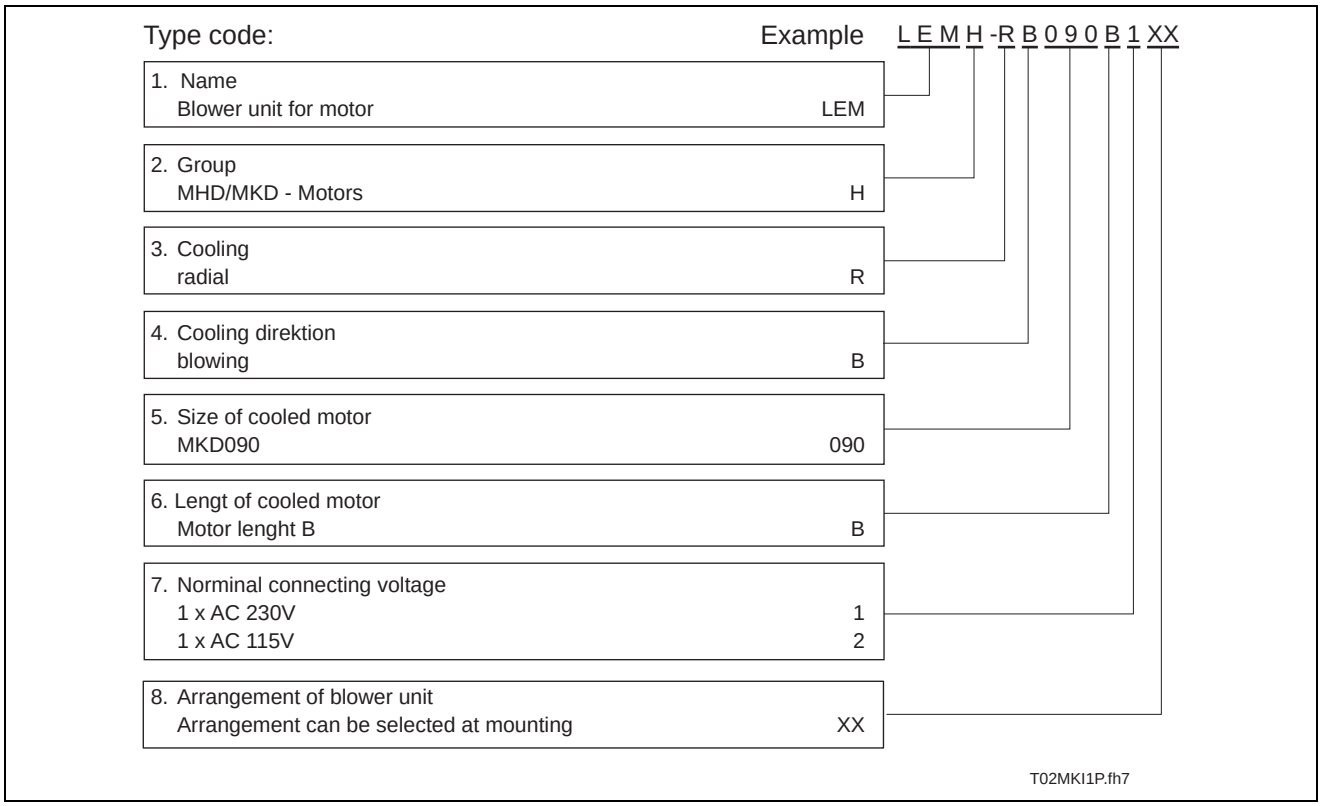


Fig. 8-14: Type codes of radial blower unit MKD090

To purchase a motor with surface cooling device mounted it is necessary to enter the relevant, above-referenced type designations of the radial blower unit onto the order as subitem of the MKD motor noting the desired blower orientation. If the bower unit is specified as a separate order item, then it will be delivered separate of the motor, in other words, not mounted.

Order position	Designation
1	1 digital AC motor MKD090B-035-GG0-KN
1.1	1 blower unit LEMH -RB090B1-XX mounted to pos. 1 blower arranged left

Fig. 8-15: Order info for an MKD motor with attached blower unit

Order position	Designation
1	1 digital AC motor MKD090B-035-GG0-KN
2	1 blower unit LEMH -RB090B1-XX

Fig. 8-16: Order info for an MKD motor with separate blower unit

9 MKD112

9.1 Technical data

Designation	Symbol	Unit	Data	
Motor type			MKD112A-024	MKD112A-058
Nominal motor speed [1]	n	min^{-1}	2000	
Torque at standstill [2] Cooling natural convection mode	M_{dN}	Nm	14.0	
Current at standstill Cooling natural convection mode	I_{dN}	A	12.3	
Theoretical maximum torque [3]	M_{max}	Nm	54.0	
Peak current	I_{max}	A	55.4	
Moment of inertia of rotor [4]	J_M	kgm^2	110×10^{-4}	
Torque constant at 20ºC	K_m	Nm/A	1.28	
Voltage constant at 20ºC [5]	K_{Eeff}	V/1000 min^{-1}	116.4	
Windings resistance at 20ºC	R_A	Ohm	1.45	
Windings inductance	L_A	mH	14.0	
Thermal time constant			90	
Mass [4]	m_M	kg	23.0	
Electrical connections			plug-in connector	
Allowable amb. temperatures[6]	T_{um}	ºC	0 to +45	
Allowable Storage and transport temperature	T_L	ºC	-20 to +80	
Max. installation elevation[7]		m	1000 above sea level	
Protection category [8]			IP 65	
Insulation class as per DIN VDE 0530, part 1			F	
Housing finish			Basic black coat (RAL 9005)	

1) Depends on torque requirements of application. For standard applications see n_{max} in the selection lists of the motor/controller combination. The usable speed for other applications is determined using the required torque as specified in the speed/torque characteristics.
2) Given 60 Kelvin overtemperature at the housing of the motor.
3) The achievable maximum torque depends on the drive controller used. **Only** the maximum torque Mmax specified in the selection lists of the motor/controller combination are binding.
4) Without holding brake und blower unit.
5) At 1000 min^{-1} .
6) Given deviating ambient temperatures, see Section 3.1.
7) Given deviating installation elevations, see Section 3.1.
8) With correct mounting of power and feedback cables.

Fig. 9-1: Technical data MKD112A

Designation		Symbol	Unit	Data		
Motor type				MKD112B-024	MKD112B-048	MKD112B-058
Nominal motor speed [1]		n	min^{-1}	2000	3500	4000
Torque at standstill [2]						
Cooling	natural convection	M_{dN}	Nm	28.0	28.0	28.0
mode	surface cooled	M_{dN}	Nm	42.0	42.0	42.0
Current at standstill						
Cooling	natural convection	I_{dN}	A	21.9	35.6	40.7
mode	surface cooled	I_{dN}	A	32.9	53.4	61.1
Theoretical maximum torque [3]		M_{max}	Nm	102	102	102
Peak current		I_{max}	A	98.5	148	183
Moment of inertia of rotor [4]		J_M	kgm²	192×10^{-4}	192×10^{-4}	192×10^{-4}
Torque constant at 20ºC		K_m	Nm/A	1.43	0.88	0.77
Voltage constant at 20ºC [5]		K_{Eeff}	V/1000 min^{-1}	130	80.0	70.0
Windings resistance at 20ºC		R_A	Ohm	0.58	0.37	0.17
Windings inductance		L_A	mH	8.2	4.8	2.5
Thermal time constant						
Cooling	natural convection	T_{th}	min	90	90	90
mode	surface cooled	T_{th}	min	60	60	60
Mass [4]		m_M	kg	34	34	34
Electrical connections				plug-in connector	plug-in connector	plug-in connector
Allowable ambient temperatures 6)		T_{um}	ºC	0 to +45		
Allowable storage and transport temperature		T_L	ºC	-20 to +80		
Maximum installation elevation [7]			m	1000 above sea level		
Protection category [8]				IP 65		
Insulation class as per DIN VDE 0530, part 1				F		
Housing finish				Basic black coat (RAL 9005)		

1) Depends on torque requirements of application. For standard applications see n_{max} in the selection lists of the motor/controller combination. The usable speed for other applications is determined using the required torque as specified in the speed/torque characteristics.
2) Given 60 Kelvin overtemperature at the housing of the motor.
3) The achievable maximum torque depends on the drive controller used. **Only** the maximum torque Mmax specified in the selection lists of the motor/controller combination are binding.
4) Without holding brake und blower unit.
5) At 1000 min^{-1} .
6) Given deviating ambient temperatures, see Section 3.1 .
7) Given deviating installation elevations, see Section 3.1 .
8) With correct mounting of power and feedback cables.

Fig. 9-2: Technical data MKD112B

Designation		**Symbol**	**Unit**	**Data**		
Motor type				MKD112C-024	MKD112C-058	MKD112D-027
Nominal motor speed [1]		n	min^{-1}	2000	4000	3000
Torque at standstill [2]						
Cooling	natural convection	M_{dN}	Nm	38.0	38.0	48.0
mode	surface cooled	M_{dN}	Nm	57.0	57.0	72.0
Current at standstill						
Cooling	natural convection	I_{dN}	A	26.6	53.2	3.,6
mode	surface cooled	I_{dN}	A	39.9	79.8	47.7
Theoretical maximum torque [3]		M_{max}	Nm	148	148	187
Peak current		I_{max}	A	120.0	239.	142.2
Moment of inertia of rotor [4]		J_M	kgm²	273 x 10^{-4}	273 x 10^{-4}	355 x 10^{-4}
Torque constant at 20ºC		K_m	Nm/A	1.6	0.80	1.7
Voltage constant at 20ºC [5]		K_{Eeff}	V/1000 min^{-1}	145.5	72.7	154.5
Windings resistance at 20ºC		R_A	Ohm	0.43	0.12	0.35
Windings inductance		L_A	mH	6.7	1.5	5.7
Thermal time constant						
Cooling	natural convection	T_{th}	min	90	90	90
mode	surface cooled	T_{th}	min	60	60	60
Mass [4]		m_M	kg	41	45	55
Electrical connections				plug-in connector	plug-in connector	plug-in connector
Allowable amb. temperatures[6]		T_{um}	ºC	0 to +45		
Allowable Storage and transport temperature		T_L	ºC	-20 to +80		
Max. installation elevation[7]			m	1000 above sea level		
Protection category [8]				IP 65		
Insulation class as per DIN VDE 0530, part 1				F		
Housing finish				Basic black coat (RAL 9005)		

1) Depends on torque requirements of application. For standard applications see n_{max} in the selection lists of the motor/controller combination. The usable speed for other applications is determined using the required torque as specified in the speed/torque characteristics.
2) Given 60 Kelvin overtemperature at the housing of the motor.
3) The achievable maximum torque depends on the drive controller used. **Only** the maximum torque Mmax specified in the selection lists of the motor/controller combination are binding.
4) Without holding brake und blower unit.
5) At 1000 min^{-1} .
6) Given deviating ambient temperatures, see Section 3.1.
7) Given deviating installation elevations, see Section 3.1.
8) With correct mounting of power and feedback cables.

Fig. 9-3: Technical data MKD112C or MKD112D

Designation	Symbol	Unit	Data Holding brake	
Motor type			MKD112A MKD112B	MKD112C, MKD112D
Holding torque	M_H	Nm	20	70
Nominal voltage	U_N	V	DC 24 ±10%	DC 24 ±10%
Nominal current	I_N	A	0.71	1.29
Moment of inertia	J_B	kgm²	3.6×10^{-4}	30×10^{-4}
Link time	t_1	ms	50	53
Separation time	t_2	ms	25	97
Mass	m_B	kg	1.1	3.8

Fig. 9-4: Technical data holding brake MKD112 (Option)

Designation	Symbol	Unit	Surface cooling data	
Motor type			MKD112B MKD112C MKD112D	
Nominal voltage	U_N	V	1 x AC 230 ±10%	1 x AC 115 ±10%
Nominal current	I_N	A	0.30 / 0.28	0.60 / 0.57
Power consumption	S_N	VA	41 / 39	41 / 39
Frequency	f	Hz	50 / 60	50 / 60

Fig. 9-5: Technical data on surface cooling MKD112 (Option)

9.2 Speed/torque characteristics

For details see Section 3.7 Speed and Torque, Page 3-12.

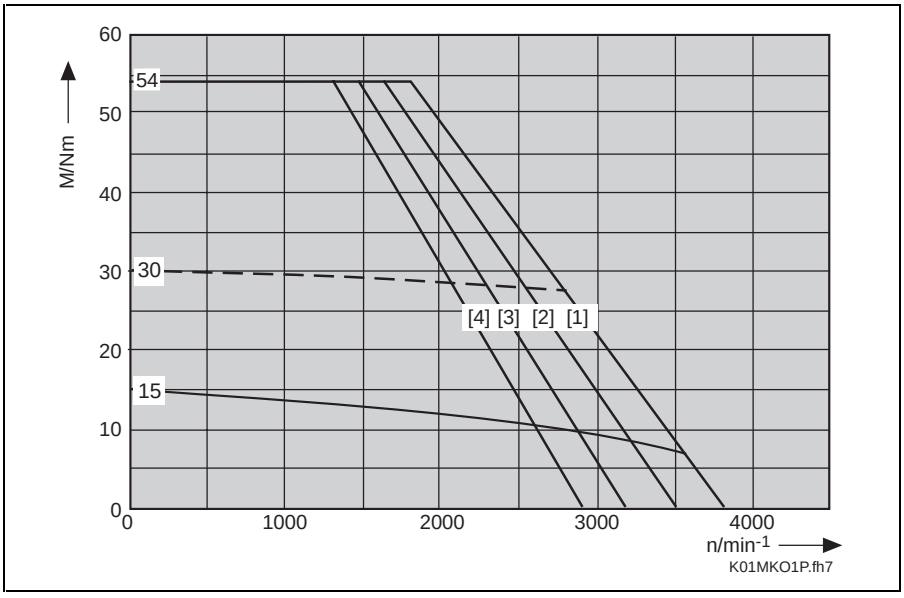


Fig. 9-6: Speed/torque characteristics MKD112A-024

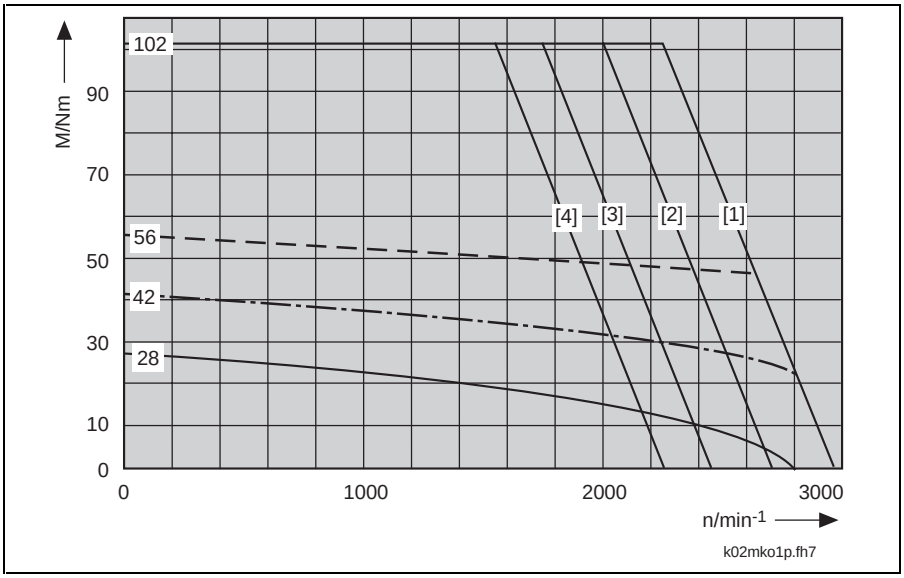


Fig. 9-7: Speed/torque characteristics MKD112B-024

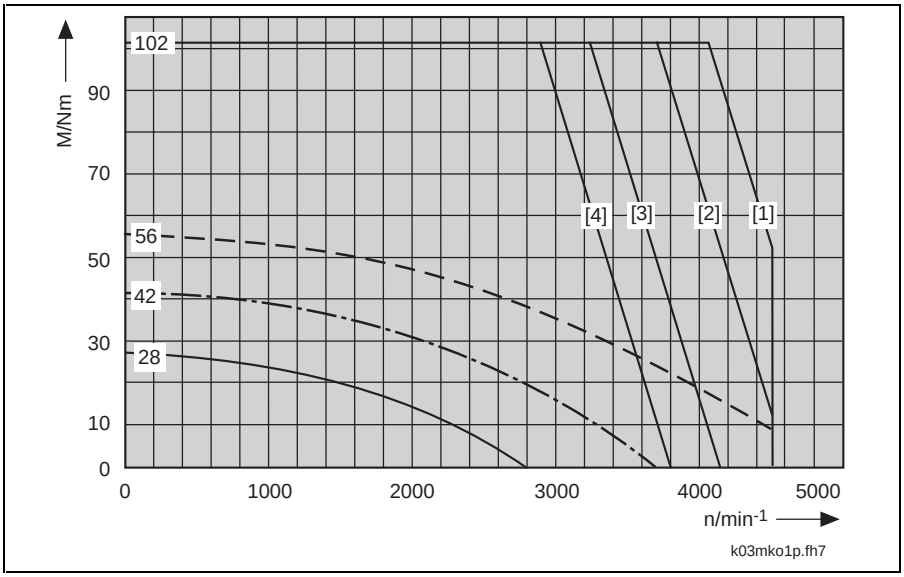


Fig. 9-8: Speed/torque characteristics MKD112B-048

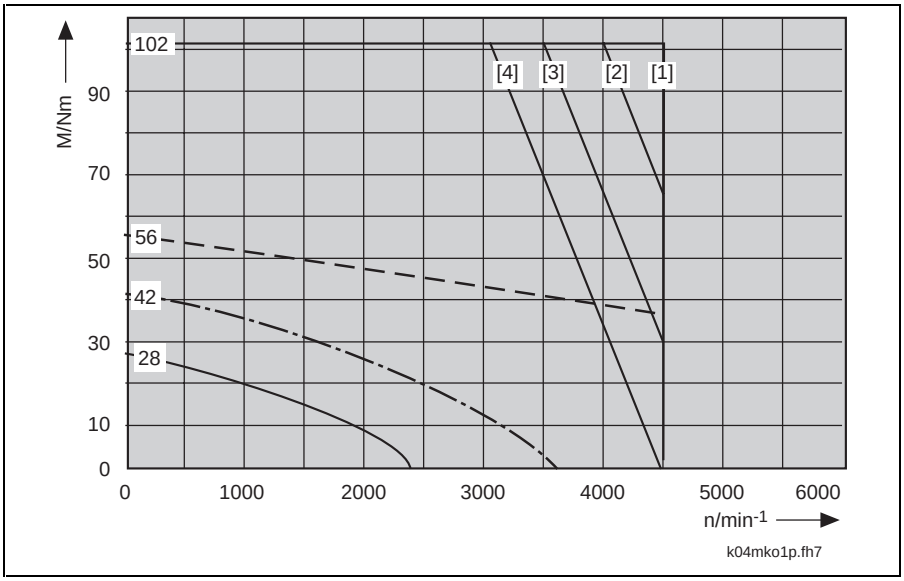


Fig. 9-9: Speed/torque characteristics MKD 112B-058

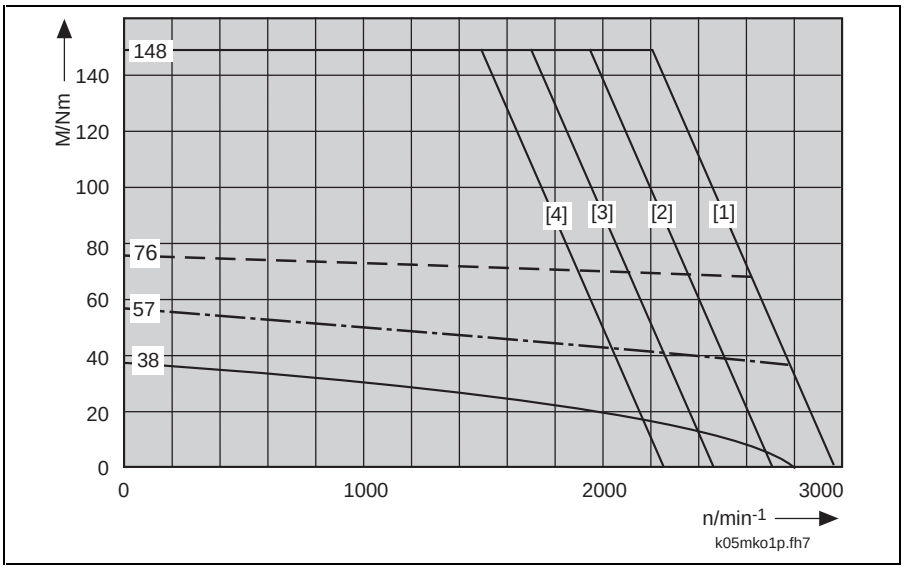


Fig. 9-10: Speed/torque characteristics MKD 112C-024

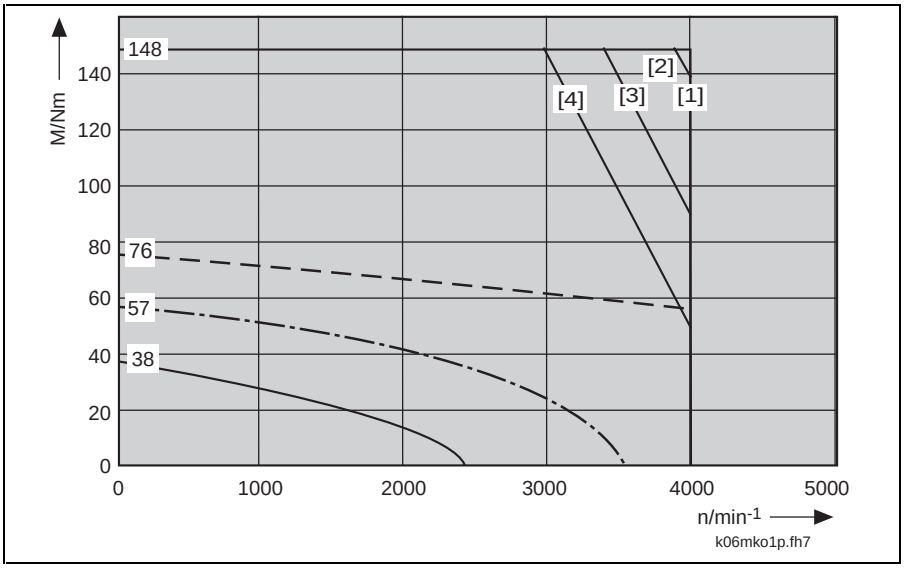


Fig. 9-11: Speed/torque characteristics MKD 112C-058

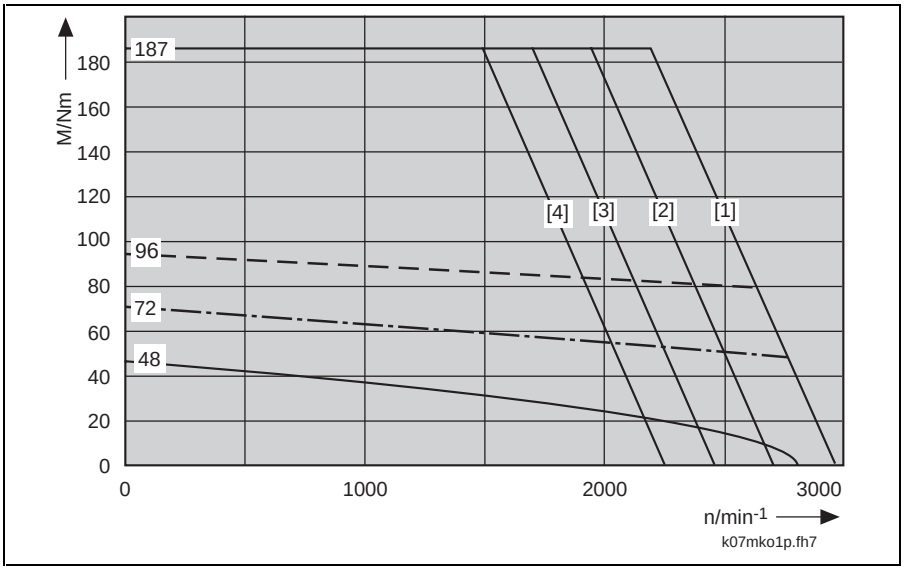


Fig. 9-12: Speed/torque characteristics MKD 112D-027

9.3 Data on determining maximum shaft load

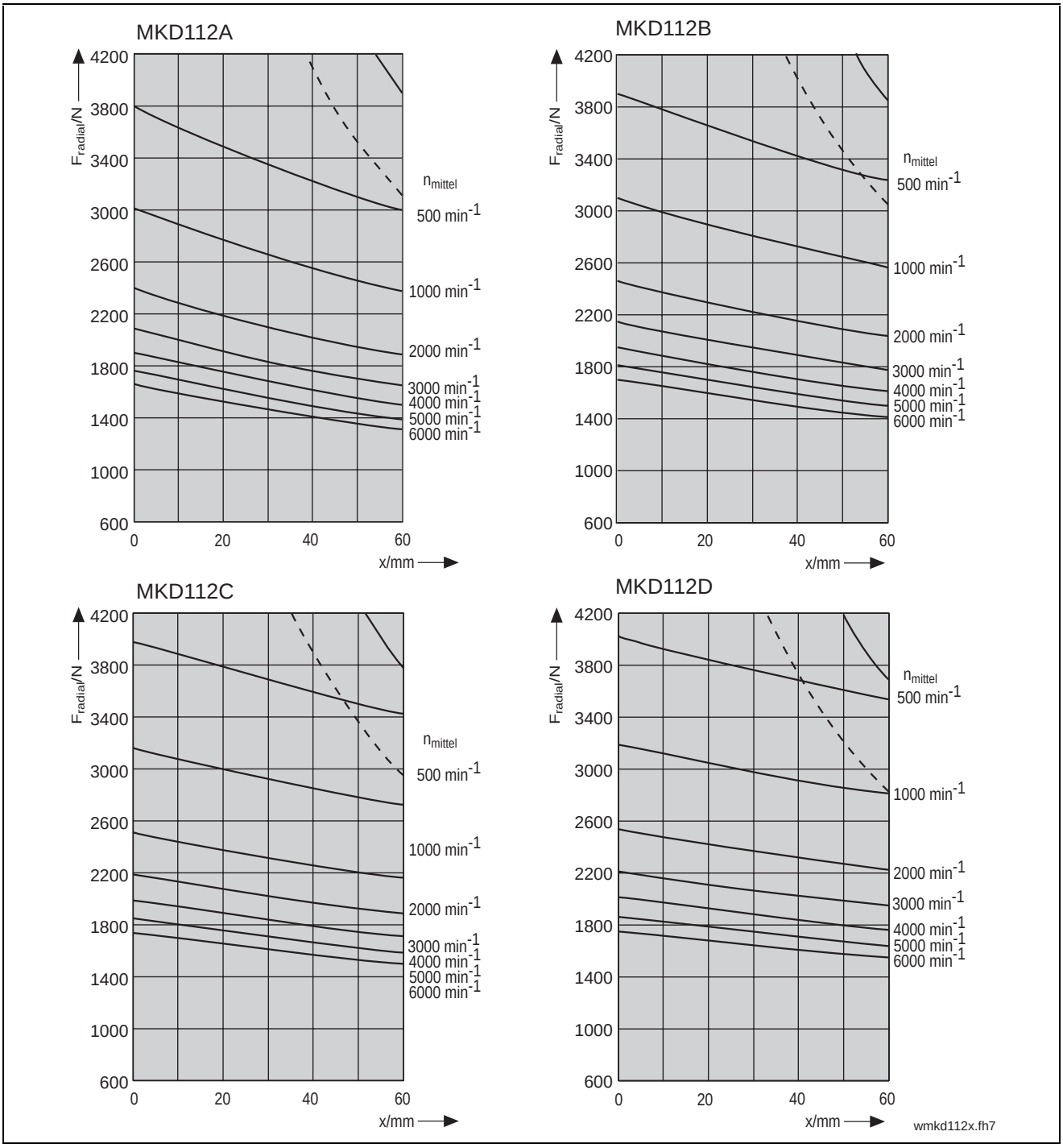


Fig. 9-13: MKD112: Allowable maximum radial force F_{radial_max} and allowable radial force F_{radial}

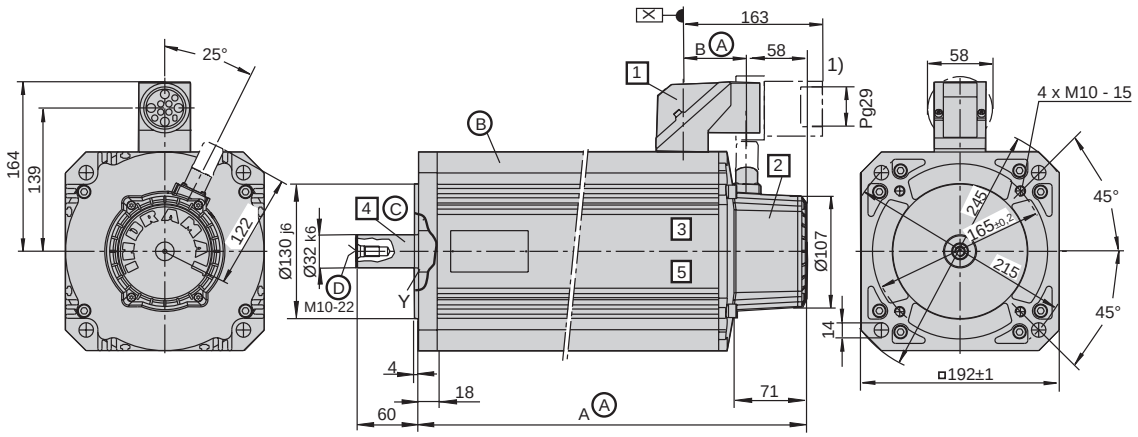
Allowable axial force F_{axial}

$$F_{axial} = x \cdot F_{radial}$$

x: 0.36 for MKD112A and MKD112B
0.35 for MKD112C and MKD112D
F_{axial}: allowable axial force in N
F_{radial}: allowable radial force in N

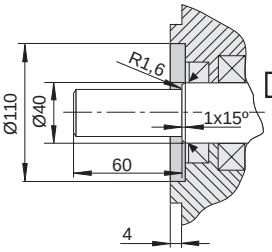
Fig. 9-14: MKD112: Allowable axial force F_{axial}

9.4 Dimensional data



1) connector must be ordered separately

Detail Y:



Ⓐ Dimensions

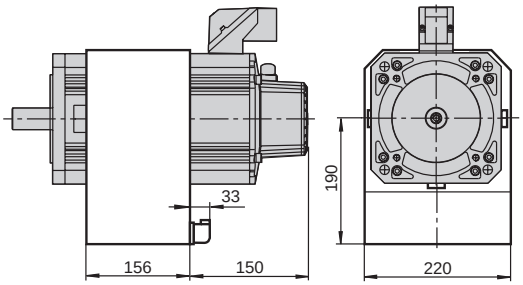
Size	Dim. A	Dim. B
MKD 112A	309	62
MKD 112B	375	62
MKD 112C	458	91
MKD 112D	526	91
Dim A: total motor length dim B. power connetion		

Ⓑ Motor as per DIN 42950, sec. 1, ed. 08.77, B5 for all mounting orientations

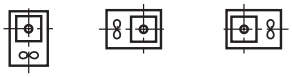
Ⓒ
- Flange as per DIN 42948,ed. 11.65
- Position accuracy per concentricity, excentriciy and coaxility to shaft as per DIN 42955 tolerance class N, ed. 12.81

Ⓓ
- Shaft end per DIN 748, sec. 3, ed. 07.75, IEC 72, ed. 1971, cylindrical
- center drill hole DS M10 per DIN 332 sec. 2, ed. 05.83 max. screw tightening torque 25.0 Nm
- vibration severity level N per DIN VDE 0530 sec. 14, ed. 02.93

5 Cooling mode:
- natural convection (dim. see above)
- radial surface cooling not with MKD112A



Possible orientations:



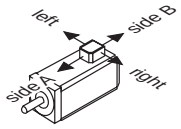
down left right

(looking onto motor shaft)

Options:

1 Power connection output direction

Select this direction at time of order. Possible directions are:
- to side A
- to side B
- to the right
- to the left



Side B is illustrated as output direction at the time of delivery. This can be altered by turning the connector housing around the X axis.

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

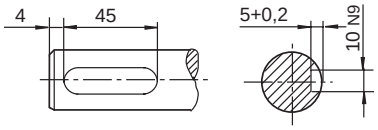
The dimensions are identical.

3 Holding brake
- without holding brake
- with holding brke

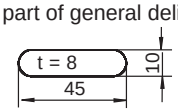
The dimensions are identical.

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

Note: balanced with entire keyway!

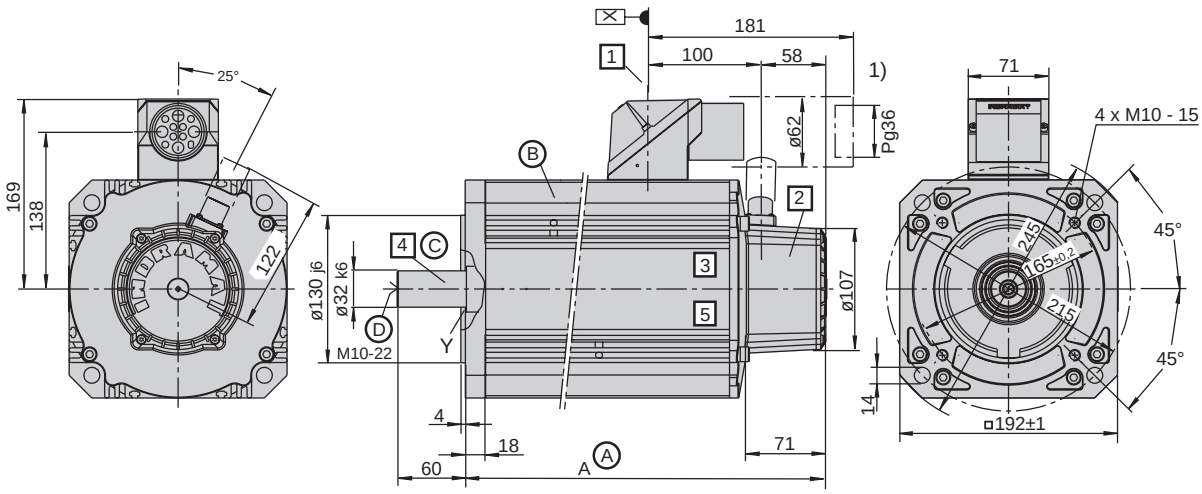


Matching keyway: DIN 6885-A 10 x 8 x 45, not part of general delivery



M01MKO1P.fh7

Fig. 9-15: Dimensions sheet for MKD112A-024, MKD112B-024, -048, -058, MKD112C-024 and MKD112D-024



1) connector must be ordered separately

Ⓐ Dimensions

Size	Dim.A
MKD 112 C	458
MKD 112 D	526

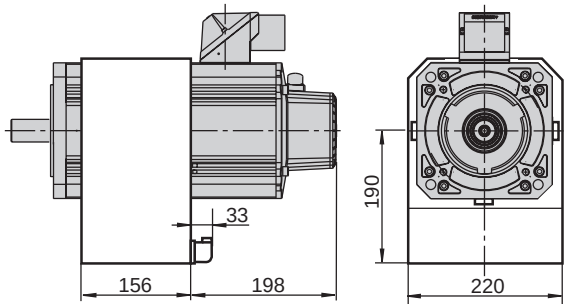
Ⓑ Motor as per DIN 42950, sec. 1, ed. 08.77, B5 for all mounting orientations

Ⓒ • Flange as per DIN 42948,ed. 11.65
• Position accuracy per concentricity, excentriciy and coaxility to shaft as per DIN 42955 tolerance class N, ed. 12.81

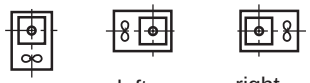
Ⓓ • Shaft end per DIN 748, sec. 3, ed. 07.75, IEC 72, ed. 1971, cylindrical
• center drill hole DS M10 per DIN 332 sec. 2, ed. 05.83 max. screw tightening torque 25.0 Nm
• vibration severity level N per DIN VDE 0530 sec. 14, ed. 02.93

5 Cooling mode:

- natural convection (dim. see above)
- radial surface cooling



Possible orientations:



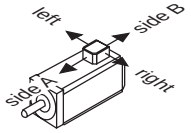
down left right (looking onto motor shaft)

Options:

1 Power connection output direction

Select this direction at time of order. Possible directions are:

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



Side B is illustrated as output direction at the time of delivery. This can be altered by turning the connector housing around the X axis.

2 Motor feedback

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

The dimensions are identical.

3 Holding brake

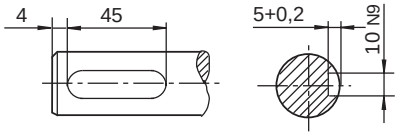
- without holding brake
- with holding brke

The dimensions are identical.

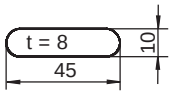
4 Output shaft

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

Note: balanced with entire keyway!



Matching keyway: DIN 6885-A 10 x 8 x 45, not part of general delivery



m02mko1p.fh7

Fig. 9-16: Dimensions sheet MKD112C-058, MKD112D-024

9.5 Available Versions and Type Codes

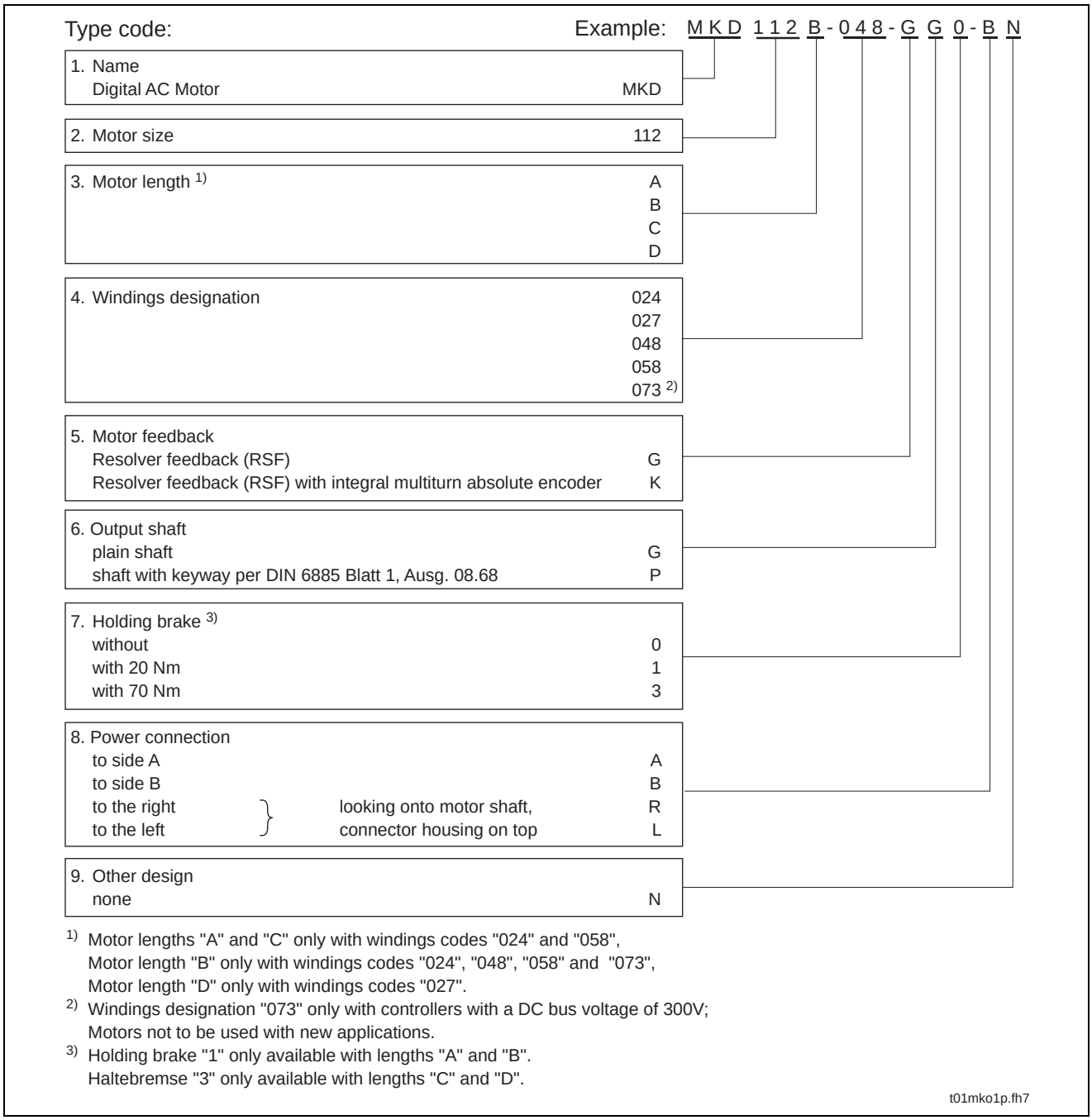


Fig. 9-17: Type codes MKD112

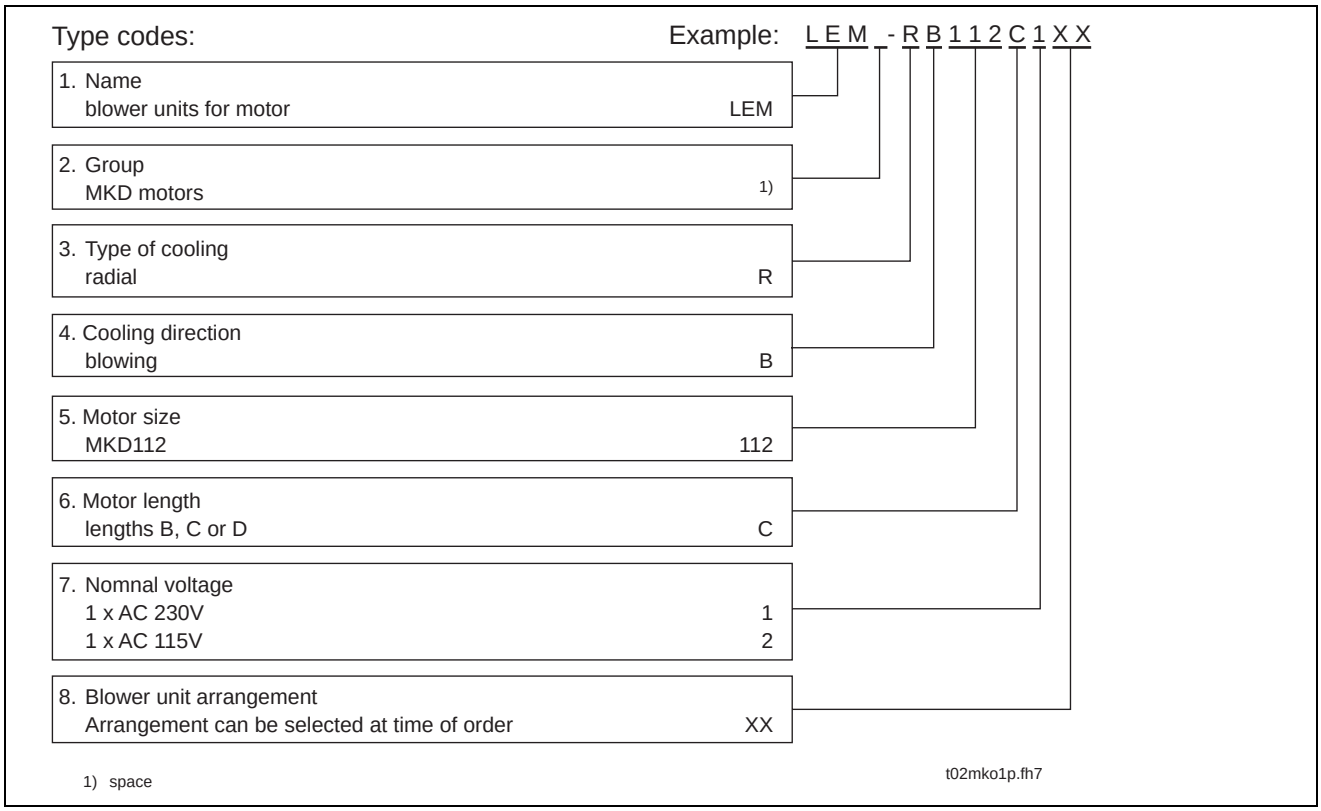


Fig. 9-18: Type codes of a radial blower unit

To purchase a motor with surface cooling device mounted it is necessary to enter the relevant, above-referenced type designations of the radial blower unit onto the order as subitem of the MKD motor noting the desired blower orientation. If the bower unit is specified as a separate order item, then it will be delivered separate of the motor, in other words, not mounted.

Order position	Designation	
1	1	digital AC motor MKD112B-048-GG0-BN
1.1	1	blower unit LEM -RB112C1-XX mounted to pos. 1 blower arranged left

Fig. 9-19: Order info for an MKD motor with attached blower unit

Order position	Designation	
1	1	digital AC motor MKD112B-048-GG0-BN
2	1	blower unit LEM -RB112C1-XX

Fig. 9-20: Order info for an MKD motor with separate blower unit

10 Condition at Delivery

10.1 General Information

The motors and accessories such as cables are packaged in cartons at delivery. Depending on the number and size of these cartons it is possible that these are secured on a pallet with metal bands. To protect against adverse weather, cartons are additionally placed over this pallet and also secured with metal bands.

10.2 Releasing the Metal Bands

CAUTION

Uncontrolled motions of the bands upon removal!
Mechanical injuries are possible.
⇒ Use caution when removing the bands!
⇒ Maintain sufficient distance!

10.3 Documents

The shipment is accompanied by only one delivery slip in a single envelope. The merchandise is listed on the slip by name and order designation. If the contents are distributed over several transport boxes or containers, then this will be specified on the delivery slip or freight papers.

The following information is on the packaging of each motor:

- type designations of the motors
- customer
- delivery slip number
- consignment number
- freight company

(See also Section „11 Identifying the merchandise “)

10.4 What is Included in the Delivery

The delivery contains:

- MKD motor
- two type plates
- packaging list with connecting accessories and customizing instructions (with motors with terminal box).

Note: The packaging list is in the terminal box.

- Blower unit (option)

Not included in the delivery:

- Accessories needed to connect to drive controllers.

Note: Standard cables do not require any connecting accessories. The connectors needed for DIAX04 drive controllers and ECODRIVES are a part of the delivery.

11 Identifying the merchandise

11.1 Delivery slip

The entire delivery is accompanied by one copy of a delivery slip which is placed in an envelope. The merchandise is listed on this slip with type and order codes and designations. If the listed contents are distributed over several transport containers or boxes, then this will be duly noted on the delivery slip or freight documentation.

11.2 Barcode stickers

There are barcode stickers on the packaging of every motor which list the following information:

- Type designation of the motor
- Customer
- Delivery slip number
- Consignment
- Freight company

The barcode sticker serves to identify the contents.

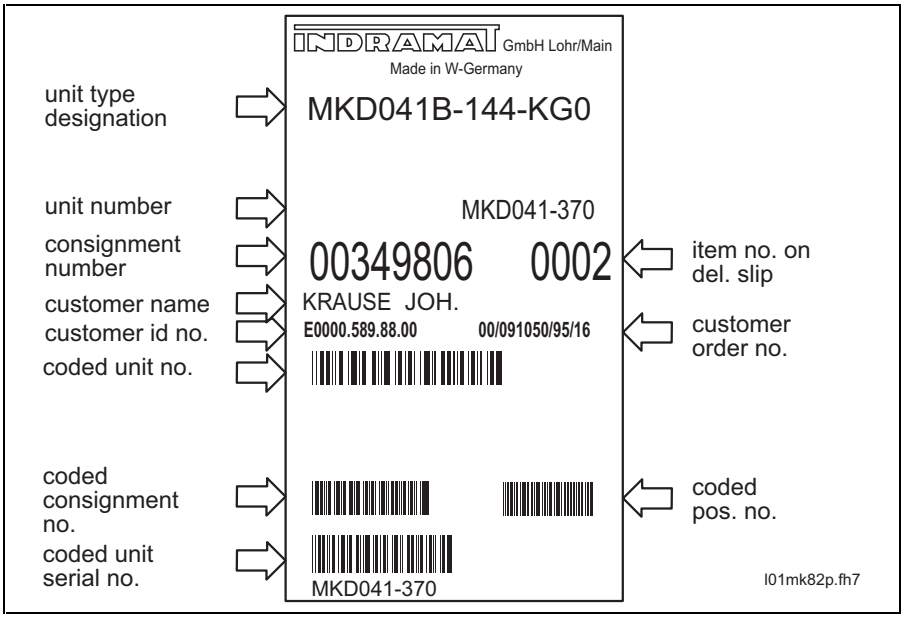


Fig. 11-1: Barcode sticker (example)

11.3 Name plate

Motors The motor is delivered with an attached name plate. This is mounted to the housing of the motor. An additional name plate is taped over the initial name plate on the motor housing with the use of a double-sided tape. This can easily be located on the machine if the original name plate on the motor is in any way obscured by a part or the contour of the machine.

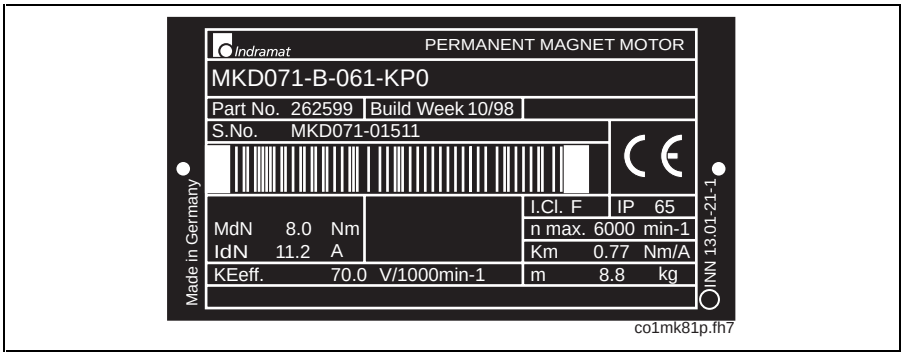


Fig. 11-2: Name plate (example)

The name plate is used to

- identify the motor
- procure a replacement in the event of a breakdown
- to supply service information.

Blower The blower unit is supplied with a rating plate. This is attached to the blower and covered with protective foil. It lists the type designation, serial number and electrical information.

Individual cable parts Type designations are printed on the sheathing of the cable.

Individual plug-in connectors Type designations are on the plastic bag.

Ready-made cables Label (at cable end) with type designation.

12 Storage, transport and handling

12.1 Notes on packaging

Instructions on storage, transportation and handling of the pieces are printed on the bag. These must be complied with.

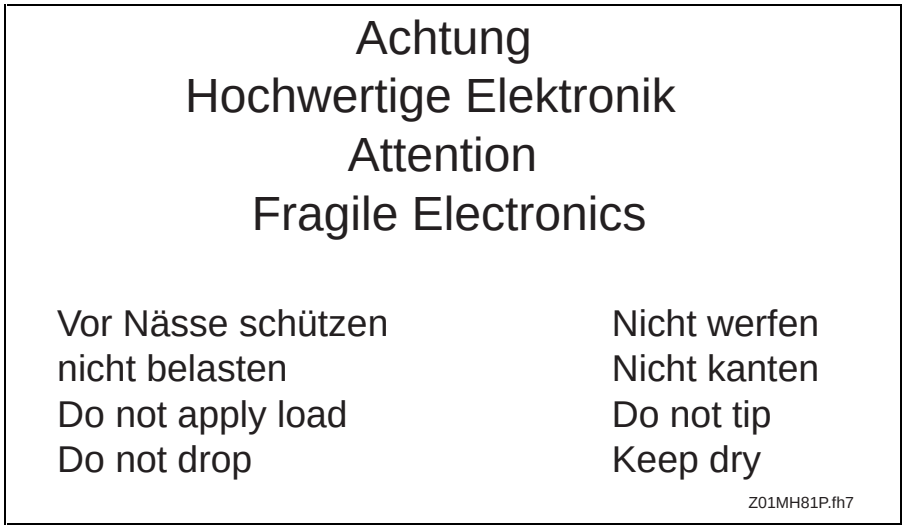


Fig. 12-1: Notes on storage, transportation and handling on the packaging

12.2 Storage

WARNING

Motor damage and guarantee forfeiture!
If the motor is not properly stored, it could be damaged. The guarantee is also forfeited in this case.
⇒ Please note the following instructions.

Maintain the following during storage:

⇒ Permissible temperature range: -20° C to +80° C.
⇒ Store motors dry, dust free and protected against vibrations/shocks.
⇒ Store motors lying down.
⇒ Do not remove the protective plastic sleeves on the housing of the connectors and motor shaft. These protect against moisture and mechanical damage.

12.3 Transportation and handling

WARNING

Motor damage and guarantee forfeiture!
Improper handling and transport can damage the motor resulting in forfeiture of guarantee.
⇒ Please note the following instructions.

Maintain the following conditions during transport and when handling:

⇒ Use suitable transportation. Take weight of component into account (weights are listed in the individual sections on the motors in the technical data or on the name plate of the motor).

⇒ Use impact resistant transport containers if vibrations or shocks could occur during transport. Note the limit data as listed in section "Maximum Vibration and Shock Demands ".

⇒ Transport in a horizontal position only.

⇒ Do not lift the motor by grasping the surface cooling unit.

⇒ Use cranes and safety belts when lifting.

⇒ With MKD112 motors, the M8 ring screws (DIN580) must be screwed into their windings on the motor housing and used when lifting with chains.

⇒ Do not damage motor flange and motor shaft!

⇒ Avoid impacts to the motor shaft.

⇒ Do not remove the protective plastic sleeves on the connector housing and motor shaft until shortly before mounting the motor.

Note: If the motor is equipped with a holding brake and was stored prior to mounting for a period longer than two years, then the holding brake must be refinished. Note the instructions in section "13.5 Refinishing the holding brake".

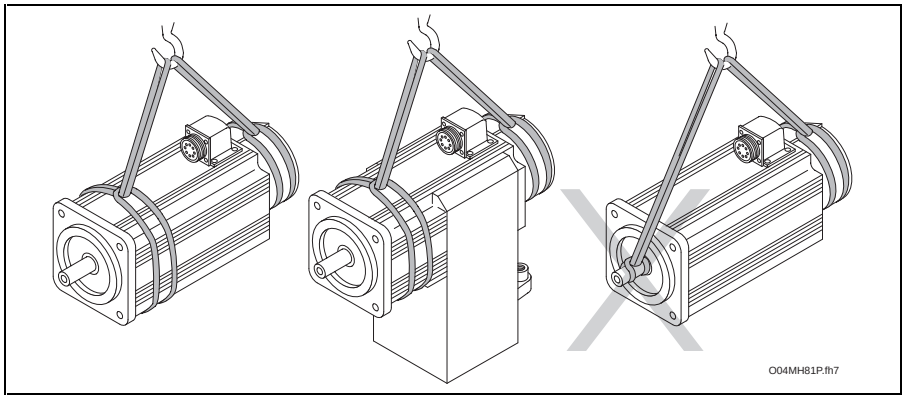


Fig. 12-2: Lifting and transporting the motor with the help of lifting belts

13 Mounting and Installation

13.1 General Information on Mounting

⇒ Please note and comply with all the warnings and safety guidelines specified in the section 2. This helps minimize accidents and avoid damage to the installation and motor.

⇒ Please follow all the instructions. This ensures proper mounting and removal of the components.

13.2 Mounting the Motor

⇒ Obtain tools, aids, measuring and testing materials.

⇒ Check whether the motor to be mounted has been stored for more than two years. If it has, then please read section "13.5„ before proceeding with the steps outlned below.

⇒ Check to make sure that all components are clean.

⇒ Check whether the components have any visible damage. Damaged components may not be mounted.

⇒ Mounting should take place in a dry, dust-free environment.

⇒ Make sure that the motor flange has no burrs before mounting.

⇒ Mount the motor. All dimensions and tolerances of the machine must be maintained. Relevant data is listed in the section "MKD ...", subsection "Dimensional data".

⇒ If the motor is equipped with a "resolver feedback" then note when placing the reference point switches that over the course of a complete motor revolution several zero pulses are generated. This is due to the basic principle of the resolver itself. (Also see section Motor feedback“).

⇒ If the motor is equipped with a "resolver feedback with integrated multiturn absolute encoder" make sure that the battery of the feedback electronics is functional. Empty batteries must be properly recycled. If it must be replaced, then proceed as outlined.

13.3 Connecting the Motor

Once the motor has been mechanically mounted, then connect it.

DANGER

Danger to life due to electric voltage!

Moving or working within the area of voltage-conducting parts is dangerous. Therefore:

⇒ Only trained personnel may work on the machine and they must use the proper tools.

⇒ The installation must be shutdown before anyone proceeds with any work and the mains switch secured against unintentional or deliberate switch ons.

⇒ Before starting work, using suitable measuring equipment to check to see whether there is any residual voltage anywhere within the installation, e.g., due to capacitors, etc. Wait until they have discharged.

WARNING

Personnel injury or property damage possible!

Interrupting or breaking voltage-conducting lines can lead to unpredictably dangerous situations or property damages. Therefore:

⇒ plug-in connectors may only be inserted or removed if dry.

⇒ While the installation is up and runnng, all plug-in connectors must be firmly in place.

WARNING

Danger of shorts due to coolants or lubricants

A short circuit in voltage-conductive lines can trigger unpredictably dangerous situations or damage property. Therefore:

⇒ Open sockets should be capped during installation or when replacing drive components especially in the presence of lubricants or coolants.

The terminal diagrams from INDRAMAT exclusively support the generation of terminal circuits!

⇒ Connect the motor as specified in the circuit diagrams of the manufacturer of the machine. The terminal diagrams in section 4.2 or 4.3 can be used as a help.

⇒ Note the following sections when mounting the cables.

Mounting Standard Cables to Motors with Terminal Boxes

WARNING

Damage to terminal box or cables!

Tightening torque too high could damage screws or pinch cables. If screw mounts are damaged, then protection category IP 65 of the terminal box can no longer be guaranteed!

⇒ Therefore do not use automatic screwdrivers such as AT electronic, pneumatic or hydro screwdrivers!

If the motor has a terminal box then it is necessary to use those cables that correspond to standard INDRAMAT cables. Mount the cables in the order illustrated below:

⇒ Remove the terminal box lid (1) by removing screws (7).

⇒ Remove parts (2) to (5) by unscrewing screws (6).

⇒ Pull out connectors X1 and X2 from the motor connecting panel.

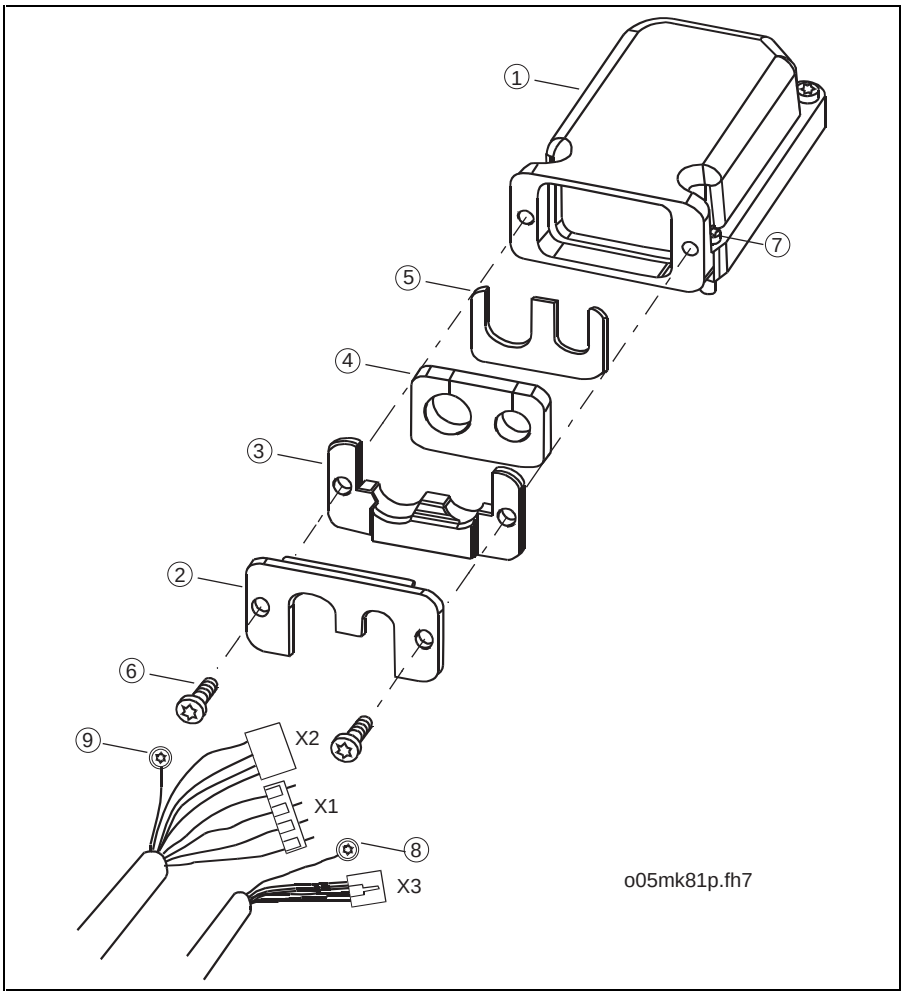


Fig. 13-1: Explosion designations of the terminal box

⇒ Mount support sheet (5), seal (4) and pressure pieces (3) and (2) around the cable.

⇒ Pull the cable ends through the opening of the terminal box (see Fig. 13-1) and slightly screw in screws (6) of the cable leadthrough.

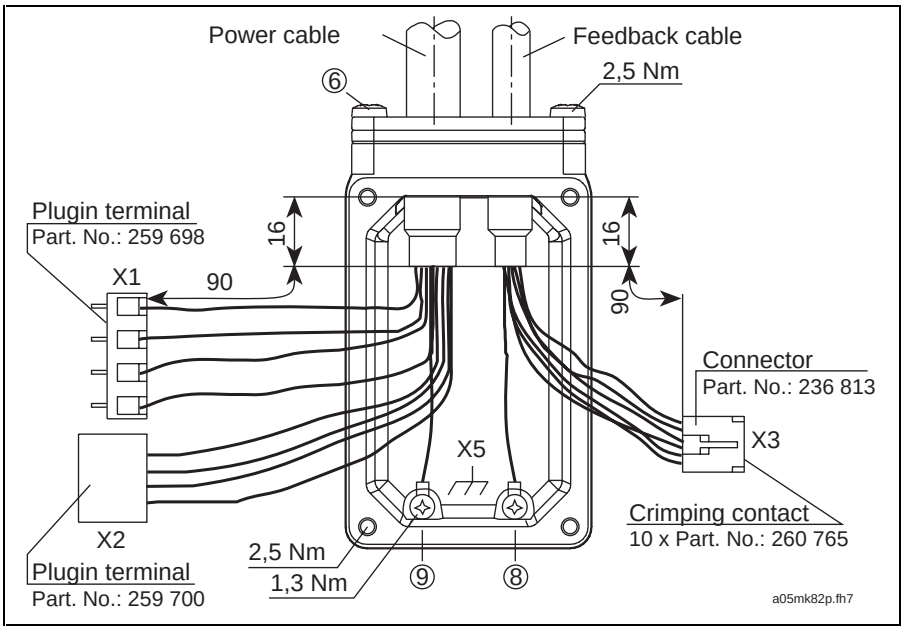


Fig. 13-2: Pulling power and feedback cables through

⇒ Pull the cable back to the point where the shrink sleeve penetrates the inside of the terminal box by about 16 mm (see Fig. 13-2).

⇒ Tighten screws (6) with 2.5 Nm.

⇒ Tighten grounding ring terminals (8) and (9) with 1.3 Nm to terminal box lid (1).

⇒ Insert X1, X2 and feedback connector X3 into their positions on the motor panel.

⇒ Secure X1 with 4 screws against loosening.

⇒ Place the terminal box with desired cable output direction back into place.

⇒ Make sure that no cable cores are pinched or damaged and then screw terminal box into place with 2.5 Nm.

Changing Cable Output Direction in Motors with Terminal Boxes

The terminal box lid can be turned 180° when it is mounted. This means that the cable output direction can be set to

- side A or
- side B.

Note: The cable output direction at the time of delivery is side B.

The cable output direction can be selected when mounting standard power and feedback cables (see Mounting Standard Cables to Motors with Terminal Boxes).

Connecting Standard Cables to Motors with Plug-in Connectors

Power Cables

Connecting power connectors to MKD025B

When connecting power connector INS0681 with thread, please note the following:

⇒ Place power connector to the thread of the connector housing into the correct position.

⇒ Manually pull over the power connector nut. Once the cable has been pulled through, then the power connector can be gradually brought into its final position.

⇒ Tighten the nut "by hand".

Connecting power connector on MKD112

When connecting power connectors INS0381 or INS0481, these have a bayonet connector, proceed as follows:

⇒ Place the power connector on the bayonet thread of the connector housing into the correction position.

⇒ Turn the nut of the power connector by hand until it clicks into the end position (note the red dot and the red triangular that should, upon clicking, be opposite each other).

Feedback cable

Connecting the feedback connector

Proceed as follows to connect feedback connectors:

⇒ Place the feedback connector to the thread of the housing in the correct position.

⇒ Tighten the nut of the feedback connector manually. By pulling the cable gradually through, it is possible to bring the feedback connector into its correct position.

⇒ Manually tighten the nut.

Changing the Direction of the Power and Feedback Connections

Power connector

Changing the connector output direction MKD025B

The output direction of the power connectors of MKD025B motors can be selected at the time of mounting. The flanged sockets can be turned. They have a rotational range of 270°.

Described below is the way to set the desired cable output direction.

Note: Do not use any tools, e.g., pliers or screwdrivers, when turning the flanged socket of the motor. This could damage it

---

This piece can be easily turned if a relevant connector has been mounted. The lever effect of the mounted connector means that the flanged socket can be manually placed into the position wanted.

Procedure:

⇒ Motor power cable must be connected to flange socket.

⇒ Move flanged socket into the output direction wanted by turning the connected connector.

The desired direction is now set.

Note: Each turning of the flanged socket decreases the holding torque of the position which has been set. To ensure the required torque, however, the cable output direction should be changed a maximum of five (5) times!

A „reconstruction“ (removal and mounting of the flanged socket by 90°) of the flanged socket is unnecessary. The following problems and risks could result:

- The seals of the O rings between the flanged socket and the motor housing is no longer guaranteed.
- The prescribed tightening torques might not be maintained.
- The TFL coating (secure screws) of the mounting screws is worn down by screwing in and out and it then no longer effective.

Note: **Guarantee is forfeited!**

If the cable direction is altered as a result of **„Reconstruction“,** then the guarantee is forfeited for the entire drive system. Change the cable direction only by turning the flanged socket.

Changing the cable output direction on an MKD112

If the cable output direction of the power connector for MKD112 motors is not taken into account when the order is placed and then does not agree with the direction that is needed, then it can be turned by 90°.

Proceed as follows:

⇒ Slacken the two mounting screws 4 and remove terminal box lid 2.

⇒ Release the four mounting screws 3.

⇒ Turn the connector housing 1 into the desired position (in increments of 90°).

⇒ Note that no cable core is damaged or unnecessarily stretched. Use the opening created by the removal of the terminal box lid 2.

⇒ Retighten the four screws 3 (tightening torque 3.1 Nm ±10%).

⇒ Note that neither cable cores nor seals are damaged.

⇒ Remount terminal box lid 2 onto connector housing 1 and retighten screws 4 (tightening torque 3.1 Nm ±10%).

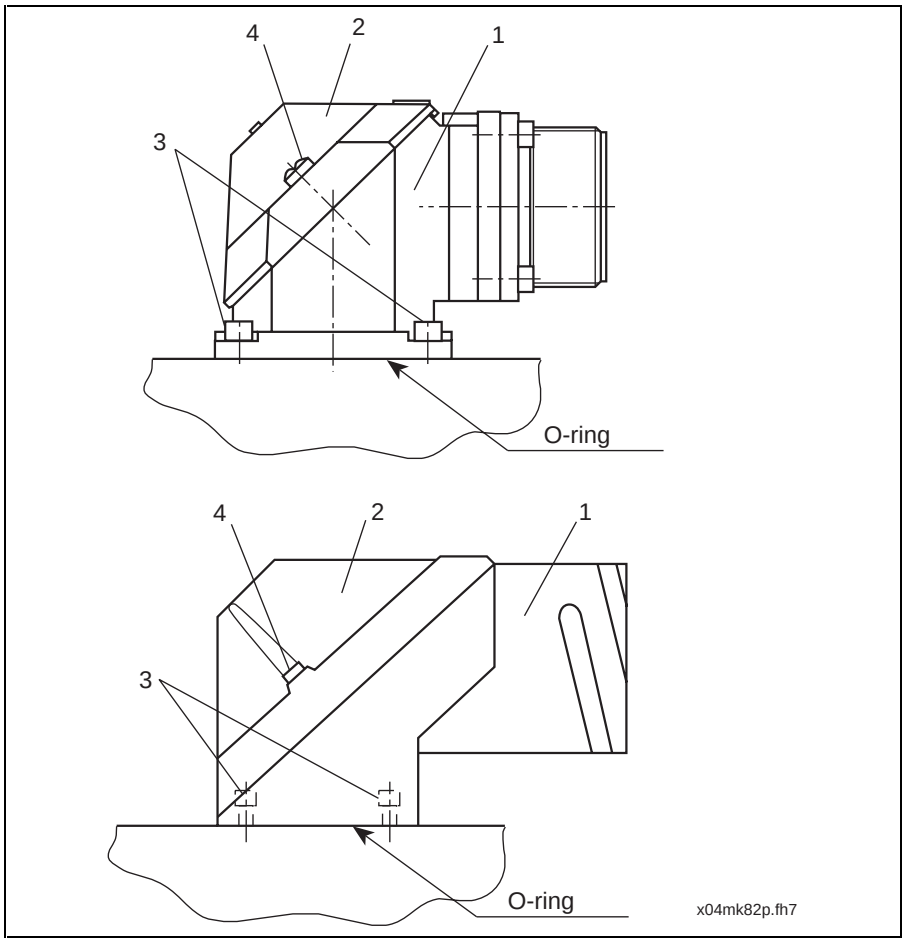


Fig. 13-3: Turning the power connector

Note: The connector output direction can be selected using the relevant type codes at the time the order is placed.

Feedback connector

Changing the connector output direction on an MKD025B

It is possible with the MKD025B motors to select the output direction. The flanged sockets can be turned with a range of 270°.

How to set the direction is described below.

Note: Do not use any tools, e.g., pliers or screwdrivers, when turning the flanged socket of the motor. This could damage it.

The motor flange can be easily turned if a connector is mounted. The lever effect of it means that the flanged socket can be manually moved into the desired direction.

Procedure:

⇒ Connect feedback cable to flanged socket.

⇒ Move socket into wanted position by turning the connected cable.

The desired direction is now set.

Note: Each turning of the flanged socket decreases the holding torque of the position which has been set. To ensure the required torque, however, the cable output direction should be changed a maximum of five (5) times

A „reconstruction“ (removal and mounting of the flanged socket by 90°) of the flanged socket is unnecessary. The following problems and risks could result:

- The seals of the O rings between flanged socket and motor housing is no longer guaranteed.
- The prescribed tightening torques might not be maintained.
- The TFL coating (secure screws) of the mounting screws is worn down by screwing in and out and it then no longer effective.

Note: **Guarantee is forfeited!**

If the cable direction is altered as a result of **„Reconstruction“,** then the guarantee is forfeited for the entire drive system. Change the cable direction only by turning the flanged socket.

Changing the cable output direction on an MKD112

If the cable output direction of the angled feedback connector in an MKD112 motor does not agree with the desired direction, then it can be turned by 90° increments. Proceed as follows:

⇒ Release the four mounting screws on the top of the connector.

⇒ Turn the part of the connector with nut into position wanted in increments of 90°.

⇒ Retighten the mounting screws with a tightening torque of 0.8 Nm ±10%.

⇒ Make sure that no cable strand of seal are damaged when retightening the screws.

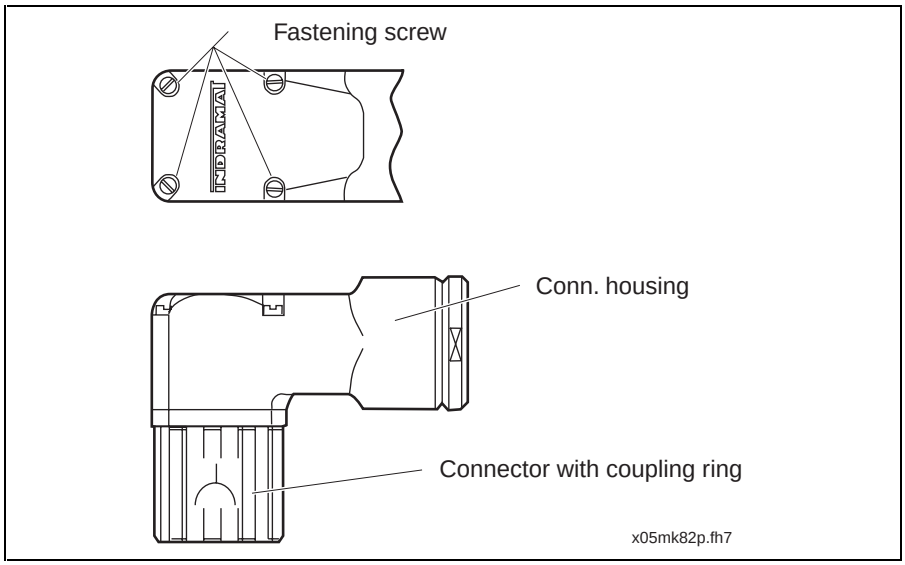


Fig. 13-4: Connector parts of an angle feedback connector

Note: If an application has high vibration or shock loads then secure the feedback connector with a screw bonding substances.

13.4 Connecting and Mounting Blower Connector

Electrical connections

The connecting cable should have three strands with a minimum cross section of 0.75 mm^2.

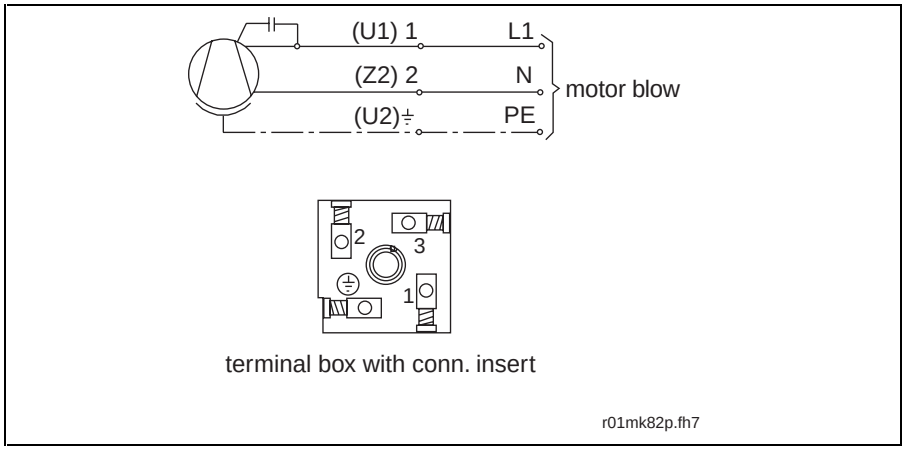


Fig. 13-5: Blower connecting schematics

Procedure on mounting the connecting cable to the blower connector:

⇒ release conduit thread 6 (SW 17).

⇒ remove cylinder screw 1 with screwdriver 5 from socket 4.

⇒ pull housng 2 with connector insert 3 out of socket 4.

⇒ pull out screw 1.

⇒ pull insert 3 with screwdriver 5 out (see Fig. 13-6) of connector housing 2.

⇒ push conduit thread 6, ring 7, seal 8 and connector housing 2 onto connecting cable (3 x 0.75 mm^2).

⇒ strip exterior cable sheath back by about 20 mm, the litz wires by about 10 mm and connect to connector insert 3 as per schematics above.

⇒ pull connector insert 3 into connector housing 2, insert cylinder screw 1, screw connector on socket 4.

⇒ tighten conduit thread 6, not strain relief.

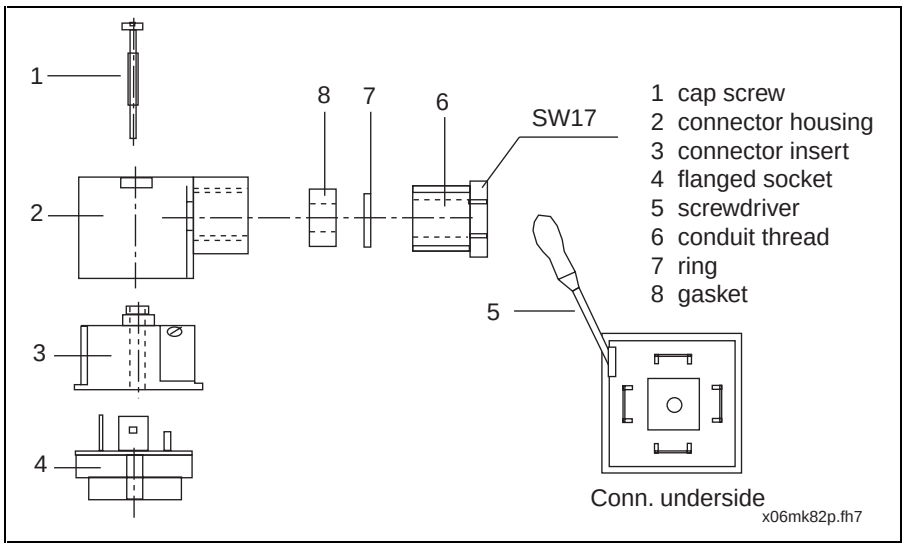


Fig. 13-6: Mounting the connecting cable of the blower connector

13.5 Refinishing the holding brake

Note: Premature wear of the holding brake is possible! The holding brake wears down after about 20,000 motor revolutions when in a closed state. Therefore, please note the following instructions.

To ensure a flawless functioning of the holding brake check the holding torque of the brake prior to installation.

If the holding torque specified in the data sheets is not obtained, then the brake must be re-ground.

To grind the holding brakes it is necessary to remove all connections between motor and drive controllers (power and feedback cables).

⇒ Make sure that the motor is not electrically connected to the drive controller.

⇒ Turn the motor shaft in contrast to the motor housing when the holding brake is closed. Do so manually about 50 times.

The holding brake is now ready to operate.

14 Service Guidelines

14.1 Replacing the battery

⇒ If the motor is equipped "with integrated multiturn absolute encoder" then include the battery of the feedback electronics into the maintenance program. Nominal lifespan of the battery is approximately ten years.

How to change the battery

⇒ Have the following tools and aids ready:

- torx screwdriver (size 10), pointed pliers, torque key with setting range 1.8 Nm .
- New battery (INDRAMAT part no. 257 101).

DANGER

Danger from electrical voltage!
Battery replacement must be performed while the control voltage is on. Therefore:

⇒ Only fully-trained electricians may conduct the work.

⇒ Power supply to drive controllers must be switched off and secured against being switched back on!

DANGER

Dangerous movements!
Danger to life and limb or property damage!

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

⇒ Batteries can only be replaced with control voltage to the drive controllers on. If the control voltage is switched off while the battery is removed, then the absolute dimension will be lost causing faulty movements when the machine is switched back on.

Removing the battery

⇒ Release torx screws (1) with a size 10 screwdriver and pull out.

⇒ Remove the lid of the motor feedback.

⇒ Pull the connector of the battery (2) out.

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

Mounting the battery

⇒ Insert battery (part no. 257 101) and screw clamping device (4) back into place with screws (3) (tightening torque max. 1.0 Nm).

Note: Do not pinch the battery cable!

⇒ Insert battery connector (2).

⇒ Close the motor feedback lid.

⇒ Tighten torx screws (1) and tighten with the torque key at 1.4 Nm in the MKD025 and 041, to 3.0 Nm in the MKD071, 090 and 112.

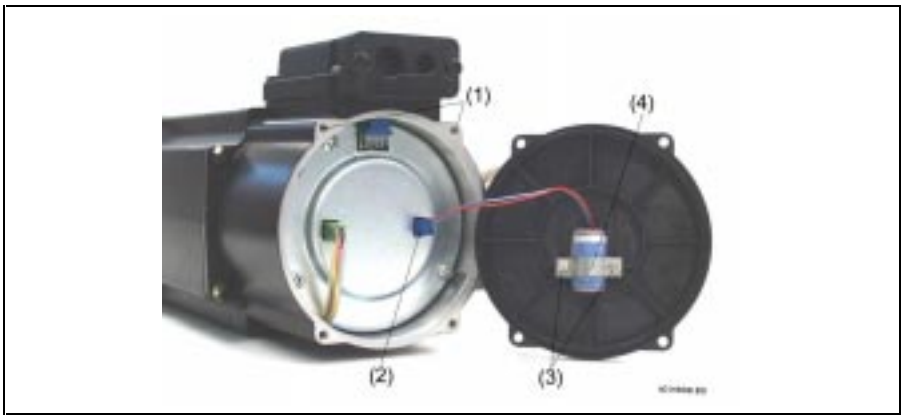


Fig. 14-1: Replacing the battery

Switching machine back on

⇒ Switch power of drive controllers back on.

⇒ Run a test on the axes.

14.2 Maintenance

The following should be performed within the first year and then regularly:

- remove dust, chips and similar types of dirt from the motor,
- check any given motor blowers of the surface cooling unit
- and the air circulation of any existing surface cooling as well.

14.3 Contacting Customer Service

Our Service Hotline is at your disposal for quick and effective assistance.

⇒ Before calling, please make a note of ...

- the type designations of the respective drive controllers and motors,
- the problem and the
- fault and diagnostics displays (if given).

Our Service Hotline can be reached:

Mondays - Friday	7 a.m. to 11 p.m. CET
Saturdays	8 a.m. to 8 p.m. CET
Sundays and holidays	9 a.m. to 7 p.m. CET

at the following telephone numbers:

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

⇒ If it is necessary to send motors back, then please copy the following fault report, fill it out and include it in the return shipment.

⇒ Make a copy of the completed fault report, include it so that the user of the machine can access it if needed.

This will facilitate the repair and expedite the elimination of your problems.

14.4 Fault report

See next page.

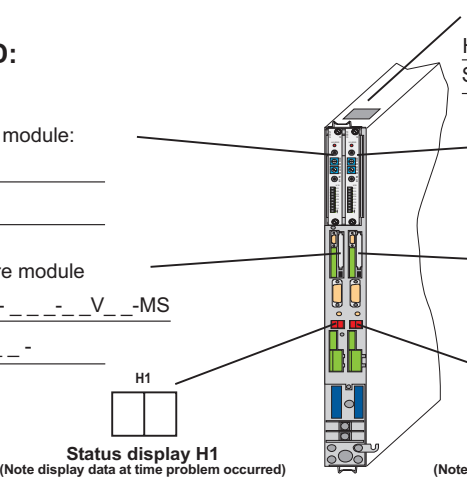
Indramat

Fault Report
for DIAX04 Units

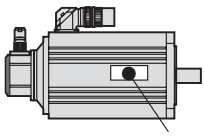
This report is intended to clarify problems and their causes. It is absolutely necessary in order to find hidden, sporadic or application-related problems and to eliminate them.
- Always include fault report when sending in repairs.
- Otherwise mail fault reports to your local INDRAMAT representative or to the address printed on the reverse.
INDRAMAT appreciates your cooperation.

Fault report from:	Co.:	Loc.:	Tele.:
	Dept.:	Name:	Date:

Data on HDD:

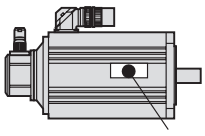


Motor data:



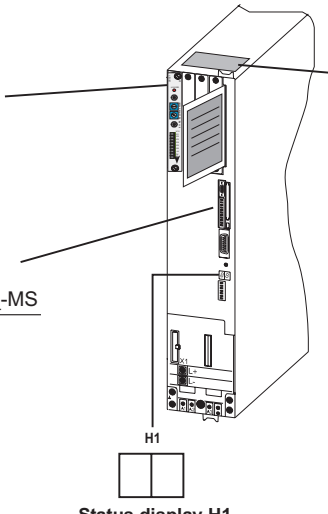
Motor type::
Serial no.

Motor data:

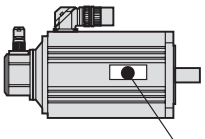


Motor type:
Serial no.:

Data on HDS:



Motor data:



Motor type: MHD
Serial no:

Please note back of page!

u01mh81p.fh7

Indramat GmbH • Bgm.-Dr.-Nebel-Straße 2 • D-97816 Lohr • Telefon 09352 / 404-0 • Tx 689 421 • Fax 09352 / 404-885

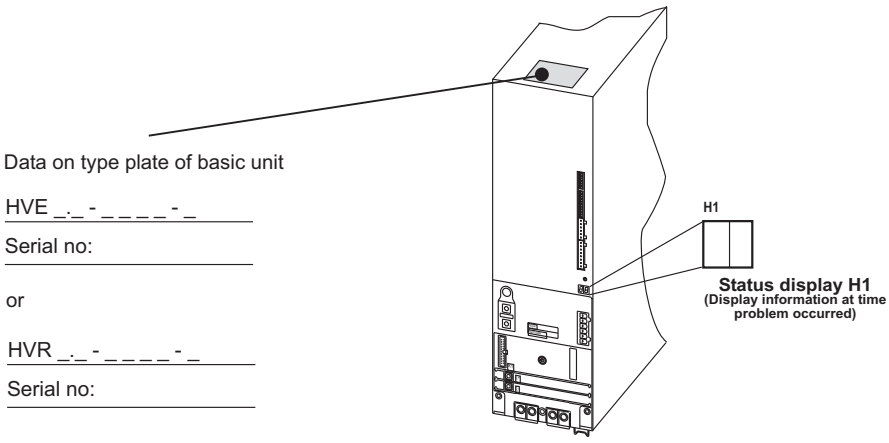
Fig. 14-2: Fault Report - Page 1

Indramat

Fault Report
for DIAX04 Units

Page 2

Data on HVE or HVR:



Data on type plate of basic unit

HVE _._ - _ _ _ _ - _

Serial no:

or

HVR _._ - _ _ _ _ - _

Serial no:

Data on machine with problem:

Type: _____ Oper. hrs.: _____ Where problem: _____

Machine number: _____ Comm. date _____

Number of drives _____

In which axis did the problem take place: _____ -axis

Explain the problem:

Additional data:

Problem:	Cause:	Other problems	
☐ is constantly present ☐ at commissioning ☐ sporadically present ☐ occurs after ☐ hrs. ☐ occurs with shocks ☐ is temperature-dep.	☐ unknown ☐ conn. error ☐ external causes ☐ mechanical damage ☐ lose line connection ☐ moisture in unit ☐ foreign object in unit	☐ Problem in mechanics ☐ mains failures ☐ control failure ☐ motor failure ☐ cable break ☐ defective blower ☐ defective feedback	Have there previously been problems with this axis? How often _____ Did problems occur on certain days or times of the day?

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Fig. 14-3: Fault Report - Page 2

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R

S

T

16 Kundenbetreuungsstellen - Sales & Service Facilities

Deutschland – Germany

vom Ausland: (0) nach Landeskennziffer weglassen!!
from abroad: don't dial (0) after country code!

Vertriebsgebiet Mitte ☒ SALES Germany Centre ☒ Service INDRAMAT GmbH Bgm.-Dr.-Nebel-Str. 2 D - 97816 Lohr am Main Telefon: +49 (0)9352/40-0 Telefax: +49 (0)9352/40-4885	Vertriebsgebiet Ost ☒ SALES Germany East ☒ Service INDRAMAT GmbH Beckerstraße 31 D - 09120 Chemnitz Telefon: +49 (0)371/35 55-0 Telefax: +49 (0)371/35 55-333	Vertriebsgebiet West ☒ SALES Germany West ☒ Service Mannesmann Rexroth AG Vertrieb Deutschland Regionalzentrum West Borsigstrasse 15 D - 40880 Ratingen Telefon: +49 (0)2102/409-0 Telefax: +49 (0)2102/409-406	Vertriebsgebiet Nord ☒ SALES Germany North ☐ Service INDRAMAT GmbH Kieler Straße 212 D - 22525 Hamburg Telefon: +49 (0)40/85 31 57-0 Telefax: +49 (0)40/85 31 57-15
Vertriebsgebiet Süd ☒ SALES Germany South ☐ Service INDRAMAT GmbH Ridlerstraße 75 D-80339 München Telefon: +49 (0)89/540138-30 Telefax: +49 (0)89/540138-10 indramat.mue@t-online.de	Gebiet Südwest ☒ SALES Germany South-West ☒ Service INDRAMAT GmbH Böblinger Straße 25 D-71229 Leonberg Telefon: +49 (0)7152/9 72-6 Telefax: +49 (0)7152/9 72-727	Vertriebsgebiet Mitte ☒ SALES Germany Centre ☐ Service Mannesmann Rexroth AG Geschäftsbereich INDRAMAT Lillistraße 14-18 D – 63067 Offenbach Telefon: +49 (0) 62/82 00 90-0 Telefax: +49 (0) 62/82 00 90-80	Vertriebsgebiet Nord ☒ SALES Germany North ☐ Service Mannesmann Rexroth AG Vertriebsniederlassung Region Nord Geschäftsbereich INDRAMAT Schützenstraße 20 D – 30853 Langenhagen Telefon: +49 (0) 511/72 66 57-0 Telefax: +49 (0) 511/72 66 57-93
			INDRAMAT Service-Hotline INDRAMAT GmbH Telefon: +49 (0)172/660 04 06 oder/or Telefon: +49 (0)171/333 88 26 Hotline ERSATZTEILE: - nur an Werktagen von 15 -18 Uhr - +49 (0) 93 52/40 42 22

Kundenbetreuungsstellen in Deutschland - Service agencies in Germany

Europa – Europe

vom Ausland: (0) nach Landeskennziffer weglassen, 0 nach Landeskennziffer mitwählen!
from abroad: don't dial (0) after country code, dial 0 after country code!

Austria ☒ SALES ☐ Service

Mannesmann Rexroth Ges.m.b.H.
Geschäftsbereich INDRAMAT
Hägelingasse 3
A - 1140 Wien

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Telefax: +43 (0)1/9852540-93

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e-mail: indramat@hydraudyne.nl

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