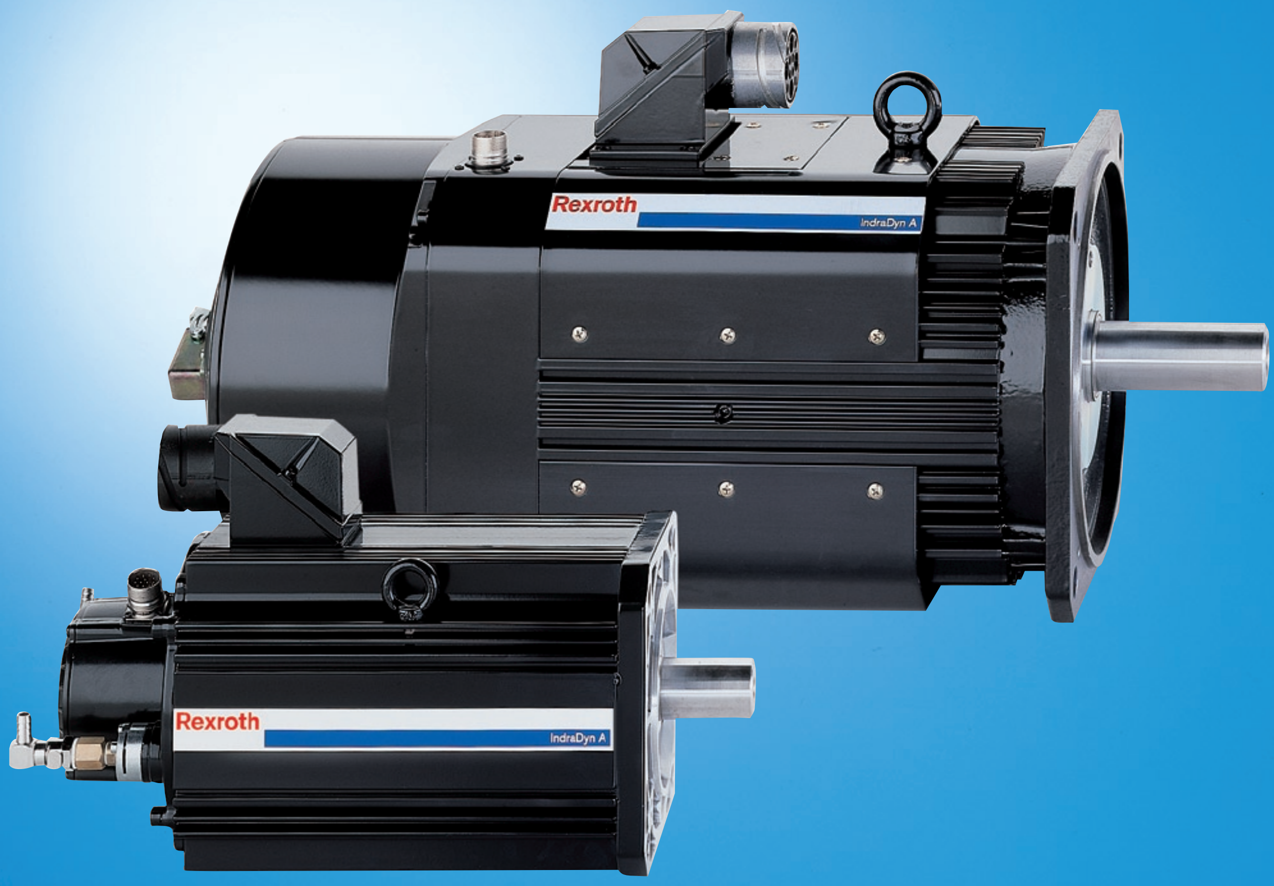
Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth Bosch Group

# Rexroth IndraDyn A Asynchronous Motors MAD / MAF

**R911295781**
Edition 06

**Project Planning Manual**



**Title** Rexroth IndraDyn A
Asynchronous Motors MAD / MAF

**Type of Documentation** Project Planning Manual

**Document Typecode** DOK-MOTOR*-MAD/MAF****-PR06-EN-P

**Internal File Reference** RS-217b481c84cf5c230a6846a001447b0d-4-en-US-6

**Purpose of Documentation** This documentation…

- explains product features and applications, technical data as well as conditions and limits for operation and
- provides information regarding product selection, handling and operation.

**Record of Revision**

| Edition | Release Date | Notes |
|---|---|---|
| DOK-MOTOR*-MAD/MAF****-PR01-EN-P | 09/2003 | 1. Version |
| DOK-MOTOR*-MAD/MAF****-PR02-EN-P | 10/2004 | 2. Version |
| DOK-MOTOR*-MAD/MAF****-PR03-EN-P | 05/2006 | 3. Version |
| DOK-MOTOR*-MAD/MAF****-PR04-EN-P | 03/2008 | 4. Version |
| DOK-MOTOR*-MAD/MAF****-PR05-EN-P | 06/2008 | 5. Version |
| DOK-MOTOR*-MAD/MAF****-PR06-EN-P | 08/2008 | 6. Version |



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**Published by** Bosch Rexroth AG

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# 1 Introduction to the Product

## 1.1 General Information

The Rexroth motor generation **IndraDyn A** consists of asynchronous box motors with squirrel-cage rotor and it is available as

- **MAD series** with surface ventilation by solidly connected fan unit.


*Fig.1-1: Exemplary illustration MAD130*

- **MAF series** with liquid cooling


*Fig.1-2: Exemplary illustration MAF130*

IndraDyn A motors provide high permanent performance at compact dimensions and can be used as main and servo drives for all rotary driving tasks.

The optimized design with safety class IP65 for motor and fan allows for operation in adverse conditions. Easy-to-service design reduces maintenance frequency and allows for maintenance works during operation.

Furthermore, IndraDyn A motors in **ATEX design** can be used in certain explosive areas under certain preconditions. For this, the special notes on these motors in chapter 13 "Motors in Ex-pd Design for Explosive Areas" on page

319 and chapter 14 "Motors in Ex-nA Design for Explosive Areas" on page 333 have to be observed in particular.

Combined with control devices from the Rexroth IndraDrive series, this results in intelligent drive solutions with a high power density and open functions.

# 1.2 About this Documentation

## 1.2.1 Document Structure

This documentation includes safety regulations, technical data and operating instructions. The following table provides an overview of the contents of this documentation.

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*Fig. 1-3: Chapter structure*

## 1.2.2 Additional Documentation

For project planning your drive systems with motors of the IndraDyn A series you will possible need additional documentation, according to the devices used. Rexroth provides for the overall product documentation in the Bosch Rexroth media directory athttp://www.boschrexroth.com/various/utilities/mediadirectory/index.jsp in PDF format.

### 1.2.3 Additional Components

Documentation for external systems which are connected to Bosch Rexroth components are not included in the scope of delivery and must be ordered directly from the corresponding manufacturers.

You will find notes on the manufacturers in the corresponding chapters of this documentation.

### 1.2.4 Your Feedback

Your experiences are an essential part of the process of improving both the product and the documentation.

Please do not hesitate to inform us of any mistakes you detect in this documentation or of any modifications you might desire. We would appreciate your feedback.

Please send your remarks to:

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### 1.2.5 Standards

This documentation refers to German, European and international technical standards. Documents and sheets on standards are subject to copyright protection and may not be passed on to third parties by Rexroth. If need be, please contact the authorized sales outlets or, in Germany, directly:

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# 2 Important Instructions on Use

## 2.1 Intended Use

### 2.1.1 Introduction

Rexroth products are developed and manufactured in accordance with the corresponding state of the art. Before they are delivered, they are inspected to ensure that they operate safely.

The products may only be used in the proper manner. If they are inappropriately used, situations may arise that result in damage to material and personnel.

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☞ Regarding damages caused by inappropriate use of the product, Bosch Rexroth, as the manufacturer, does not provide any warranty, assume any liability or pay any damages. Any risks resulting from the products not being used as intended are the sole responsibility of the user.

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Before using Bosch Rexroth products, the following prerequisites have to be fulfilled to ensure that they are used as intended:

- Everyone who in any way deals with one of our products must read and understand the corresponding notes regarding safety and regarding the intended use.
- If the products are hardware, they must be kept in their original state, i.e. no constructional modifications must be made. Software products must not be decompiled; their source codes must not be modified.
- Damaged or improperly working products must not be installed or put into operation.
- It must be ensured that the products are installed according to the regulations specified in the documentation.

### 2.1.2 Areas of Use and Application

Rexroth IndraDyn A series asynchronous motors are designed to be used as rotary main and servo drive motors. The following are typical fields of application:

- Machine tools
- Printing and paper-processing machines
- Packaging and food-processing machines
- Metal-forming machines.

Unit types with different driving powers and different interfaces are available for an application-specific use of the motors.

Controlling and monitoring of the motors may require connection of additional sensors and actuators.

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☞ The motors may only be used with the accessories specified in the documentation. Components that are not explicitly mentioned must neither be attached nor connected. The same holds true for cables and lines.

Operation may be carried out only in the explicitly mentioned configurations and combinations of the component and with the software and firmware specified in the corresponding functional description.

---

Any connected drive controller must be programmed before startup in order to ensure that the motor executes the functions specific to the particular application.

The motors may only be operated under the assembly, mounting and installation conditions, in the normal position, and under the environmental conditions (temperature, protection class, humidity, EMC, and the like) specified in this documentation.

## 2.2 Inappropriate Use

Any use of the motors outside of the fields of application mentioned above or under operating conditions and technical data other than those specified in this documentation is considered to be ”inappropriate use”.

IndraDyn A motors may not be used if:

- They are subject to operating conditions which do not comply with the ambient conditions described above. For example, they must not be operated under water, under extreme temperature fluctuations or extreme maximum temperatures.
- The intended fields of application have not been expressly released for the motors by Rexroth. For this, it is important to observe the statements in the general safety instructions as well as the details in chapters 13 and 14 for explosion protection of the motors.

# 3 Safety Instructions for Electric Drives and Controls

## 3.1 Safety Instructions - General Information

### 3.1.1 Using the Safety Instructions and Passing them on to Others

Do not attempt to install or commission this device without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with the device. If you do not have the user documentation for the device, contact your responsible Bosch Rexroth sales representative. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the device.

If the device is resold, rented and/or passed on to others in any other form, these safety instructions must be delivered with the device in the official language of the user's country.

WARNING

**Improper use of these devices, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, may result in material damage, bodily harm, electric shock or even death!**

Observe the safety instructions!

### 3.1.2 How to Employ the Safety Instructions

Read these instructions before initial commissioning of the equipment in order to eliminate the risk of bodily harm and/or material damage. Follow these safety instructions at all times.

- Bosch Rexroth AG is not liable for damages resulting from failure to observe the warnings provided in this documentation.
- Read the operating, maintenance and safety instructions in your language before commissioning the machine. If you find that you cannot completely understand the documentation for your product, please ask your supplier to clarify.
- 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 device.
- Only assign trained and qualified persons to work with electrical installations:
  - Only persons who are trained and qualified for the use and operation of the device may work on this device or within its proximity. The persons 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 must be trained, instructed and qualified to switch electrical circuits and devices on and off in accordance with technical safety regulations, to ground them and to mark them according to the requirements of safe work practices. They must have adequate safety equipment and be trained in first aid.
- Only use spare parts and accessories approved by the manufacturer.

- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
- The devices have been designed for installation in industrial machinery.
- The ambient conditions given in the product documentation must be observed.
- Only use safety-relevant applications that are clearly and explicitly approved in the Project Planning Manual. If this is not the case, they are excluded. Safety-relevant are all such applications which can cause danger to persons and material damage.
- The information given in the documentation of the product with regard to the use of the delivered components contains only examples of applications and suggestions.

  The machine and installation manufacturer must
  - make sure that the delivered components are suited for his individual application and check the information given in this documentation with regard to the use of the components,
  - make sure that his application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
- Commissioning of the delivered components is only permitted once it is sure that the machine or installation in which they are installed complies with the national regulations, safety specifications and standards of the application.
- 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 section on EMC in the respective documentation (Project Planning Manuals of components and system).

  The machine or installation manufacturer is responsible for compliance with the limiting values as prescribed in the national regulations.
- Technical data, connection and installation conditions are specified in the product documentation and must be followed at all times.

*National regulations which the user must take into account*

- European countries: according to European EN standards
- United States of America (USA):
  - National Electrical Code (NEC)
  - National Electrical Manufacturers Association (NEMA), as well as local engineering regulations
  - regulations of the National Fire Protection Association (NFPA)
- Canada: Canadian Standards Association (CSA)
- Other countries:
  - International Organization for Standardization (ISO)
  - International Electrotechnical Commission (IEC)

### 3.1.3 Explanation of Warning Symbols and Degrees of Hazard Seriousness

The safety instructions describe the following degrees of hazard seriousness. The degree of hazard seriousness informs about the consequences resulting from non-compliance with the safety instructions:

| Warning symbol | Signal word | Degree of hazard seriousness acc. to ANSI Z 535.4-2002 |
|---|---|---|
| | Danger | Death or severe bodily harm will occur. |
| | Warning | Death or severe bodily harm may occur. |
| | Caution | Minor or moderate bodily harm or material damage may occur. |

*Fig.3-1: Hazard classification (according to ANSI Z 535)*

## 3.1.4 Hazards by Improper Use

DANGER

**High electric voltage and high working current! Risk of death or severe bodily injury by electric shock!**

Observe the safety instructions!

DANGER

**Dangerous movements! Danger to life, severe bodily harm or material damage by unintentional motor movements!**

Observe the safety instructions!

WARNING

**High electric voltage because of incorrect connection! Risk of death or bodily injury by electric shock!**

Observe the safety instructions!

WARNING

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

Observe the safety instructions!

CAUTION

**Hot surfaces on device housing! Danger of injury! Danger of burns!**

Observe the safety instructions!

CAUTION

**Risk of injury by improper handling! Risk of bodily injury by bruising, shearing, cutting, hitting or improper handling of pressurized lines!**

Observe the safety instructions!

CAUTION

**Risk of injury by improper handling of batteries!**

Observe the safety instructions!

# 3.2 Instructions with Regard to Specific Dangers

## 3.2.1 Protection Against Contact with Electrical Parts and Housings

This section concerns devices and drive components with voltages of **more than 50 Volt**.

Contact with parts conducting voltages above 50 Volts can cause personal danger and electric shock. When operating electrical equipment, it is unavoidable that some parts of the devices conduct dangerous voltage.

DANGER

**High electrical voltage! Danger to life, electric shock and severe bodily injury!**

- Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain and repair this equipment.
- Follow general construction and safety regulations when working on power installations.
- Before switching on the device, the equipment grounding conductor must have been non-detachably connected to all electrical equipment in accordance with the connection diagram.
- Do not operate electrical equipment at any time, even for brief measurements or tests, if the equipment grounding conductor is not permanently connected to the mounting points of the components provided for this purpose.
- Before working with electrical parts with voltage potentials higher than 50 V, the device must be disconnected from the mains voltage or power supply unit. Provide a safeguard to prevent reconnection.
- With electrical drive and filter components, observe the following:

  Wait **30 minutes** after switching off power to allow capacitors to discharge before beginning to work. Measure the electric voltage on the capacitors before beginning to 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. Do not remove or plug in connectors when the component has been powered.
- Install the covers and guards provided with the equipment properly before switching the device on. Before switching the equipment on, cover and safeguard live parts safely to prevent contact with those parts.
- A residual-current-operated circuit-breaker or r.c.d. cannot be used for electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device according to the relevant standards.
- Secure built-in devices from direct touching of electrical parts by providing an external housing, for example a control cabinet.

For electrical drive and filter components with voltages of **more than 50 volts**, observe the following additional safety instructions.

DANGER

**High housing voltage and high leakage current! Risk of death or bodily injury by electric shock!**

- Before switching on, the housings of all electrical equipment and motors must be connected or grounded with the equipment grounding conductor to the grounding points. This is also applicable before short tests.
- The equipment grounding conductor of the electrical equipment and the devices must be non-detachably and permanently connected to the power supply unit at all times. The leakage current is greater than 3.5 mA.
- Over the total length, use copper wire of a cross section of a minimum of 10 $mm^2$ for this equipment grounding connection!
- Before commissioning, also in trial runs, always attach the equipment grounding conductor or connect to the ground wire. Otherwise, high voltages may occur at the housing causing electric shock.

## 3.2.2 Protection Against Electric Shock by Protective Extra-Low Voltage

Protective extra-low voltage is used to allow connecting devices with basic insulation to extra-low voltage circuits.

All connections and terminals with voltages between 5 and 50 volts at Rexroth products are PELV systems. [1) ] It is therefore allowed to connect devices equipped with basic insulation (such as programming devices, PCs, notebooks, display units) to these connections and terminals.

WARNING

**High electric voltage by incorrect connection! Risk of death or bodily injury by electric shock!**

If extra-low voltage circuits of devices containing voltages and circuits of more than 50 volts (e.g. the mains connection) are connected to Rexroth products, the connected extra-low voltage circuits must comply with the requirements for PELV. [2)]

## 3.2.3 Protection Against Dangerous Movements

Dangerous movements can be caused by faulty control of connected motors. Some common examples are:

- improper or wrong wiring of cable connections
- incorrect operation of the equipment components
- wrong input of parameters before operation
- malfunction of sensors, encoders and monitoring devices
- defective components
- software or firmware errors

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

1) *"Protective Extra-Low Voltage"*

2) *"Protective Extra-Low Voltage"*

The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily harm and material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

DANGER

**Dangerous movements! Danger to life, risk of injury, severe bodily harm or material damage!**

- Ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation.

  These measures have to be provided for by the user according to the specific conditions within the installation and a hazard and fault analysis. The safety regulations applicable for the installation have to be taken into consideration. Unintended machine motion or other malfunction is possible if safety devices are disabled, bypassed or not activated.

**To avoid accidents, bodily harm and/or material damage:**

- Keep free and clear of the machine's range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine's range of motion:
  - use safety fences
  - use safety guards
  - use protective coverings
  - install light curtains or light barriers
- Fences and coverings must be strong enough to resist maximum possible momentum.
- Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before startup. Don't operate the device if the emergency stop is not working.
- Isolate the drive power connection by means of an emergency stop circuit or use a safety related starting lockout to prevent unintentional start.
- Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone.
- Additionally secure vertical axes against falling or dropping after switching off the motor power by, for example:
  - mechanically securing the vertical axes,
  - adding an external braking/ arrester/ clamping mechanism or
  - ensuring sufficient equilibration of the vertical axes.
- The standard equipment motor brake or an external brake controlled directly by the drive controller are **not sufficient to guarantee personal safety**!
- Disconnect electrical power to the equipment using a master switch and secure the switch against reconnection for:
  - maintenance and repair work
  - cleaning of equipment
  - long periods of discontinued equipment use
- Prevent the operation of high-frequency, remote control and radio equipment near electronics circuits and supply leads. If the use of such devices cannot be avoided, verify the system and the installation for possible malfunctions in all possible positions of normal use before initial startup. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.

## 3.2.4 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors and permanent magnets in motors represent a serious personal danger to those 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 heart pacemakers and metal implants are not permitted to enter following areas:
  - Areas in which electrical equipment and parts are mounted, being operated or commissioned.
  - Areas in which parts of motors with permanent magnets are being stored, repaired or mounted.
- If it is necessary for somebody with a pacemaker to enter such an area, a doctor must be consulted prior to doing so. The noise immunity of present or future implanted heart pacemakers differs greatly so that no general rules can be given.
- Those with metal implants or metal pieces, as well as with hearing aids, must consult a doctor before they enter the areas described above. Otherwise health hazards may occur.

## 3.2.5 Protection Against Contact with Hot Parts

CAUTION

**Hot surfaces at motor housings, on drive controllers or chokes! Danger of injury! Danger of burns!**

- Do not touch surfaces of device housings and chokes in the proximity of heat sources! Danger of burns!
- Do not touch housing surfaces of motors! Danger of burns!
- According to the operating conditions, temperatures can be **higher than 60 °C**, 140°F during or after operation.
- Before accessing motors after having switched them off, let them cool down for a sufficiently long time. Cooling down can require **up to 140 minutes**! Roughly estimated, the time required for cooling down is five times the thermal time constant specified in the Technical Data.
- After switching drive controllers or chokes off, wait 15 minutes to allow them to cool down before touching them.
- Wear safety gloves or do not work at hot surfaces.
- For certain applications, the manufacturer of the end product, machine or installation, according to the respective safety regulations, has to take measures to avoid injuries caused by burns in the end application. These measures can be, for example: warnings, guards (shielding or barrier), technical documentation.

## 3.2.6 Protection During Handling and Mounting

In unfavorable conditions, handling and mounting certain parts and components in an improper way can cause injuries.

CAUTION

**Risk of injury by improper handling! Bodily injury by bruising, shearing, cutting, hitting!**

- Observe the general construction and safety regulations on handling and mounting.
- Use suitable devices for mounting and transport.
- Avoid jamming and bruising by appropriate measures.
- Always use suitable tools. Use special tools if specified.
- Use lifting equipment and tools in the correct manner.
- If necessary, use suitable protective equipment (for example safety goggles, safety shoes, safety gloves).
- Do not stand under hanging loads.
- Immediately clean up any spilled liquids because of the danger of skidding.

## 3.2.7 Battery Safety

Batteries consist of active chemicals enclosed in a solid housing. Therefore, improper handling can cause injury or material damage.

CAUTION

**Risk of injury by improper handling!**

- Do not attempt to reactivate low batteries by heating or other methods (risk of explosion and cauterization).
- Do not recharge the batteries as this may cause leakage or explosion.
- Do not throw batteries into open flames.
- Do not dismantle batteries.
- When replacing the battery/batteries do not damage electrical parts installed in the devices.
- Only use the battery types specified by the manufacturer.

☞ Environmental protection and disposal! The batteries contained in the product are considered dangerous goods during land, air, and sea transport (risk of explosion) in the sense of the legal regulations. Dispose of used batteries separate from other waste. Observe the local regulations in the country of assembly.

## 3.2.8 Protection Against Pressurized Systems

According to the information given in the Project Planning Manuals, motors cooled with liquid and compressed air, as well as drive controllers, can be partially supplied with externally fed, pressurized media, such as compressed air, hydraulics oil, cooling liquids and cooling lubricating agents. Improper handling of the connected supply systems, supply lines or connections can cause injuries or material damage.

CAUTION

**Risk of injury by improper handling of pressurized lines!**

- Do not attempt to disconnect, open or cut pressurized lines (risk of explosion).
- Observe the respective manufacturer's operating instructions.
- Before dismounting lines, relieve pressure and empty medium.
- Use suitable protective equipment (for example safety goggles, safety shoes, safety gloves).
- Immediately clean up any spilled liquids from the floor.

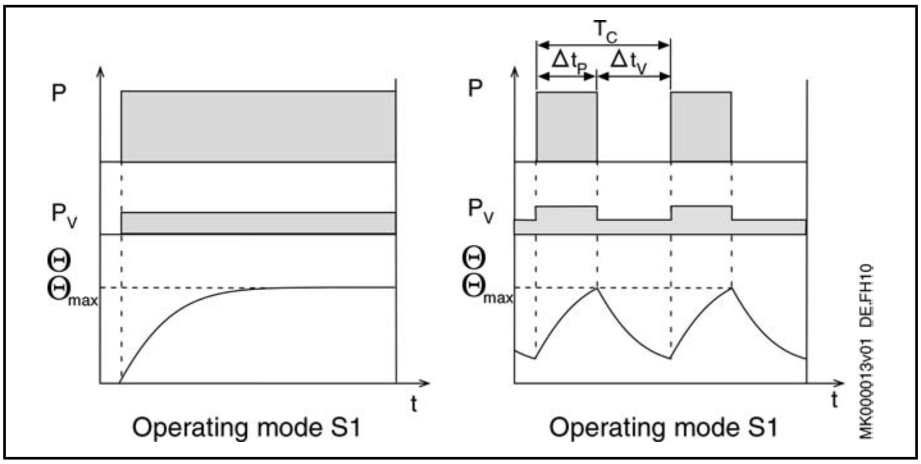
☞ Environmental protection and disposal! The agents used to operate the product might not be economically friendly. Dispose of ecologically harmful agents separately from other waste. Observe the local regulations in the country of assembly.

# 4 Technical Data

## 4.1 Operating Modes

### 4.1.1 General Information

Bosch Rexroth motors are documented according to the test criteria and measuring methods of EN 60034-1. Stated technical data refer to operating modes S1 (continuous operation) and S6 (periodic operation), each with surface cooling through direct-connected fan units or liquid cooling.




| | |
|---|---|
| P | Load |
| $P_V$ | Electric losses |
| Θ | Temperature |
| $Θ_{max}$ | Highest temperature (stator) |
| t | Time |
| $T_C$ | Cycle time |
| $Δt_P$ | Operating time with constant load |
| $Δt_V$ | Idling time |

*Fig.4-1: Operating modes according to EN 60034-1:1998*

### 4.1.2 On Time

Operating mode S6 is supplemented by specification of the ON time (ED) in %. The duty cycle is calculated as follows:

$$ED = \frac{\Delta t_P}{T_C} \cdot 100\%$$

| | |
|---|---|
| DC | Relative duty cycle in % |
| $Δt_P$ | Operating time with constant load |
| $T_C$ | Cycle time |

*Fig.4-2: Relative duty cycle*

## 4.2 Operating Behavior

### 4.2.1 General Information

In the following, parameters and characteristic curves of the IndraDyn A series and specifications of the motor data sheet are explained.

## 4.2.2 Characteristics

**Rated Torque**

$M_N$ = Available torque that can be output at the rated speed in operating mode S1 (continuous operation). Unit = Newton meters (Nm).

**Rated Power**

$P_N$ = Mechanical power output of the motor while running at the rated speed and rated torque. Unit = kilowatts (kW).

**Rated Current**

$I_N$ = Phase current of the motor while running at the rated speed and rated torque, specified as a root-mean-squared value in amps (A).

**Rated Speed**

$n_N$ = Typical working speed defined by the manufacturer. Depending on the particular application, other working speeds are possible (see speed-torque characteristic curve).

**Maximum Torque**

$M_{max}$ = This is the maximum torque in Nm available using maximum current $I_{max}$.

- The maximum torque that can be attained depends on the drive control device used. Only the specified maximum torque $M_{max}$ in the selection lists is binding.

**Maximum Output**

$P_{max}$ = maximum output of the motor at 540$V_{DC}$, specified in kilowatts (kW).

- The maximum output that can be attained depends on the drive controller used and on the power supply.

  For reasons of an uniform representation of the motor characteristic curves the output $P_{max}$ is specified for the speed, at which $M_{max}$ may be specified as well. However, the actually achievable $P_{max}$ value may deviate from the aforementioned and is specified in the data sheet of the motor.
- Thus, please note that the maximum output specified in the selection data (data sheet) is binding.

**Maximum Current**

$I_{max}$ = Maximum short-term phase current of the motor permitted without damaging the winding, given as a root-mean-square value in amperes (A).

- To avoid a thermal overload during operation of the motor with external controllers, note that the current is to be reduced after 400 ms to 2.2x the rated current and that $I_{max}$ may be reapplied only if the winding temperature is in the permitted range if the degree of relief of the motor permits this.

**Maximum Speed**

$n_{max}$ = Maximum admissible speed of the motor in ($min^{-1}$) depending on the selected bearing type according to type designation code. Normally the maximum speed is limited by mechanic factors such as centrifugal forces, bearing load or the use of a holding brake.

**Torque Constant in the Rated Point at 20°C**

$K_{M\_N}$ = Ratio of torque increase to motor torque-forming current. Unit = Nm/A. Valid up to rated current $I_N$.

**Discharge Capacity**

$C_{ab}$ = Capacity of short-circuited power connections U, V, W against the motor housing. Unit = nF.

**Power Wire Cross Section**

Rated for cables in dependence on current carrying capacity according to VDE 0298-4 (1992) and for installation mode B2 according to EN 60204-1 (1993) at an ambient temperature of 40 °C. The power wire cross section in mm², specified in the data sheets, can deviate depending on the selected type of connection - plug or terminal box. Therefore, when selecting the appropriate power cable, observe the information in chapter 8 "Connection Techniques" and to the documentation for Rexroth connection cables, MNR R911322948.

**Rotor Moment of Inertia**

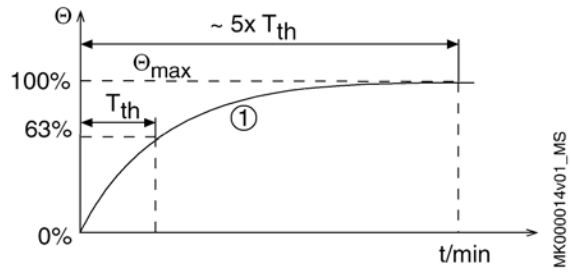
$J_{rot}$ = The moment of inertia of the rotor without brake, bearing and encoder. Unit = kgm².

**Motor Mass**

m = Mass of the motor in standard version, without holding brake, specified in kilograms (kg).

**Thermal Time Constant**

$T_{th}$ = Duration of the temperature rise to 63% of the final temperature of the motor under load with rated torque in S1 operation and surface ventilation by direct-connected fan units.




(1) Curve of the motor temperature over time
$T_{th}$ Thermal time constant
*Fig.4-3: Thermal time constant*

**Cycle Duration**

$T_C$ = Duration of the cycle in S6 operating mode until the thermally steady-state condition is reached when the maximum temperature equals the end temperature in S1 operation (see fig. 4-1 "Operating modes according to EN 60034-1:1998" on page 17).

**Number of Pole Pairs**

p = Number of pole pairs of the motor.

**Pressure Drop**

$\Delta p_{diff}$ = pressure drop in bar wihout quick coupling at $Q_{min}$.

Is the coolant connection done with a quick coupling (option), consider the following constant of the quick coupling additionally to the specified pressure drop constant in the dimension sheet:

$$\text{MAF100...130:} \quad k_{dp2} = 0{,}032\ \text{bar}/(\text{l/min})^{1{,}75}$$

$$\text{MAF160...225:} \quad k_{dp2} = 0{,}036\ \text{bar}/(\text{l/min})^{1{,}75}$$

$k_{dp2}$ Pressure drop constant of quick coupling
l/min Coolant flow rate
*Fig.4-4: Constant to determine the pressure drop with quick coupling*

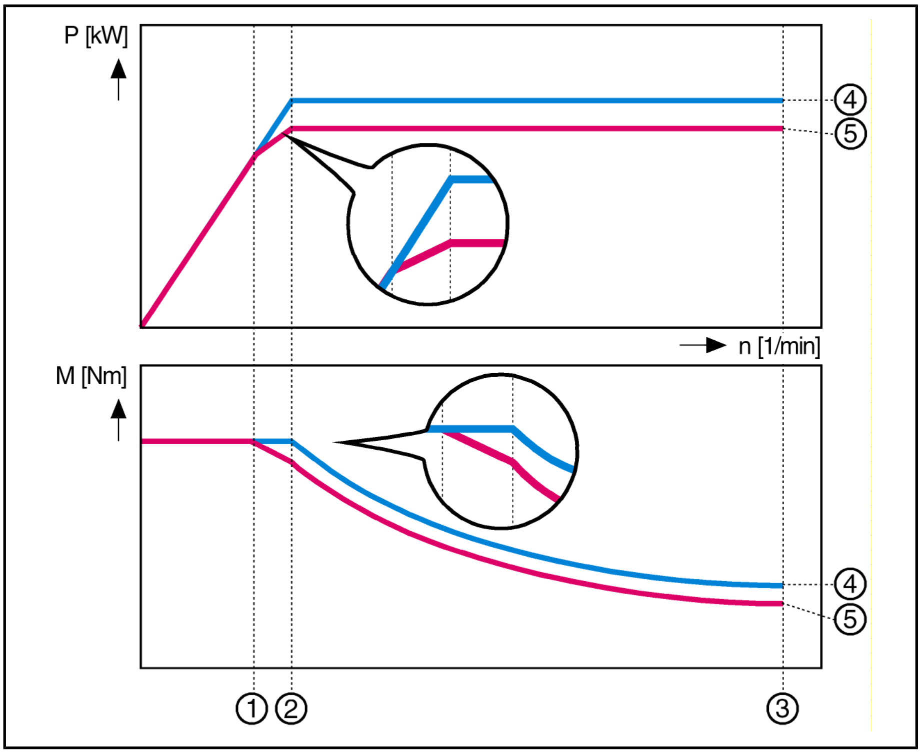
When using a quick coupling (option) the following pressure drop results over the whole motor:

$$\Delta p_{diff2} = (k_{dp} + k_{dp2}) \cdot Q_{min}^{1{,}75}$$

$\Delta p_{diff2}$ Pressure drop with quick coupling
$k_{dp}$ Constant without quick coupling (see motor data sheet)
$k_{dp2}$ Constant with quick coupling
$Q_{min}$ see motor data sheet
*Fig.4-5: Pressure drop with quick coupling*

When using other couplings or coolant ducts, heed the appropriate pressure drop values when designing the coolant system.

## 4.2.3 Exemplary Characteristic Curves




| | |
|---|---|
| P | Mechanical output in kilowatts [kW] |
| M | Torque available on the output shaft, in Newton meters [Nm] |
| n | Motor speed, in revolutions per minute [min-1] |
| ① | Key speed (n1 in data sheet) |
| ② | Rated speed (nN) |
| ③ | Max. torque (nmax) |
| ④ | Characteristic curve without de-rating |
| ⑤ | Characteristic curve with de-rating |
| *Fig.4-6:* | *IndraDyn A exemplary characteristic curves* |

The achievable torque depends on the drive controller used. The reference value for the motor characteristic curves is an unregulated DC bus voltage of $540V_{DC}$.

## 4.2.4 Explanation

**(1) Key Speed**

Start of a drop in speed and power before reaching the rated speed $n_N$. This behavior is called **De-rating** and occurs only with some versions of motor windings. **Without de-rating, the key speed equals the rated speed.**.

Until the key speed is reached, continuous current at standstill $I_1$ applies (effective value). **Without de-rating, the continuous current at standstill equals the rated current $I_N$.**

Until the key speed is reached, continuous torque at standstill $M_1$ is available for S1 operation. **Without de-rating, the continuous torque at standstill equals rated torque $M_N$.**

With an effective de-rating, torque is reduced when the key speed is reached. fig. 4-6 " IndraDyn A exemplary characteristic curves" on page 20 shows two characteristic curves starting at the key speed.

**(2) Rated Speed** Without de-rating effect, asynchronous motors provide a constant torque up to the rated speed (rated torque); starting at the rated speed, constant **rated output $P_N$** is available.

**(3) Maximum Speed** The speed limit up to which a motor can be safely operated. This is usually limited by the mechanical construction (bearing) or by using a holding brake.

# 4.3 Technical Data MAD 100

## 4.3.1 Data Sheet MAD100B

| Description | Symbol | Unit | MAD100B | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** [1] | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Rated torque | $M_N$ | Nm | 34 | 31 | 30 | 28 | 25 |
| Rated power | $P_N$ | kW | 1.8 | 3.2 | 4.7 | 5.9 | 6.5 |
| Rated current | $I_N$ | A | 5.3 | 8.9 | 12.9 | 14.6 | 16.2 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 | 2,500 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 | 2,000 |
| Maximum torque | $M_{max}$ | Nm | 75.1 | 74.7 | 68 | 66.2 | 61.5 |
| Maximum output | $P_{max}$ | kW | 3.69 | 6.56 | 9.66 | 12.1 | 13.3 |
| Maximum current | $I_{max}$ | A | 10.3 | 18 | 23.5 | 28.9 | 28.3 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 6,300 | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | not available | | | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 | 11,000 [6] | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 34 | 34 | 31 | 30 | 28 |
| Continuous current at standstill | $I_{n1}$ | A | 5.3 | 9.4 | 13 | 15.3 | 16.2 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 7.66 | 4.31 | 2.83 | 2.41 | 2.11 |
| Thermal time constant | $T_{th\_nenn}$ | min | 20 | | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 10 | | | | |
| Discharge capacity | $C_{ab}$ | nF | 6 | 5.7 | 5.7 | 6 | 6 |
| Number of pole pairs | p | | 3 | | | | |
| Power wire cross-section [2] | A | mm² | 1.5 | 1.5 | 1.5 | 1.5 | 2.5 |
| Moment of inertia of rotor[3] | $J_{rot}$ | kgm² | 0.019 | | | | |
| Weight [4] | m | kg | 43 | | | | |
| Sound pressure level [5] | $L_P$ | dB(A) | 70 (+3) | | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | | |
| Motor protection class | | | IP65 | | | | |

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

[2]) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

[3]) Value without holding brake.

[4]) Value without holding brake, with fan.

[5]) At 1m distance, with PWM = 4 kHz.

[6]) Value without holding brake. Observe maximum speed of holding brake.

*Fig.4-7: Data sheet MAD100B*

## 4.3.2 Motor Characteristic Curves MAD100B

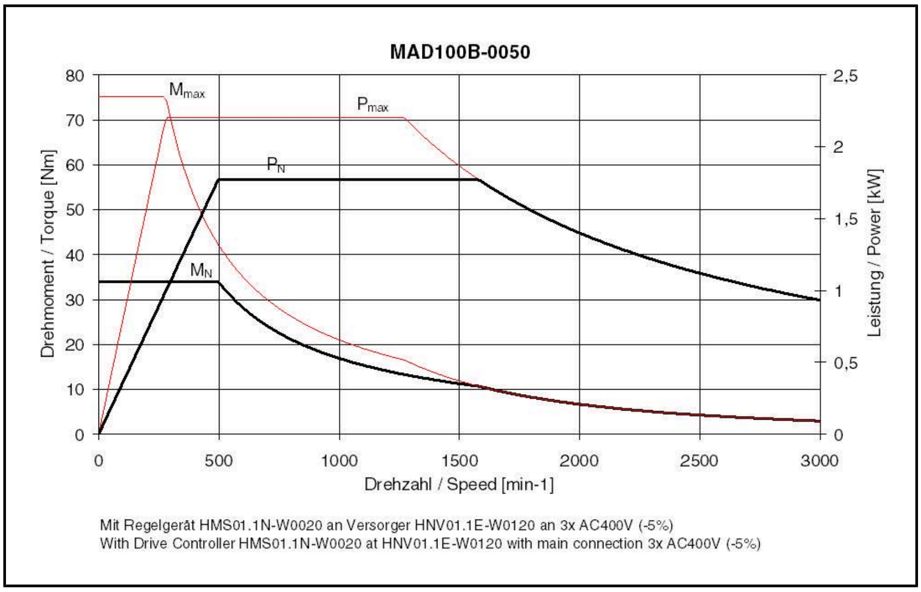



*Fig.4-8: Motor characteristic curve MAD100B-0050*

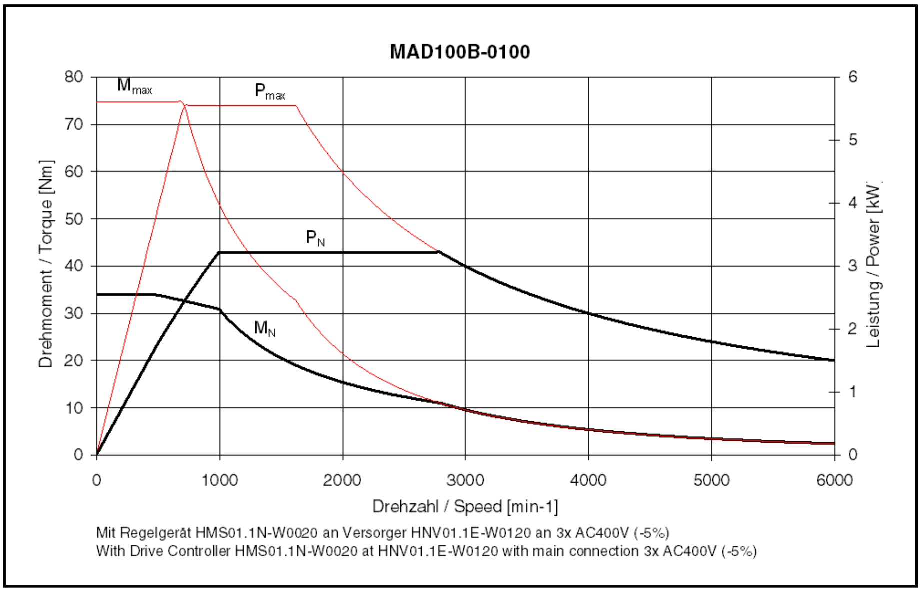



*Fig.4-9: Motor characteristic curve MAD100B-0100*

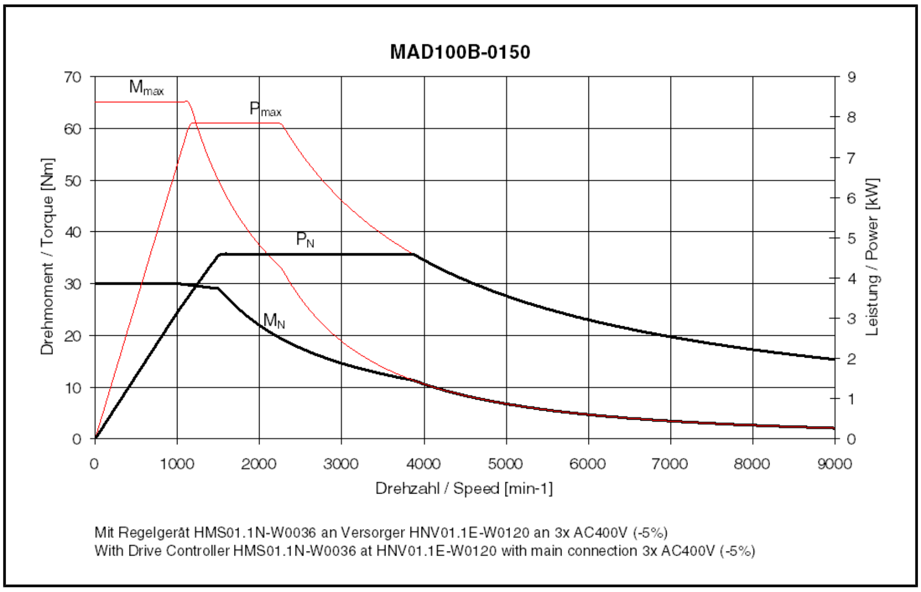



*Fig.4-10: Motor characteristic curve of MAD100B-0150*

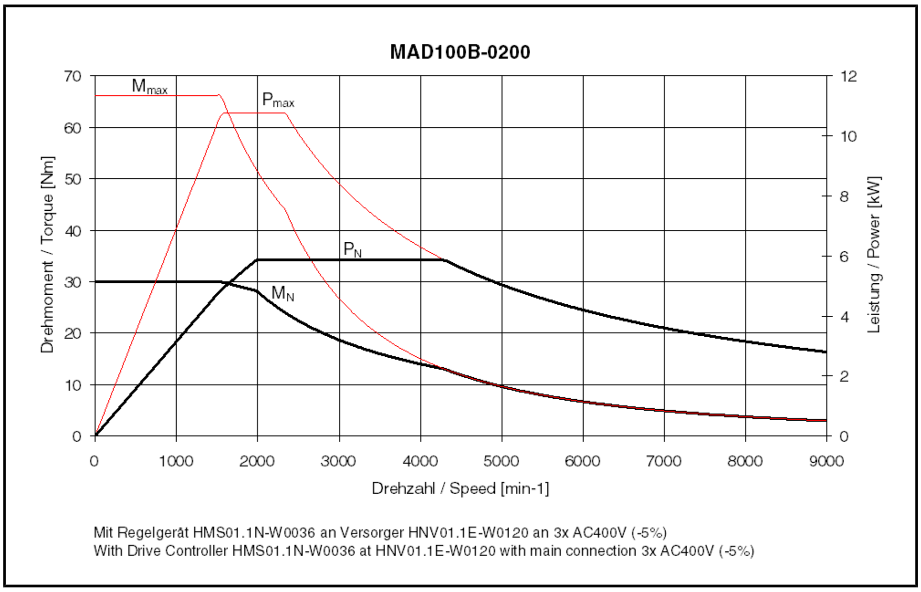



*Fig.4-11: Motor characteristic curve MAD100B-0200*

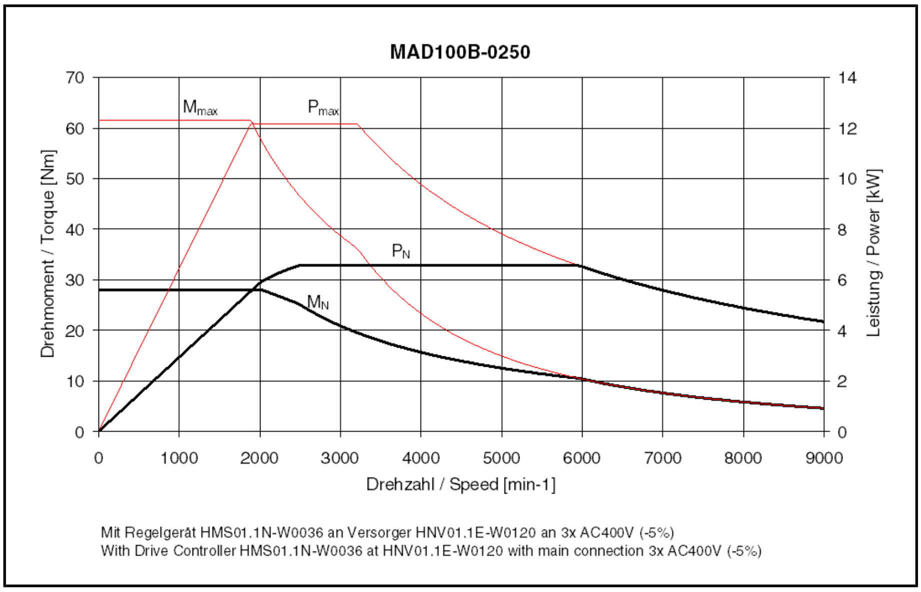



*Fig.4-12: Motor characteristic curve MAD100B-0250*

## 4.3.3 Data Sheet MAD100C

| Description | Symbol | Unit | MAD100C | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** [1)] | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Rated torque | $M_N$ | Nm | 51 | 50 | 48 | 45 | 40 |
| Rated power | $P_N$ | kW | 2.7 | 5.2 | 7.5 | 9.4 | 10.5 |
| Rated current | $I_N$ | A | 8.2 | 13.2 | 19.7 | 25.7 | 27.8 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 | 2,500 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 | 2,000 |
| Maximum torque | $M_{max}$ | Nm | 112 | 119 | 110 | 105.5 | 91 |
| Maximum output | $P_{max}$ | kW | 5.5 | 10.7 | 15.4 | 19.3 | 22.5 |
| Maximum current | $I_{max}$ | A | 15.9 | 25.4 | 39 | 47.3 | 64.3 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 6,300 | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | not available | | | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 | 11,000 [6)] | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 51 | 54 | 50 | 48 | 42 |
| Continuous current at standstill | $I_{n1}$ | A | 8.2 | 13.8 | 20.2 | 26.6 | 28.8 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 7.4 | 4.94 | 2.94 | 2.41 | 1.67 |
| Thermal time constant | $T_{th\_nenn}$ | min | 20 | | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 10 | | | | |
| Discharge capacity | $C_{ab}$ | nF | 9 | 8.5 | 8.1 | 8.5 | 9.2 |
| Number of pole pairs | p | | 3 | | | | |
| Power wire cross-section [2)] | A | mm² | 1.5 | 1.5 | 2.5 | 4 | 4 |
| Moment of inertia of rotor[3)] | $J_{rot}$ | kgm² | 0.0284 | | | | |
| Weight [4)] | m | kg | 59 | | | | |
| Sound pressure level [5)] | $L_P$ | dB(A) | 70 (+3) | | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | | |
| Motor protection class | | | IP65 | | | | |

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

[2]) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

[3]) Value without holding brake.

[4]) Value without holding brake, with fan.

[5]) At 1m distance, with PWM = 4 kHz.

[6]) Value without holding brake. Observe maximum speed of holding brake.

*Fig.4-13: Data sheet MAD100C*

Technical Data

## 4.3.4 Motor Characteristic Curves MAD100C

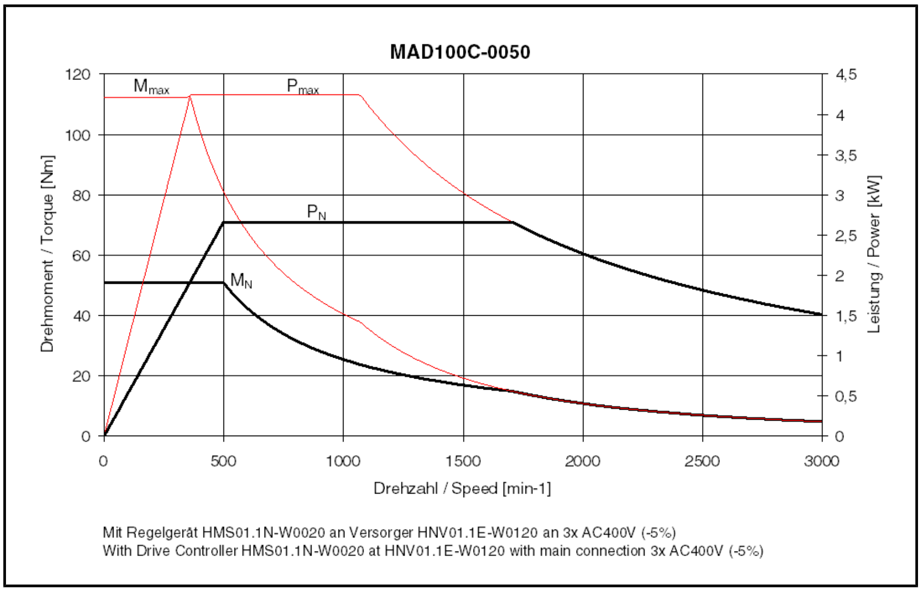



*Fig.4-14: Motor characteristic curve MAD100C-0050*

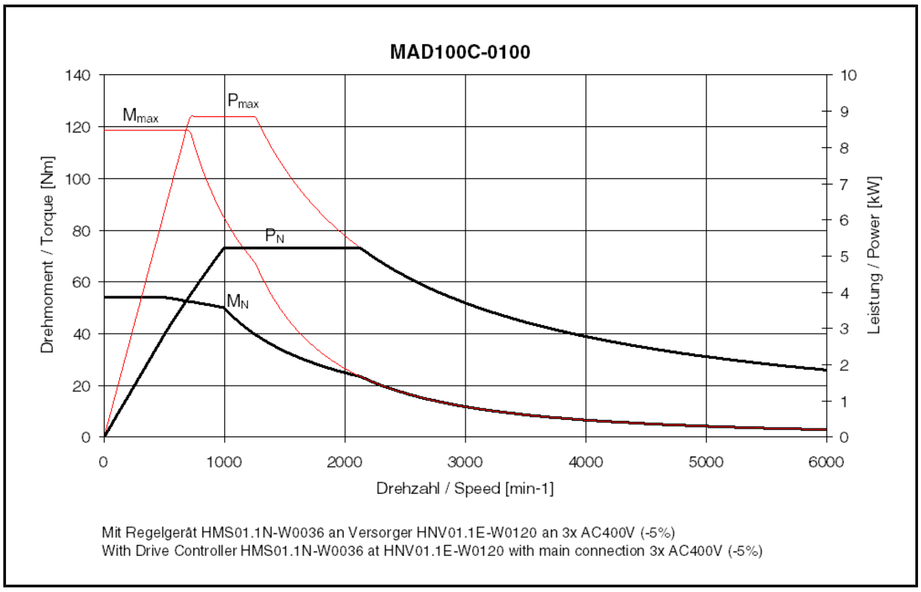



*Fig.4-15: Motor characteristic curve MAD100C-0100*

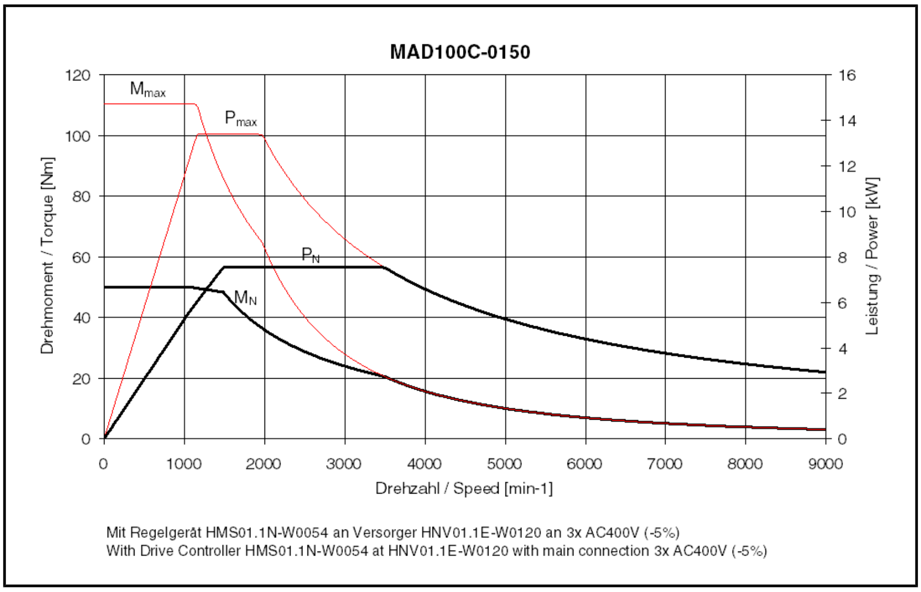



*Fig.4-16: Motor characteristic curve MAD100B-0150*

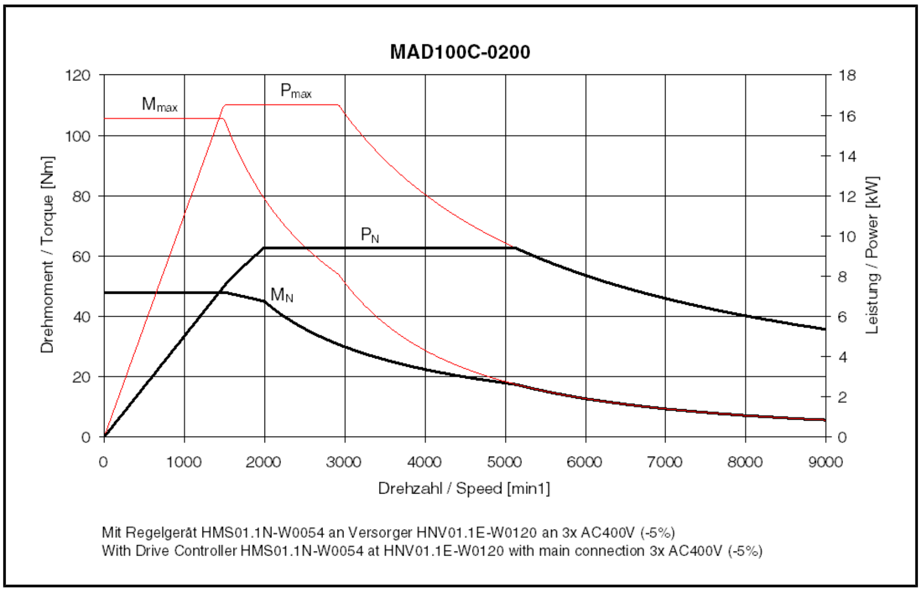



*Fig.4-17: Motor characteristic curve MAD100C-0200*

Technical Data

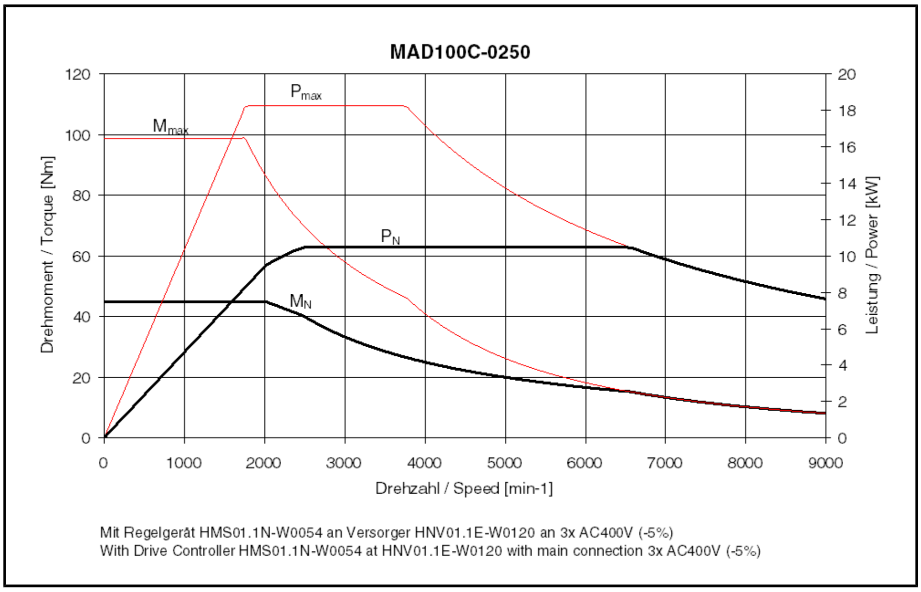



*Fig.4-18: Motor characteristic curve MAD100C-0250*

## 4.3.5 Data Sheet MAD100D

| Description | Symbol | Unit | MAD100D | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** [1] | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Rated torque | $M_N$ | Nm | 70 | 64 | 59 | 54 | 50 |
| Rated power | $P_N$ | kW | 3.7 | 6.7 | 9.3 | 11.3 | 13.1 |
| Rated current | $I_N$ | A | 10.1 | 19.3 | 25.6 | 27.2 | 32.4 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 | 2,500 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 | 2,000 |
| Maximum torque | $M_{max}$ | Nm | 154 | 146.5 | 141 | 130 | 119 |
| Maximum output | $P_{max}$ | kW | 7.6 | 13.7 | 19.1 | 23.2 | 26.9 |
| Maximum current | $I_{max}$ | A | 19.1 | 34.3 | 47.6 | 52.7 | 64 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 6,300 | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | not available | | | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 | 11,000 [6] | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 70 | 70 | 64 | 59 | 54 |
| Continuous current at standstill | $I_{n1}$ | A | 10.1 | 20.4 | 26.8 | 28.65 | 34.7 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 8.52 | 4.5 | 3.19 | 2.62 | 2.04 |
| Thermal time constant | $T_{th\_nenn}$ | min | 20 | | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 10 | | | | |
| Discharge capacity | $C_{ab}$ | nF | 11 | 11 | 10.2 | 11.5 | 11.9 |
| Number of pole pairs | p | | 3 | | | | |
| Power wire cross-section [2] | A | mm² | 1.5 | 2.5 | 4 | 4 | 6 |
| Moment of inertia of rotor [3] | $J_{rot}$ | kgm² | 0.0392 | | | | |
| Weight [4] | m | kg | 72 | | | | |
| Sound pressure level [5] | $L_P$ | dB(A) | 70 (+3) | | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | | |
| Motor protection class | | | IP65 | | | | |

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

[2]) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

[3]) Value without holding brake.

[4]) Value without holding brake, with fan.

[5]) At 1m distance, with PWM = 4 kHz.

[6]) Value without holding brake. Observe maximum speed of holding brake.

*Fig.4-19: Data Sheet MAD100D*

## 4.3.6 Motor Characteristic Curves MAD100D

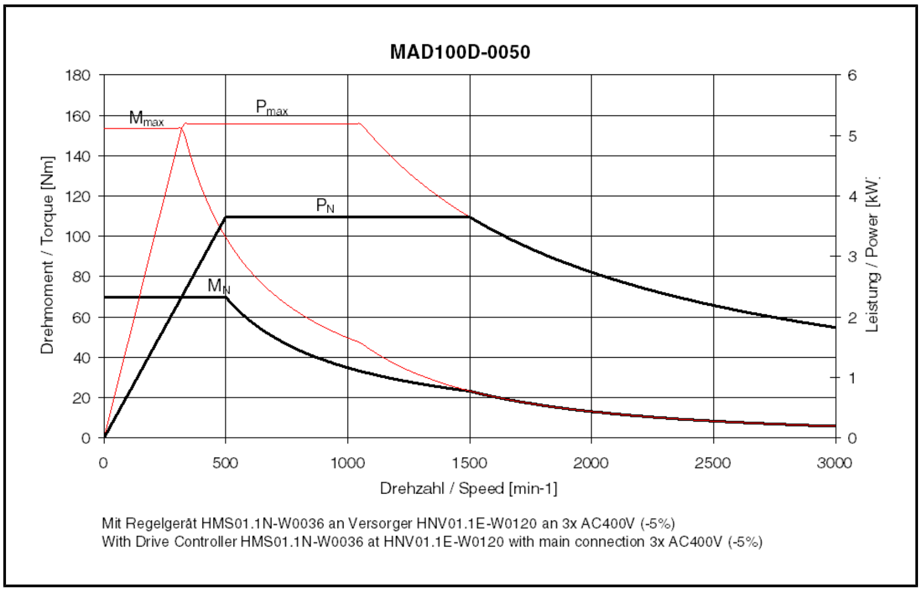



*Fig.4-20: Motor characteristic curve MAD100D-0050*

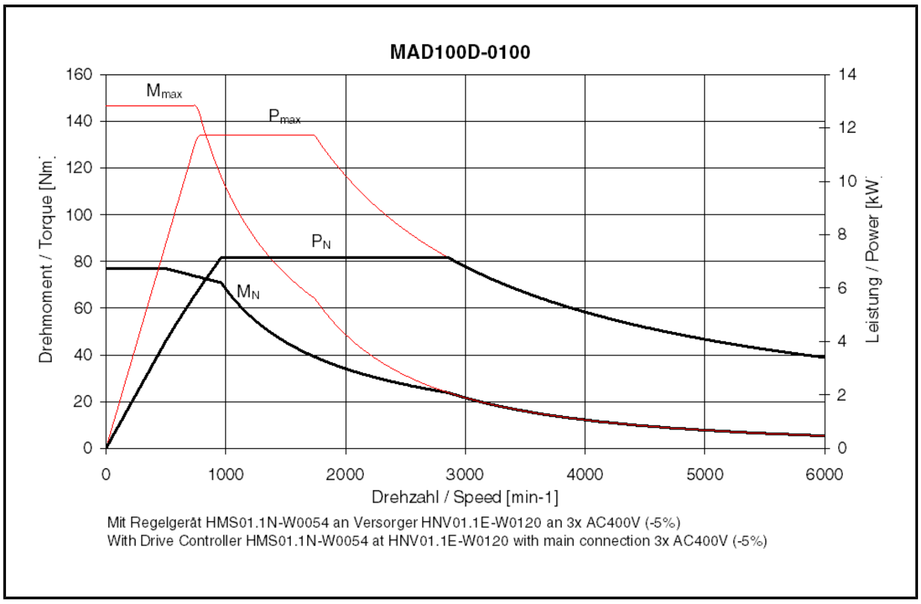



*Fig.4-21: Motor characteristic curve MAD100D-0100*

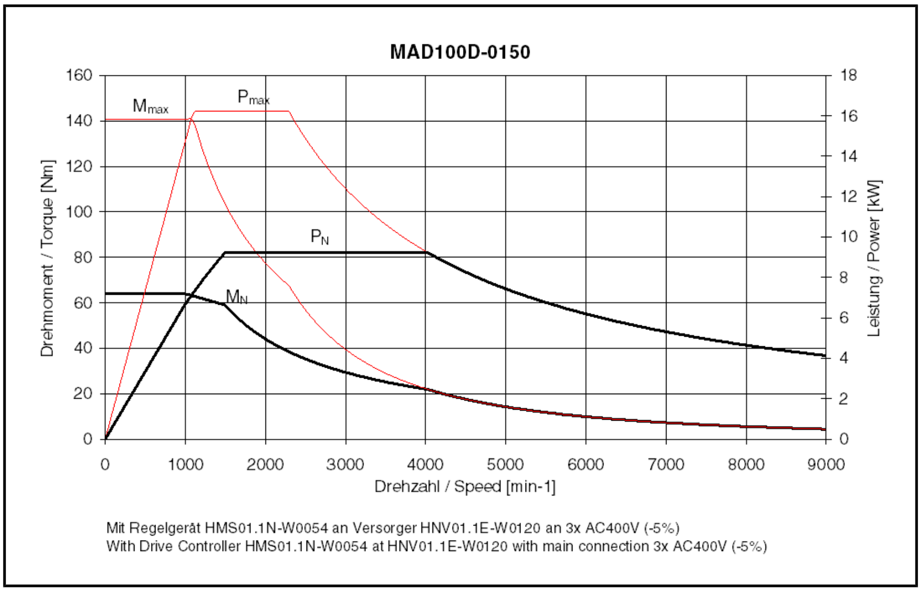



*Fig.4-22: Motor characteristic curve MAD100D-0150*

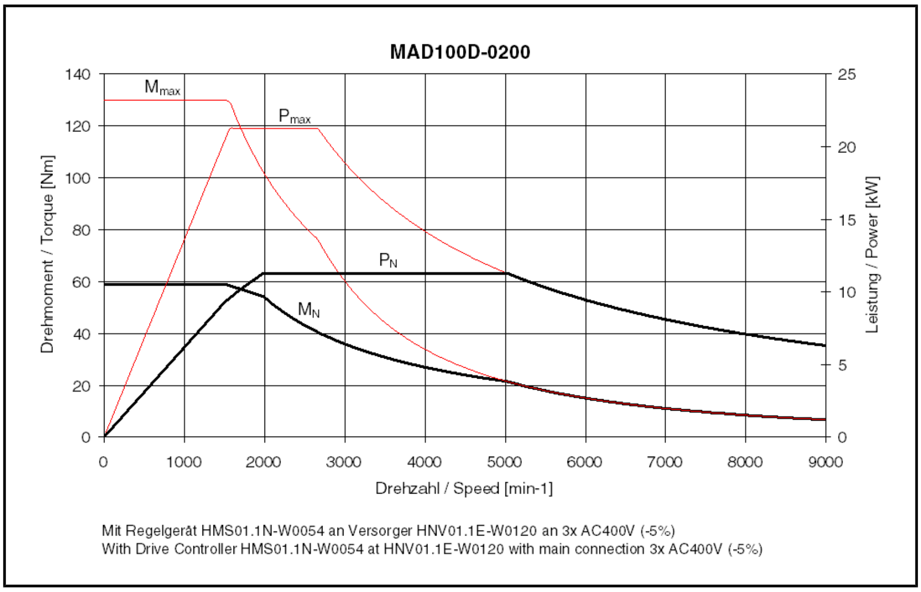



*Fig.4-23: Motor characteristic curve MAD100D-0200*

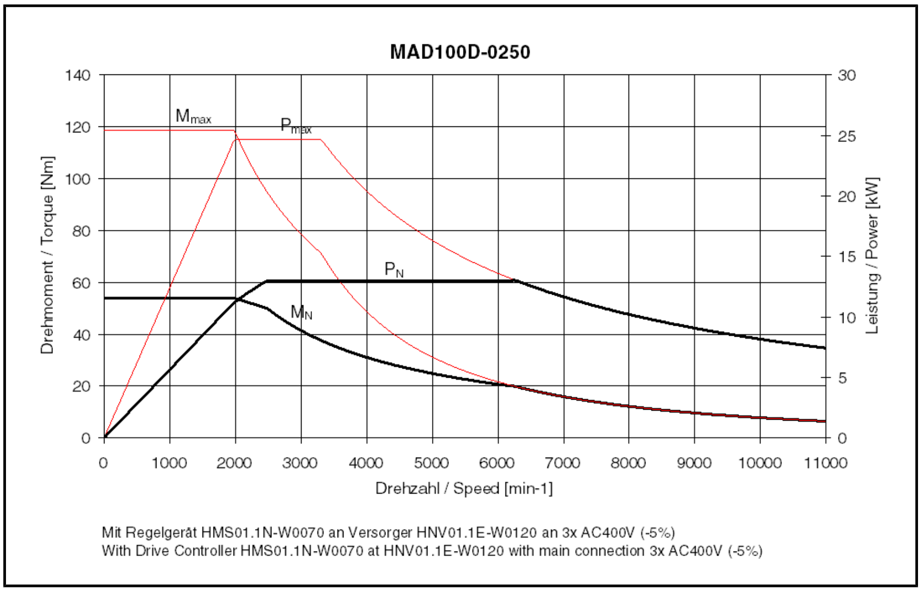



*Fig.4-24: Motor characteristic curve MAD100D-0250*

## 4.3.7 Fan MAD100

**Axial fan MAD100 - Technical data**

| Fan | Symbol | Unit | Axial Fan |
|---|---|---|---|
| Air current | | | B ⇒ A, blowing |
| Connection voltage | $U_N$ | V | 3 x 400V ± 15 %, 50/60 Hz...<br>3 x 480V ± 10 %, 50/60 Hz |
| Power consumption | $S_N$ | VA | 83...100 |
| Fan flow [1)] | $I_N$ | A | 0.12 |
| Medium air volume | V | m³/h | 300 |
| 1) If $I_N$ is + 20% or more, the fan flow should be monitored. | | | |

*Fig.4-25: Axial fan MAD100*

## 4.3.8 Holding Brake MAD100 (Option)

**Holding brakes MAD/MAF100 - Technical data**

| Holding brake | Symbol | Unit | Electrically clamping | Electrically releasing |
|---|---|---|---|---|
| Transmittable torque | $M_4$ | Nm | 30 | 24 |
| Connection voltage | $U_{Br}$ | V | DC 24 ± 10% | |
| Rated current | $I_{Br}$ | A | 0,9 | 1,1 |
| Moment of inertia | $J_{Br}$ | kgm² | 0,00056 | |
| Max. permissible braking energy | $W_{max}$ | Ws | 4800 | 12500 |
| Disconnection time | $t_2$ | ms | 50 | 90 |
| Connection time | $t_1$ | ms | 42 | 30 |
| Maximum speed | $n_{Br\_max}$ | $min^{-1}$ | 10000 | |
| Mass | m | kg | 2 | 1,6 |

*Fig.4-26: Holding brakes MAD/MAF100*

# 4.4 Technical Data MAD130

## 4.4.1 Data Sheet MAD130B

| Description | Symbol | Unit | MAD130B | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** 1) | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Rated torque | $M_N$ | Nm | 95 | 100 | 85 | 80 | 75 |
| Rated power | $P_N$ | kW | 5 | 10.5 | 13.3 | 16.8 | 19.6 |
| Rated current | $I_N$ | A | 12.8 | 26.9 | 34.9 | 43 | 47.2 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 | 2,500 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 | 2,000 |
| Maximum torque | $M_{max}$ | Nm | 209 | 230 | 200 | 187 | 176.5 |
| Maximum output | $P_{max}$ | kW | 10.25 | 21.5 | 27.4 | 34.4 | 40.2 |
| Maximum current | $I_{max}$ | A | 25.4 | 53.7 | 71 | 80.8 | 83.3 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 7,500 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 5,250 | | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 7,500 | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 6) | 10,000 6) | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 95 | 110 | 95 | 85 | 80 |
| Continuous current at standstill | $I_{n1}$ | A | 12.8 | 28.7 | 37.4 | 44.5 | 47.2 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 8.49 | 4.79 | 3.07 | 2.47 | 2.15 |
| Thermal time constant | $T_{th\_nenn}$ | min | 25 | | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 10 | | | | |
| Discharge capacity | $C_{ab}$ | nF | 16 | 15.8 | 15.8 | 16.1 | 17.4 |
| Number of pole pairs | p | | 3 | | | | |
| Power wire cross-section 2) | A | mm² | 1.5 | 4 | 6 | 10 | 10 |
| Moment of inertia of rotor 3) | $J_{rot}$ | kgm² | 0.084 | | | | |
| Weight 4) | m | kg | 100 | | | | |
| Sound pressure level 5) | $L_P$ | dB(A) | 70 (+3) | | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | | |
| Motor protection class | | | IP65 | | | | |

1) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

2) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

3) Value without holding brake.

4) Value without holding brake, with fan.

5) At 1m distance, with PWM = 4 kHz.

6) Value without holding brake. Observe maximum speed of holding brake.

*Fig.4-27: Data sheet MAD130B*

## 4.4.2 Motor Characteristic Curves MAD130B

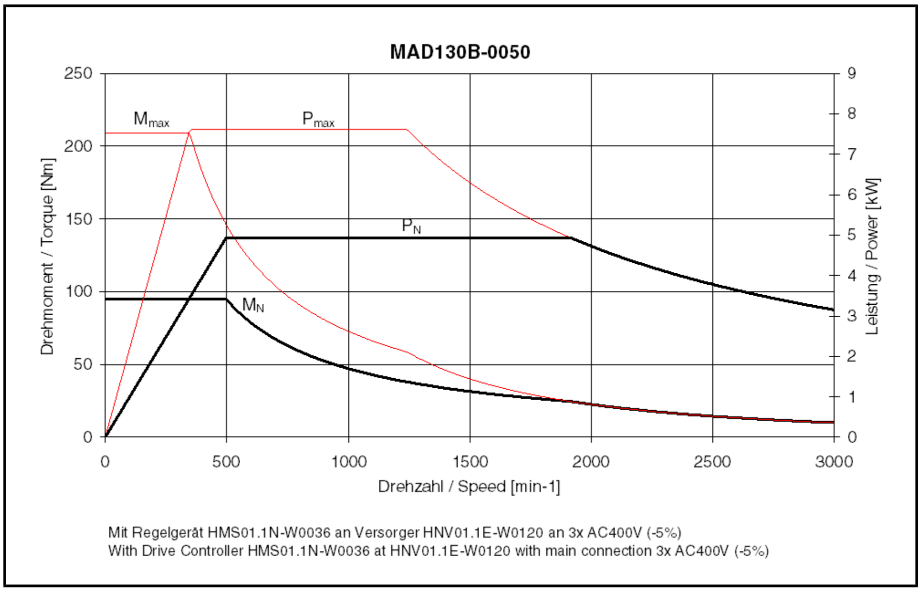



*Fig.4-28: Motor characteristic curve MAD130B-0050*

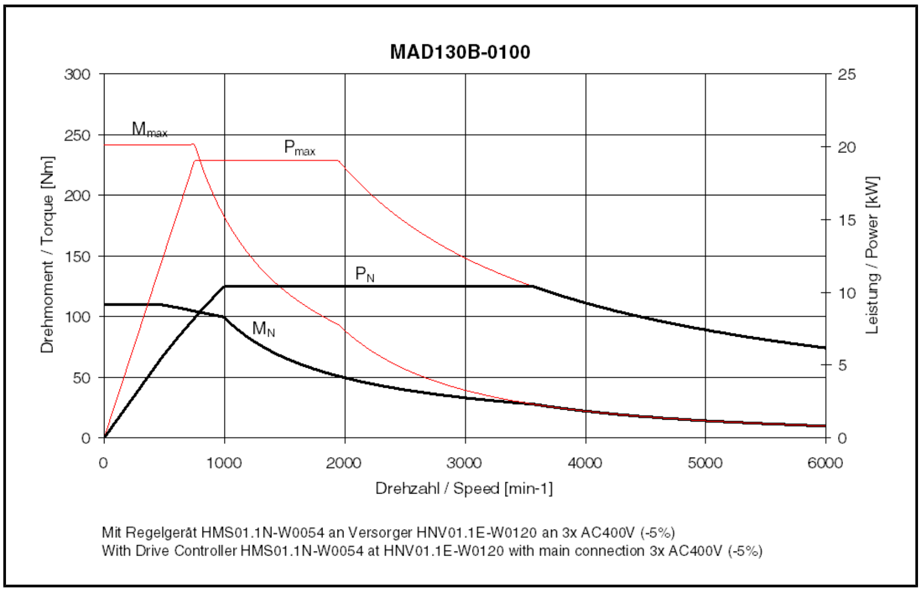



*Fig.4-29: Motor characteristic curve MAD130B-0100*

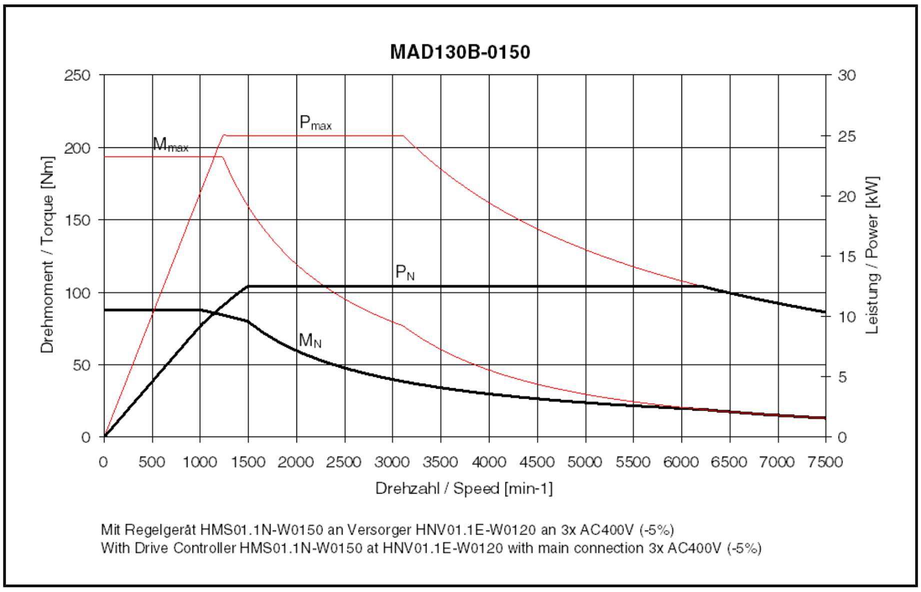



*Fig.4-30: Motor characteristic curve MAD130B-0150*

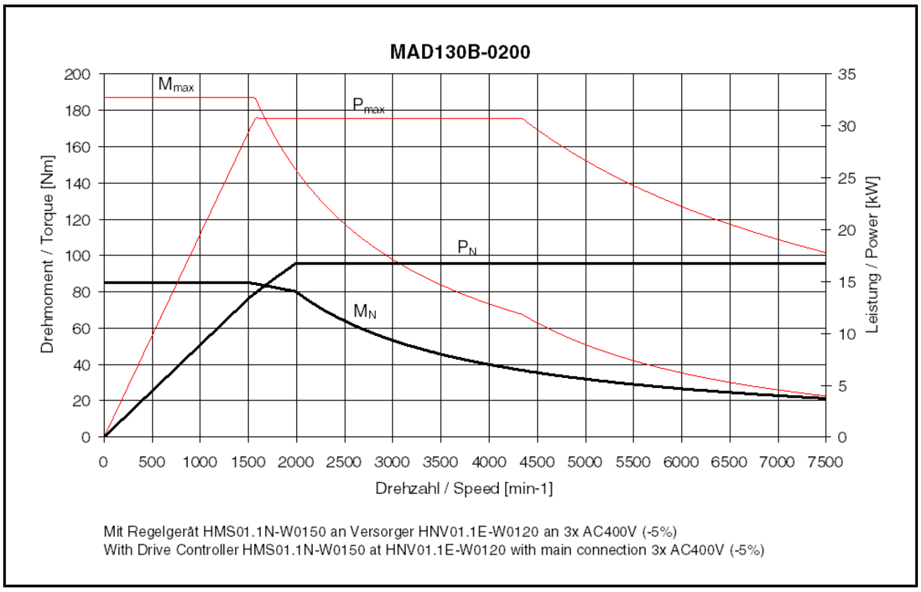



*Fig.4-31: Motor characteristic curve MAD130B-0200*

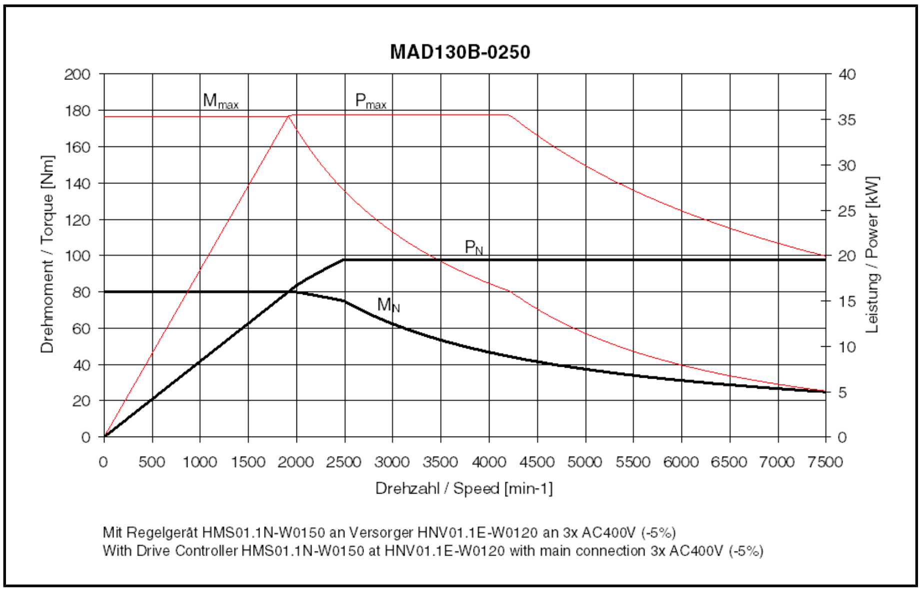



*Fig.4-32: Motor characteristic curve MAD130B-0250*

## 4.4.3 Data Sheet MAD130C

| Description | Symbol | Unit | MAD130C | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** [1)] | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Rated torque | $M_N$ | Nm | 140 | 125 | 117 | 110 | 100 |
| Rated power | $P_N$ | kW | 7.3 | 13.1 | 18.4 | 23 | 26.2 |
| Rated current | $I_N$ | A | 19,7 | 36.2 | 48.9 | 57 | 62 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 | 2,500 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 | 2,000 |
| Maximum torque | $M_{max}$ | Nm | 308 | 305 | 275 | 253 | 250 |
| Maximum output | $P_{max}$ | kW | 15 | 26.8 | 37.7 | 47.2 | 53.7 |
| Maximum current | $I_{max}$ | A | 35.4 | 73.8 | 93.3 | 106.7 | 126.6 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 7,500 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 5,250 | | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 7,500 | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 [6)] | 10,000 [6)] | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 140 | 140 | 125 | 115 | 110 |
| Continuous current at standstill | $I_{n1}$ | A | 19.7 | 38.5 | 51 | 59.6 | 65.6 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 9.31 | 4.26 | 3.1 | 2.64 | 1.96 |
| Thermal time constant | $T_{th\_nenn}$ | min | 30 | | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 10 | | | | |
| Discharge capacity | $C_{ab}$ | nF | 20 | 20.9 | 20.5 | 19.3 | 20.1 |
| Number of pole pairs | p | | 3 | | | | |
| Power wire cross-section [2)] | A | mm² | 2.5 | 6 | 10 | 16 | 16 |
| Moment of inertia of rotor[3)] | $J_{rot}$ | kgm² | 0.108 | | | | |
| Weight [4)] | m | kg | 124 | | | | |
| Sound pressure level [5)] | $L_P$ | dB(A) | 70 (+3) | | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | | |
| Motor protection class | | | IP65 | | | | |

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

[2]) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

[3]) Value without holding brake.

[4]) Value without holding brake, with fan.

[5]) At 1m distance, with PWM = 4 kHz.

[6]) Value without holding brake. Observe maximum speed of holding brake.

*Fig.4-33: Data Sheet MAD130C*

Technical Data

## 4.4.4 Motor Characteristic Curves MAD130C

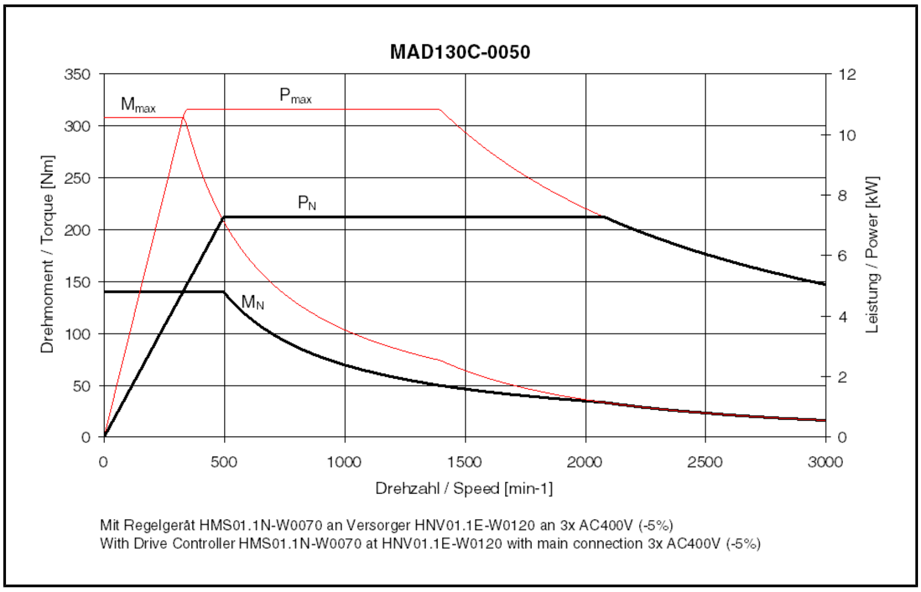



*Fig.4-34: Motor characteristic curve MAD130C-0050*

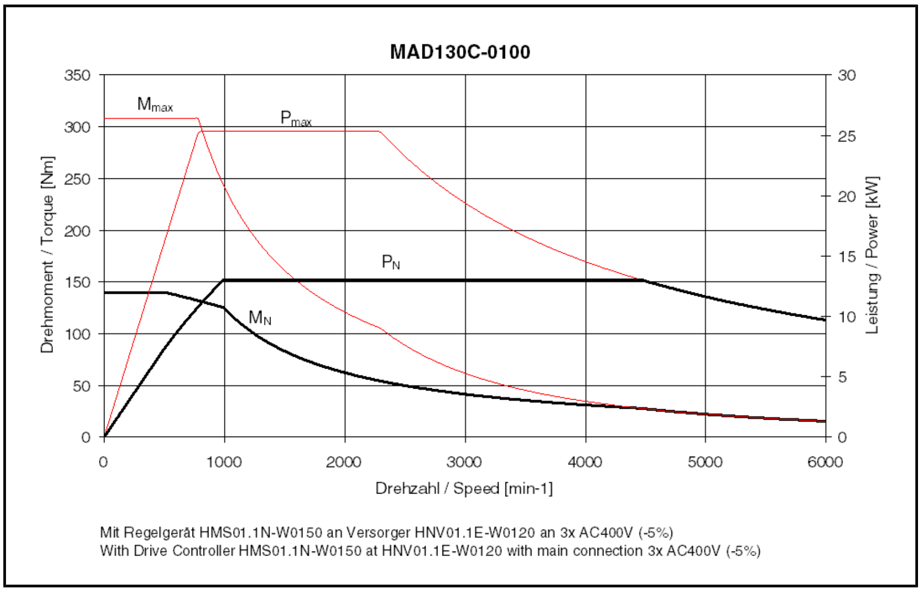



*Fig.4-35: Motor characteristic curve MAD130C-0100*

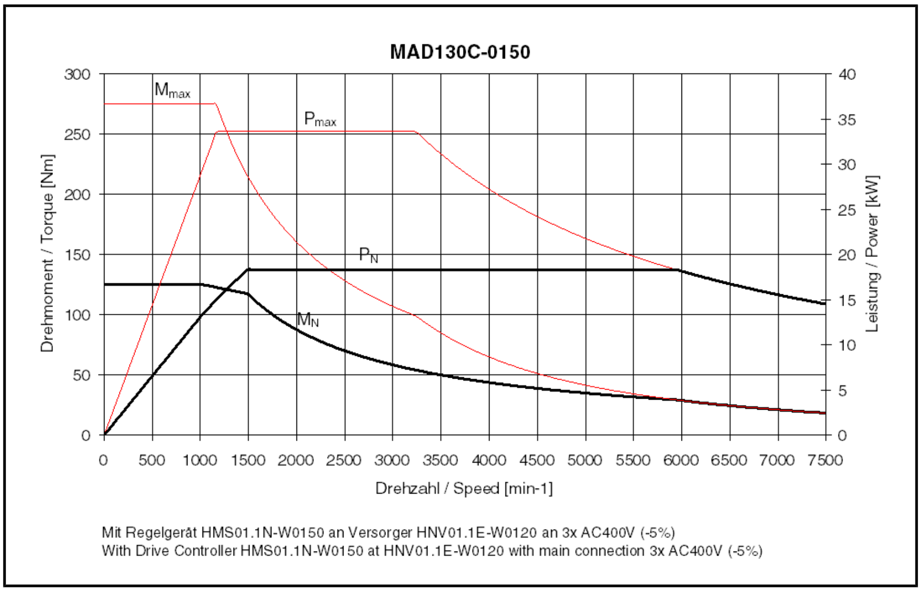



*Fig.4-36: Motor characteristic curve MAD130C-0150*

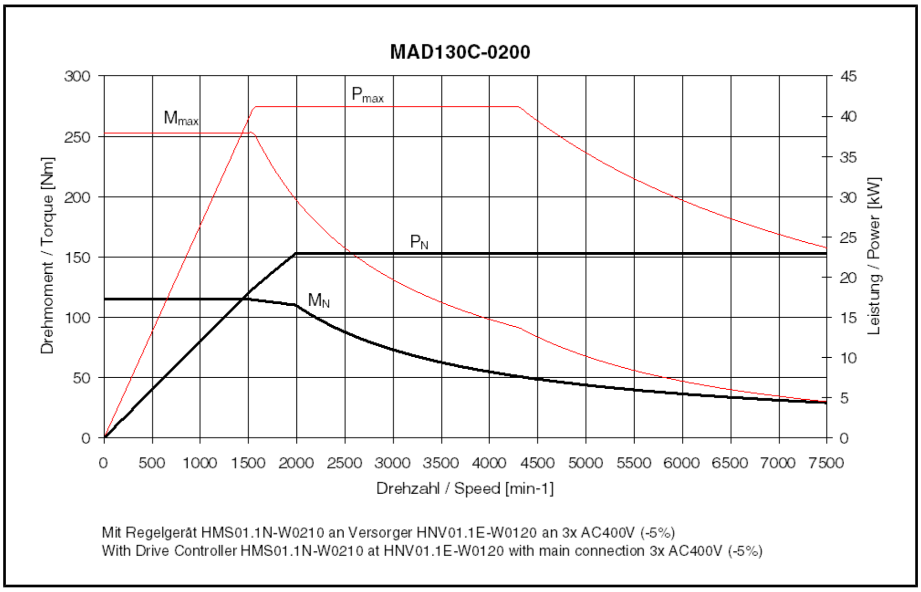



*Fig.4-37: Motor characteristic curve MAD130C-0200*

Technical Data

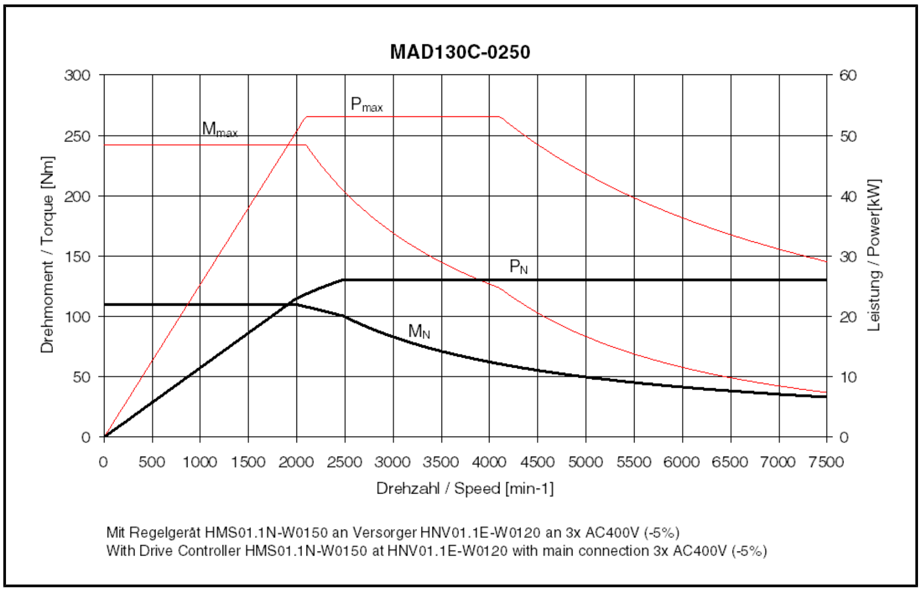



*Fig.4-38: Motor characteristic curve MAD130C-0250*

## 4.4.5 Data Sheet MAD130D

| Description | Symbol | Unit | MAD130D | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** [1] | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Rated torque | $M_N$ | Nm | 180 | 170 | 155 | 150 | 120 |
| Rated power | $P_N$ | kW | 9.4 | 17.8 | 24.3 | 31.4 | 31.4 |
| Rated current | $I_N$ | A | 24.2 | 43.7 | 61.5 | 71.3 | 72 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 | 2,500 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 | 2,000 |
| Maximum torque | $M_{max}$ | Nm | 396 | 418 | 375 | 341 | 310 |
| Maximum output | $P_{max}$ | kW | 19.3 | 36.5 | 49.8 | 64.4 | 64.4 |
| Maximum current | $I_{max}$ | A | 47 | 93.4 | 123 | 137 | 123.4 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 7,500 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 5,250 | | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 7,500 | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 [6] | 10,000 [6] | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 180 | 190 | 170 | 155 | 130 |
| Continuous current at standstill | $I_{n1}$ | A | 24.2 | 47.85 | 64.1 | 72.8 | 75.4 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 8.75 | 4.72 | 3.09 | 2.62 | 2.69 |
| Thermal time constant | $T_{th\_nenn}$ | min | 30 | | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 10 | | | | |
| Discharge capacity | $C_{ab}$ | nF | 27.5 | 27.3 | 30.5 | 27.5 | 26.4 |
| Number of pole pairs | p | | 3 | | | | |
| Power wire cross-section [2] | A | mm² | 4 | 10 | 16 | 16 | 25 |
| Moment of inertia of rotor[3] | $J_{rot}$ | kgm² | 0.164 | | | | |
| Weight [4] | m | kg | 165 | | | | |
| Sound pressure level [5] | $L_P$ | dB(A) | 70 (+3) | | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | | |
| Motor protection class | | | IP65 | | | | |

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

[2]) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

[3]) Value without holding brake.

[4]) Value without holding brake, with fan.

[5]) At 1m distance, with PWM = 4 kHz.

[6]) Value without holding brake. Observe maximum speed of holding brake.

*Fig.4-39: Data Sheet MAD130D*

Technical Data

## 4.4.6 Motor Characteristic Curves MAD130D

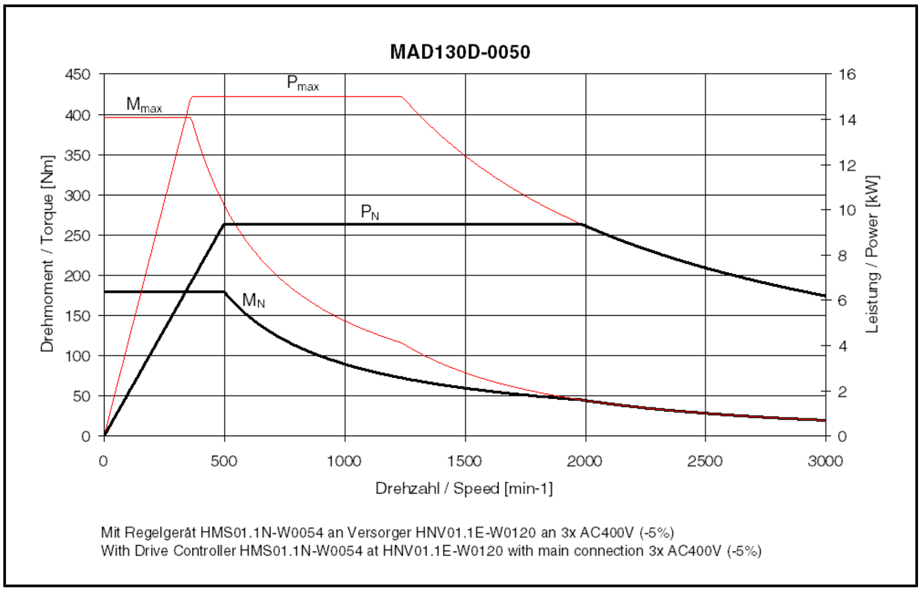



*Fig.4-40: Motor characteristic curve MAD130D-0050*

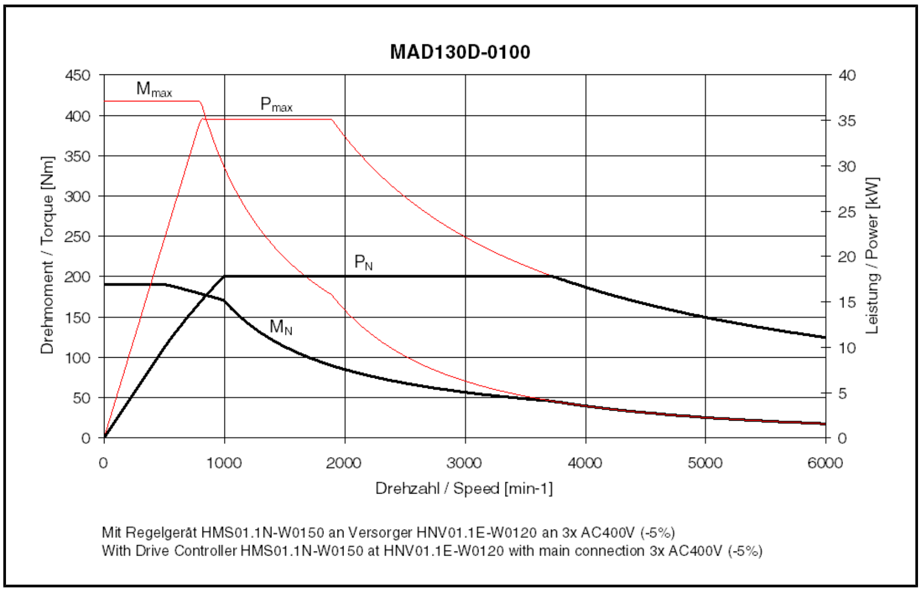



*Fig.4-41: Motor characteristic curve MAD130D-0100*

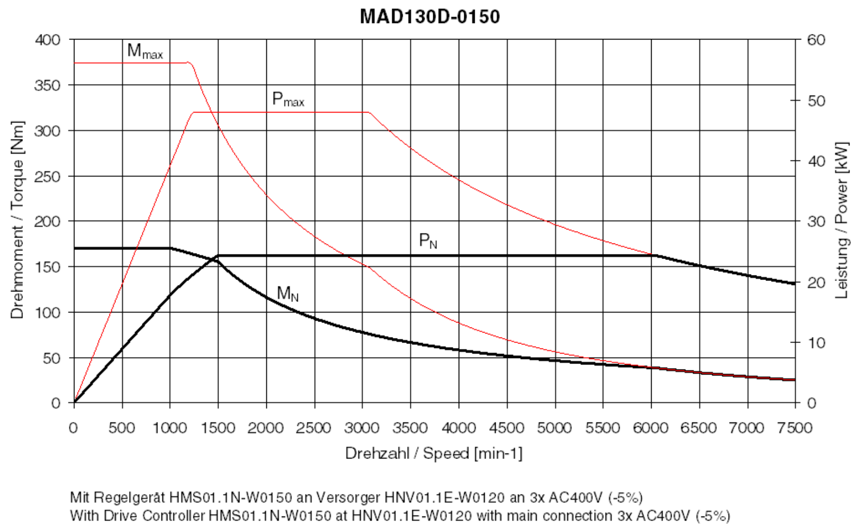



*Fig.4-42: Motor characteristic curve MAD130D-0150*

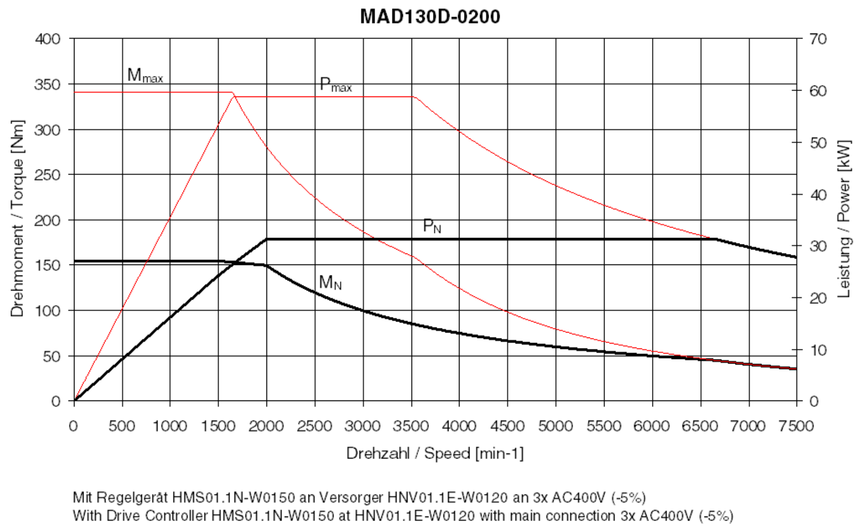



*Fig.4-43: Motor characteristic curve MAD130D-0200*

Technical Data

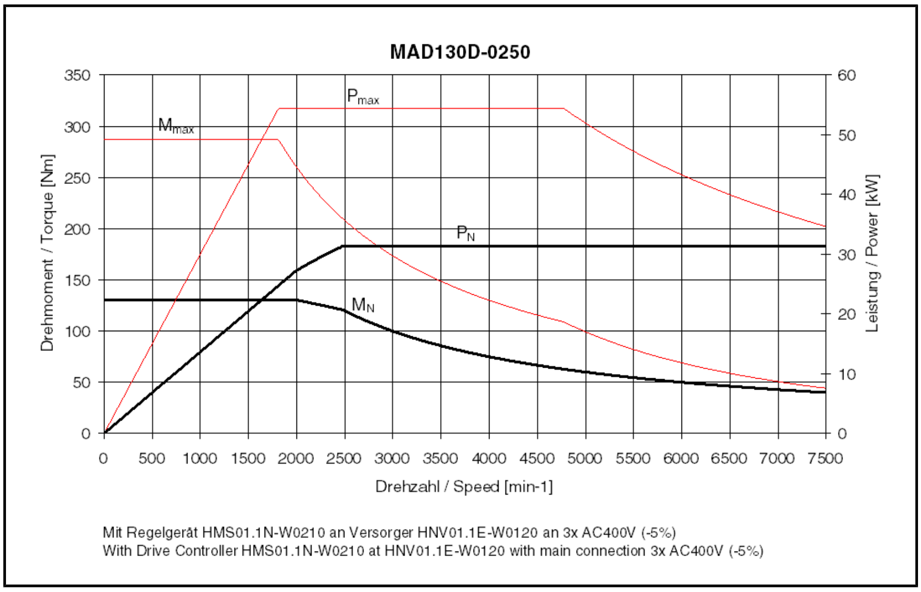



*Fig.4-44: Motor characteristic curve MAD130D-0250*

## 4.4.7 Motor Fan MAD130

### Axial fan MAD130 - Technical data

| Fan | Symbol | Unit | Axial Fan |
|---|---|---|---|
| Air current | | | B ⇒ A, blowing |
| Connection voltage | $U_N$ | V | 3 x 400V ± 15 %, 50/60 Hz...<br>3 x 480V ± 10 %, 50/60 Hz |
| Power consumption | $S_N$ | VA | 139...208 |
| Fan flow 1) | $I_N$ | A | 0.2...0.25 |
| Medium air volume | V | m³/h | 1000 |
| 1) If $I_N$ is + 20% or more, the fan flow should be monitored. | | | |

*Fig.4-45: Axial fan MAD130*

## 4.4.8 Holding Brake MAD130 (Option)

### Holding brakes MAD/MAF130 - Technical data

| Holding brake | Symbol | Unit | Electrically clamping | Electrically releasing |
|---|---|---|---|---|
| Transmittable torque | $M_4$ | Nm | 100 | 80 |
| Connection voltage | $U_{Br}$ | V | DC 24 ± 10% | |
| Rated current | $I_{Br}$ | A | 1,5 | 1,6 |
| Moment of inertia | $J_{Br}$ | kgm² | 0,002 | |
| Max. permissible braking energy | $W_{max}$ | Ws | 30000 | 25000 |
| Disconnection time | $t_2$ | ms | 65 | 140 |
| Connection time | $t_1$ | ms | 110 | 50 |
| Maximum speed | $n_{Br\_max}$ | $min^{-1}$ | 8000 | |
| Mass | m | kg | 8 | |

*Fig.4-46: Holding brakes MAD/MAF130*

# 4.5 Technical Data MAD160

## 4.5.1 Data Sheet 160B

| Description | Symbol | Unit | MAD160B | | | |
|---|---|---|---|---|---|---|
| **Motor data** 1) | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** |
| Rated torque | $M_N$ | Nm | 220 | 200 | 190 | 160 |
| Rated power | $P_N$ | kW | 11.5 | 20.9 | 29.8 | 33.5 |
| Rated current | $I_N$ | A | 26.1 | 50.8 | 61.6 | 75.8 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 |
| Maximum torque | $M_{max}$ | Nm | 484 | 520 | 440 | 375 |
| Maximum output | $P_{max}$ | kW | 23.6 | 58 | 61.2 | 68.7 |
| Maximum current | $I_{max}$ | A | 51.7 | 110 | 132.2 | 157.4 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 4,200 | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | 5,000 | 8,000 6) | | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 220 | 220 | 200 | 170 |
| Continuous current at standstill | $I_{n1}$ | A | 26.1 | 53.7 | 64 | 80.9 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 9.66 | 4.44 | 3.37 | 2.54 |
| Thermal time constant | $T_{th\_nenn}$ | min | 35 | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 10 | | | |
| Discharge capacity | $C_{ab}$ | nF | 25.5 | 35 | 35 | 34.4 |
| Number of pole pairs | p | | 2 | | | |
| Power wire cross-section 2) | A | mm² | 4 | 10 | 16 | 25 |
| Moment of inertia of rotor3) | $J_{rot}$ | kgm² | 0.25 | | | |
| Weight 4) | m | kg | 201 | | | |
| Sound pressure level 5) | $L_P$ | dB(A) | 75 (+3) | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | |
| Motor protection class | | | IP65 | | | |

1) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

2) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

3) Value without holding brake.

4) Value without holding brake, with fan.

5) At 1m distance, with PWM = 4 kHz.

6) Value without holding brake. Observe maximum speed of holding brake.

*Fig.4-47: Technical data MAD160B*

Technical Data

## 4.5.2 Motor Characteristic Curves MAD160B

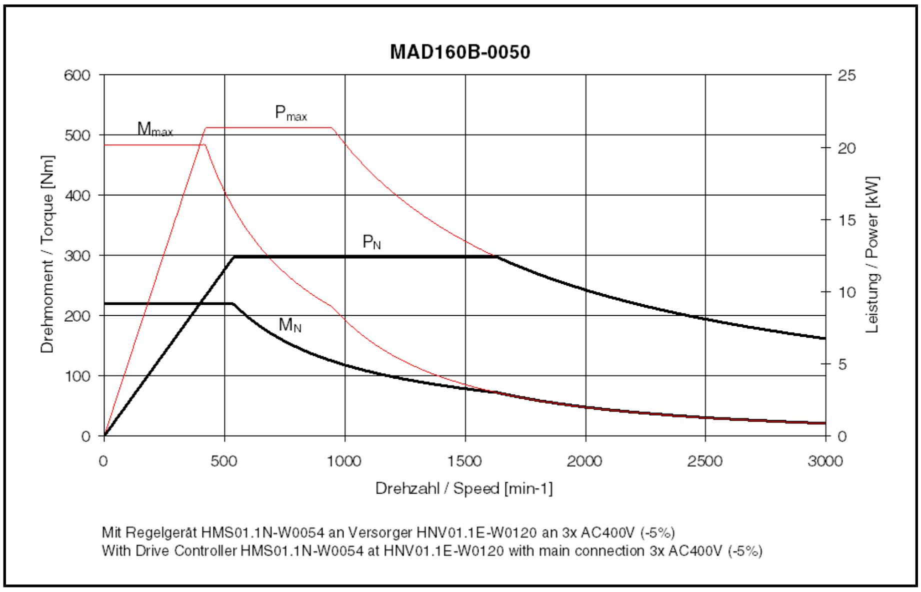



*Fig.4-48: Motor characteristic curve MAD160B-0050*

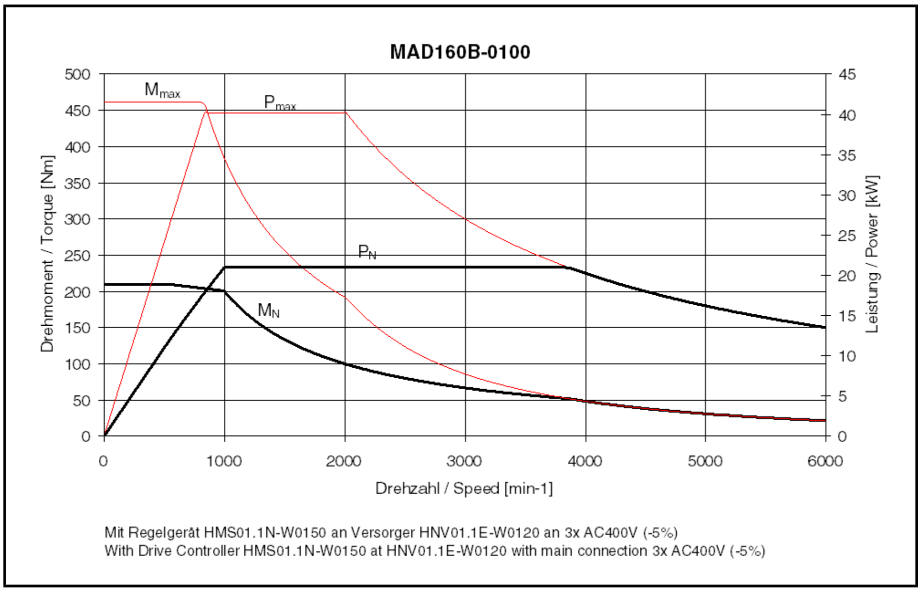



*Fig.4-49: Motor characteristic curve MAD160B-0100*

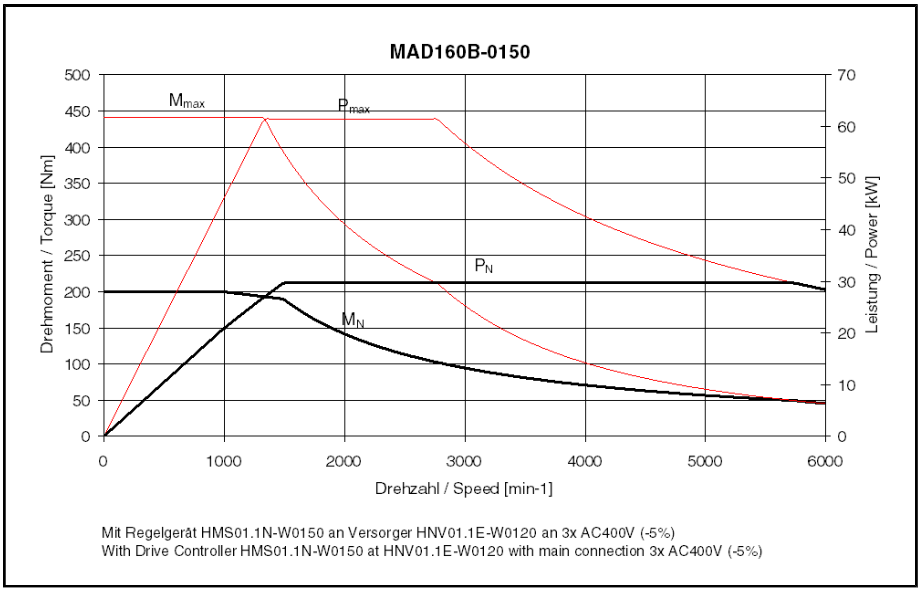



*Fig.4-50: Motor characteristic curve MAD160B-0150*

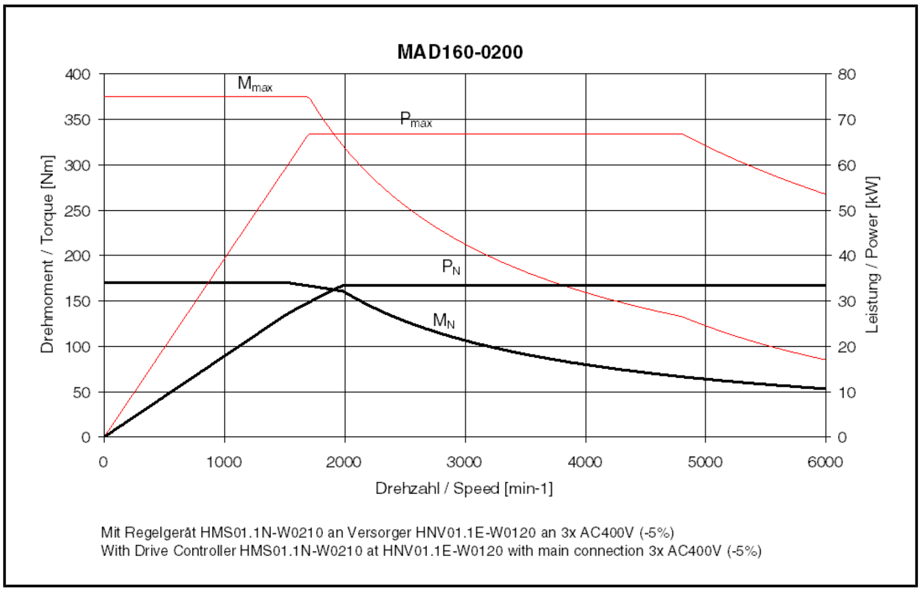



*Fig.4-51: Motor characteristic curve MAD160B-0200*

## 4.5.3 Data Sheet MAD160C

| Description | Symbol | Unit | MAD160C | | | |
|---|---|---|---|---|---|---|
| **Motor data** [1] | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** |
| Rated torque | $M_N$ | Nm | 240 | 225 | 215 | 210 |
| Rated power | $P_N$ | kW | 12.6 | 23.6 | 33.8 | 44 |
| Rated current | $I_N$ | A | 27.6 | 52.9 | 75.3 | 93.9 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 |
| Maximum torque | $M_{max}$ | Nm | 528 | 530 | 496 | 494 |
| Maximum output | $P_{max}$ | kW | 25.8 | 48.4 | 69.3 | 90.2 |
| Maximum current | $I_{max}$ | A | 54.8 | 112.3 | 152.6 | 182.4 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 4,200 | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | 5,000 | 8,000 [6] | | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 240 | 240 | 225 | 225 |
| Continuous current at standstill | $I_{n1}$ | A | 27.6 | 55.7 | 77.8 | 93.9 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 9.95 | 4.83 | 3.36 | 2.63 |
| Thermal time constant | $T_{th\_nenn}$ | min | 35 | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 10 | | | |
| Discharge capacity | $C_{ab}$ | nF | 28 | 24.4 | 27.2 | 32.3 |
| Number of pole pairs | p | | 2 | | | |
| Power wire cross-section [2] | A | mm² | 4 | 10 | 25 | 25 |
| Moment of inertia of rotor[3] | $J_{rot}$ | kgm² | 0.311 | | | |
| Weight [4] | m | kg | 238 | | | |
| Sound pressure level [5] | $L_P$ | dB(A) | 75 (+3) | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | |
| Motor protection class | | | IP65 | | | |

1) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

2) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

3) Value without holding brake.

4) Value without holding brake, with fan.

5) At 1m distance, with PWM = 4 kHz.

6) Value without holding brake. Observe maximum speed of holding brake.

*Fig.4-52: Data Sheet MAD160C*

## 4.5.4 Motor Characteristic Curves MAD160C

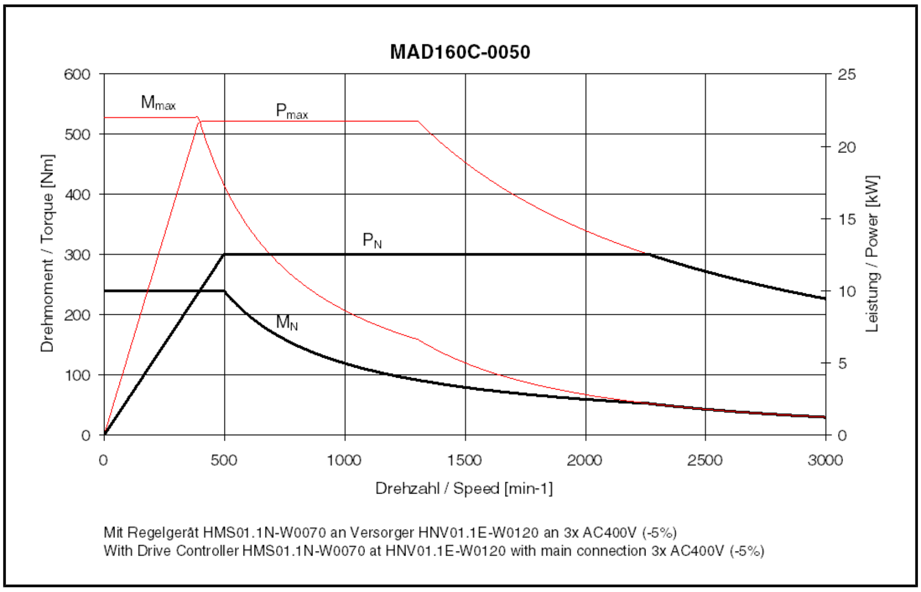



*Fig.4-53: Motor characteristic curve MAD160C-0050*

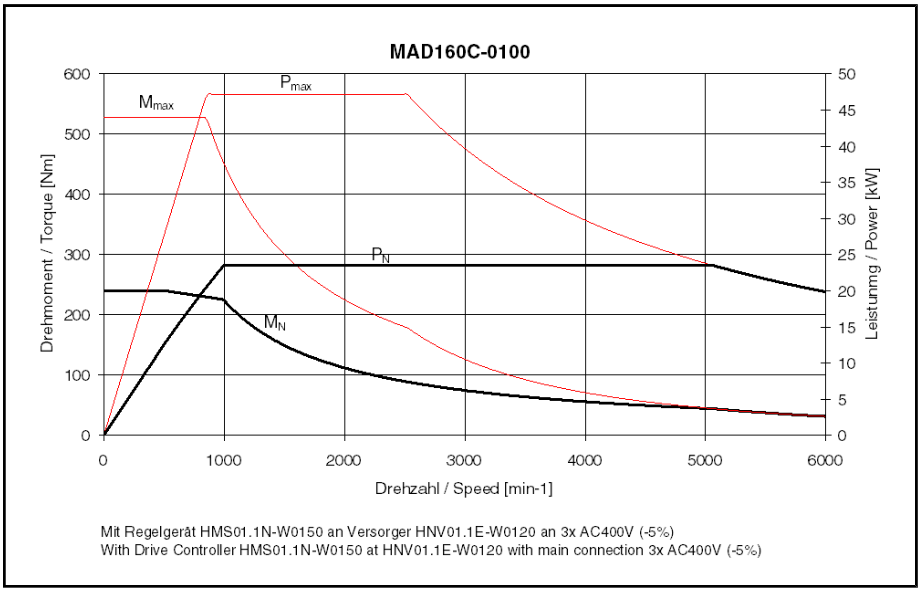



*Fig.4-54: Motor characteristic curve MAD160C-0100*

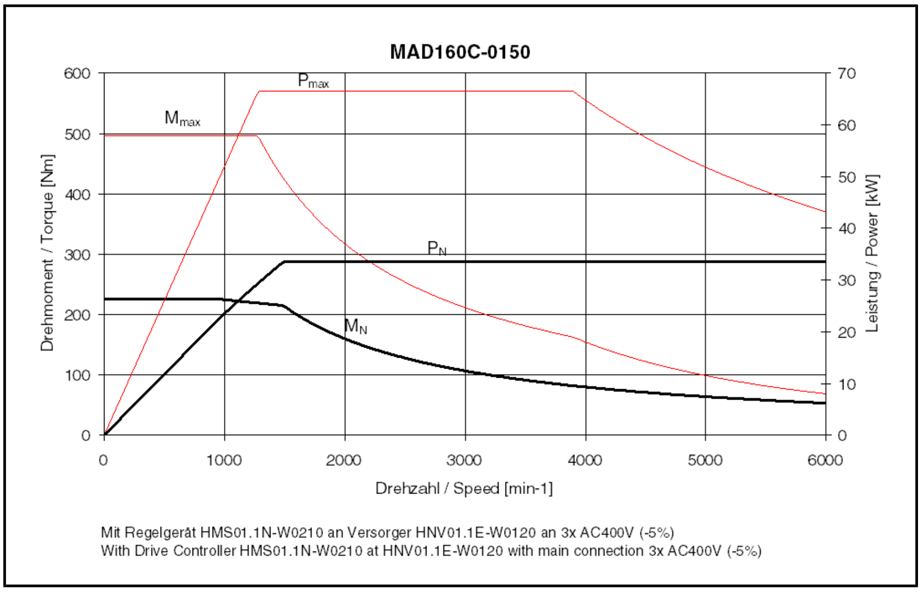



*Fig.4-55: Motor characteristic curve MAD160C-0150*

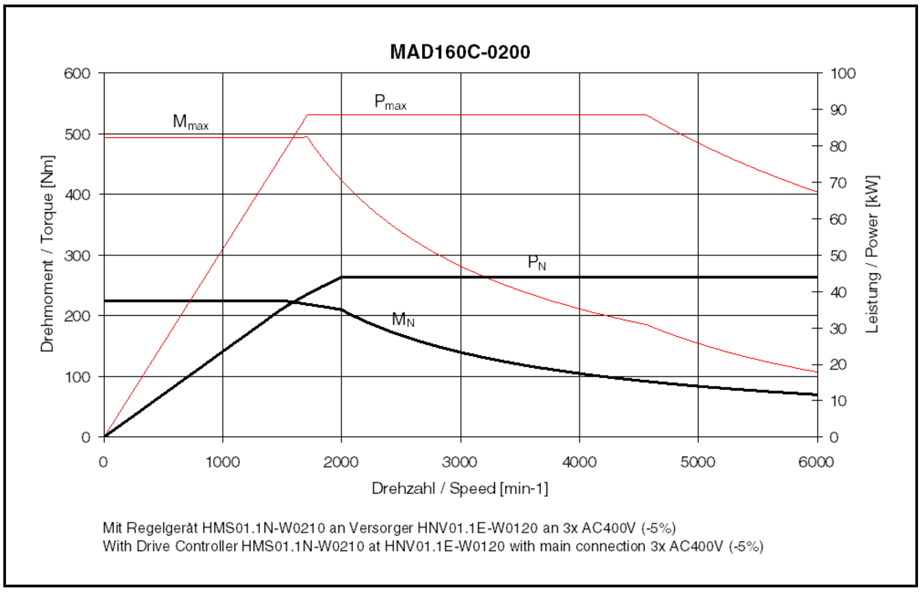



*Fig.4-56: Motor characteristic curve MAD160C-0200*

## 4.5.5 Motor Fan MAD160

**Axial fan MAD160 - Technical data**

| Fan | Symbol | Unit | Axial Fan |
|---|---|---|---|
| Air current | | | B ⇒ A, blowing |
| Connection voltage | $U_N$ | V | 3 x 400V ± 15 %, 50/60 Hz...<br>3 x 480V ± 10 %, 50/60 Hz |
| Power consumption | $S_N$ | VA | 132...175 |
| Fan flow [1)] | $I_N$ | A | 0.19...0.21 |
| Medium air volume | V | m³/h | 1000 |
| 1) If $I_N$ is + 20% or more, the fan flow should be monitored. | | | |

*Fig.4-57: Axial fan MAD160*

## 4.5.6 Holding Brake MAD160 (Option)

**Holding brakes MAD160 - Technical data**

| Holding brake | Symbol | Unit | Electrically clamping | Electrically releasing | Electrically releasing, reinforced design |
|---|---|---|---|---|---|
| Transmittable torque | $M_4$ | Nm | 100 | | 240 |
| Connection voltage | $U_{Br}$ | V | DC 24 ± 10% | | |
| Rated current | $I_{Br}$ | A | 1,8 | 2 | 1,87 |
| Moment of inertia | $J_{Br}$ | kgm² | 0,0065 | | 0,0188 |
| Max. permissible braking energy | $W_{max}$ | Ws | 12500 | 40000 | 70000 |
| Disconnection time | $t_2$ | ms | 100 | 190 | 300 |
| Connection time | $t_1$ | ms | 85 | 70 | 130 |
| Maximum speed | $n_{Br\_max}$ | $min^{-1}$ | 8000 | | 6000 |
| Mass | m | kg | 20 | | 25 |

*Fig.4-58: Holding brakes MAD160*

# 4.6 Technical Data MAD180

## 4.6.1 Data Sheet MAD180C

| Description | Symbol | Unit | MAD180C | | | |
|---|---|---|---|---|---|---|
| **Motor data** 1) | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** |
| Rated torque | $M_N$ | Nm | 325 | 300 | 270 | 250 |
| Rated power | $P_N$ | kW | 17 | 31.4 | 42.4 | 52.4 |
| Rated current | $I_N$ | A | 38.2 | 69 | 88.6 | 104.6 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 |
| Maximum torque | $M_{max}$ | Nm | 715 | 620 | 681 | 594 |
| Maximum output | $P_{max}$ | kW | 34.9 | 64.4 | 86.9 | 107.4 |
| Maximum current | $I_{max}$ | A | 76.6 | 147.5 | 182.1 | 221.7 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 4,200 | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000 | 5,000 | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | not available | | | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 325 | 330 | 300 | 270 |
| Continuous current at standstill | $I_{n1}$ | A | 38.2 | 75 | 91 | 110 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 10 | 5.19 | 3.47 | 2.7 |
| Thermal time constant | $T_{th\_nenn}$ | min | 45 | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 10 | | | |
| Discharge capacity | $C_{ab}$ | nF | 29.2 | 25.2 | 28.3 | 31.6 |
| Number of pole pairs | p | | 2 | | | |
| Power wire cross-section 2) | A | mm² | 6 | 16 | 25 | 35 |
| Moment of inertia of rotor 3) | $J_{rot}$ | kgm² | 0.458 | | | |
| Weight 4) | m | kg | 334 | | | |
| Sound pressure level 5) | $L_P$ | dB(A) | 78 (+3) | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | |
| Motor protection class | | | IP65 | | | |

1) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

2) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

3) Value without holding brake.

4) Value without holding brake, with fan.

5) At 1m distance, with PWM = 4 kHz.

*Fig.4-59: Data sheet MAD180C*

## 4.6.2 Motor Characteristic Curves MAD180C

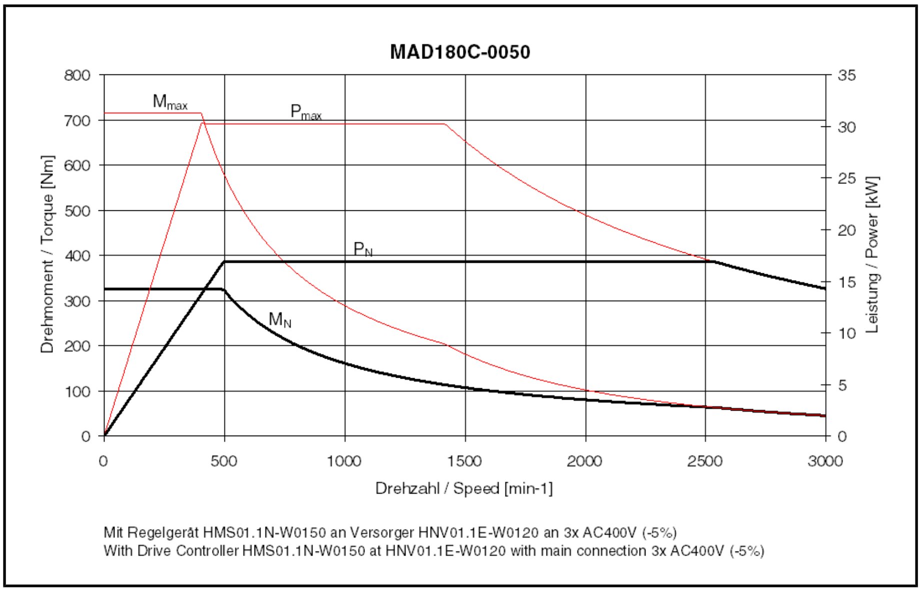



*Fig.4-60: Motor characteristic curve MAD180C-0050*

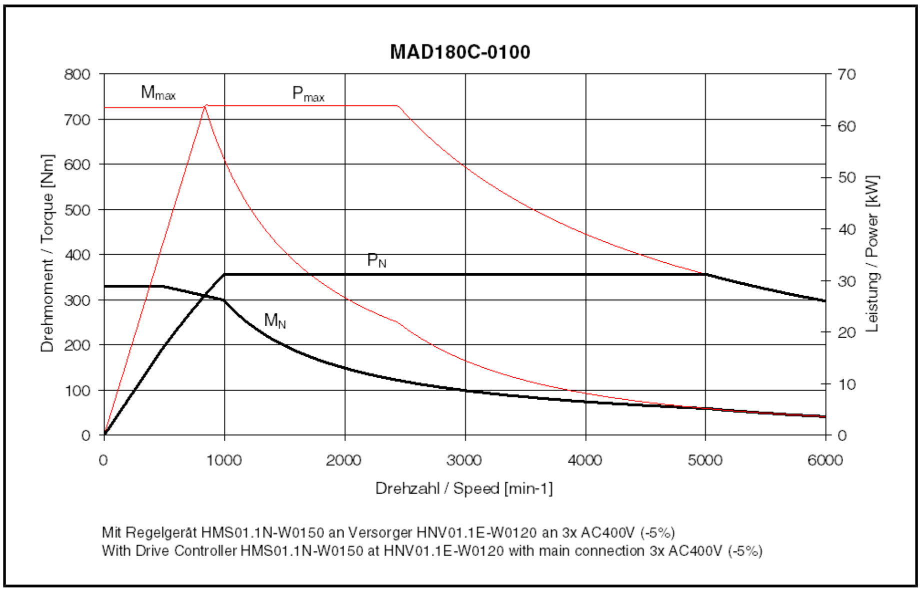



*Fig.4-61: Motor characteristic curve MAD180C-0100*

Technical Data

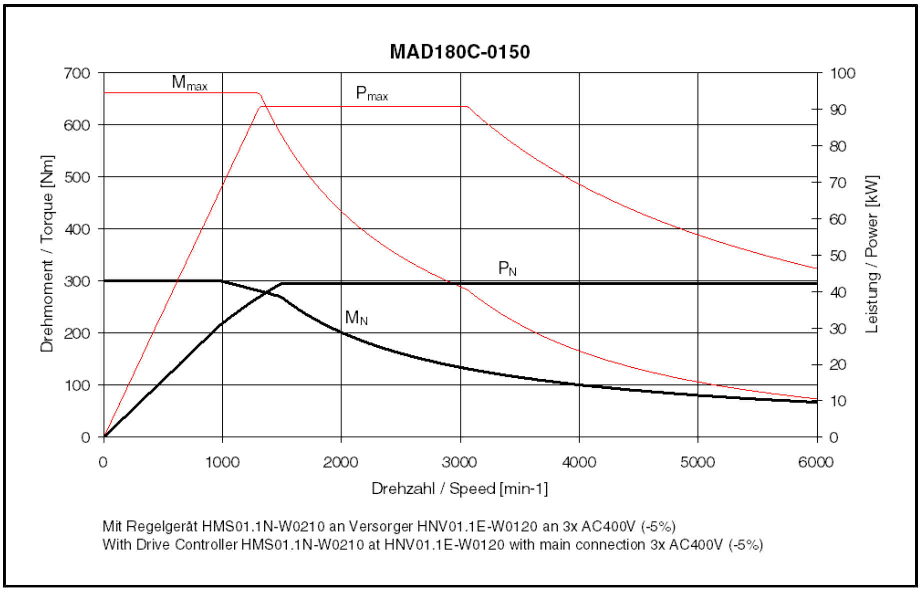



*Fig.4-62: Motor characteristic curve MAD180C-0150*

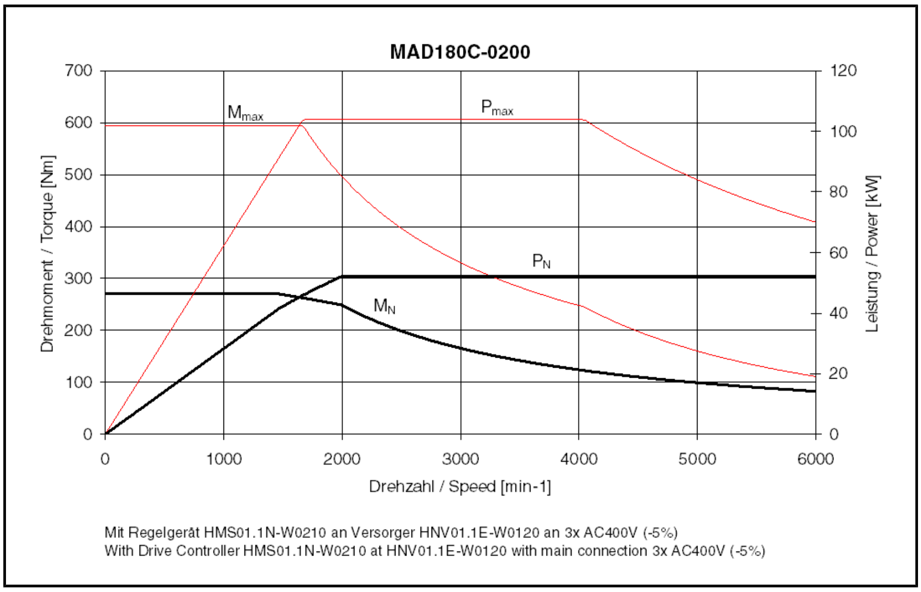



*Fig.4-63: Motor characteristic curve MAD180C-0200*

### 4.6.3 Data Sheet MAD180D

| Description | Symbol | Unit | MAD180D | | | |
|---|---|---|---|---|---|---|
| **Motor data** 1) | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** |
| Rated torque | $M_N$ | Nm | 390 | 370 | 340 | 300 |
| Rated power | $P_N$ | kW | 20.4 | 38.7 | 53.4 | 62.8 |
| Rated current | $I_N$ | A | 39.7 | 82.4 | 107.4 | 117.4 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 |
| Maximum torque | $M_{max}$ | Nm | 858 | 901 | 794 | 768 |
| Maximum output | $P_{max}$ | kW | 41.8 | 79.3 | 109.5 | 128.7 |
| Maximum current | $I_{max}$ | A | 78.4 | 188 | 220.8 | 269.7 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 4,200 | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000 | 5,000 | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | not available | | | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 390 | 410 | 370 | 350 |
| Continuous current at standstill | $I_{n1}$ | A | 39.7 | 90 | 112.3 | 132.6 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 11.31 | 5.66 | 3.72 | 2.92 |
| Thermal time constant | $T_{th\_nenn}$ | min | 45 | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 10 | | | |
| Discharge capacity | $C_{ab}$ | nF | 38 | 38.4 | 35.9 | 38 |
| Number of pole pairs | p | | 2 | | | |
| Power wire cross-section 2) | A | mm² | 10 | 25 | 35 | 2x25 |
| Moment of inertia of rotor3) | $J_{rot}$ | kgm² | 0.594 | | | |
| Weight 4) | m | kg | 403 | | | |
| Sound pressure level 5) | $L_P$ | dB(A) | 78 (+3) | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | |
| Motor protection class | | | IP65 | | | |

1) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

2) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

3) Value without holding brake.

4) Value without holding brake, with fan.

5) At 1m distance, with PWM = 4 kHz.

*Fig.4-64: Data Sheet MAD180D*

Technical Data

## 4.6.4 Motor Characteristic Curves MAD180D

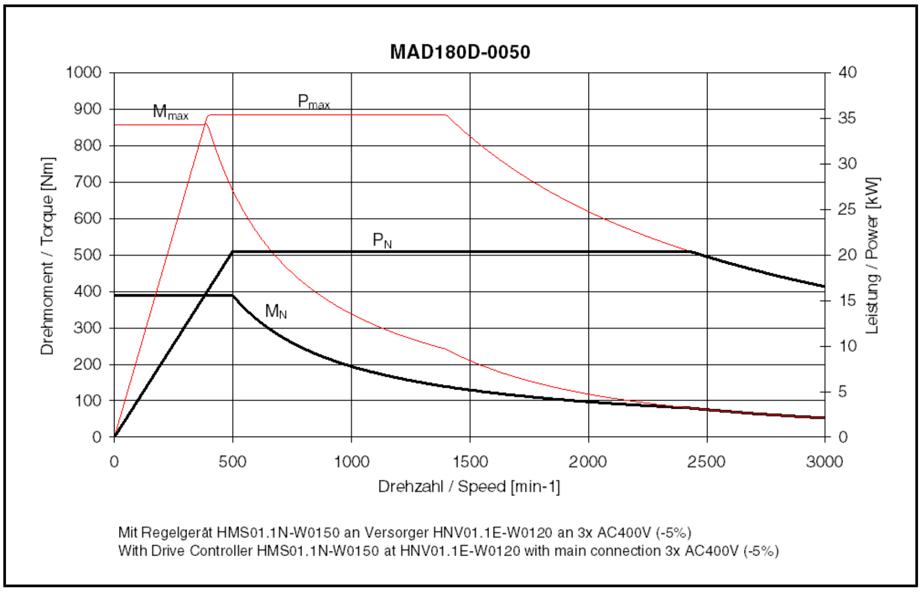



*Fig.4-65: Motor characteristic curve MAD180D-0050*

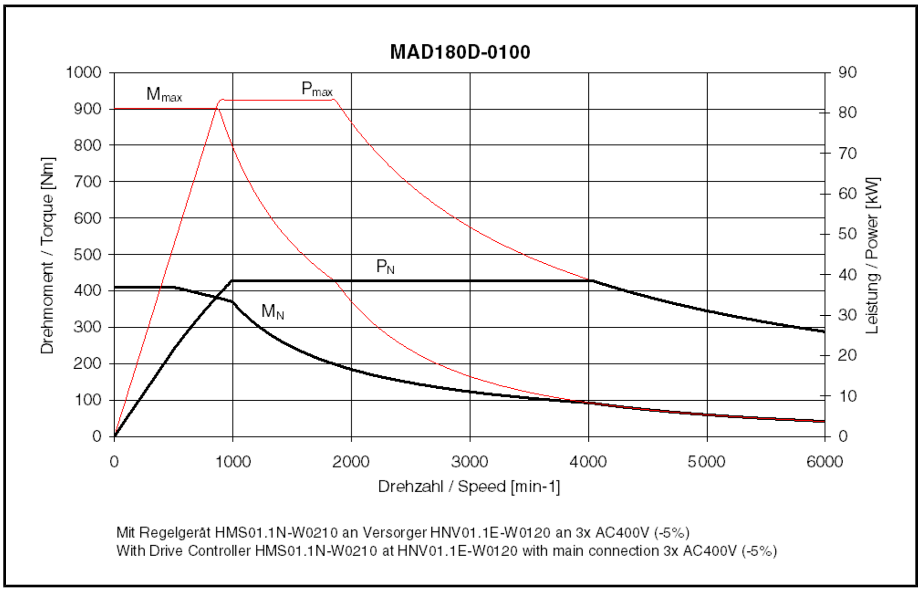



*Fig.4-66: Motor characteristic curve MAD180D-0100*

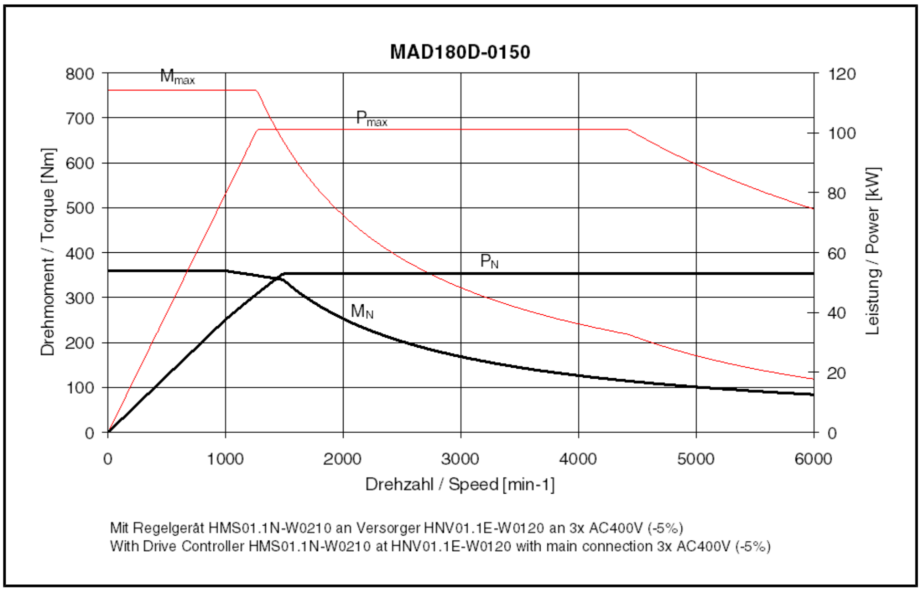



*Fig.4-67: Motor characteristic curve MAD180D-0150*

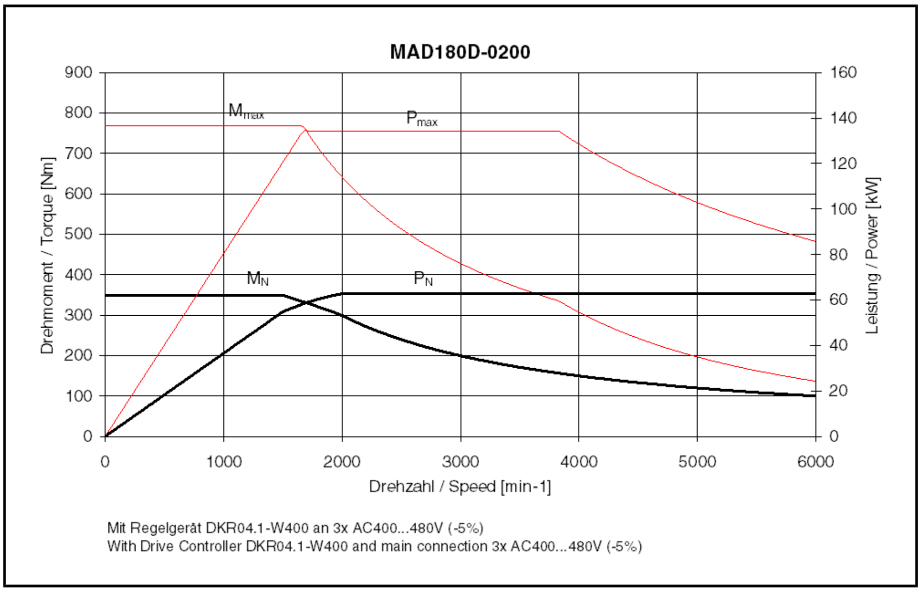



*Fig.4-68: Motor characteristic curve MAD180D-0200*

## 4.6.5 Motor Fan MAD180

**Axial fan MAD180 - Technical data**

| Fan | Symbol | Unit | Axial Fan |
|---|---|---|---|
| Air current | | | B ⇒ A, blowing |
| Connection voltage | $U_N$ | V | 3 x 400V ± 15 %, 50/60 Hz...<br>3 x 480V ± 10 %, 50/60 Hz |
| Power consumption | $S_N$ | VA | 242...382 |
| Fan flow [1)] | $I_N$ | A | 0.35...0.46 |
| Medium air volume | V | m³/h | 1500 |
| 1) If $I_N$ is + 20% or more, the fan flow should be monitored. | | | |

*Fig.4-69: Axial fan MAD180*

## 4.6.6 Holding Brake MAD180 (Option)

**Holding brakes MAD/MAF180 - Technical data**

| Holding brake | Symbol | Unit | Electrically clamping | Electrically releasing |
|---|---|---|---|---|
| Transmittable torque | $M_4$ | Nm | 300 | 240 |
| Connection voltage | $U_{Br}$ | V | DC 24 ± 10% | |
| Rated current | $I_{Br}$ | A | 2 | 1,87 |
| Moment of inertia | $J_{Br}$ | kgm² | 0,0188 | |
| Max. permissible braking energy | $W_{max}$ | Ws | 70000 | |
| Disconnection time | $t_2$ | ms | 90 | 300 |
| Connection time | $t_1$ | ms | 150 | 130 |
| Maximum speed | $n_{Br\_max}$ | $min^{-1}$ | 6000 | |
| Mass | m | kg | 25 | |

*Fig.4-70: Holding brakes MAD/MAF180*

# 4.7 Technical Data MAD225

## 4.7.1 Data Sheet MAD225C

| Description | Symbol | Unit | MAD225C | | |
|---|---|---|---|---|---|
| **Motor data** 1) | | | | | |
| **Winding** | | | **0050*** | **0100** | **0150** |
| Rated torque | $M_N$ | Nm | 660* | 640 | 593 |
| Rated power | $P_N$ | kW | 34.5* | 67 | 93.1 |
| Rated current | $I_N$ | A | 72* | 121 | 174 |
| Rated speed | $n_N$ | $min^{-1}$ | 500* | 1,000 | 1,500 |
| Key speed | $n_1$ | $min^{-1}$ | 500* | 500 | 1,000 |
| Maximum torque | $M_{max}$ | Nm | 1,450* | 1,450 | 1,450 |
| Maximum output | $P_{max}$ | kW | 70.8* | 137.4 | 190.7 |
| Maximum current | $I_{max}$ | A | 152* | 265.9 | 376 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000* | 3,750 | 3,750 |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | not available | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000* | 3,750 | 3,750 |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | not available | | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 660* | 680 | 660 |
| Continuous current at standstill | $I_{n1}$ | A | 72* | 126.3 | 187 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 10.2* | 6 | 3.9 |
| Thermal time constant | $T_{th\_nenn}$ | min | 45 | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 5 | | |
| Discharge capacity | $C_{ab}$ | nF | 120* | 48.5 | 126 |
| Number of pole pairs | p | | 2 | | |
| Power wire cross-section 2) | A | mm² | 25* | 2 x 25 | 2 x 35 |
| Rotor moment of inertia | $J_{rot}$ | kgm² | 1.65 | | |
| Weight 3) | m | kg | 610 | | |
| Sound pressure level 4) | $L_P$ | dB(A) | 78 (+3) | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | |
| Motor protection class | | | IP65 | | |

1) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

2) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

3) Value with fan.

4) At 1m distance, with PWM = 4 kHz.

*) Preliminary data

*Fig.4-71: Data Sheet MAD225C*

# 4.7.2 Motor Characteristic Curves MAD225C

Motor characteristic curve MAD225C-0050 (in preparation)

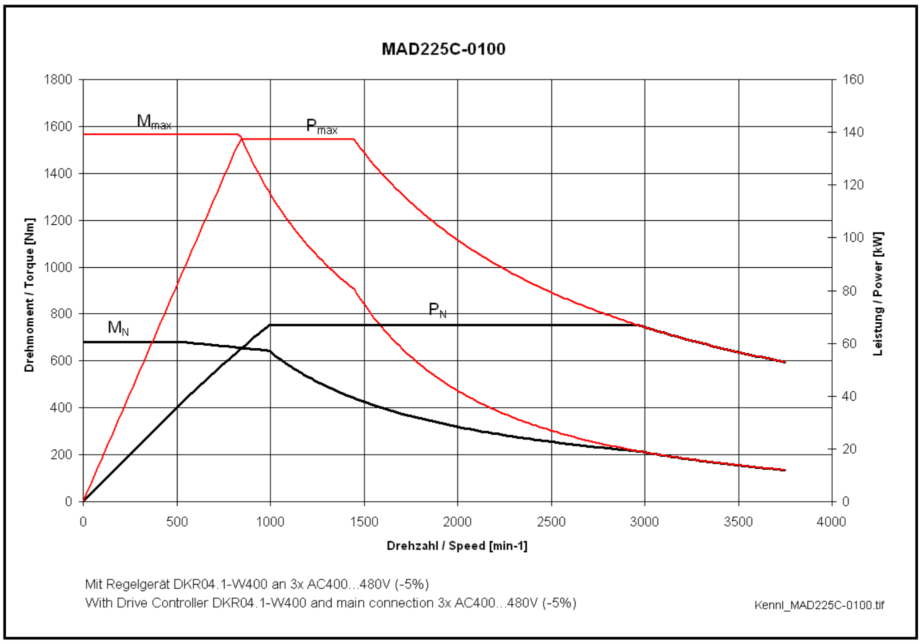



*Fig.4-72: Motor characteristic curve MAD225C-0100*

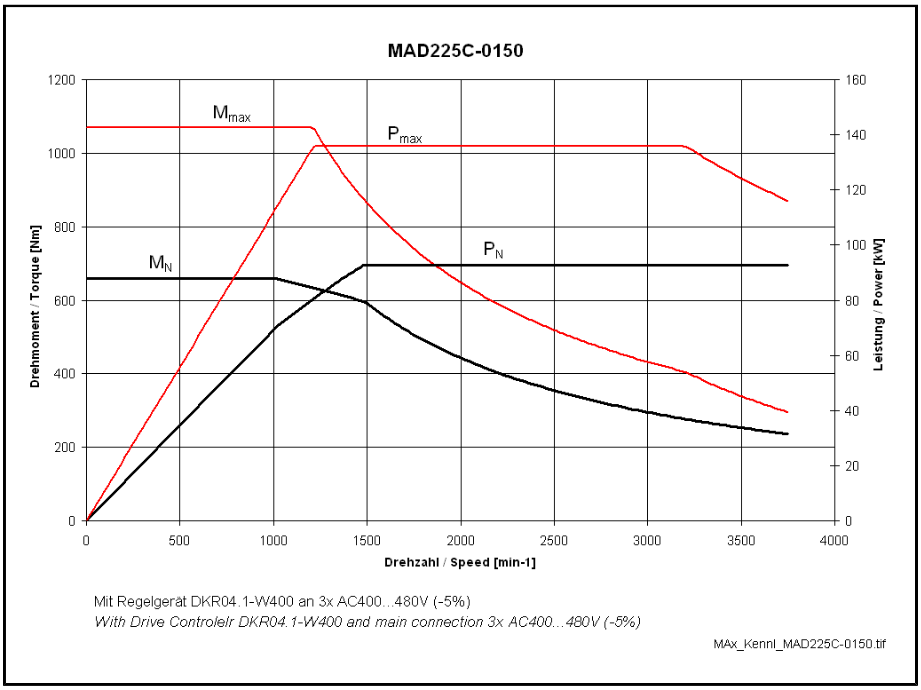



*Fig.4-73: Motor characteristic curve MAD225C-0150*

### 4.7.3 Motor Fan MAD225

**Axial fan MAD225 - Technical data**

| Fan | Symbol | Unit | Axial Fan |
|---|---|---|---|
| Air current | | | B ⇒ A, blowing |
| Connection voltage | $U_N$ | V | 3 x 400V ± 15 %, 50/60 Hz...<br>3 x 480V ± 10 %, 50/60 Hz |
| Power consumption | $S_N$ | VA | 250 |
| Fan flow [1)] | $I_N$ | A | 0.4...0.5 |
| Medium air volume | V | m³/h | 2000 |
| 1) If $I_N$ is + 20% or more, the fan flow should be monitored. | | | |

*Fig.4-74: Axial fan MAD225*

# 4.8 Technical Data MAF100

## 4.8.1 Data Sheet MAF100B

| Description | Symbol | Unit | MAF100B | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** [1] | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Rated torque | $M_N$ | Nm | 50 | 46 | 42 | 38 | 33 |
| Rated power | $P_N$ | kW | 2.6 | 4.8 | 6.6 | 8 | 8.6 |
| Rated current | $I_N$ | A | 8.5 | 15.2 | 18.1 | 23.9 | 26 |
| Rated speed | $n_N$ | min$^{-1}$ | 500 | 1,000 | 1,500 | 2,000 | 2,500 |
| Key speed | $n_1$ | min$^{-1}$ | 500 | 500 | 1,000 | 1,500 | 2,000 |
| Maximum torque | $M_{max}$ | Nm | 110 | 110 | 101 | 92.4 | 83.6 |
| Maximum output | $P_{max}$ | kW | 5.3 | 9.9 | 13.5 | 16.4 | 17.7 |
| Maximum current | $I_{max}$ | A | 20.3 | 33.3 | 46.2 | 51.7 | 50.7 |
| Maximum speed with bearing A / N | $n_{max}$ | min$^{-1}$ | 3,000 | 6,000 | 9,000 | | |
| Maximum speed with bearing R | $n_{max}$ | min$^{-1}$ | 3,000 | 6,000 | 6,300 | | |
| Maximum speed with bearing V | $n_{max}$ | min$^{-1}$ | not available | | | | |
| Maximum speed with bearing H | $n_{max}$ | min$^{-1}$ | 3,000 | 6,000 | 9,000 | 11,000 [7] | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 50 | 47 | 46 | 42 | 38 |
| Continuous current at standstill | $I_{n1}$ | A | 9.9 | 15.4 | 22.7 | 25.8 | 26 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 6.68 | 3.42 | 2.76 | 1.84 | 1.49 |
| Thermal time constant | $T_{th\_nenn}$ | min | 10 | | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 2 | | | | |
| Discharge capacity | $C_{ab}$ | nF | 6 | 6.6 | 6 | 6 | 6 |
| Number of pole pairs | p | | 3 | | | | |
| Power wire cross-section [2] | A | mm² | 1.5 | 1.5 | 2.5 | 4 | 4 |
| Moment of inertia of rotor [3] | $J_{rot}$ | kgm² | 0.019 | | | | |
| Weight [3] | m | kg | 38 | | | | |
| Sound pressure level [4] | $L_P$ | dB(A) | 70 (+3) | | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | | |
| Motor protection class | | | IP65 | | | | |
| **Liquid cooling** [5] | | | | | | | |
| Power loss to be dissipated | $P_V$ | kW | 1.0 | 1.15 | 1.18 | 1.2 | 1.25 |
| Admissible coolant inlet temperature [6] | $T_{ein}$ | °C | +10...+40 | | | | |
| Admissible coolant temperature rise at $P_V$ | $\Delta T_{diff}$ | K | 10 | | | | |
| Pressure drop at $Q_{min}$ without quick coupler [8] | $\Delta p_{diff}$ | bar | 0.2 | | 0.3 | | |
| Pressure drop constant [8] | $k_{dp}$ | | 0.1 | | | | |
| Required coolant flow at $P_V$ | $Q_{min}$ | l/min | 1.4 | 1.6 | 1.7 | | 1.8 |
| Admissible coolant inlet pressure | $p_{max}$ | bar | 3 | | | | |

| Description | Symbol | Unit | MAF100B | | | | |
|---|---|---|---|---|---|---|---|
| Motor data [1)] | | | | | | | |
| Winding | | | 0050 | 0100 | 0150 | 0200 | 0250 |
| Volume of coolant duct | $V_{kuehl}$ | l | 0.06 | | | | |

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

[2]) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

[3]) Value without holding brake.

[4]) At 1m distance, with PWM = 4 kHz.

[5]) Data refer to water as a cooling agent. When other coolants are used, convert data.

[6]) Please observe the notes for coolant inlet temperature in chapter 9.8.6 "Coolant Inlet Temperature " on page 266

[7]) Value without holding brake. Observe maximum speed of holding brake.

[8]) When using a quick coupling (option) for coolant connection, heed the notes regarding pressure drop under chapter 4.2.2 "Characteristics" on page 18.

*Fig.4-75: Data sheet MAF100B*

## 4.8.2 Motor Characteristic Curves MAF100B

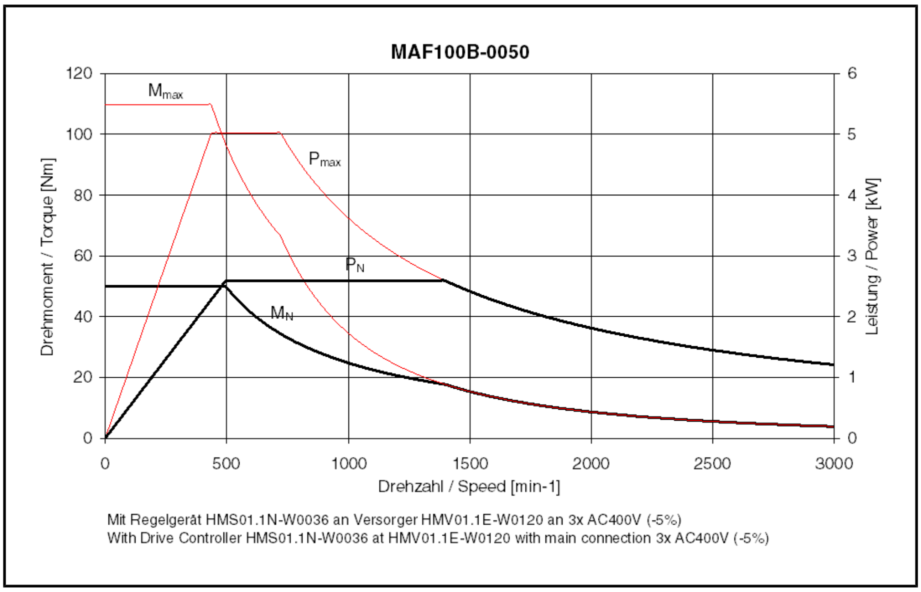



*Fig.4-76: Motor characteristic curve MAF100B-0050*

Technical Data

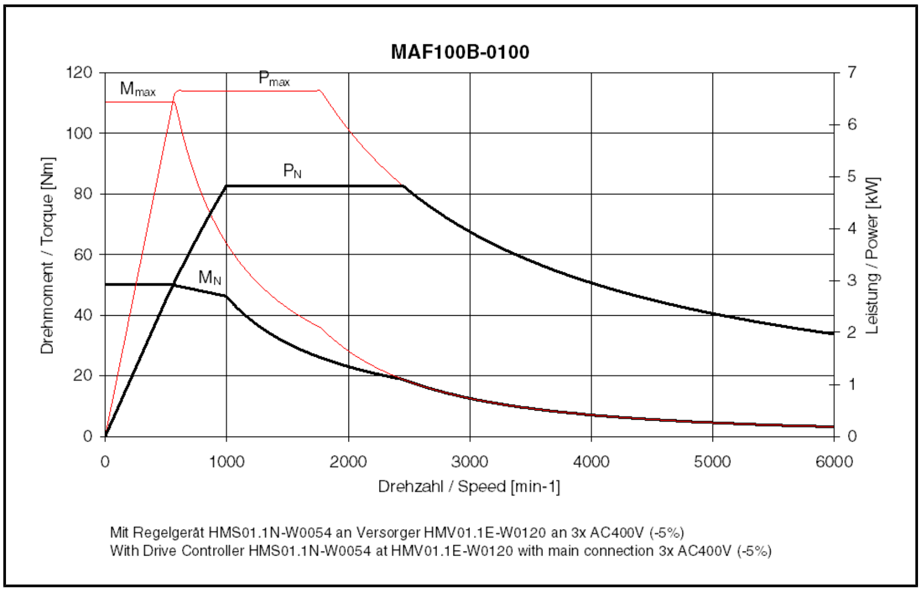



*Fig.4-77: Motor characteristic curve MAF100B-0100*

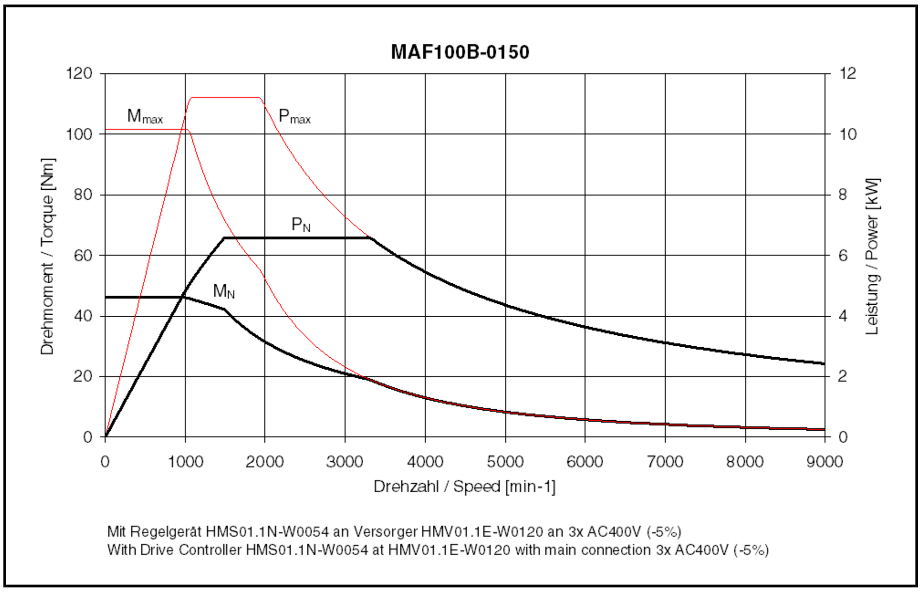



*Fig.4-78: Motor characteristic curve MAF100B-0150*

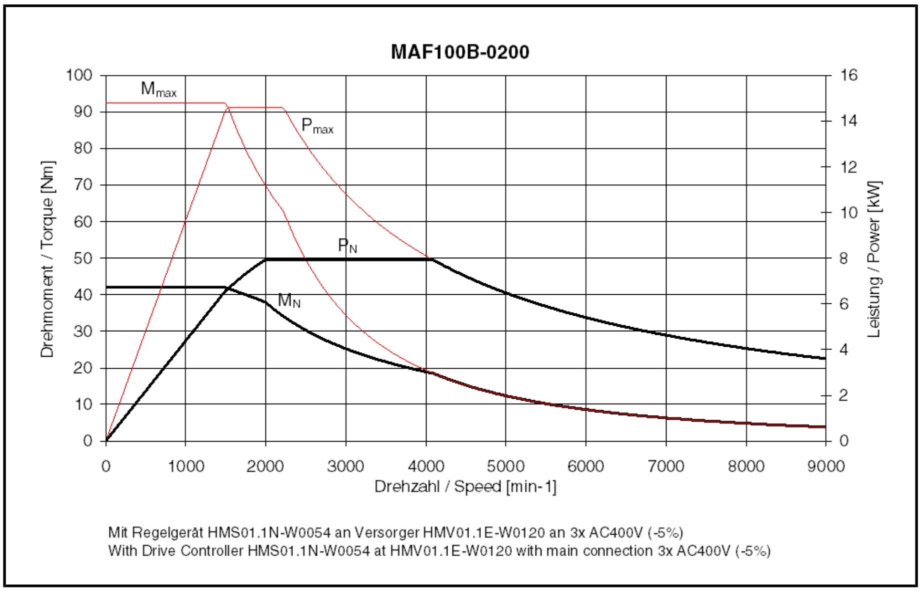



*Fig.4-79: Motor characteristic curve MAF100B-0200*

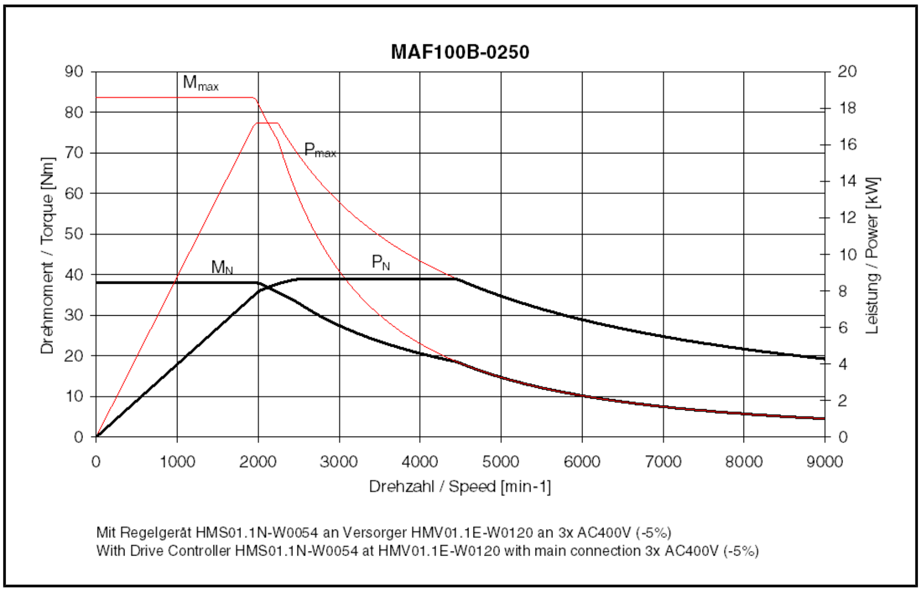



*Fig.4-80: Motor characteristic curve MAF100B-0250*

## 4.8.3 Data Sheet MAF100C

| Description | Symbol | Unit | MAF100C | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** [1] | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Rated torque | $M_N$ | Nm | 70 | 68 | 66 | 64 | 62 |
| Rated power | $P_N$ | kW | 3.9 | 7.5 | 10.4 | 13.4 | 16.2 |
| Rated current | $I_N$ | A | 12.1 | 19 | 27.9 | 36.7 | 40.2 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 | 2,500 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 | 2,000 |
| Maximum torque | $M_{max}$ | Nm | 154 | 154 | 149.5 | 145.2 | 138 |
| Maximum output | $P_{max}$ | kW | 8 | 15.4 | 21.3 | 27.5 | 33.3 |
| Maximum current | $I_{max}$ | A | 25.6 | 41.4 | 60.4 | 77.5 | 85.8 |

Technical Data

| Description | Symbol | Unit | MAF100C | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** [1] | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 6,300 | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | not available | | | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 | 11,000 [7] | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 70 | 70 | 68 | 66 | 64 |
| Continuous current at standstill | $I_{n1}$ | A | 12.1 | 19.5 | 28.6 | 37.6 | 38.5 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 6.06 | 3.77 | 2.5 | 1.91 | 1.55 |
| Thermal time constant | $T_{th\_nenn}$ | min | 10 | | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 5 | | | | |
| Discharge capacity | $C_{ab}$ | nF | 8.5 | 8.5 | 8.6 | 8.5 | 9.4 |
| Number of pole pairs | p | | 3 | | | | |
| Power wire cross-section [2] | A | mm² | 1.5 | 2.5 | 4 | 6 | 10 |
| Moment of inertia of rotor[3] | $J_{rot}$ | kgm² | 0.0284 | | | | |
| Weight [3] | m | kg | 52 | | | | |
| Sound pressure level [4] | $L_P$ | dB(A) | 70 (+3) | | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | | |
| Motor protection class | | | IP65 | | | | |
| **Liquid cooling** [5] | | | | | | | |
| Power loss to be dissipated | $P_V$ | kW | 1.1 | | 1.2 | 1.3 | 1.97 |
| Admissible coolant inlet temperature [6] | $T_{ein}$ | °C | +10...+40 | | | | |
| Admissible coolant temperature rise at $P_V$ | $\Delta T_{diff}$ | K | 10 | | | | |
| Pressure drop at $Q_{min}$ without quick coupler [8] | $\Delta p_{diff}$ | bar | 0.2 | | 0.3 | | 0.6 |
| Pressure drop constant [8] | $k_{dp}$ | | 0.1 | | | | |
| Required coolant flow at $P_V$ | $Q_{min}$ | l/min | 1.6 | | 1.7 | 1.9 | 2.8 |
| Admissible coolant inlet pressure | $p_{max}$ | bar | 3 | | | | |
| Volume of coolant duct | $V_{kuehl}$ | l | 0.08 | | | | |

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

[2]) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

[3]) Value without holding brake.

[4]) At 1m distance, with PWM = 4 kHz.

[5]) Data refer to water as a cooling agent. When other coolants are used, convert data.

[6]) Please observe the notes for coolant inlet temperature in chapter 9.8.6 "Coolant Inlet Temperature " on page 266

[7]) Value without holding brake. Observe maximum speed of holding brake.

[8]) When using a quick coupling (option) for coolant connection, heed the notes regarding pressure drop under chapter 4.2.2 "Characteristics" on page 18.

*Fig.4-81: Data Sheet MAF100C*

## 4.8.4 Motor Characteristic Curves MAF100C

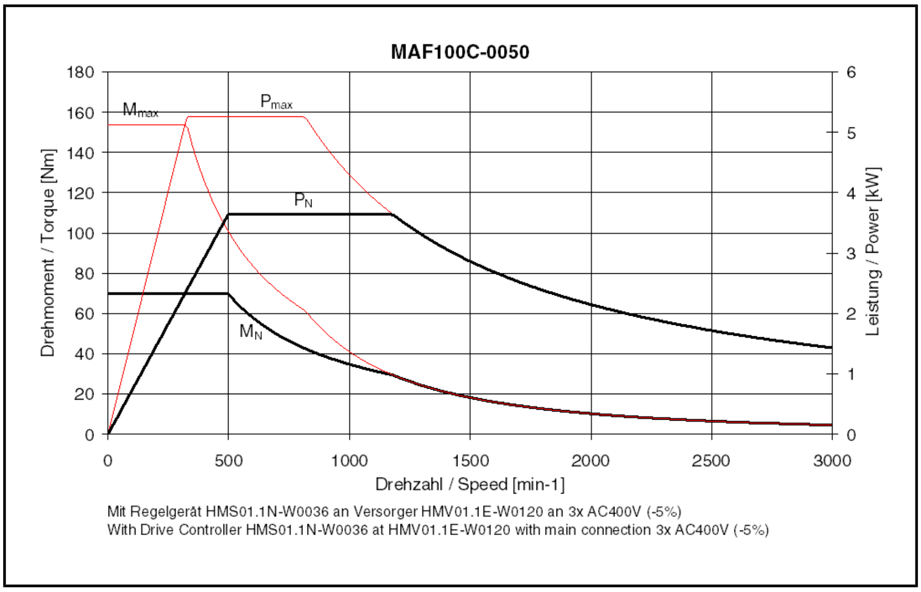



*Fig.4-82: Motor characteristic curve MAF100C-0050*

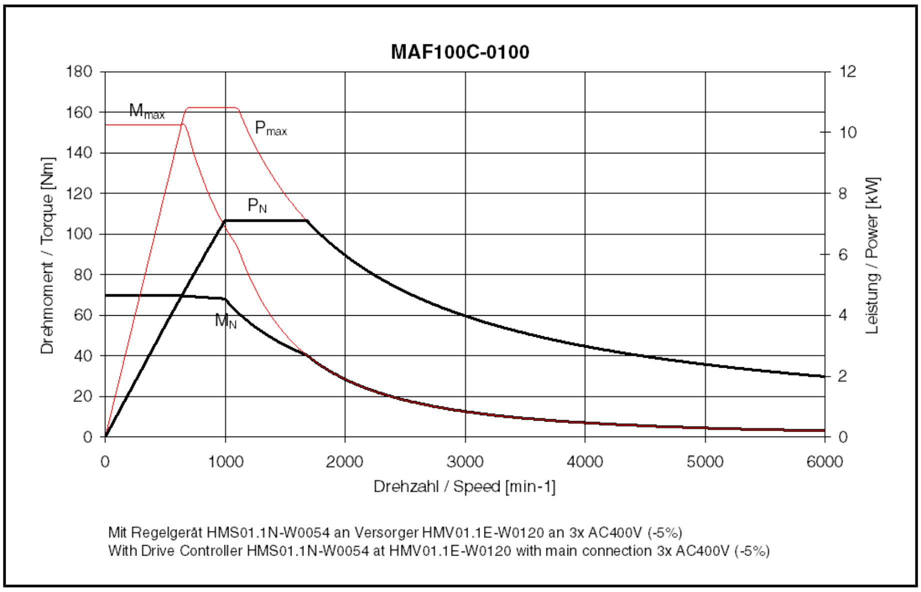



*Fig.4-83: Motor characteristic curve MAF100C-0100*

Technical Data

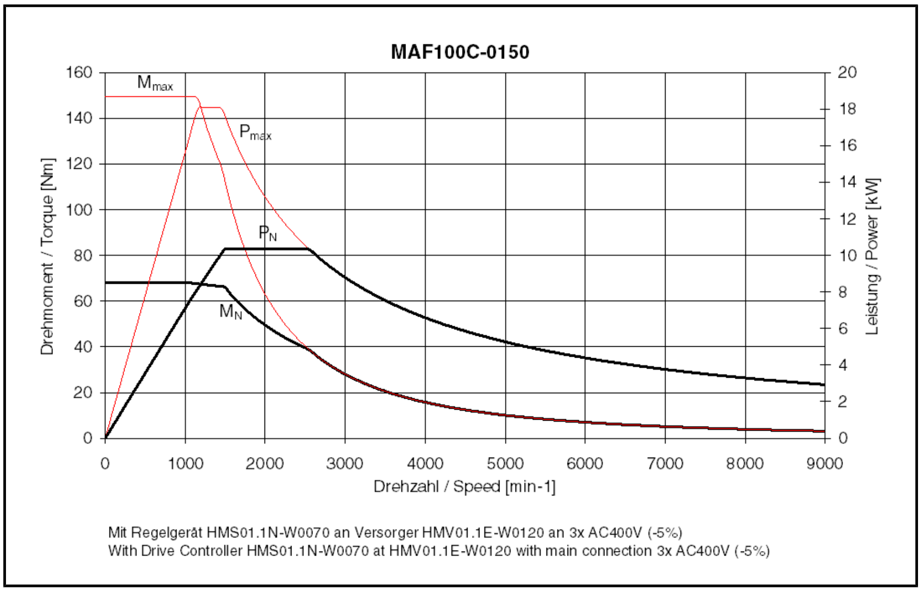



*Fig.4-84: Motor characteristic curve MAF100C-0150*

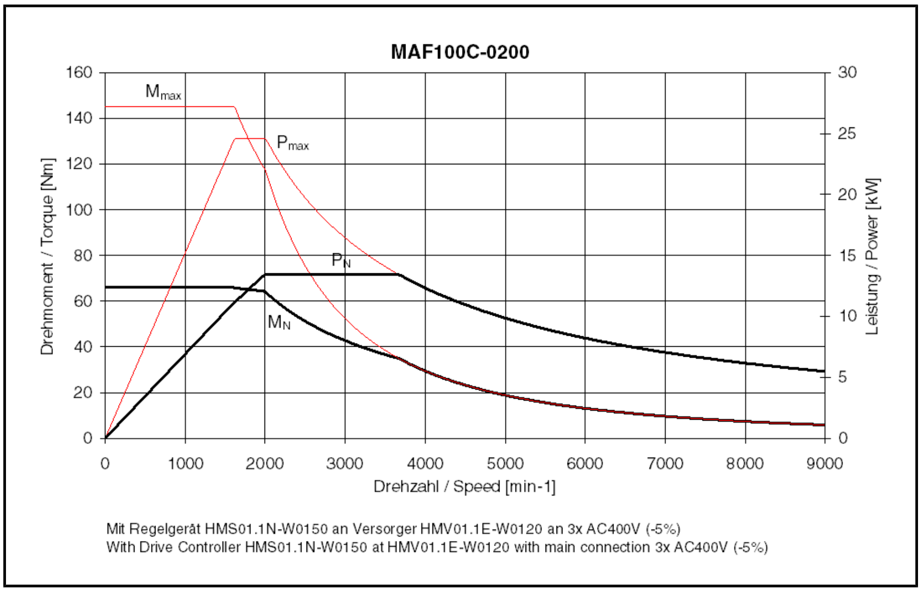
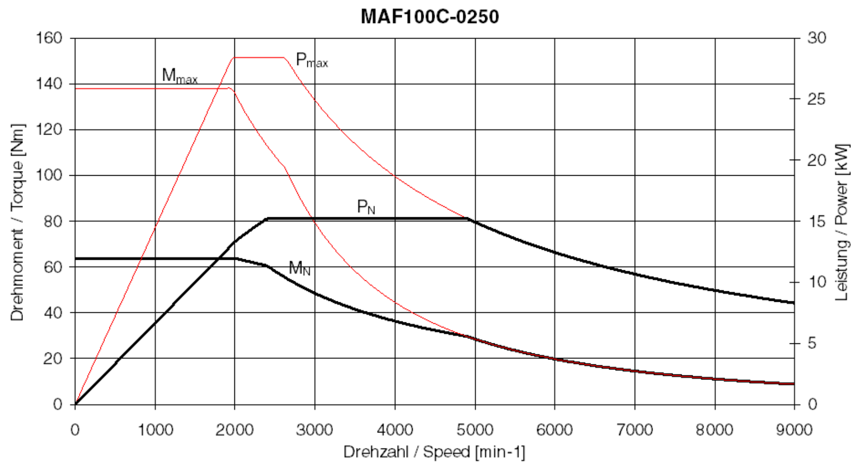



*Fig.4-85: Motor characteristic curve MAF100C-0200*




Mit Regelgerät HMS01.1N-W0150 an Versorger HMV01.1E-W0120 an 3x AC400V (-5%)
With Drive Controller HMS01.1N-W0150 at HMV01.1E-W0120 with main connection 3x AC400V (-5%)

*Fig.4-86: Motor characteristic curve MAF100C-0250*

## 4.8.5 Data Sheet MAF100D

| Description | Symbol | Unit | MAF100D | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** [1] | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Rated torque | $M_N$ | Nm | 88 | 84 | 79 | 80 | 75 |
| Rated power | $P_N$ | kW | 4.6 | 8.8 | 12.4 | 16.8 | 19.6 |
| Rated current | $I_N$ | A | 14.5 | 27.1 | 32.7 | 43.1 | 45.76 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 | 2,500 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 | 2,000 |
| Maximum torque | $M_{max}$ | Nm | 193.3 | 190 | 185.3 | 182.3 | 177.5 |
| Maximum output | $P_{max}$ | kW | 9.4 | 18 | 25.4 | 34.4 | 40.2 |
| Maximum current | $I_{max}$ | A | 29.2 | 58 | 68.7 | 91.3 | 100.4 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 6,300 | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | not available | | | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 | 11,000 [7] | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 87.8 | 88 | 84.2 | 83 | 80 |
| Continuous current at standstill | $I_{n1}$ | A | 14.5 | 27.7 | 34.3 | 44.4 | 56.1 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 6.79 | 3.51 | 2.77 | 2.04 | 1.55 |
| Thermal time constant | $T_{th\_nenn}$ | min | 10 | | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 5 | | | | |
| Discharge capacity | $C_{ab}$ | nF | 11 | 11.2 | 11 | 10 | 9.2 |
| Number of pole pairs | p | | 3 | | | | |
| Power wire cross-section [2] | A | mm² | 1.5 | 4 | 6 | 10 | 10 |
| Moment of inertia of rotor[3] | $J_{rot}$ | kgm² | 0.032 | | | | |
| Weight [3] | m | kg | 64 | | | | |
| Sound pressure level [4] | $L_P$ | dB(A) | 70 (+3) | | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | | |

Technical Data

| Description | Symbol | Unit | MAF100D | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** [1] | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | | |
| Motor protection class | | | IP65 | | | | |
| **Liquid cooling** [5] | | | | | | | |
| Power loss to be dissipated | $P_V$ | kW | 1.4 | 1.65 | 1.7 | 1.74 | 1.94 |
| Admissible coolant inlet temperature [6] | $T_{ein}$ | °C | +10...+40 | | | | |
| Admissible coolant temperature rise at $P_V$ | $\Delta T_{diff}$ | K | 10 | | | | |
| Pressure drop at $Q_{min}$ without quick coupler [8] | $\Delta p_{diff}$ | bar | 0.5 | 0.6 | 0.7 | | 0.8 |
| Pressure drop constant [8] | $k_{dp}$ | | 0.14 | | | | |
| Required coolant flow at $P_V$ | $Q_{min}$ | l/min | 2.0 | 2.4 | | 2.5 | 2.8 |
| Admissible coolant inlet pressure | $p_{max}$ | bar | 3 | | | | |
| Volume of coolant duct | $V_{kuehl}$ | l | 0.11 | | | | |

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

[2]) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

[3]) Value without holding brake.

[4]) At 1m distance, with PWM = 4 kHz.

[5]) Data refer to water as a cooling agent. When other coolants are used, convert data.

[6]) Please observe the notes for coolant inlet temperature in chapter 9.8.6 "Coolant Inlet Temperature " on page 266

[7]) Value without holding brake. Observe maximum speed of holding brake.

[8]) When using a quick coupling (option) for coolant connection, heed the notes regarding pressure drop under chapter 4.2.2 "Characteristics" on page 18.

*Fig.4-87: Data Sheet MAF100D*

## 4.8.6 Motor Characteristic Curves MAF100D

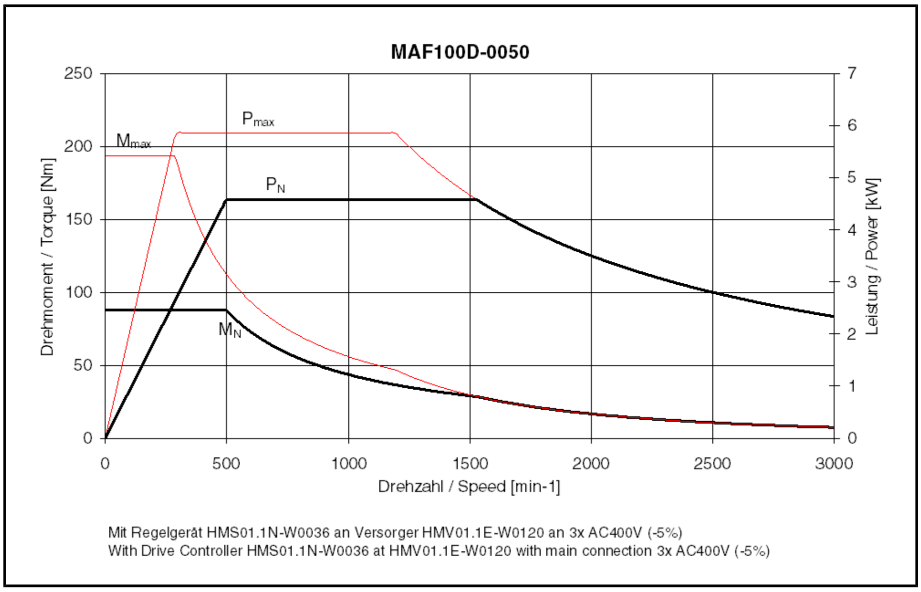



*Fig.4-88: Motor characteristic curve MAF100D-0050*

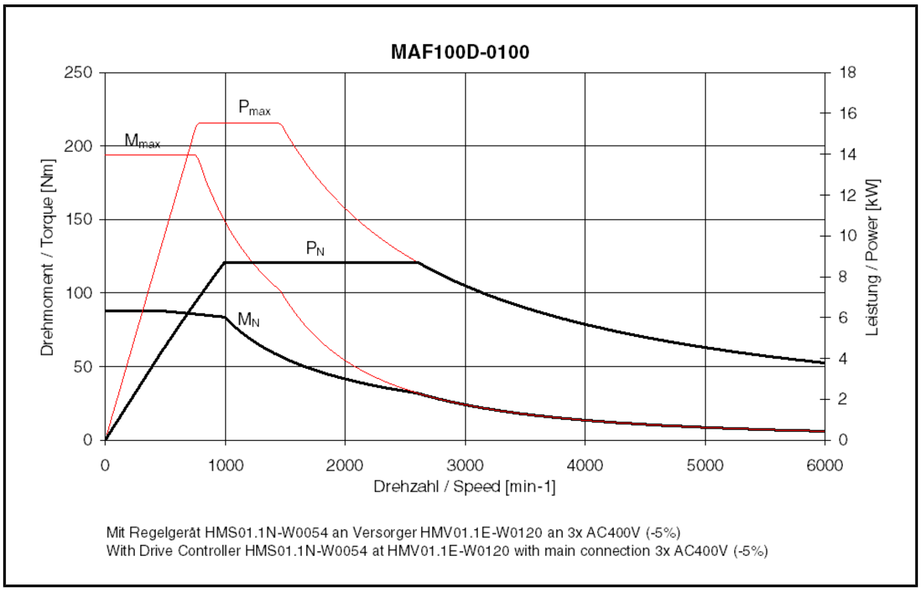



*Fig.4-89: Motor characteristic curve MAF100D-0100*

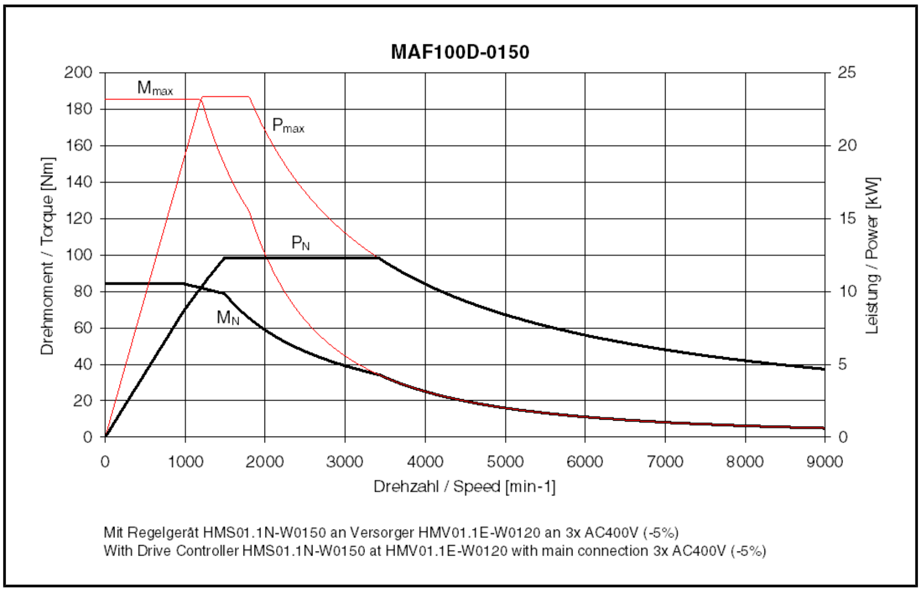



*Fig.4-90: Motor characteristic curve MAF100D-0150*

Technical Data

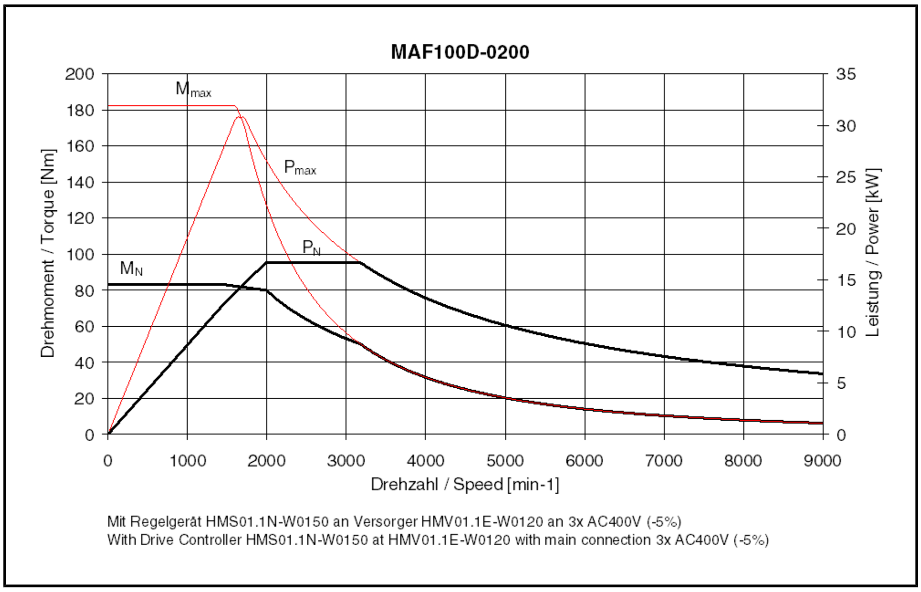



*Fig.4-91: Motor characteristic curve MAF100D-0200*

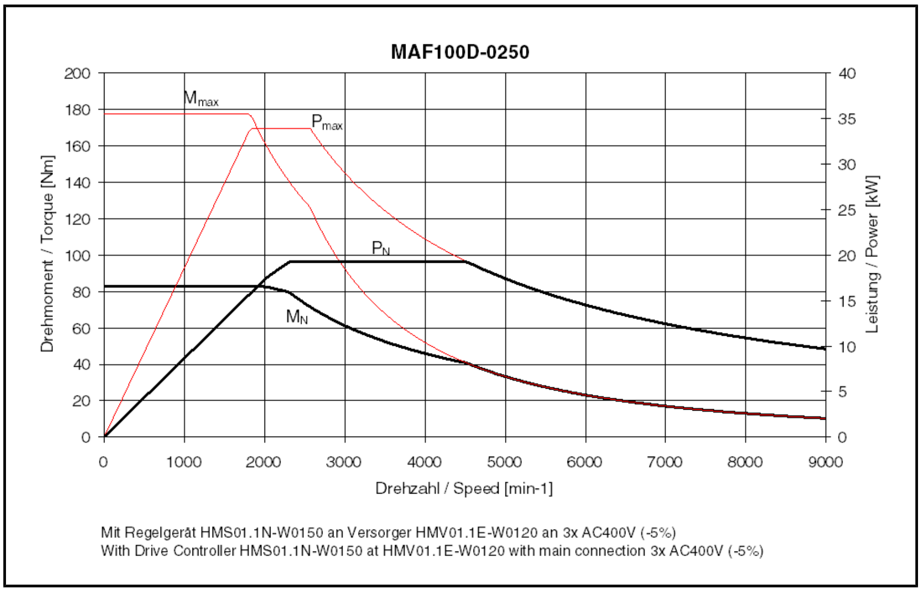



*Fig.4-92: Motor characteristic curve MAF100D-0250*

## 4.8.7 Holding Brake MAF100 (Option)

**Holding brakes MAD/MAF100 - Technical data**

| Holding brake | Symbol | Unit | Electrically clamping | Electrically releasing |
|---|---|---|---|---|
| Transmittable torque | $M_4$ | Nm | 30 | 24 |
| Connection voltage | $U_{Br}$ | V | DC 24 ± 10% | |
| Rated current | $I_{Br}$ | A | 0,9 | 1,1 |
| Moment of inertia | $J_{Br}$ | kgm² | 0,00056 | |
| Max. permissible braking energy | $W_{max}$ | Ws | 4800 | 12500 |
| Disconnection time | $t_2$ | ms | 50 | 90 |
| Connection time | $t_1$ | ms | 42 | 30 |
| Maximum speed | $n_{Br\_max}$ | min$^{-1}$ | 10000 | |
| Mass | m | kg | 2 | 1,6 |

*Fig.4-93: Holding brakes MAD/MAF100*

# 4.9 Technical Data MAF130

## 4.9.1 Data Sheet MAF130B

| Description | Symbol | Unit | MAF130B | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** [1] | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Rated torque | $M_N$ | Nm | 116 | 112 | 115 | 100 | 90 |
| Rated power | $P_N$ | kW | 6.1 | 11.7 | 18.1 | 20.9 | 23.6 |
| Rated current | $I_N$ | A | 14.7 | 28.4 | 43.7 | 52.7 | 58.8 |
| Rated speed | $n_N$ | min$^{-1}$ | 500 | 1,000 | 1,500 | 2,000 | 2,500 |
| Key speed | $n_1$ | min$^{-1}$ | 500 | 500 | 1,000 | 1,500 | 2,000 |
| Maximum torque | $M_{max}$ | Nm | 255 | 255 | 264 | 220 | 210 |
| Maximum output | $P_{max}$ | kW | 12.5 | 24 | 37.1 | 42.9 | 48.3 |
| Maximum current | $I_{max}$ | A | 30.5 | 60.95 | 94.7 | 108.9 | 126.6 |
| Maximum speed with bearing A / N | $n_{max}$ | min$^{-1}$ | 3,000 | 6,000 | 7,500 | | |
| Maximum speed with bearing R | $n_{max}$ | min$^{-1}$ | 3,000 | 5,250 | | | |
| Maximum speed with bearing V | $n_{max}$ | min$^{-1}$ | 3,000 | 6,000 | 7,500 | | |
| Maximum speed with bearing H | $n_{max}$ | min$^{-1}$ | 3,000 | 6,000 | 9,000 [7] | 10,000 [7] | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 115.8 | 115.8 | 120 | 108 | 95 |
| Continuous current at standstill | $I_{n1}$ | A | 14.6 | 29.3 | 45.3 | 53 | 61.2 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 8.46 | 4.25 | 2.83 | 2.07 | 1.77 |
| Thermal time constant | $T_{th\_nenn}$ | min | 15 | | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 5 | | | | |
| Discharge capacity | $C_{ab}$ | nF | 16 | 16 | 16 | 11.6 | 13.2 |
| Number of pole pairs | p | | 3 | | | | |
| Power wire cross-section [2] | A | mm² | 1.5 | 4 | 10 | 10 | 16 |
| Moment of inertia of rotor[3] | $J_{rot}$ | kgm² | 0.079 | | | | |
| Weight [3] | m | kg | 82 | | | | |
| Sound pressure level [4] | $L_P$ | dB(A) | 70 (+3) | | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | | |

Technical Data

| Description | Symbol | Unit | MAF130B | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** 1) | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | | |
| Motor protection class | | | IP65 | | | | |
| **Liquid cooling** 5) | | | | | | | |
| Power loss to be dissipated | $P_V$ | kW | 1.8 | 1.9 | 2 | 2.2 | |
| Admissible coolant inlet temperature 6) | $T_{ein}$ | °C | +10...+40 | | | | |
| Admissible coolant temperature rise at $P_V$ | $\Delta T_{diff}$ | K | 10 | | | | |
| Pressure drop at $Q_{min}$ without quick coupler 8) | $\Delta p_{diff}$ | bar | 0.1 | | | 0.1 | |
| Pressure drop constant 8) | $k_{dp}$ | | 0.02 | | | | |
| Required coolant flow at $P_V$ | $Q_{min}$ | l/min | 2.6 | 2.7 | 2.9 | 3.2 | |
| Admissible coolant inlet pressure | $p_{max}$ | bar | 3 | | | | |
| Volume of coolant duct | $V_{kuehl}$ | l | 0.15 | | | | |

1) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

2) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

3) Value without holding brake.

4) At 1m distance, with PWM = 4 kHz.

5) Data refer to water as a cooling agent. When other coolants are used, convert data.

6) Please observe the notes for coolant inlet temperature in chapter 9.8.6 "Coolant Inlet Temperature " on page 266

7) Value without holding brake. Observe maximum speed of holding brake.

8) When using a quick coupling (option) for coolant connection, heed the notes regarding pressure drop under chapter 4.2.2 "Characteristics" on page 18.

*Fig.4-94: Data Sheet MAF130B*

## 4.9.2 Motor Characteristic Curve MAF130B

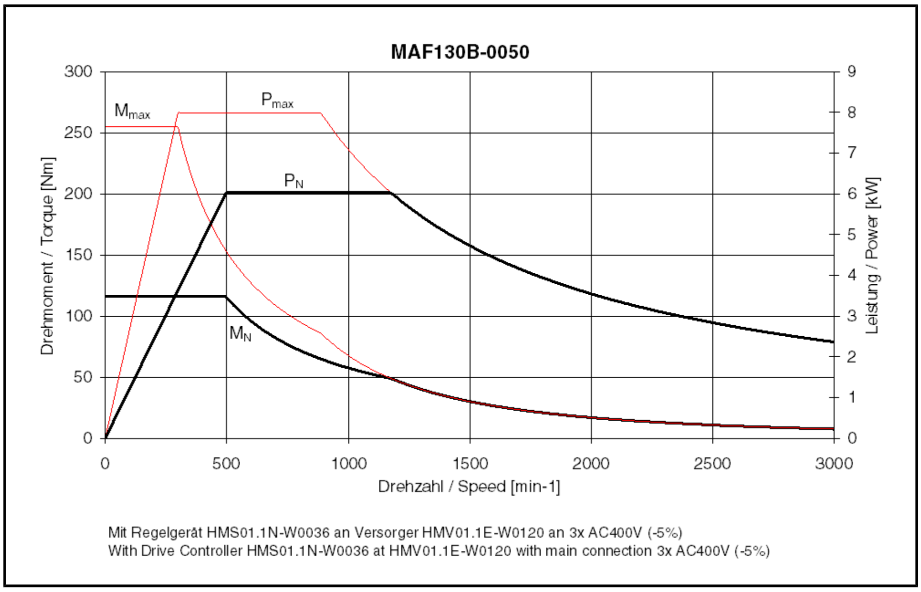



*Fig.4-95: Motor characteristic curve MAF130B-0050*

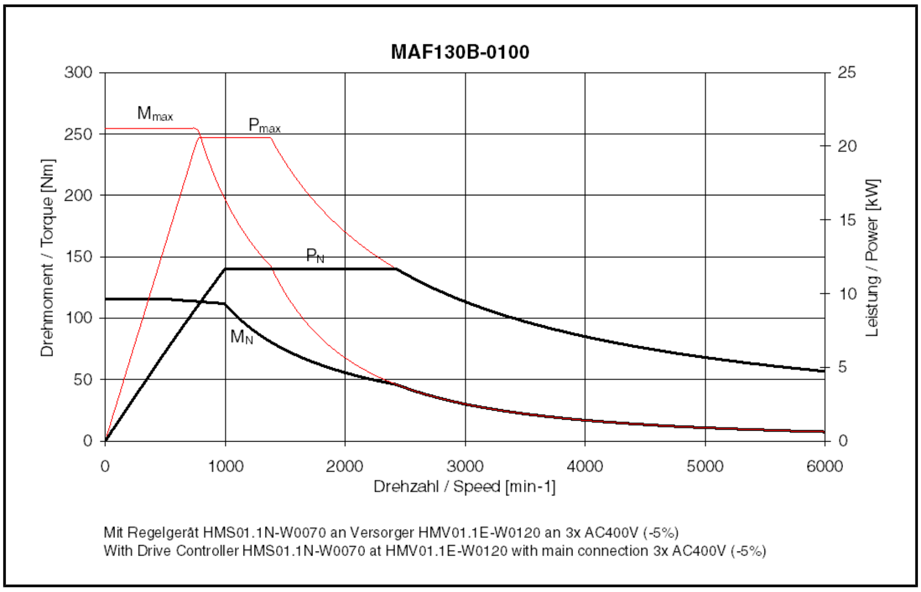



*Fig.4-96: Motor characteristic curve MAF130B-0100*

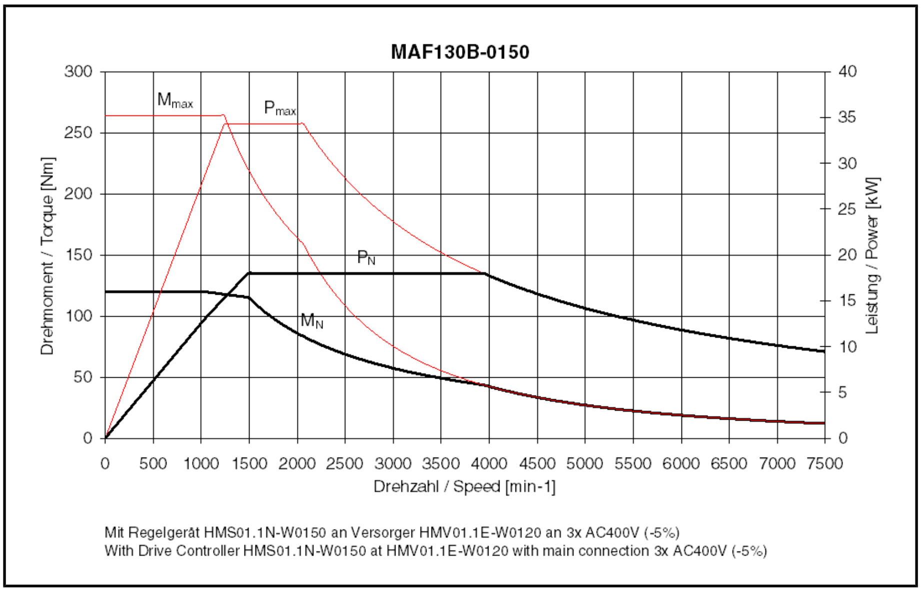



*Fig.4-97: Motor characteristic curve MAF130B-0150*

Technical Data

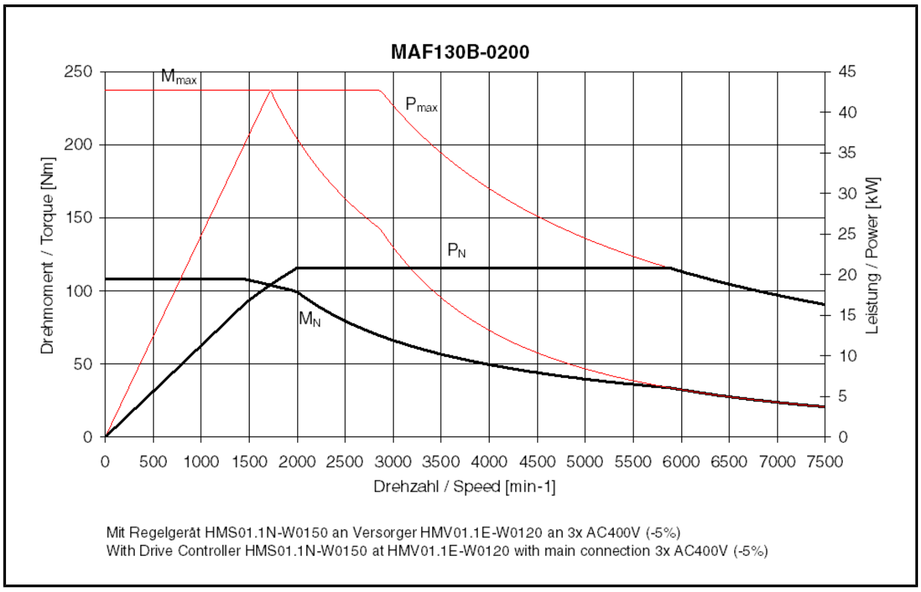



*Fig.4-98: Motor characteristic curve MAF130B-0200*

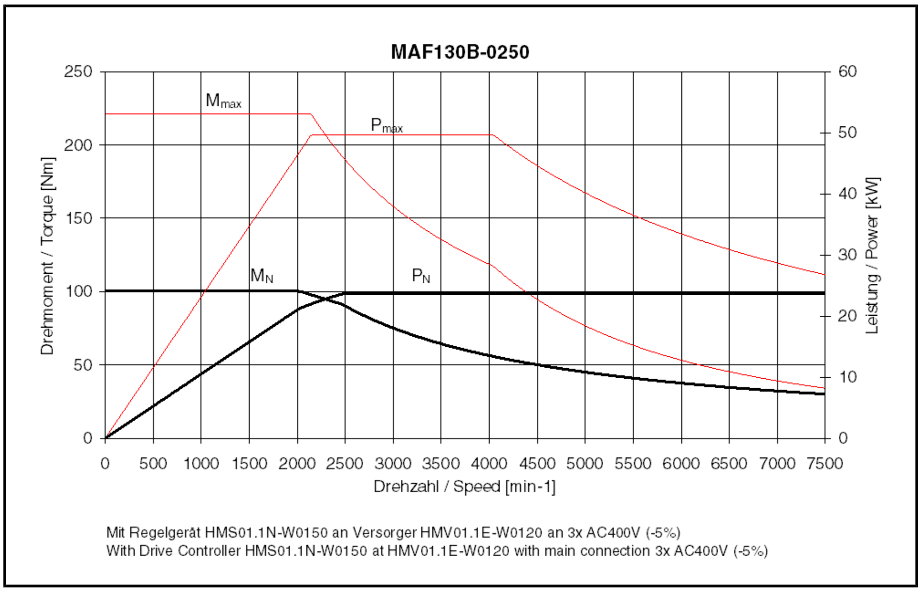



*Fig.4-99: Motor characteristic curve MAF130B-0250*

## 4.9.3 Data Sheet MAF130C

| Description | Symbol | Unit | MAF130C | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** 1) | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Rated torque | $M_N$ | Nm | 155 | 150 | 145 | 135 | 125 |
| Rated power | $P_N$ | kW | 8.1 | 15.7 | 22.8 | 28.3 | 32.7 |
| Rated current | $I_N$ | A | 21 | 38 | 53.2 | 69.8 | 75.5 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 | 2,500 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 | 2,000 |
| Maximum torque | $M_{max}$ | Nm | 340 | 330 | 330 | 315 | 298 |
| Maximum output | $P_{max}$ | kW | 16.6 | 32.2 | 46.7 | 58 | 67.1 |
| Maximum current | $I_{max}$ | A | 42.6 | 71.8 | 111 | 142.9 | 150,8 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 7,500 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 5,250 | | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 7,500 | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 7) | 10,000 7) | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 155 | 155 | 150 | 143 | 135 |
| Continuous current at standstill | $I_{n1}$ | A | 20.8 | 39 | 54.7 | 71.2 | 75.5 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 8.04 | 5.09 | 3.04 | 2.19 | 1.88 |
| Thermal time constant | $T_{th\_nenn}$ | min | 15 | | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 5 | | | | |
| Discharge capacity | $C_{ab}$ | nF | 20 | 15.4 | 20 | 16.8 | 20 |
| Number of pole pairs | p | | 3 | | | | |
| Power wire cross-section 2) | A | mm² | 2.5 | 6 | 16 | 16 | 25 |
| Moment of inertia of rotor3) | $J_{rot}$ | kgm² | 0.101 | | | | |
| Weight 3) | m | kg | 106 | | | | |
| Sound pressure level 4) | $L_P$ | dB(A) | 70 (+3) | | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | | |
| Motor protection class | | | IP65 | | | | |
| **Liquid cooling** 5) | | | | | | | |
| Power loss to be dissipated | $P_V$ | kW | 2.2 | 2.3 | | | 2.35 |
| Admissible coolant inlet temperature 6) | $T_{ein}$ | °C | +10...+40 | | | | |
| Admissible coolant temperature rise at $P_V$ | $\Delta T_{diff}$ | K | 10 | | | | |
| Pressure drop at $Q_{min}$ without quick coupler 8) | $\Delta p_{diff}$ | bar | 0.2 | | | | |
| Pressure drop constant 8) | $k_{dp}$ | | 0.02 | | | | |
| Required coolant flow at $P_V$ | $Q_{min}$ | l/min | 3.1 | 3.3 | | | 3.4 |
| Admissible coolant inlet pressure | $p_{max}$ | bar | 3 | | | | |

Technical Data

| Description | Symbol | Unit | MAF130C | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** [1)] | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Volume of coolant duct | $V_{kuehl}$ | l | 0.2 | | | | |

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

[2]) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

[3]) Value without holding brake.

[4]) At 1m distance, with PWM = 4 kHz.

[5]) Data refer to water as a cooling agent. When other coolants are used, convert data.

[6]) Please observe the notes for coolant inlet temperature in chapter 9.8.6 "Coolant Inlet Temperature " on page 266

[7]) Value without holding brake. Observe maximum speed of holding brake.

[8]) When using a quick coupling (option) for coolant connection, heed the notes regarding pressure drop under chapter 4.2.2 "Characteristics" on page 18.

*Fig.4-100: Data Sheet MAF130C*

## 4.9.4 Motor Characteristic Curves MAF130C

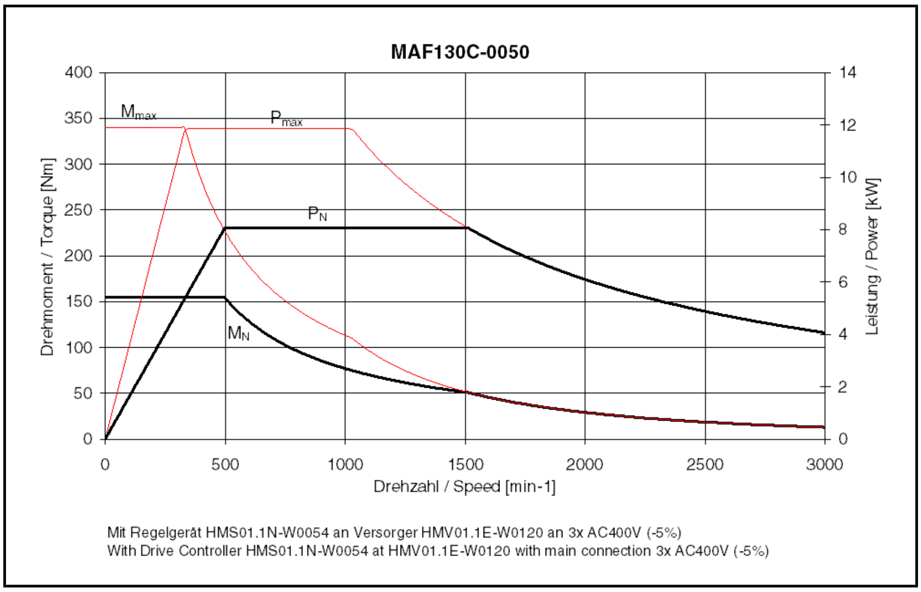



*Fig.4-101: Motor characteristic curve MAF130C-0050*

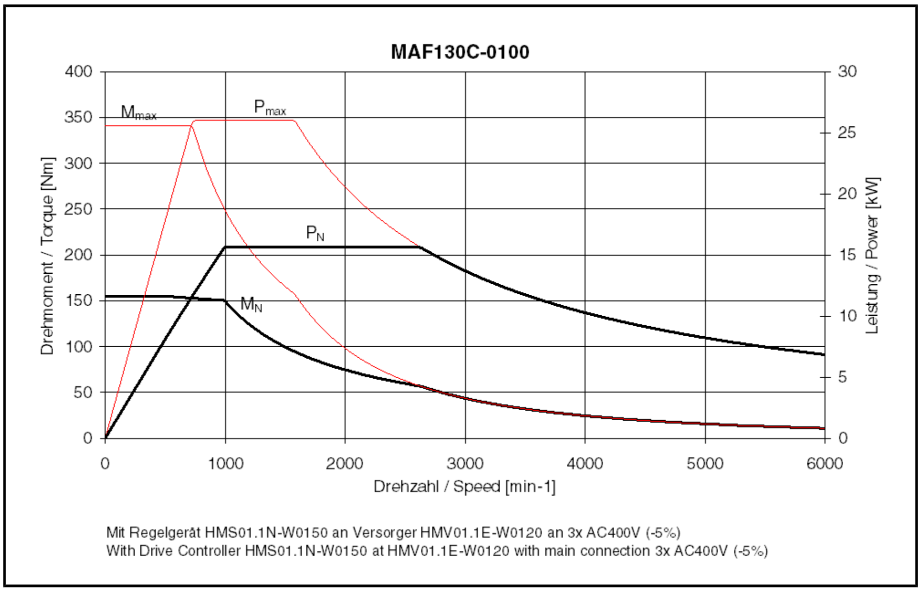



*Fig.4-102: Motor characteristic curve MAF130C-0100*

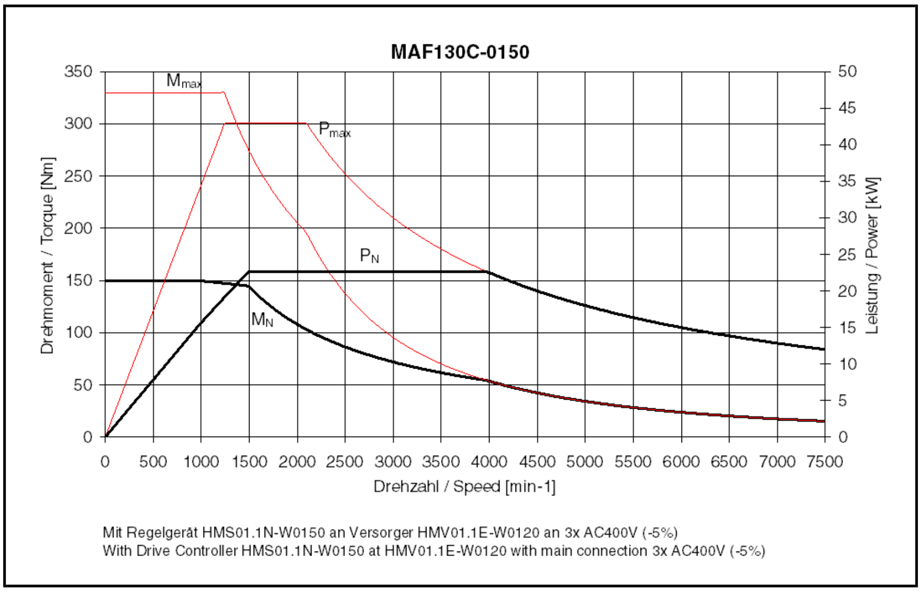



*Fig.4-103: Motor characteristic curve MAF130C-0150*

Technical Data

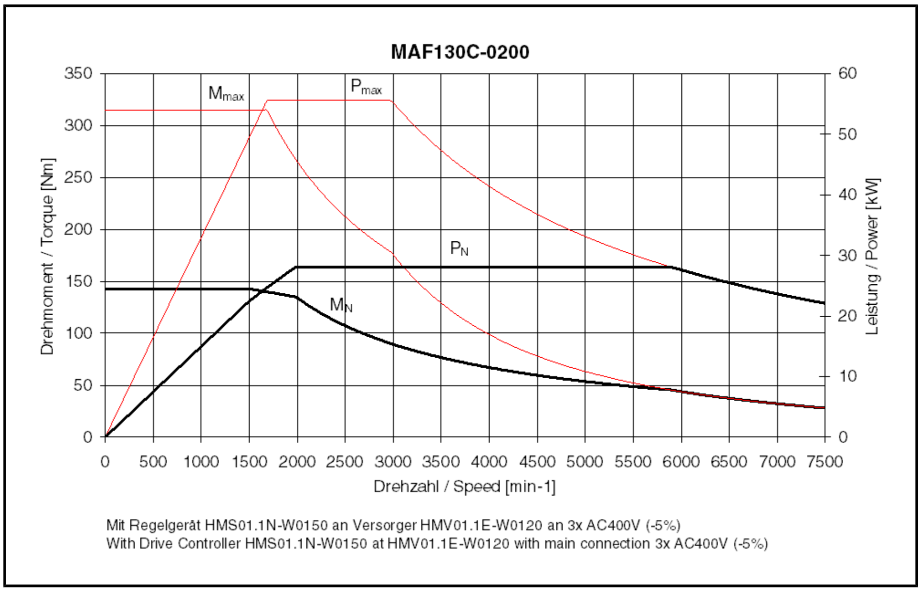



*Fig.4-104: Motor characteristic curve MAF130C-0200*

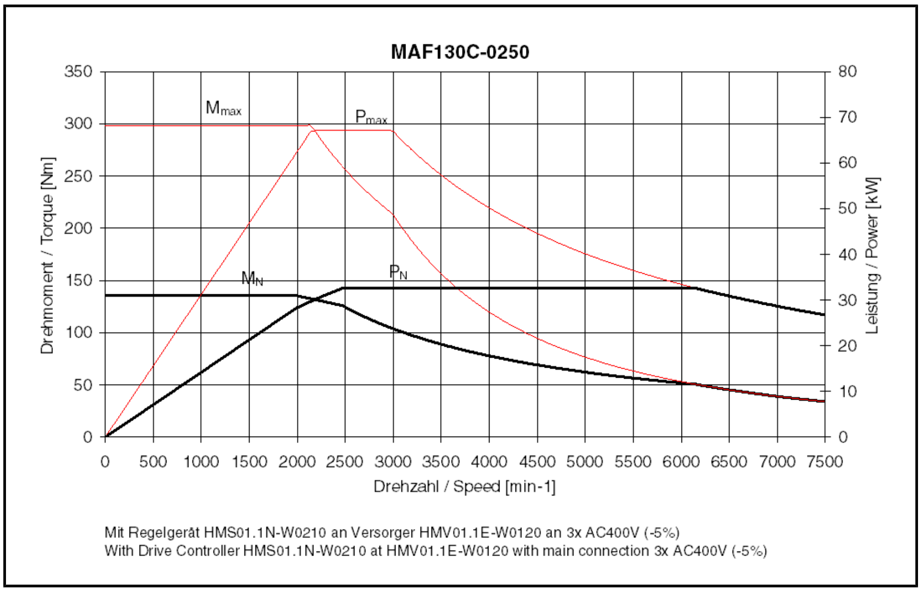



*Fig.4-105: Motor characteristic curve MAF130C-0250*

## 4.9.5 Data Sheet MAF130D

| Description | Symbol | Unit | MAF130D | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** 1) | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Rated torque | $M_N$ | Nm | 230 | 220 | 200 | 200 | 190 |
| Rated power | $P_N$ | kW | 12 | 23 | 31.4 | 41.9 | 49.7 |
| Rated current | $I_N$ | A | 32.3 | 50.7 | 72.6 | 93.9 | 113 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 | 2,500 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 | 2,000 |
| Maximum torque | $M_{max}$ | Nm | 506 | 500 | 484 | 461 | 450 |
| Maximum output | $P_{max}$ | kW | 24.6 | 47.2 | 64.4 | 85.9 | 140 |
| Maximum current | $I_{max}$ | A | 64.3 | 109 | 155.4 | 190.9 | 238 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 7,500 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 5,250 | | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 7,500 | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | 9,000 7) | 10,000 7) | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 230 | 230 | 220 | 210 | 195 |
| Continuous current at standstill | $I_{n1}$ | A | 31.3 | 52.4 | 78 | 97.5 | 113 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 7.71 | 4.97 | 3.21 | 2.51 | 1.71 |
| Thermal time constant | $T_{th\_nenn}$ | min | 15 | | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 5 | | | | |
| Discharge capacity | $C_{ab}$ | nF | 27.5 | 26.7 | 27.5 | 25.1 | 28.6 |
| Number of pole pairs | p | | 3 | | | | |
| Power wire cross-section 2) | A | mm² | 6 | 10 | 25 | 25 | 35 |
| Moment of inertia of rotor3) | $J_{rot}$ | kgm² | 0.151 | | | | |
| Weight 3) | m | kg | 147 | | | | |
| Sound pressure level 4) | $L_P$ | dB(A) | 70 (+3) | | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | | |
| Motor protection class | | | IP65 | | | | |
| Liquid cooling 5) | | | | | | | |
| Power loss to be dissipated | $P_V$ | kW | 3.25 | 3.2 | 3,3 | 3.35 | 3.5 |
| Admissible coolant inlet temperature 6) | $T_{ein}$ | °C | +10...+40 | | | | |
| Admissible coolant temperature rise at $P_V$ | $\Delta T_{diff}$ | K | 10 | | | | |
| Pressure drop at $Q_{min}$ without quick coupler 8) | $\Delta p_{diff}$ | bar | 0.3 | | 0.4 | | |
| Pressure drop constant 8) | $k_{dp}$ | | 0.02 | | | | |
| Required coolant flow at $P_V$ | $Q_{min}$ | l/min | 4.6 | | 4.7 | 4.8 | 5 |
| Admissible coolant inlet pressure | $p_{max}$ | bar | 3 | | | | |

Technical Data

| Description | Symbol | Unit | MAF130D | | | | |
|---|---|---|---|---|---|---|---|
| **Motor data** 1) | | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** | **0250** |
| Volume of coolant duct | $V_{kuehl}$ | l | 0.29 | | | | |

1) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

2) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

3) Value without holding brake.

4) At 1m distance, with PWM = 4 kHz.

5) Data refer to water as a cooling agent. When other coolants are used, convert data.

6) Please observe the notes for coolant inlet temperature in chapter 9.8.6 "Coolant Inlet Temperature " on page 266

7) Value without holding brake. Observe maximum speed of holding brake.

8) When using a quick coupling (option) for coolant connection, heed the notes regarding pressure drop under chapter 4.2.2 "Characteristics" on page 18.

*Fig.4-106: Data Sheet MAF130D*

## 4.9.6 Motor Characteristic Curves MAF130D

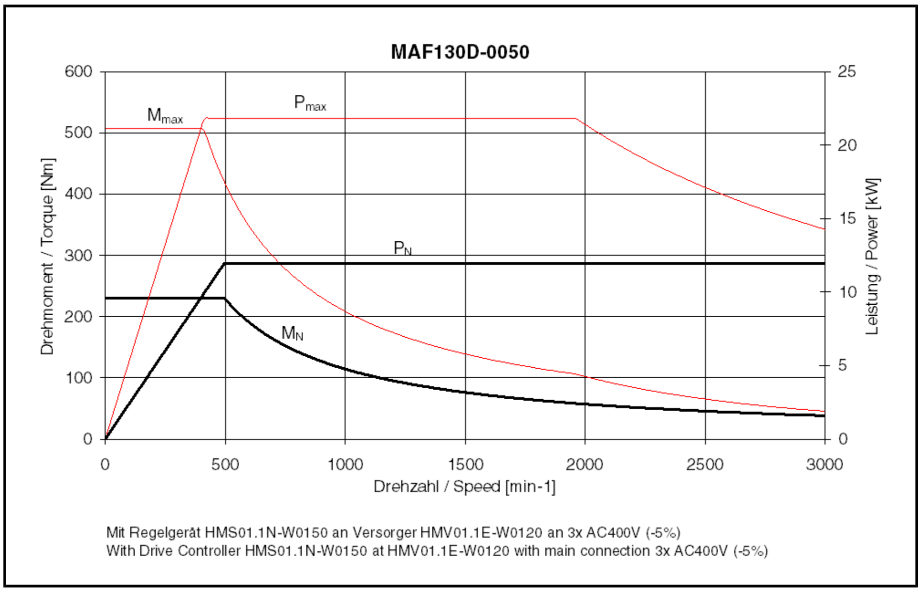



*Fig.4-107: Motor characteristic curve MAF130D-0050*

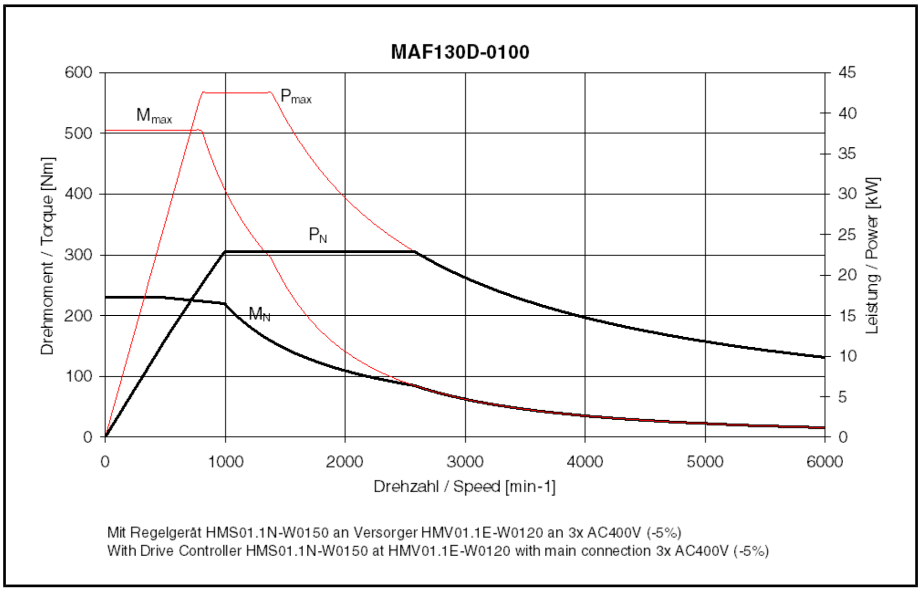



*Fig.4-108: Motor characteristic curve MAF130D-0100*

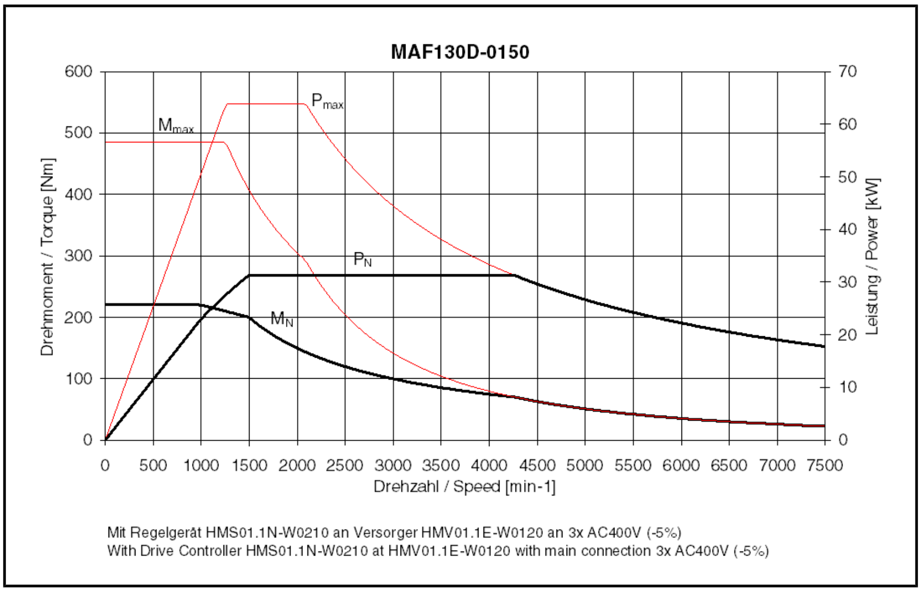



*Fig.4-109: Motor characteristic curve MAF130D-0150*

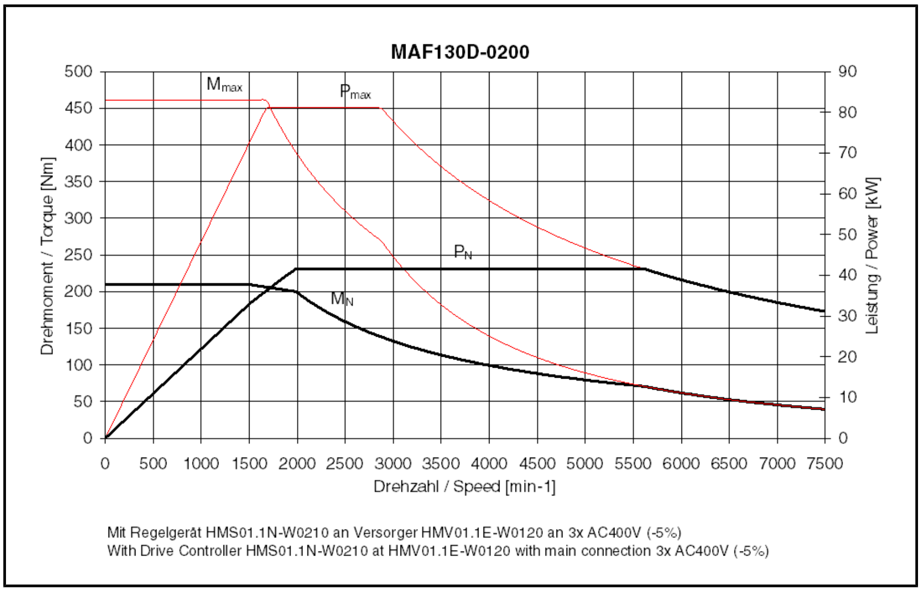



*Fig.4-110: Motor characteristic curve MAF130D-0200*

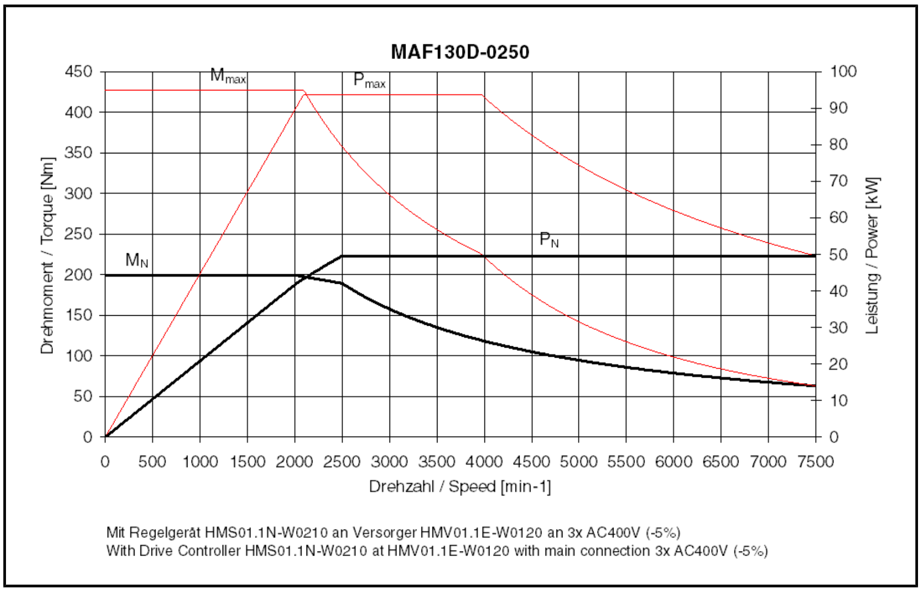



*Fig.4-111: Motor characteristic curve MAF130D-0250*

## 4.9.7 Holding Brake MAF130 (Option)

**Holding brakes MAD/MAF130 - Technical data**

| Holding brake | Symbol | Unit | Electrically clamping | Electrically releasing |
|---|---|---|---|---|
| Transmittable torque | $M_4$ | Nm | 100 | 80 |
| Connection voltage | $U_{Br}$ | V | DC 24 ± 10% | |
| Rated current | $I_{Br}$ | A | 1,5 | 1,6 |
| Moment of inertia | $J_{Br}$ | kgm² | 0,002 | |
| Max. permissible braking energy | $W_{max}$ | Ws | 30000 | 25000 |
| Disconnection time | $t_2$ | ms | 65 | 140 |
| Connection time | $t_1$ | ms | 110 | 50 |

| Holding brake | Symbol | Unit | Electrically clamping | Electrically releasing |
|---|---|---|---|---|
| Maximum speed | $n_{Br\_max}$ | $min^{-1}$ | 8000 | |
| Mass | m | kg | 8 | |

*Fig.4-112: Holding brakes MAD/MAF130*

# 4.10 Technical Data MAF160

## 4.10.1 Data Sheet MAF160B

| Description | Symbol | Unit | MAF160B | | | |
|---|---|---|---|---|---|---|
| **Motor data** 1) | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** |
| Rated torque | $M_N$ | Nm | 270 | 260 | 250 | 240 |
| Rated power | $P_N$ | kW | 14.1 | 27.2 | 39.3 | 50.3 |
| Rated current | $I_N$ | A | 34.2 | 73.7 | 89.5 | 108.5 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 |
| Maximum torque | $M_{max}$ | Nm | 594 | 593 | 571 | 550 |
| Maximum output | $P_{max}$ | kW | 28.9 | 55.8 | 80.6 | 103.1 |
| Maximum current | $I_{max}$ | A | 65.4 | 149 | 179.7 | 232.7 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 4,200 | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | not available | | | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 270 | 270 | 260 | 250 |
| Continuous current at standstill | $I_{n1}$ | A | 34.2 | 75.8 | 92.1 | 112.3 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 9.5 | 4.13 | 3.3 | 2.4 |
| Thermal time constant | $T_{th\_nenn}$ | min | 20 | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 5 | | | |
| Discharge capacity | $C_{ab}$ | nF | 26.9 | 35 | 35 | 21.7 |
| Number of pole pairs | p | | 3 | | | |
| Power wire cross-section 2) | A | mm² | 6 | 25 | 25 | 35 |
| Moment of inertia of rotor3) | $J_{rot}$ | kgm² | 0.23 | | | |
| Weight 3) | m | kg | 197 | | | |
| Sound pressure level 4) | $L_P$ | dB(A) | 72 (+3) | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | |
| Motor protection class | | | IP65 | | | |
| **Liquid cooling** 5) | | | | | | |
| Power loss to be dissipated | $P_V$ | kW | 3.1 | 4 | | 4.5 |
| Admissible coolant inlet temperature 6) | $T_{ein}$ | °C | +10...+40 | | | |
| Admissible coolant temperature rise at $P_V$ | $\Delta T_{diff}$ | K | 10 | | | |
| Pressure drop at $Q_{min}$ without quick coupler 7) | $\Delta p_{diff}$ | bar | 0.05 | 0.1 | | |

Technical Data

| Description | Symbol | Unit | MAF160B | | | |
|---|---|---|---|---|---|---|
| **Motor data** 1) | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** |
| Pressure drop constant 7) | $k_{dp}$ | | 0.004 | | | |
| Required coolant flow at $P_V$ | $Q_{min}$ | l/min | 4.4 | 5.7 | | 6.4 |
| Admissible coolant inlet pressure | $p_{max}$ | bar | 3 | | | |
| Volume of coolant duct | $V_{kuehl}$ | l | 0.82 | | | |

1) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

2) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

3) Value without holding brake.

4) At 1m distance, with PWM = 4 kHz.

5) Data refer to water as a cooling agent. When other coolants are used, convert data.

6) Please observe the notes for coolant inlet temperature in chapter 9.8.6 "Coolant Inlet Temperature " on page 266

7) When using a quick coupling (option) for coolant connection, heed the notes regarding pressure drop under chapter 4.2.2 "Characteristics" on page 18.

*Fig.4-113: Data Sheet MAF160B*

## 4.10.2 Motor Characteristic Curves MAF160B

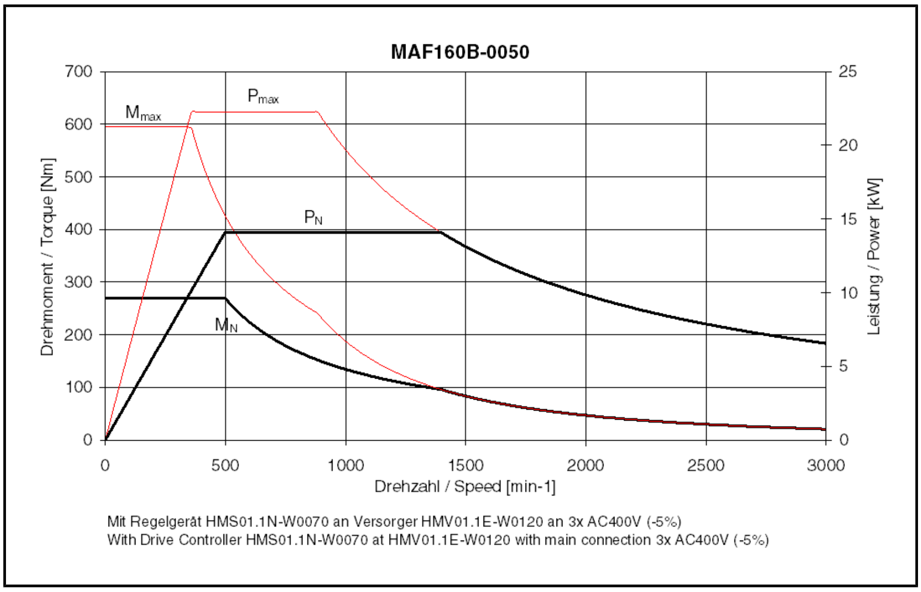



*Fig.4-114: Motor characteristic curve MAF160B-0050*

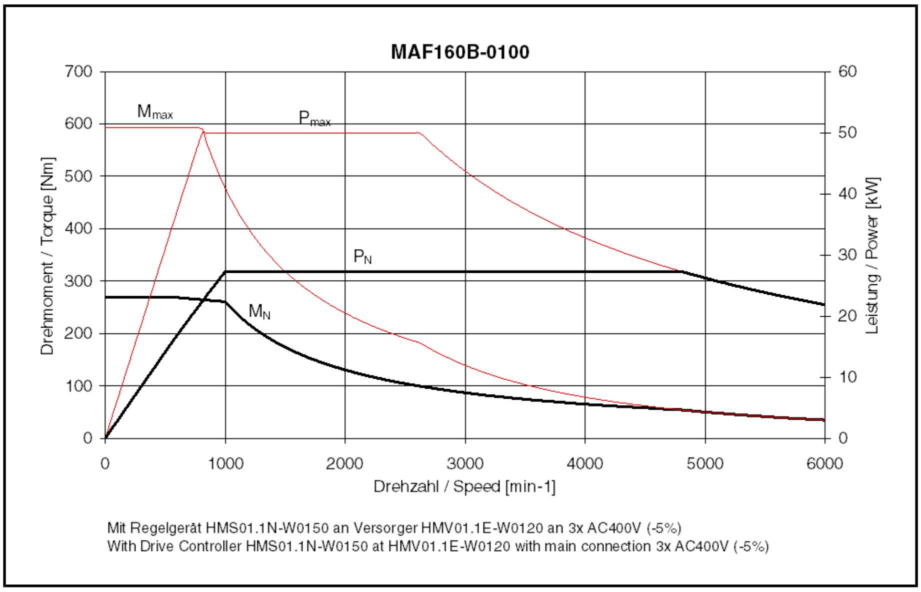



*Fig.4-115: Motor characteristic curve MAF160B-0100*

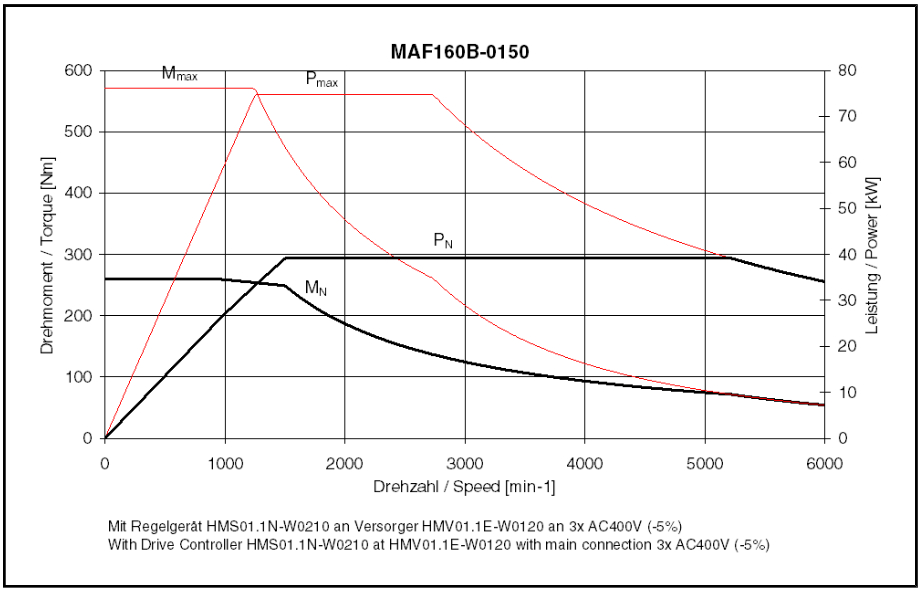



*Fig.4-116: Motor characteristic curve MAF160B-0150*

Technical Data

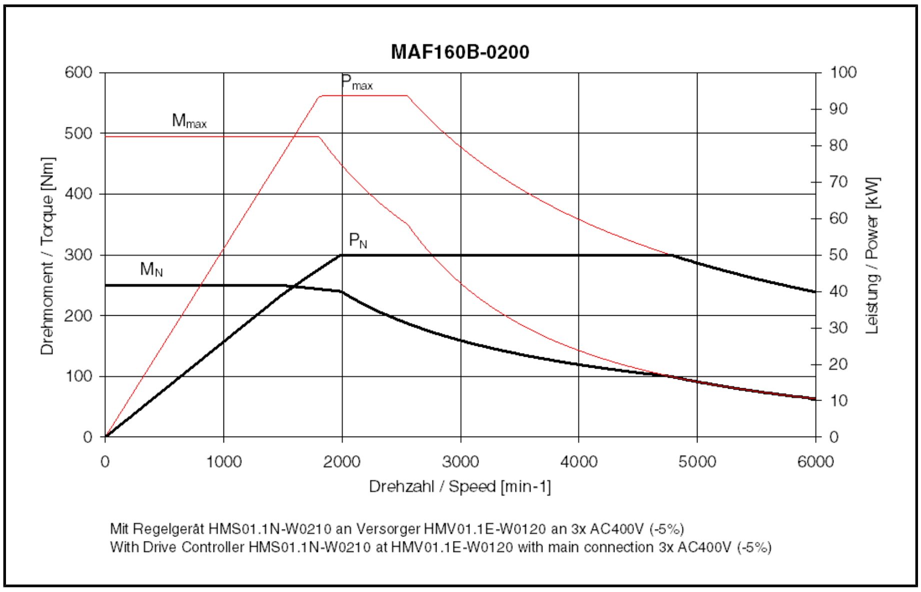



*Fig.4-117: Motor characteristic curve MAF160B-0200*

## 4.10.3 Data Sheet MAF160C

| Description | Symbol | Unit | MAF160C | | | |
|---|---|---|---|---|---|---|
| **Motor data** 1) | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** |
| Rated torque | $M_N$ | Nm | 340 | 325 | 300 | 285 |
| Rated power | $P_N$ | kW | 17.8 | 34 | 47.1 | 59.7 |
| Rated current | $I_N$ | A | 47.4 | 91.2 | 109.5 | 136 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 |
| Maximum torque | $M_{max}$ | Nm | 748 | 746 | 681 | 677 |
| Maximum output | $P_{max}$ | kW | 36.5 | 69.7 | 96.6 | 122.4 |
| Maximum current | $I_{max}$ | A | 98 | 196 | 212.2 | 290.7 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 4,200 | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | not available | | | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 340 | 340 | 310 | 295 |
| Continuous current at standstill | $I_{n1}$ | A | 47.4 | 94.8 | 111.9 | 141.4 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 7.76 | 3.88 | 3.37 | 2.3 |
| Thermal time constant | $T_{th\_nenn}$ | min | 20 | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 5 | | | |
| Discharge capacity | $C_{ab}$ | nF | 28 | 28 | 28.8 | 25.3 |
| Number of pole pairs | p | | 3 | | | |
| Power wire cross-section 2) | A | mm² | 10 | 25 | 35 | 2x25 |
| Moment of inertia of rotor3) | $J_{rot}$ | kgm² | 0.26 | | | |
| Weight 3) | m | kg | 227 | | | |
| Sound pressure level 4) | $L_P$ | dB(A) | 72 (+3) | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | |

| Description | Symbol | Unit | MAF160C | | | |
|---|---|---|---|---|---|---|
| **Motor data** 1) | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | |
| Motor protection class | | | IP65 | | | |
| **Liquid cooling** 5) | | | | | | |
| Power loss to be dissipated | $P_V$ | kW | 3.5 | 3.7 | 3.8 | 4.2 |
| Admissible coolant inlet temperature 6) | $T_{ein}$ | °C | +10...+40 | | | |
| Admissible coolant temperature rise at $P_V$ | $\Delta T_{diff}$ | K | 10 | | | |
| Pressure drop at $Q_{min}$ without quick coupler 7) | $\Delta p_{diff}$ | bar | 0.1 | | | |
| Pressure drop constant 7) | $k_{dp}$ | | 0.01 | | 0.004 | |
| Required coolant flow at $P_V$ | $Q_{min}$ | l/min | 5 | 5.3 | 5.4 | 6 |
| Admissible coolant inlet pressure | $p_{max}$ | bar | 3 | | | |
| Volume of coolant duct | $V_{kuehl}$ | l | 1 | | | |

1) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

2) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

3) Value without holding brake.

4) At 1m distance, with PWM = 4 kHz.

5) Data refer to water as a cooling agent. When other coolants are used, convert data.

6) Please observe the notes for coolant inlet temperature in chapter 9.8.6 "Coolant Inlet Temperature " on page 266

7) When using a quick coupling (option) for coolant connection, heed the notes regarding pressure drop under chapter 4.2.2 "Characteristics" on page 18.

*Fig.4-118: Data Sheet MAF160C*

## 4.10.4 Motor Characteristic Curves MAF160C

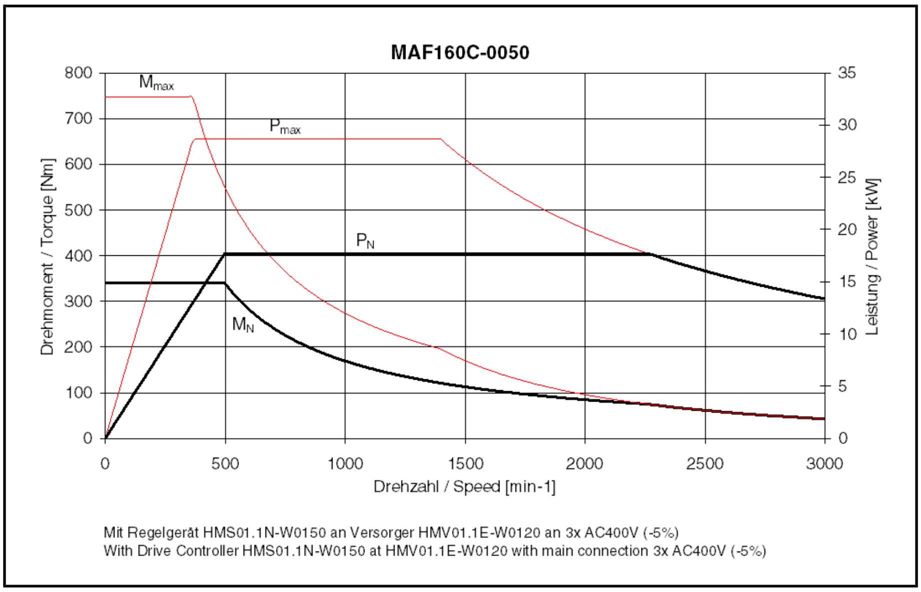



*Fig.4-119: Motor characteristic curve MAF160C-0050*

Technical Data

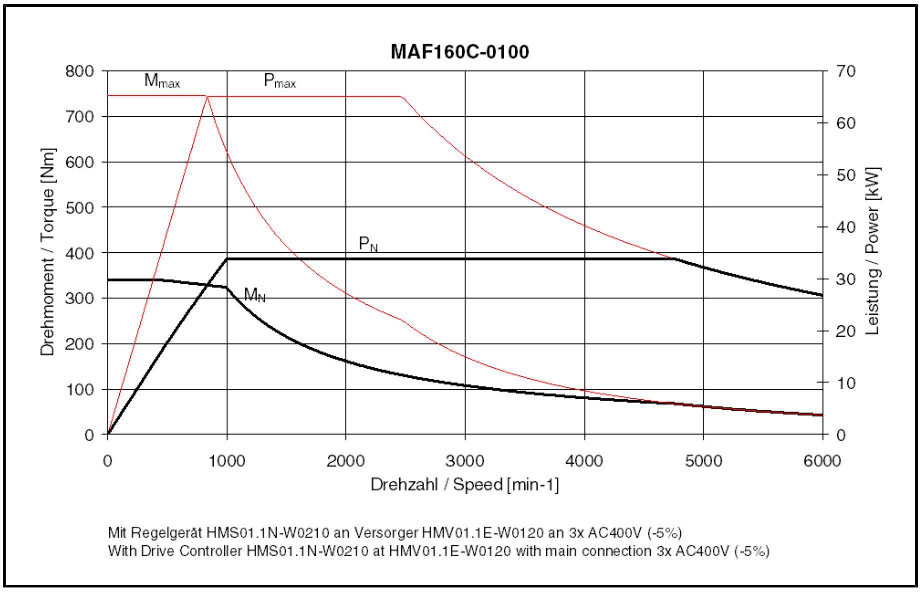



*Fig.4-120: Motor characteristic curve MAF160C-0100*

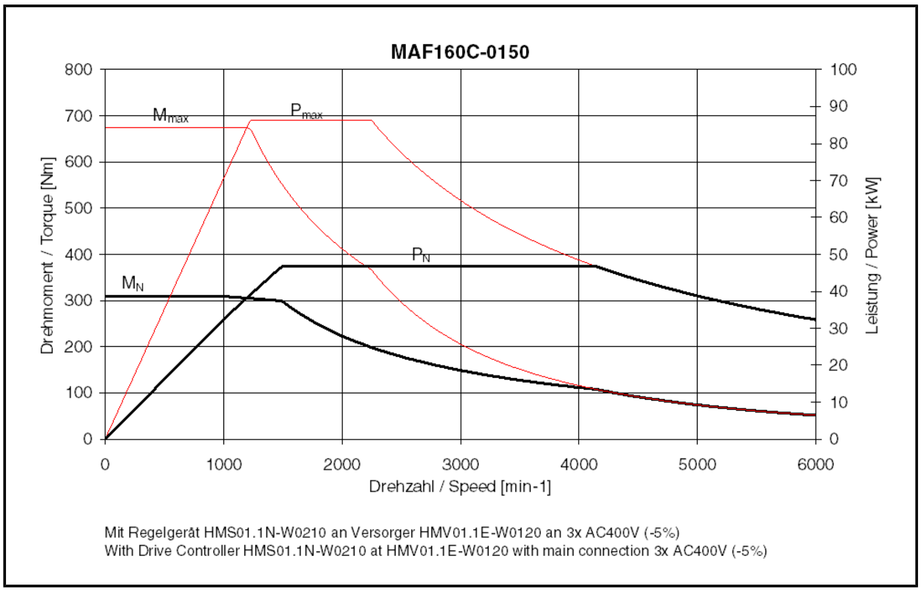



*Fig.4-121: Motor characteristic curve MAF160C-0150*

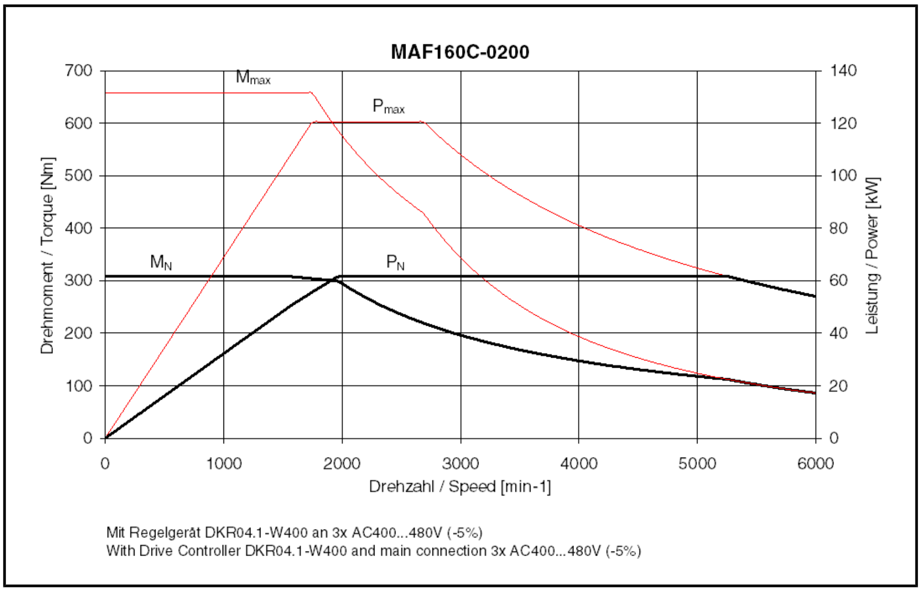



*Fig.4-122: Motor characteristic curve MAF160C-0200*

### 4.10.5 Holding Brake MAF160 (Option)

**Holding brake MAF160 - Technical data**

| Holding brake | Symbol | Unit | Electrically clamping | Electrically releasing |
|---|---|---|---|---|
| Transmittable torque | $M_4$ | Nm | 100 | |
| Connection voltage | $U_{Br}$ | V | DC 24 ± 10% | |
| Rated current | $I_{Br}$ | A | 1,8 | 2 |
| Moment of inertia | $J_{Br}$ | kgm² | 0,0065 | |
| Max. permissible braking energy | $W_{max}$ | Ws | 12500 | 40000 |
| Disconnection time | $t_2$ | ms | 100 | 190 |
| Connection time | $t_1$ | ms | 85 | 70 |
| Maximum speed | $n_{Br\_max}$ | $min^{-1}$ | 8000 | |
| Mass | m | kg | 20 | |

*Fig.4-123: Holding Brake MAF160*

## 4.11 Technical Data MAF180

### 4.11.1 Data Sheet MAF180C

| Description | Symbol | Unit | MAF180C | | | |
|---|---|---|---|---|---|---|
| **Motor data** [1)] | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** |
| Rated torque | $M_N$ | Nm | 435 | 400 | 365 | 318 |
| Rated power | $P_N$ | kW | 22.8 | 41.9 | 57.3 | 66.,6 |
| Rated current | $I_N$ | A | 50 | 93.5 | 128.8 | 154 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 |
| Maximum torque | $M_{max}$ | Nm | 986 | 957 | 858 | 739 |

Technical Data

| Description | Symbol | Unit | MAF180C | | | |
|---|---|---|---|---|---|---|
| **Motor data** [1] | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** |
| Maximum output | $P_{max}$ | kW | 46.7 | 82 | 117.5 | 136.5 |
| Maximum current | $I_{max}$ | A | 104.7 | 215 | 280.9 | 318.9 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 4,200 | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | not available | | | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 435 | 435 | 390 | 336 |
| Continuous current at standstill | $I_{n1}$ | A | 51.2 | 97.6 | 136.1 | 160.5 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 9.61 | 5.04 | 3.11 | 2.39 |
| Thermal time constant | $T_{th\_nenn}$ | min | 20 | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 5 | | | |
| Discharge capacity | $C_{ab}$ | nF | 32.5 | 35.9 | 30 | 38.9 |
| Number of pole pairs | p | | 3 | | | |
| Power wire cross-section [2] | A | mm² | 10 | 25 | 2x25 | 2x35 |
| Moment of inertia of rotor[3] | $J_{rot}$ | kgm² | 0.49 | | | |
| Weight [3] | m | kg | 322 | | | |
| Sound pressure level [4] | $L_P$ | dB(A) | 75 (+3) | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | |
| Motor protection class | | | IP65 | | | |
| **Liquid cooling** [5] | | | | | | |
| Power loss to be dissipated | $P_V$ | kW | 3.9 | 4 | 4.5 | |
| Admissible coolant inlet temperature [6] | $T_{ein}$ | °C | +10...+40 | | | |
| Admissible coolant temperature rise at $P_V$ | $\Delta T_{diff}$ | K | 10 | | | |
| Pressure drop at $Q_{min}$ without quick coupler [7] | $\Delta p_{diff}$ | bar | 0.1 | | 0.2 | |
| Pressure drop constant [7] | $k_{dp}$ | | 0.001 | | | |
| Required coolant flow at $P_V$ | $Q_{min}$ | l/min | 5.6 | 5.7 | 6.4 | |
| Admissible coolant inlet pressure | $p_{max}$ | bar | 3 | | | |
| Volume of coolant duct | $V_{kuehl}$ | l | 1.25 | | | |

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

[2]) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

[3]) Value without holding brake.

[4]) At 1m distance, with PWM = 4 kHz.

[5]) Data refer to water as a cooling agent. When other coolants are used, convert data.

[6]) Please observe the notes for coolant inlet temperature in chapter 9.8.6 "Coolant Inlet Temperature " on page 266

[7]) When using a quick coupling (option) for coolant connection, heed the notes regarding pressure drop under chapter 4.2.2 "Characteristics" on page 18.

*Fig.4-124: Data Sheet MAF180C*

## 4.11.2 Motor Characteristic Curves MAF180C

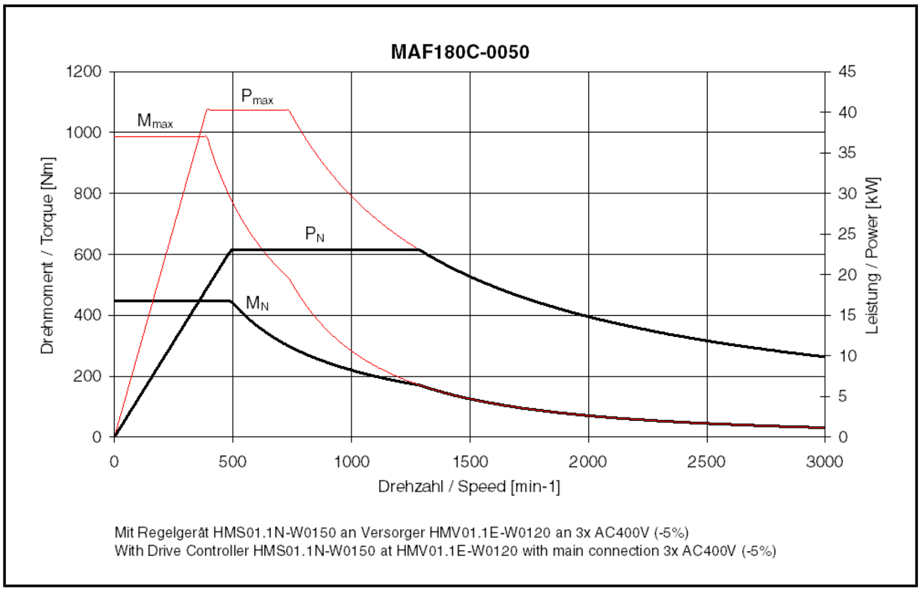



*Fig.4-125: Motor characteristic curve MAF180C-0050*

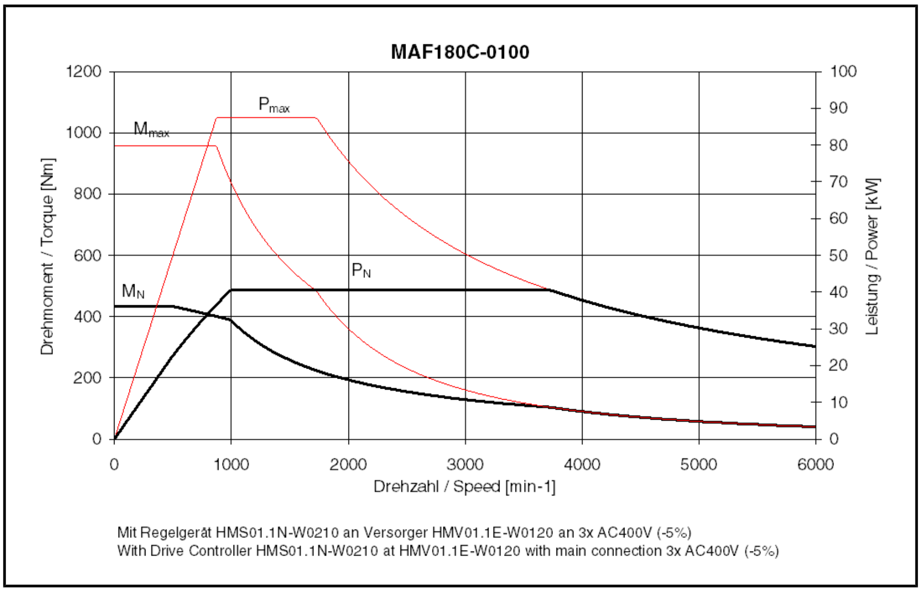



*Fig.4-126: Motor characteristic curve MAF180C-0100*

Technical Data

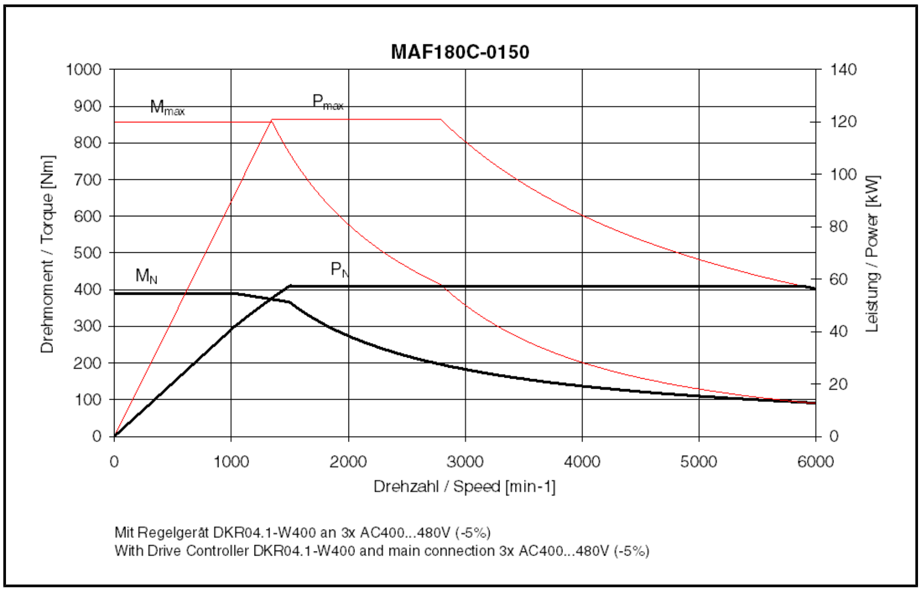



*Fig.4-127: Motor characteristic curve MAF180C-0150*

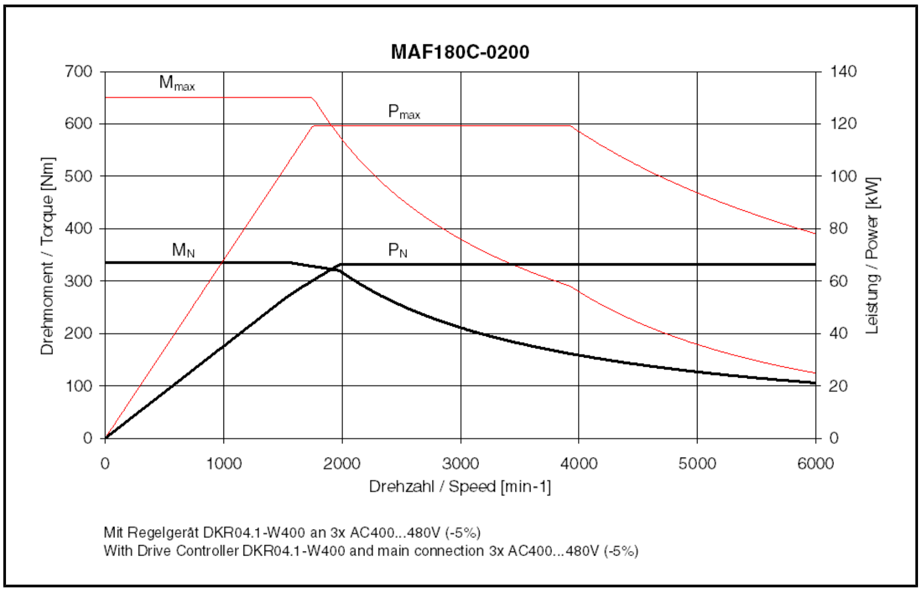



*Fig.4-128: Motor characteristic curve MAF180C-0200*

## 4.11.3 Data Sheet MAF180D

| Description | Symbol | Unit | MAF180D | | | |
|---|---|---|---|---|---|---|
| **Motor data** [1] | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** |
| Rated torque | $M_N$ | Nm | 500 | 460 | 435 | 400 |
| Rated power | $P_N$ | kW | 26.2 | 48.1 | 68.3 | 83.8 |
| Rated current | $I_N$ | A | 60.4 | 94.8 | 146.1 | 168.5 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 | 2,000 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 | 1,500 |
| Maximum torque | $M_{max}$ | Nm | 1,100 | 1,094 | 1,013 | 1,008 |
| Maximum output | $P_{max}$ | kW | 53.7 | 98.8 | 140 | 171.8 |
| Maximum current | $I_{max}$ | A | 117.3 | 213.1 | 296.2 | 377.1 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | 3,000 | 4,200 | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000 | 6,000 | | |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | not available | | | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 500 | 500 | 460 | 460 |
| Continuous current at standstill | $I_{n1}$ | A | 60.4 | 101.9 | 146.1 | 187.3 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 10 | 5.23 | 3.3 | 2.75 |
| Thermal time constant | $T_{th\_nenn}$ | min | 20 | | | |
| Duty cycle time (S6-44%) | $T_C$ | min | 5 | | | |
| Discharge capacity | $C_{ab}$ | nF | 37.4 | 38 | 30.3 | 50 |
| Number of pole pairs | p | | 3 | | | |
| Power wire cross-section [2] | A | mm² | 16 | 35 | 2x25 | 2x35 |
| Moment of inertia of rotor[3] | $J_{rot}$ | kgm² | 0.61 | | | |
| Weight [3] | m | kg | 382 | | | |
| Sound pressure level [4] | $L_P$ | dB(A) | 75 (+3) | | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | | |
| Motor protection class | | | IP65 | | | |
| **Liquid cooling** [5] | | | | | | |
| Power loss to be dissipated | $P_V$ | kW | 3.5 | | 3.6 | 5.4 |
| Admissible coolant inlet temperature [6] | $T_{ein}$ | °C | +10...+40 | | | |
| Admissible coolant temperature rise at $P_V$ | $\Delta T_{diff}$ | K | 10 | | | |
| Pressure drop at $Q_{min}$ without quick coupler [7] | $\Delta p_{diff}$ | bar | 0.1 | | | 0.2 |
| Pressure drop constant [7] | $k_{dp}$ | | 0,001 | | | |
| Required coolant flow at $P_V$ | $Q_{min}$ | l/min | 5 | | 5.2 | 7.7 |
| Admissible coolant inlet pressure | $p_{max}$ | bar | 3 | | | |

Technical Data

| Description | Symbol | Unit | MAF180D | | | |
|---|---|---|---|---|---|---|
| **Motor data** [1) ] | | | | | | |
| **Winding** | | | **0050** | **0100** | **0150** | **0200** |
| Volume of coolant duct | $V_{kuehl}$ | l | 1.45 | | | |

[1]) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

[2]) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

[3]) Value without holding brake.

[4]) At 1m distance, with PWM = 4 kHz.

[5]) Data refer to water as a cooling agent. When other coolants are used, convert data.

[6]) Please observe the notes for coolant inlet temperature in chapter 9.8.6 "Coolant Inlet Temperature " on page 266

[7]) When using a quick coupling (option) for coolant connection, heed the notes regarding pressure drop under chapter 4.2.2 "Characteristics" on page 18.

*Fig.4-129: Data Sheet MAF180D*

## 4.11.4 Motor Characteristic Curves MAF180D

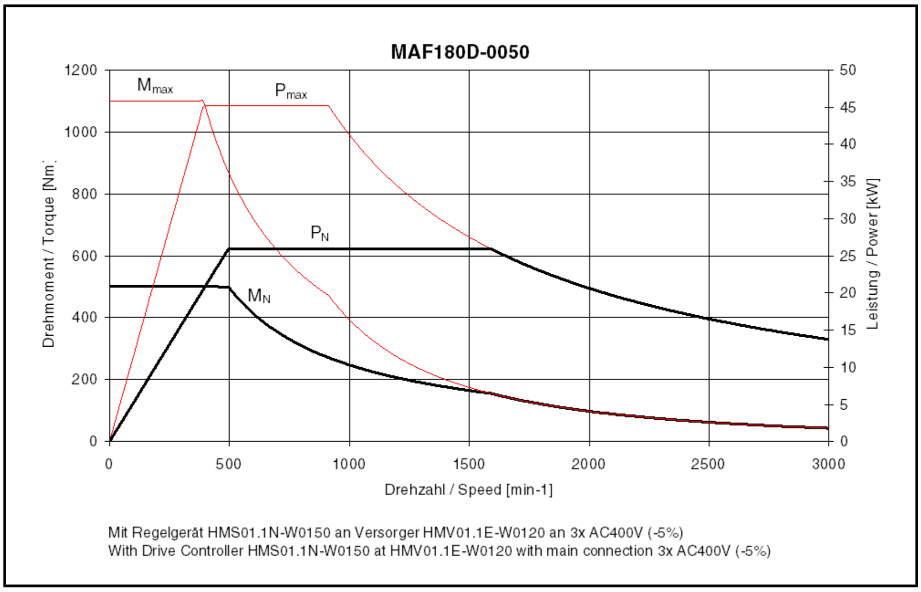



*Fig.4-130: Motor characteristic curve MAF180D-0050*

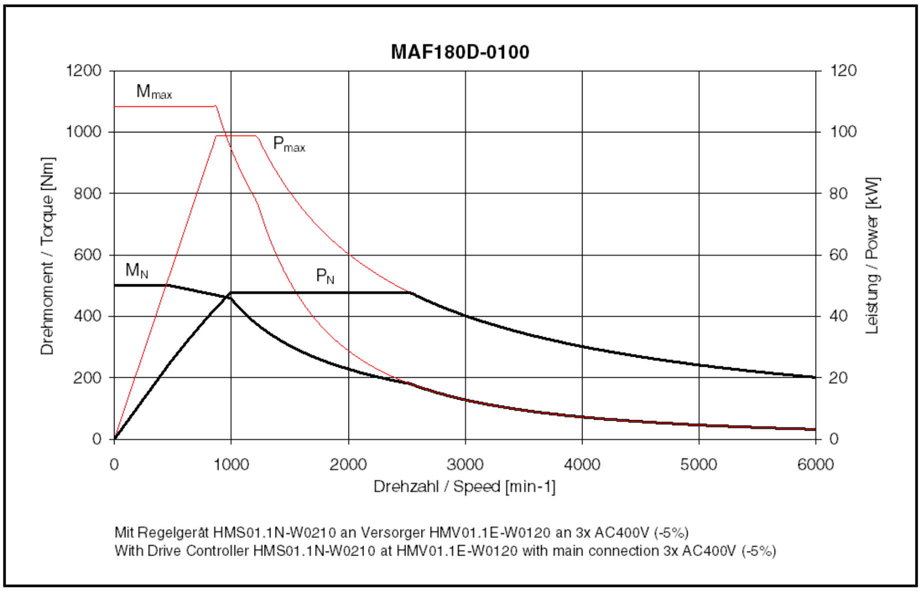



*Fig.4-131: Motor characteristic curve MAF180D-0100*

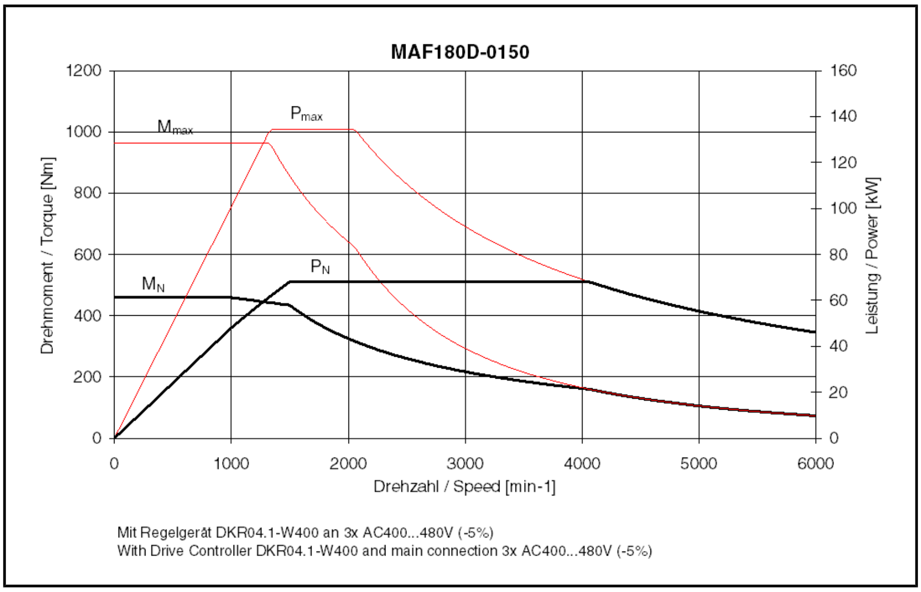



*Fig.4-132: Motor characteristic curve MAF180D-0150*

Technical Data

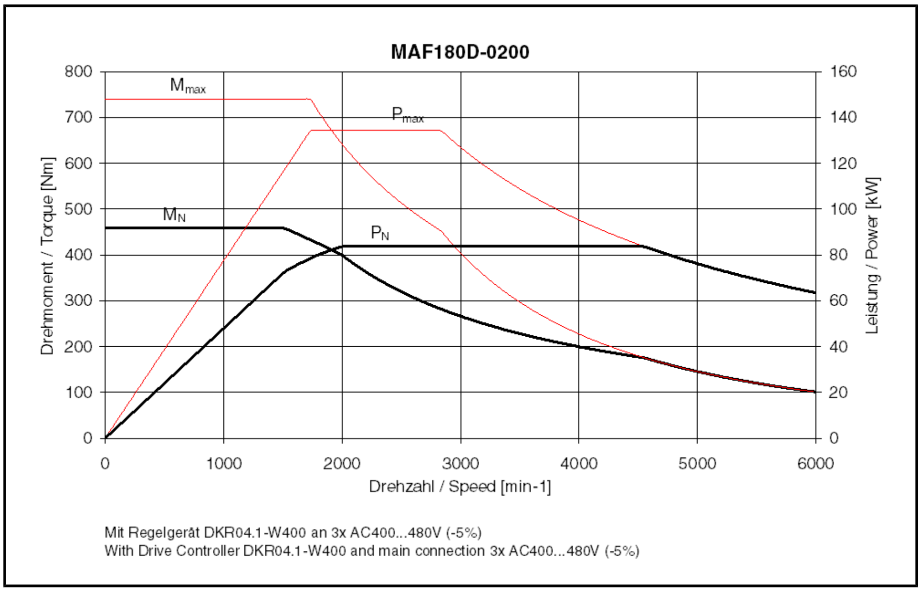



*Fig.4-133: Motor characteristic curve MAF180D-0200*

## 4.11.5 Holding Brake MAF180 (Option)

**Holding brakes MAD/MAF180 - Technical data**

| Holding brake | Symbol | Unit | Electrically clamping | Electrically releasing |
|---|---|---|---|---|
| Transmittable torque | $M_4$ | Nm | 300 | 240 |
| Connection voltage | $U_{Br}$ | V | DC 24 ± 10% | |
| Rated current | $I_{Br}$ | A | 2 | 1,87 |
| Moment of inertia | $J_{Br}$ | kgm² | 0,0188 | |
| Max. permissible braking energy | $W_{max}$ | Ws | 70000 | |
| Disconnection time | $t_2$ | ms | 90 | 300 |
| Connection time | $t_1$ | ms | 150 | 130 |
| Maximum speed | $n_{Br\_max}$ | $min^{-1}$ | 6000 | |
| Mass | m | kg | 25 | |

*Fig.4-134: Holding brakes MAD/MAF180*

# 4.12 Technical Data MAF225

## 4.12.1 Data Sheet MAF225C

| Description | Symbol | Unit | MAF225C | | |
|---|---|---|---|---|---|
| **Motor data** 1) | | | | | |
| **Winding** | | | **0050*** | **0100** | **0150** |
| Rated torque | $M_N$ | Nm | 860* | 820 | 764 |
| Rated power | $P_N$ | kW | 45* | 85.9 | 120 |
| Rated current | $I_N$ | A | 98* | 165 | 211.2 |
| Rated speed | $n_N$ | $min^{-1}$ | 500 | 1,000 | 1,500 |
| Key speed | $n_1$ | $min^{-1}$ | 500 | 500 | 1,000 |
| Maximum torque | $M_{max}$ | Nm | 1,750* | 1,750 | 1,750 |

| Description | Symbol | Unit | MAF225C | | |
|---|---|---|---|---|---|
| **Motor data** 1) | | | | | |
| **Winding** | | | **0050*** | **0100** | **0150** |
| Maximum output | $P_{max}$ | kW | 92.3* | 200 | 246 |
| Maximum current | $I_{max}$ | A | 208* | 355 | 489.2 |
| Maximum speed with bearing A / N | $n_{max}$ | $min^{-1}$ | 3,000* | 3,750* | 3,750 |
| Maximum speed with bearing R | $n_{max}$ | $min^{-1}$ | not available | | |
| Maximum speed with bearing V | $n_{max}$ | $min^{-1}$ | 3,000* | 3,750 | 3,750 |
| Maximum speed with bearing H | $n_{max}$ | $min^{-1}$ | not available | | |
| Continuous torque at standstill | $M_{n1}$ | Nm | 860* | 950 | 825 |
| Continuous current at standstill | $I_{n1}$ | A | 98* | 183 | 228 |
| Torque constant at 20 °C | $K_{M\_N}$ | Nm/A | 9.7* | 5.21 | 3.75 |
| Thermal time constant | $T_{th\_nenn}$ | min | 35* | 35 | 35 |
| Duty cycle time (S6-44%) | $T_C$ | min | 5* | 5 | 5 |
| Discharge capacity | $C_{ab}$ | nF | 40* | 39.7 | 43.9 |
| Number of pole pairs | p | | 3 | | |
| Power wire cross-section 2) | A | mm² | 35* | 2x35 | 2x50 |
| Moment of inertia of rotor 3) | $J_{rot}$ | kgm² | 1.65 | | |
| Weight 3) | m | kg | 587 | | |
| Sound pressure level 4) | $L_P$ | dB(A) | 75 (+3) | | |
| Admissible ambient temperature in operation | $T_{um}$ | °C | 0...+40 | | |
| Insulation class according to DIN EN 60034-1 | | | 155 (F) | | |
| Motor protection class | | | IP65 | | |
| **Liquid cooling** 5) | | | | | |
| Power loss to be dissipated | $P_V$ | kW | 6.4* | 6.6 | 8 |
| Admissible coolant inlet temperature 6) | $T_{ein}$ | °C | +10...+40 | | |
| Admissible coolant temperature rise at $P_V$ | $\Delta T_{diff}$ | K | 10 | | |
| Pressure drop at $Q_{min}$ without quick coupler 7) | $\Delta p_{diff}$ | bar | 0.4 | | 0.6 |
| Pressure drop constant 7) | $k_{dp}$ | | 0.01 | | |
| Required coolant flow at $P_V$ | $Q_{min}$ | l/min | 9.2 | 9.5 | 11.5 |
| Admissible coolant inlet pressure | $p_{max}$ | bar | 3 | | |
| Volume of coolant duct | $V_{kuehl}$ | l | 1.86 | | |

1) Values determined according to IEC 60034-1. Current and voltage specified as root-mean-square values. Reference value 540 $V_{DC}$ DC bus voltage.

2) Please note the information on the power wire cross section in chapter 4.2.2 "Characteristics" on page 18.

3) Value without holding brake.

4) At 1m distance, with PWM = 4 kHz.

5) Data refer to water as a cooling agent. When other coolants are used, convert data.

6) Please observe the notes for coolant inlet temperature in chapter 9.8.6 "Coolant Inlet Temperature " on page 266

7) When using a quick coupling (option) for coolant connection, heed the notes regarding pressure drop under chapter 4.2.2 "Characteristics" on page 18.

*) = Preliminary data

*Fig.4-135: Data Sheet MAF225C*

## 4.12.2 Motor Characteristic Curves MAF225C

Motor characteristic curve MAF225C-0050 (in preparation)

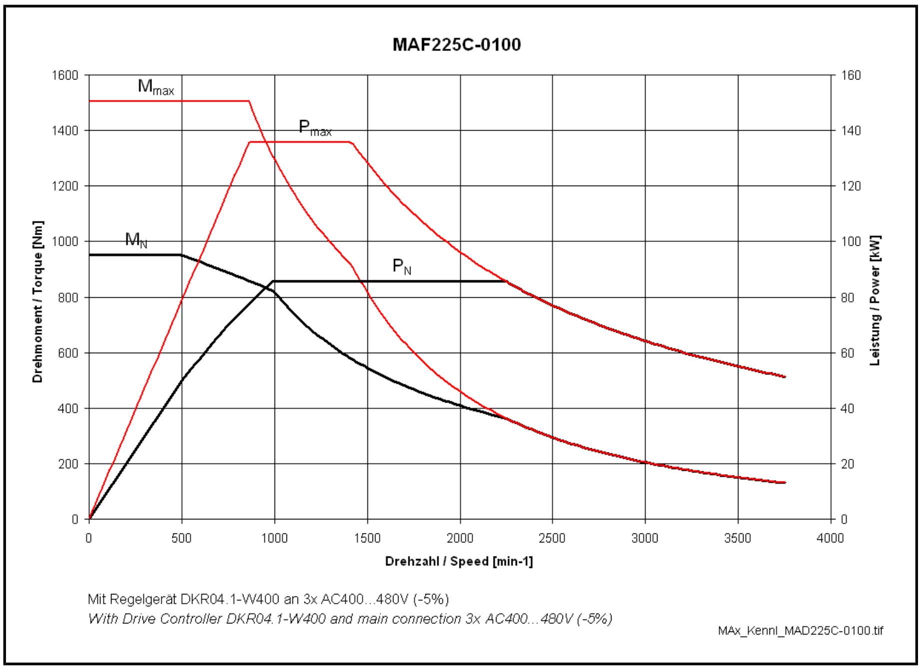



*Fig.4-136: Motor characteristic curve MAF225C-0100*

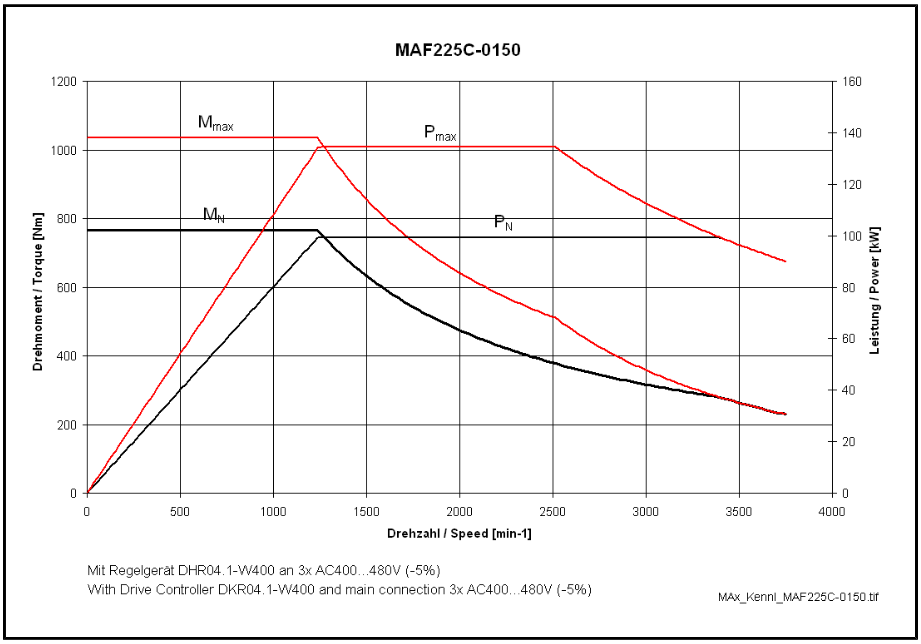
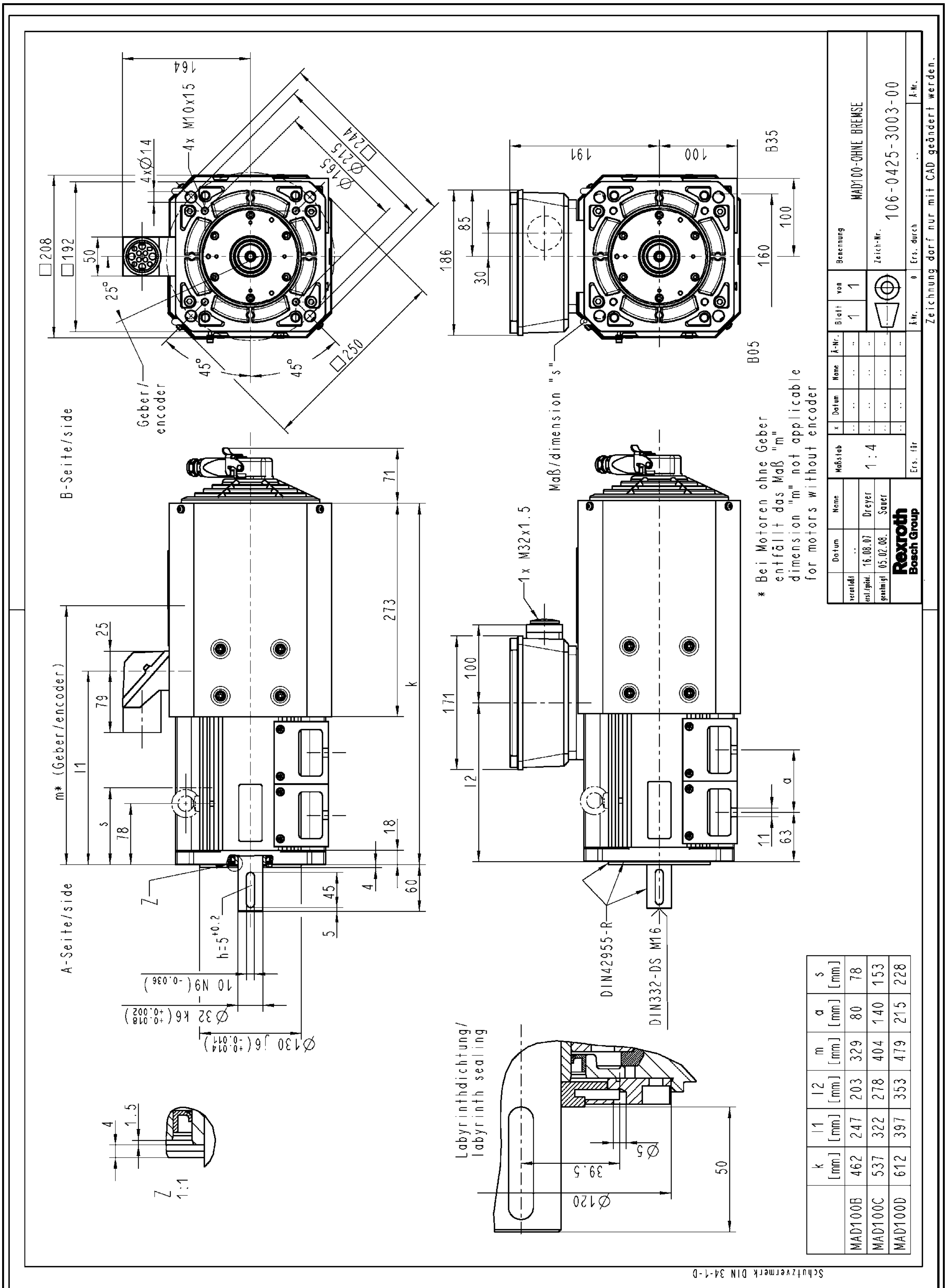



*Fig.4-137: Motor characteristic curve MAF225C-0150*

# 5 Dimension Sheets IndraDyn A

## 5.1 Frame Size MAD100

### 5.1.1 MAD100 without Brake (Terminal Box Rotatable)




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAD100B | 462 | 247 | 203 | 329 | 80 | 78 |
| MAD100C | 537 | 322 | 278 | 404 | 140 | 153 |
| MAD100D | 612 | 397 | 353 | 479 | 215 | 228 |

Dimension Sheets IndraDyn A

## 5.1.2 MAD100 without Brake

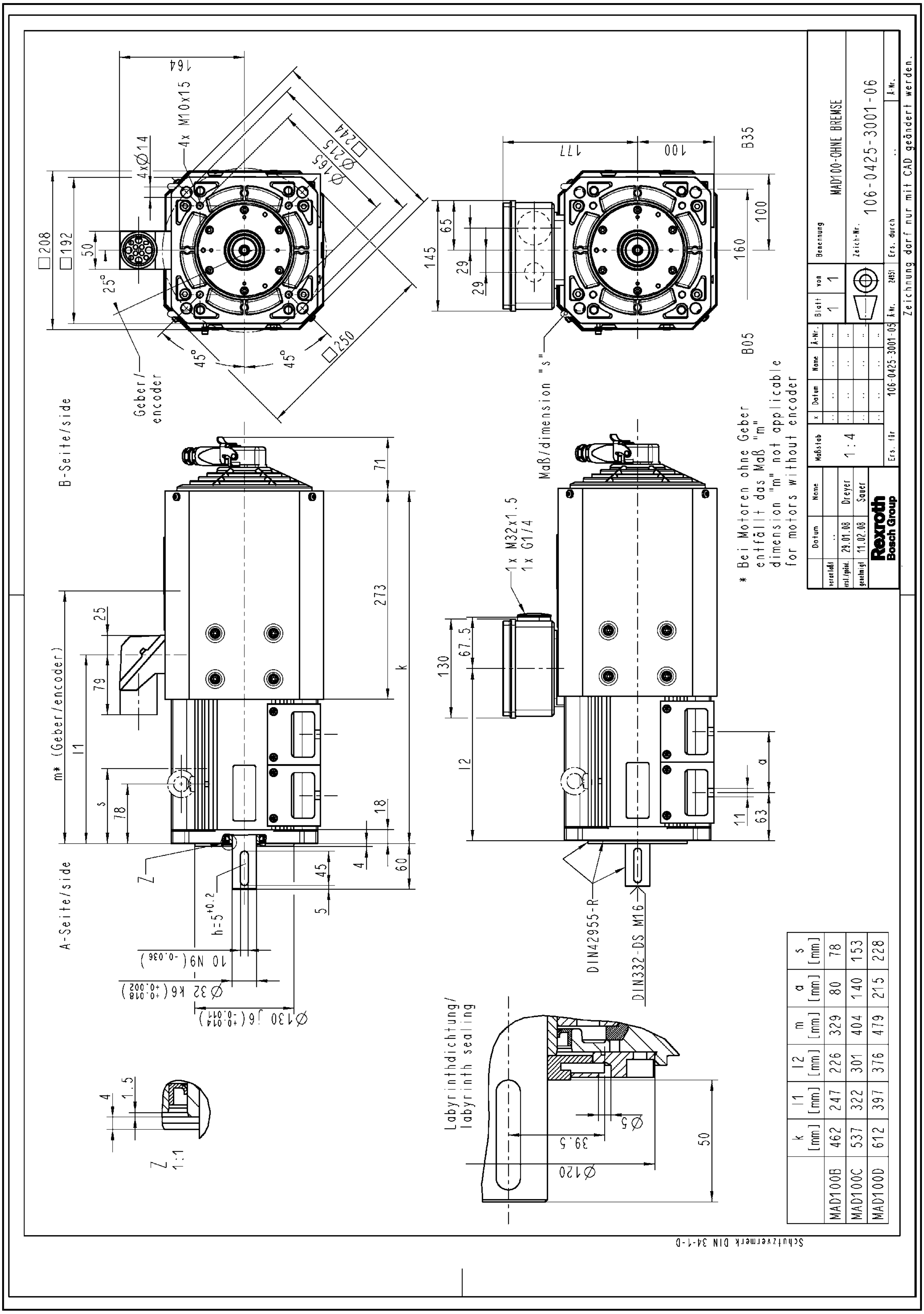


Fig.5-2: MAD100 without brake

### 5.1.3 MAD100 with Brake 1 or 5 (Terminal Box Rotatable)

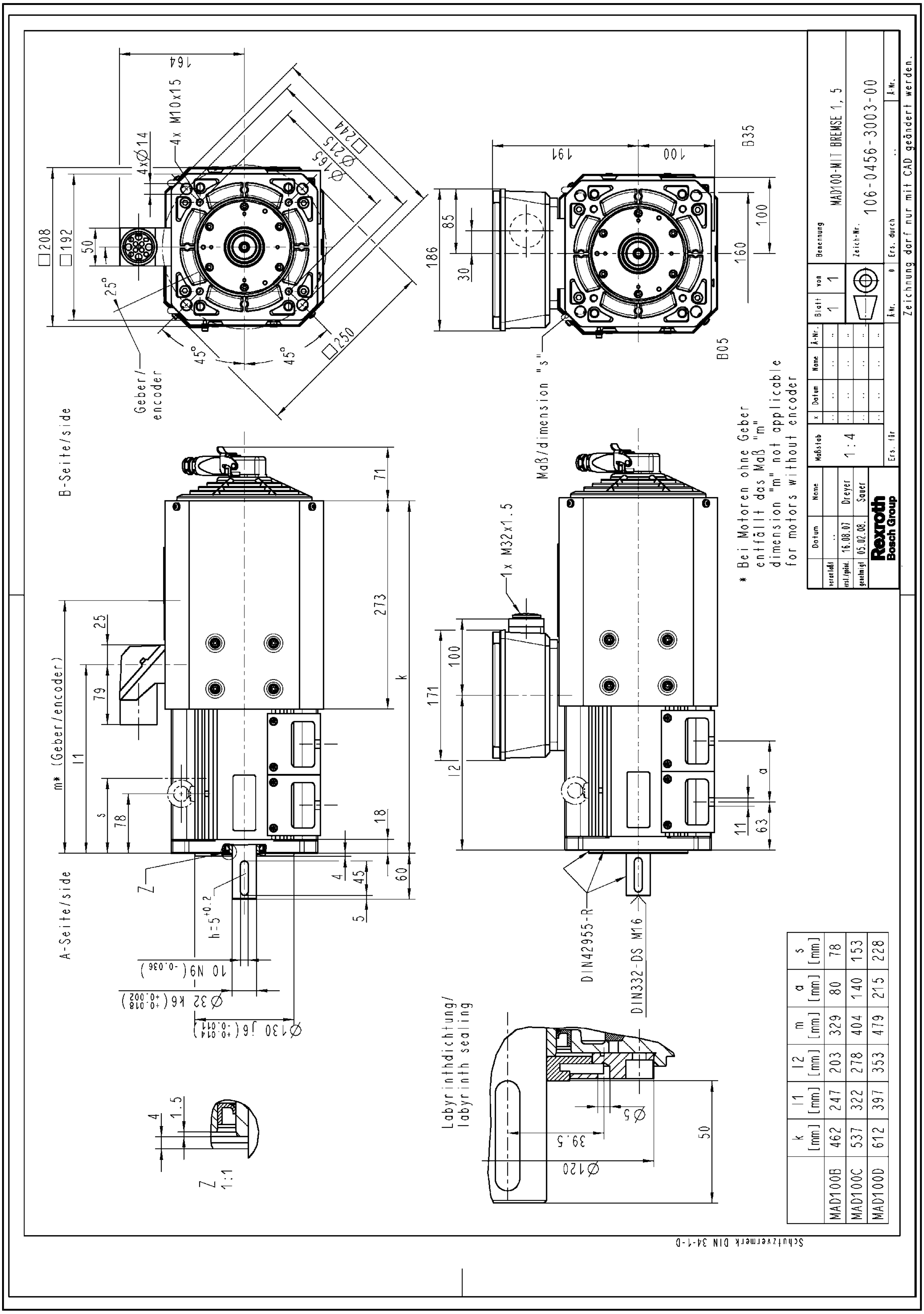
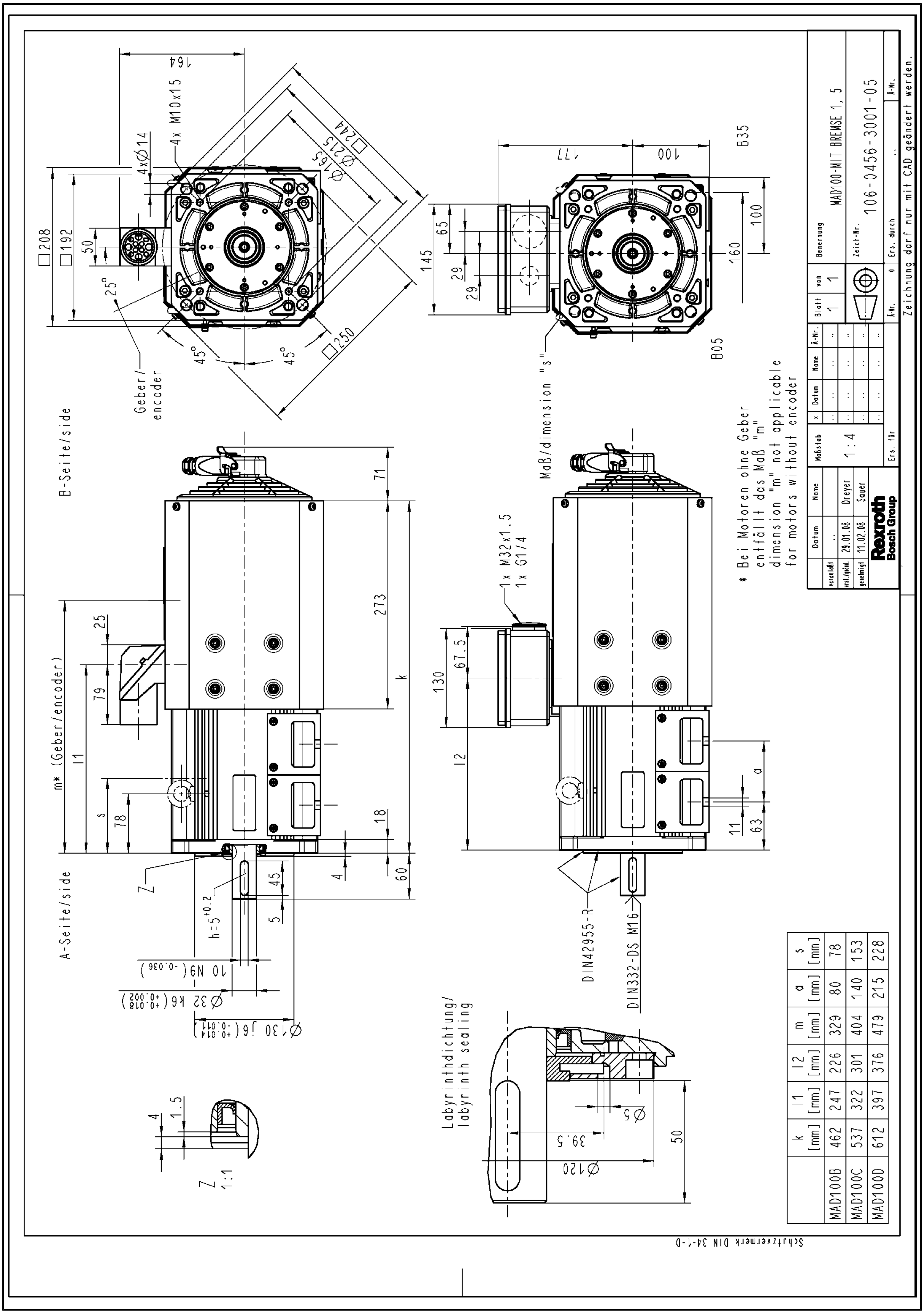



*Fig.5-3:* *MAD100 with brake 1/5 (terminal box rotatable)*

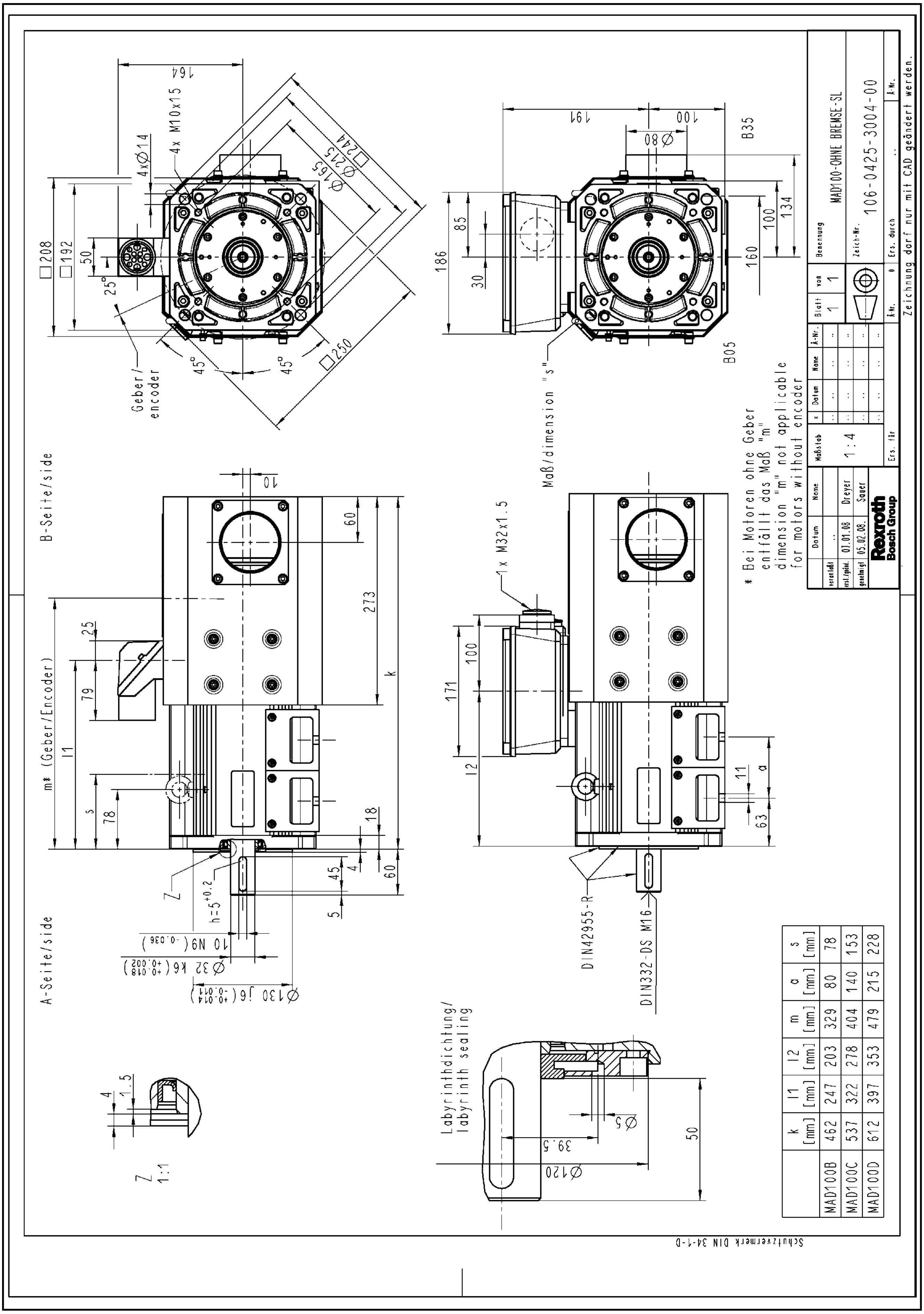
## 5.1.4 MAD100 with Brake 1 or 5



| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAD100B | 462 | 247 | 226 | 329 | 80 | 78 |
| MAD100C | 537 | 322 | 301 | 404 | 140 | 153 |
| MAD100D | 612 | 397 | 376 | 479 | 215 | 228 |

*Fig.5-4: Dimension sheet MAD100 with brake 1/5*

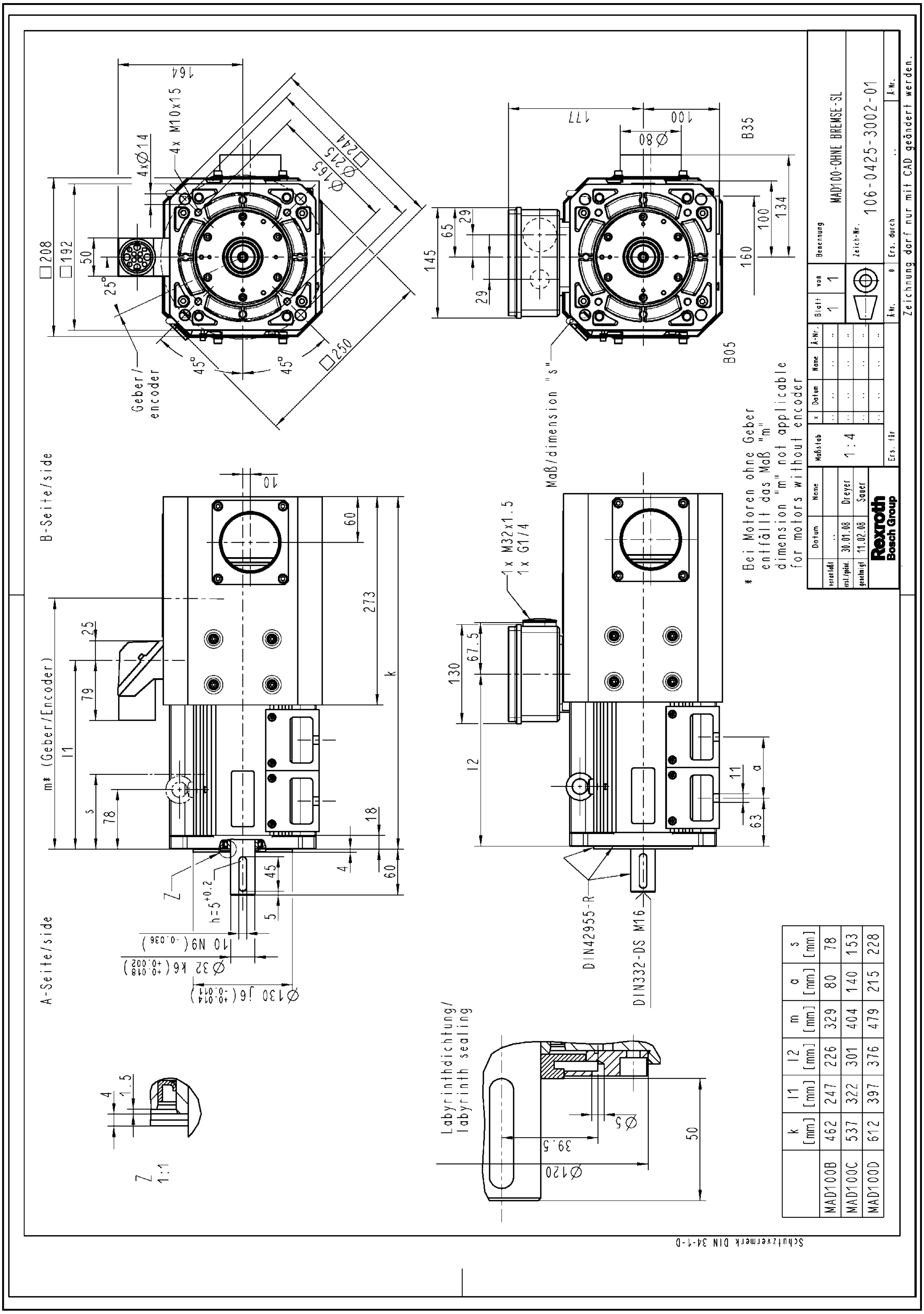
## 5.1.5 MAD100 with Fan Adapter, without Brake (Terminal Box Rotatable)



| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAD100B | 462 | 247 | 203 | 329 | 80 | 78 |
| MAD100C | 537 | 322 | 278 | 404 | 140 | 153 |
| MAD100D | 612 | 397 | 353 | 479 | 215 | 228 |

*Fig.5-5: MAD100 with fan adapter, without brake (terminal box rotatable)*

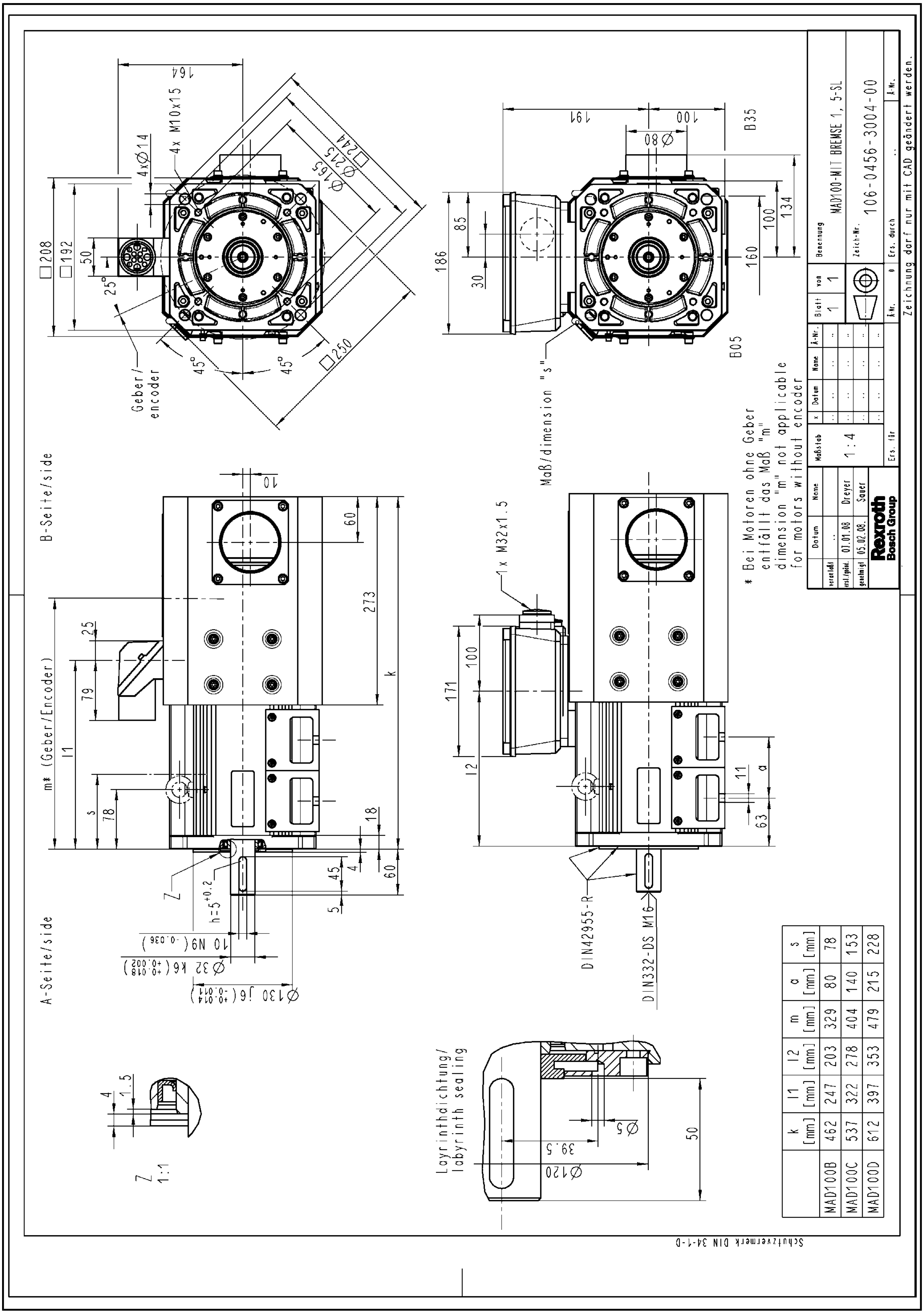
## 5.1.6 MAD100 with Fan Adapter, without Brake




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAD100B | 462 | 247 | 226 | 329 | 80 | 78 |
| MAD100C | 537 | 322 | 301 | 404 | 140 | 153 |
| MAD100D | 612 | 397 | 376 | 479 | 215 | 228 |

*Fig.5-6: Dimension sheet MAD100 with SL cooling, without holding brake*

## 5.1.7 MAD100 with Fan Adapter, Brake 1 or 5 (Terminal Box Rotatable)

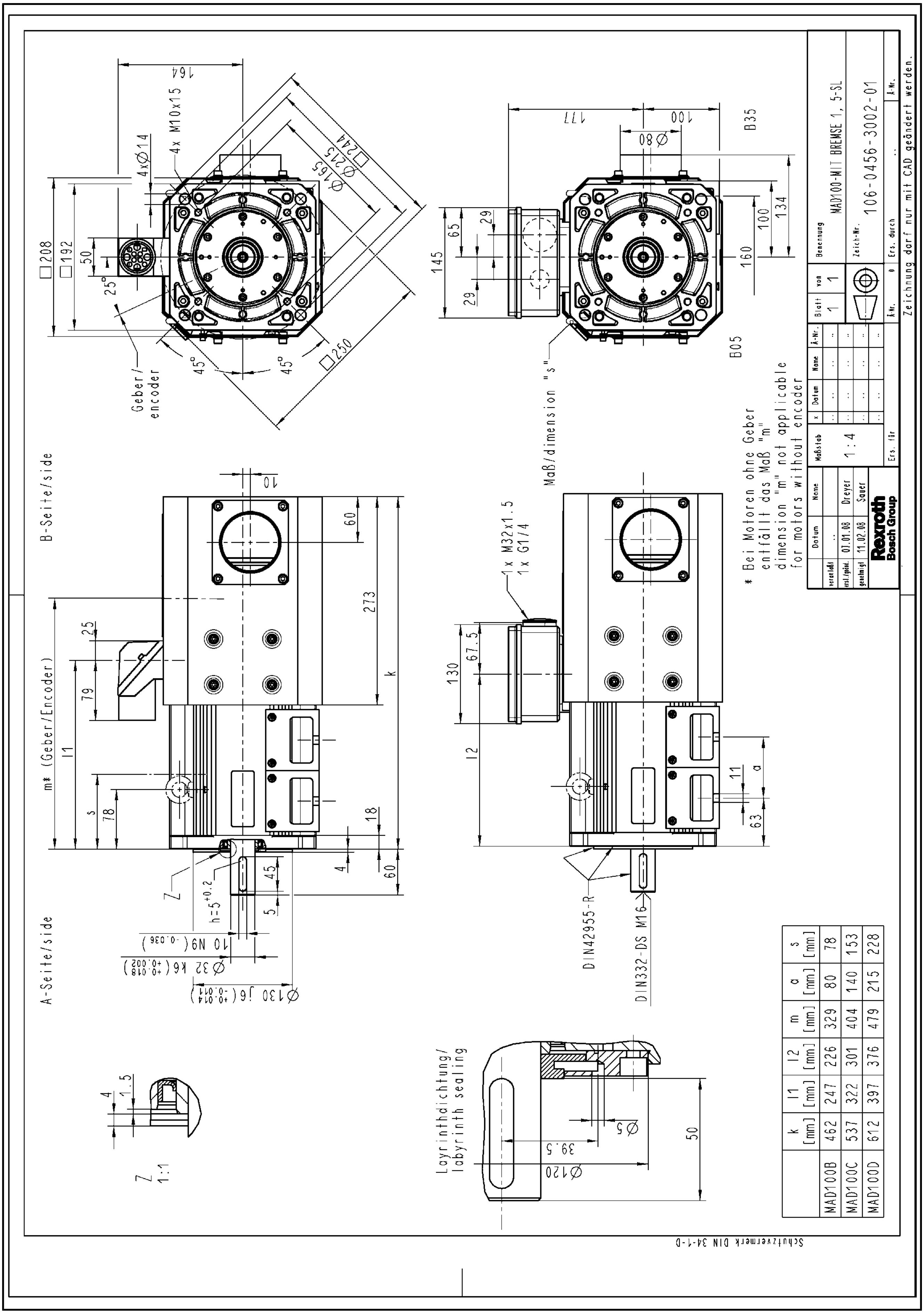



| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAD100B | 462 | 247 | 203 | 329 | 80 | 78 |
| MAD100C | 537 | 322 | 278 | 404 | 140 | 153 |
| MAD100D | 612 | 397 | 353 | 479 | 215 | 228 |

*Fig.5-7: MAD100 with SL cooling, brake 1/5 (terminal box rotatable)*

Dimension Sheets IndraDyn A

## 5.1.8 MAD100 with Fan Adapter, Brake 1 or 5




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAD100B | 462 | 247 | 226 | 329 | 80 | 78 |
| MAD100C | 537 | 322 | 301 | 404 | 140 | 153 |
| MAD100D | 612 | 397 | 376 | 479 | 215 | 228 |

*Fig.5-8: Dimension sheet MAD100 with SL cooling and brake 1/5*

## 5.1.9 MAD100 in ATEX Design with Encoder M6 or S6, without Brake (Terminal Box Rotatable)

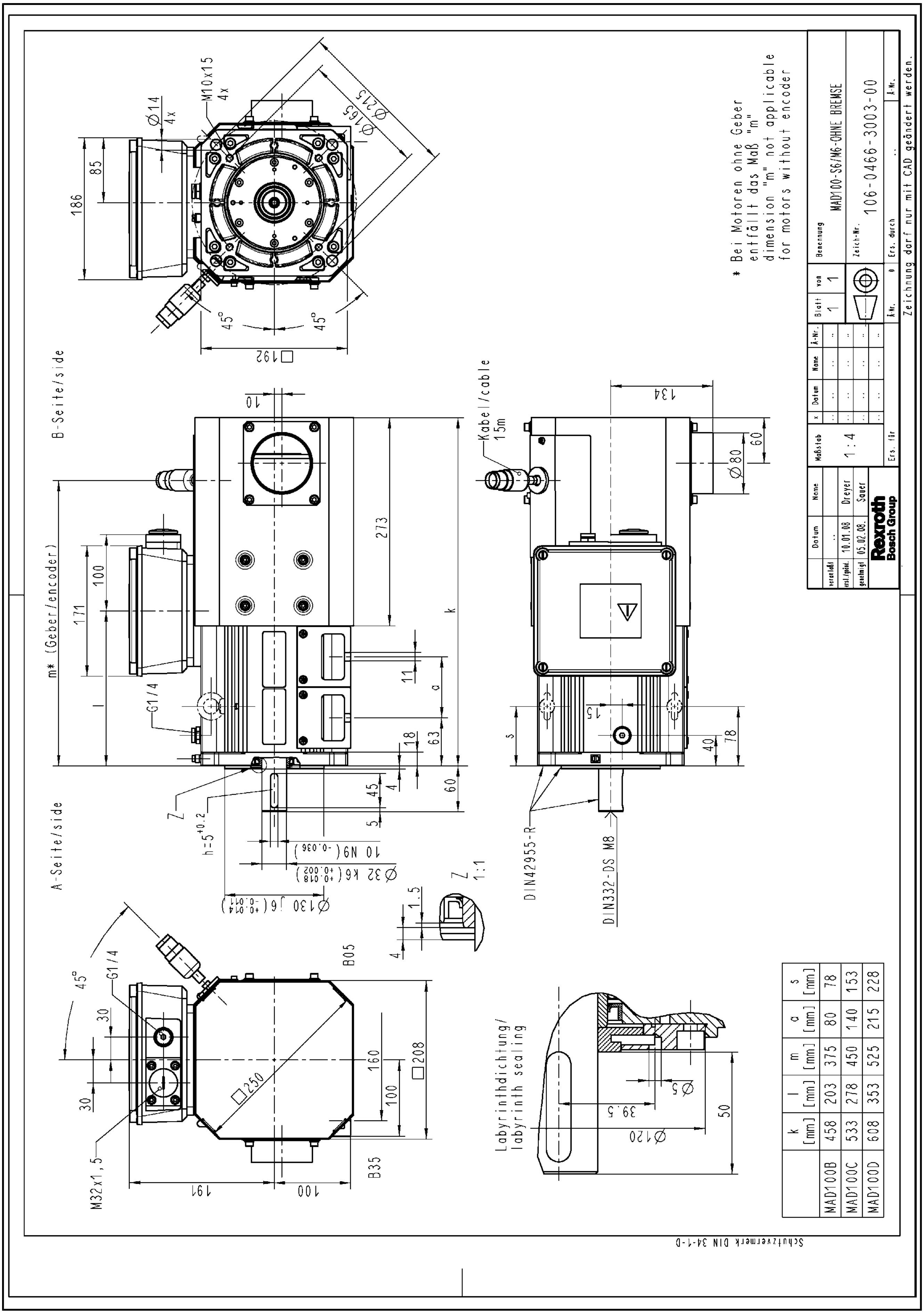



*Fig.5-9: MAD100 with encoder M6/S6, without brake (terminal box rotatable)*

## 5.1.10 MAD100 in ATEX Design with Encoder M6 or S6, without Brake

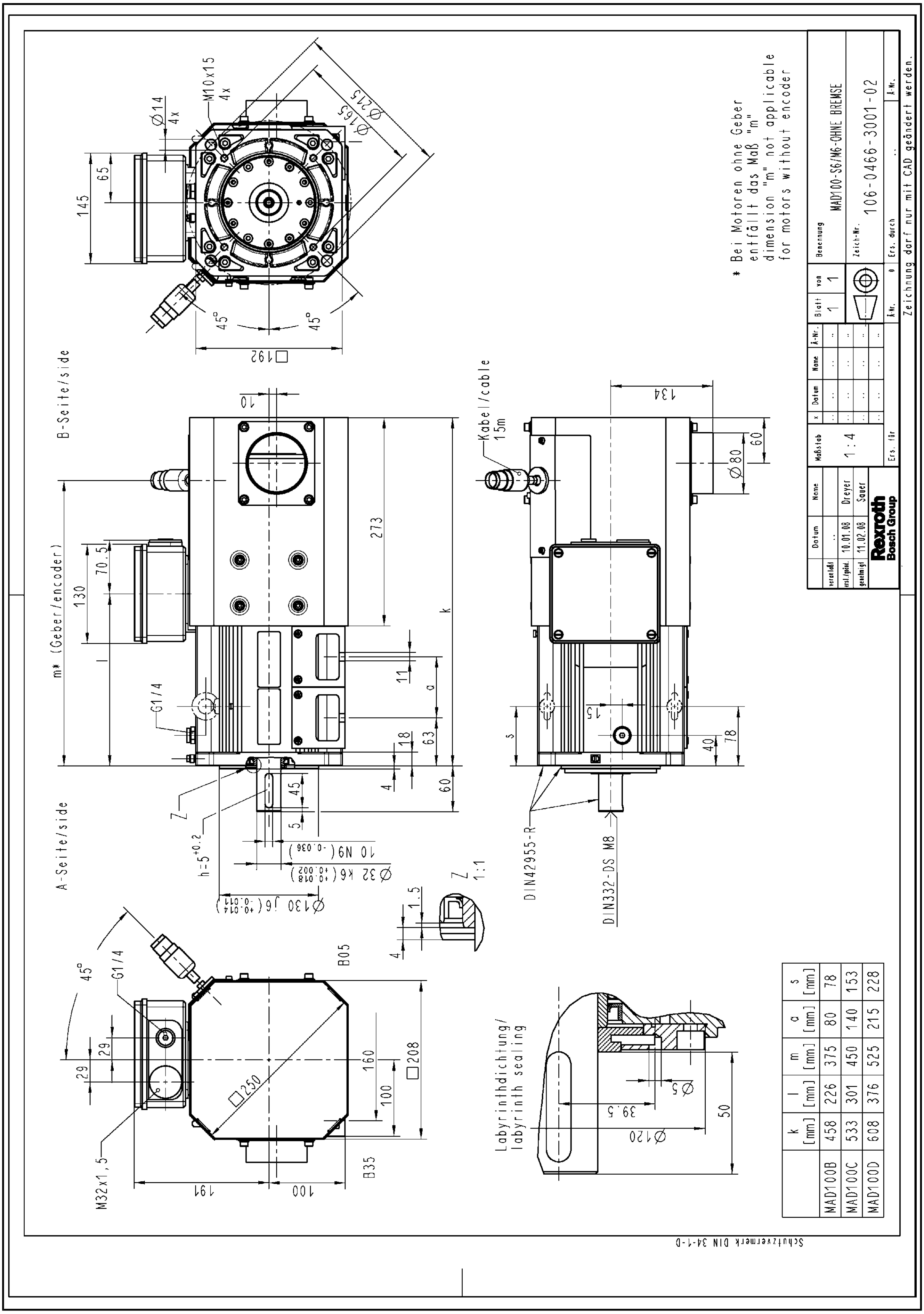



*Fig.5-10: Dimension sheet MAD100 with encoder M6 or S6, without brake*

### 5.1.11 MAD100 in ATEX Design with Encoder M6 or S6, Brake 1 or 5 (Terminal Box Rotatable)

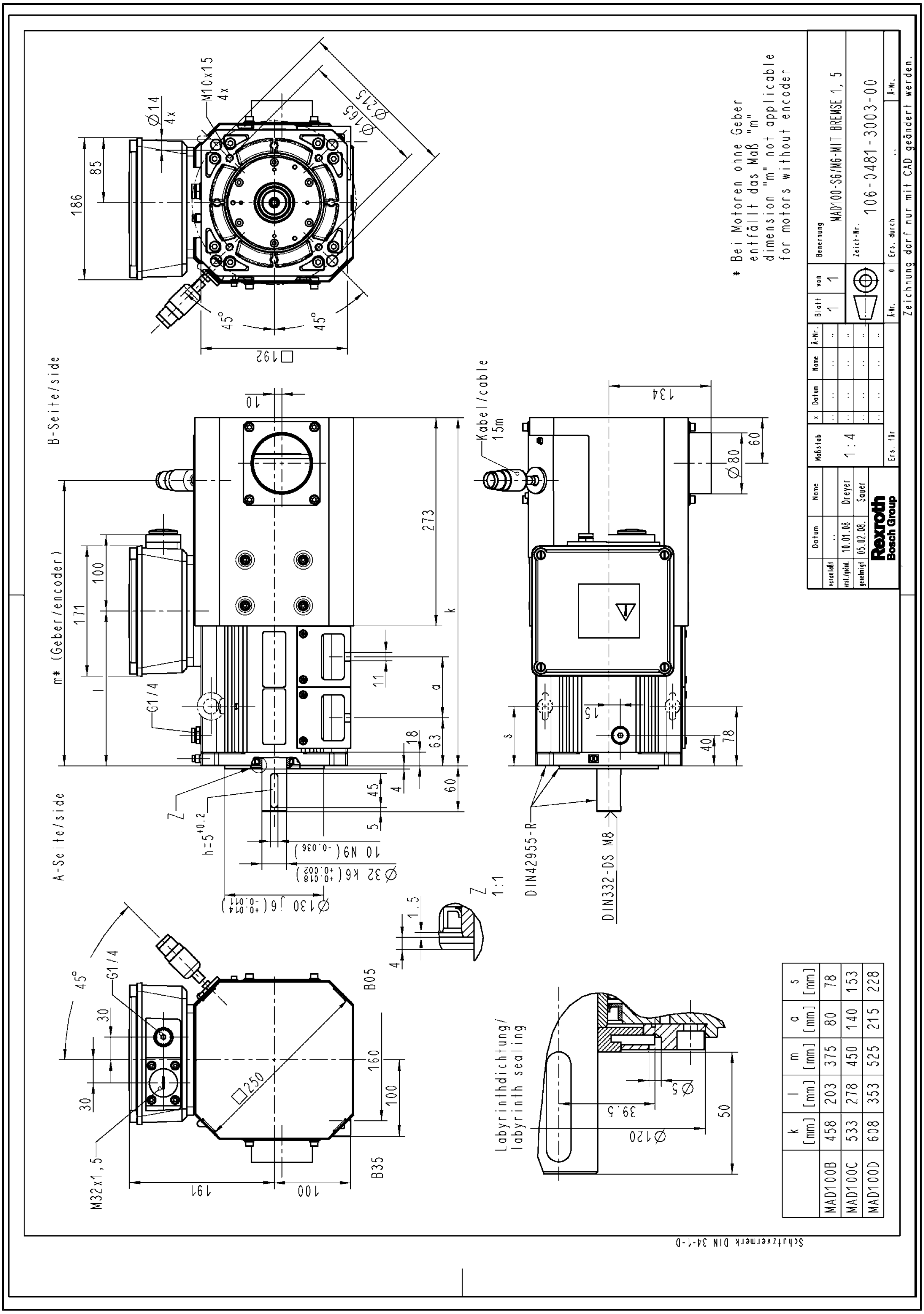



*Fig.5-11: MAD100 with encoder M6/S6, brake 1/5 (terminal box rotatable)*

## 5.1.12 MAD100 in ATEX Design with Encoder M6 or S6, Brake 1 or 5

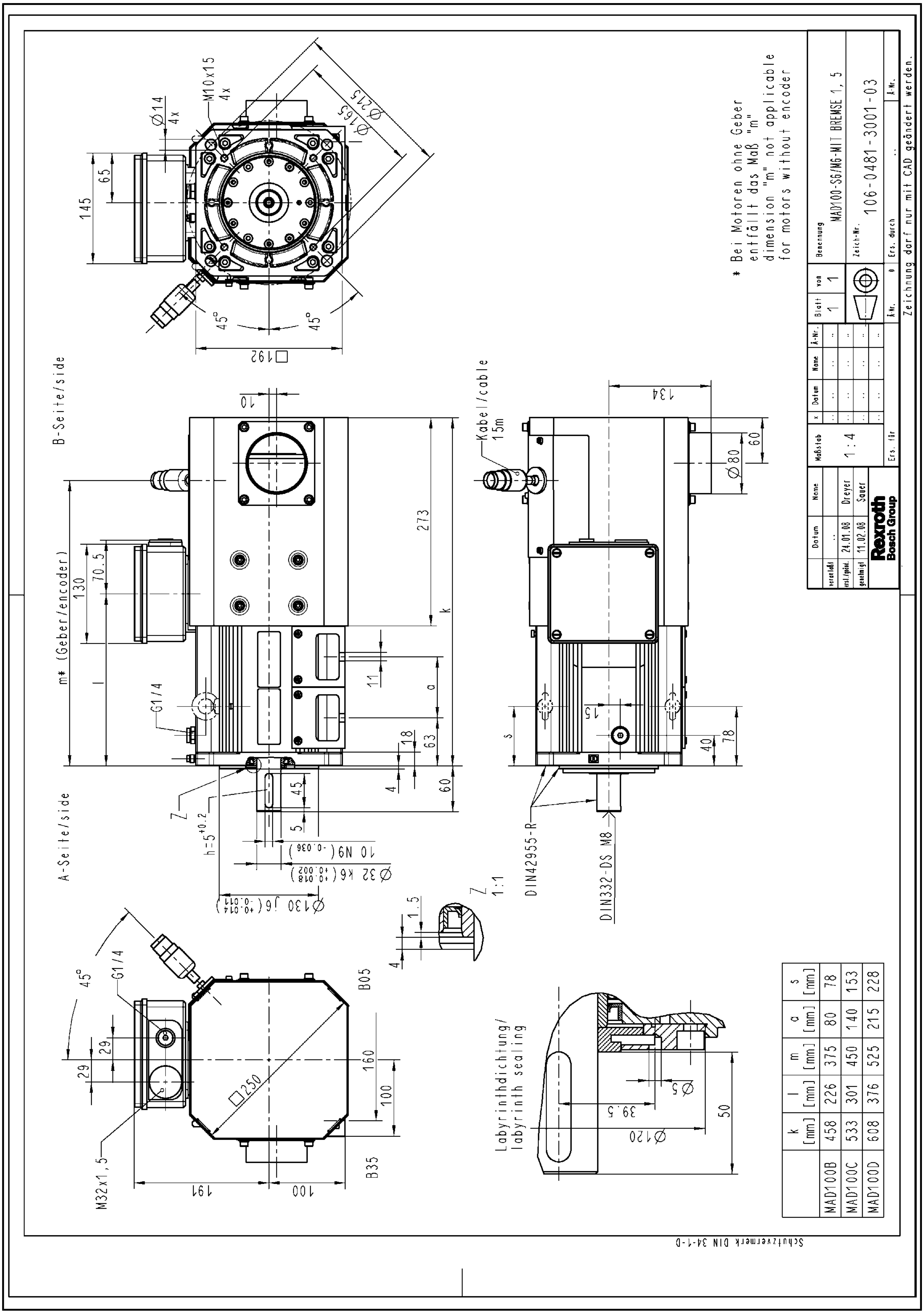
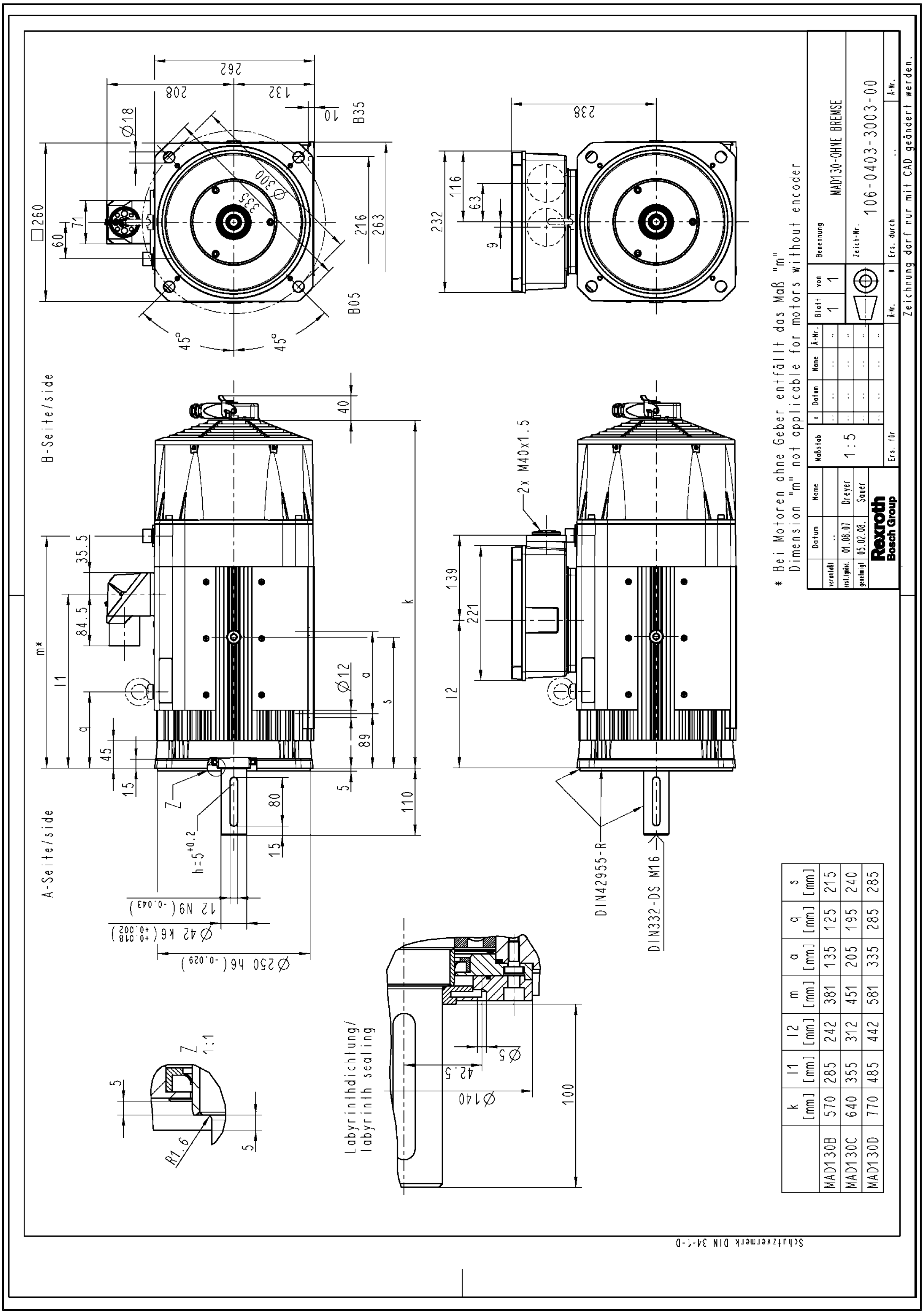



*Fig.5-12: Dimension sheet MAD100 with encoder M6/S6, brake 1/5*

# 5.2 Frame Size MAD130

## 5.2.1 MAD130 without Brake (Terminal Box Rotatable)




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|---|
| MAD130B | 570 | 285 | 242 | 381 | 135 | 125 | 215 |
| MAD130C | 640 | 355 | 312 | 451 | 205 | 195 | 240 |
| MAD130D | 770 | 485 | 442 | 581 | 335 | 285 | 285 |

Dimension Sheets IndraDyn A

## 5.2.2 MAD130 without Brake

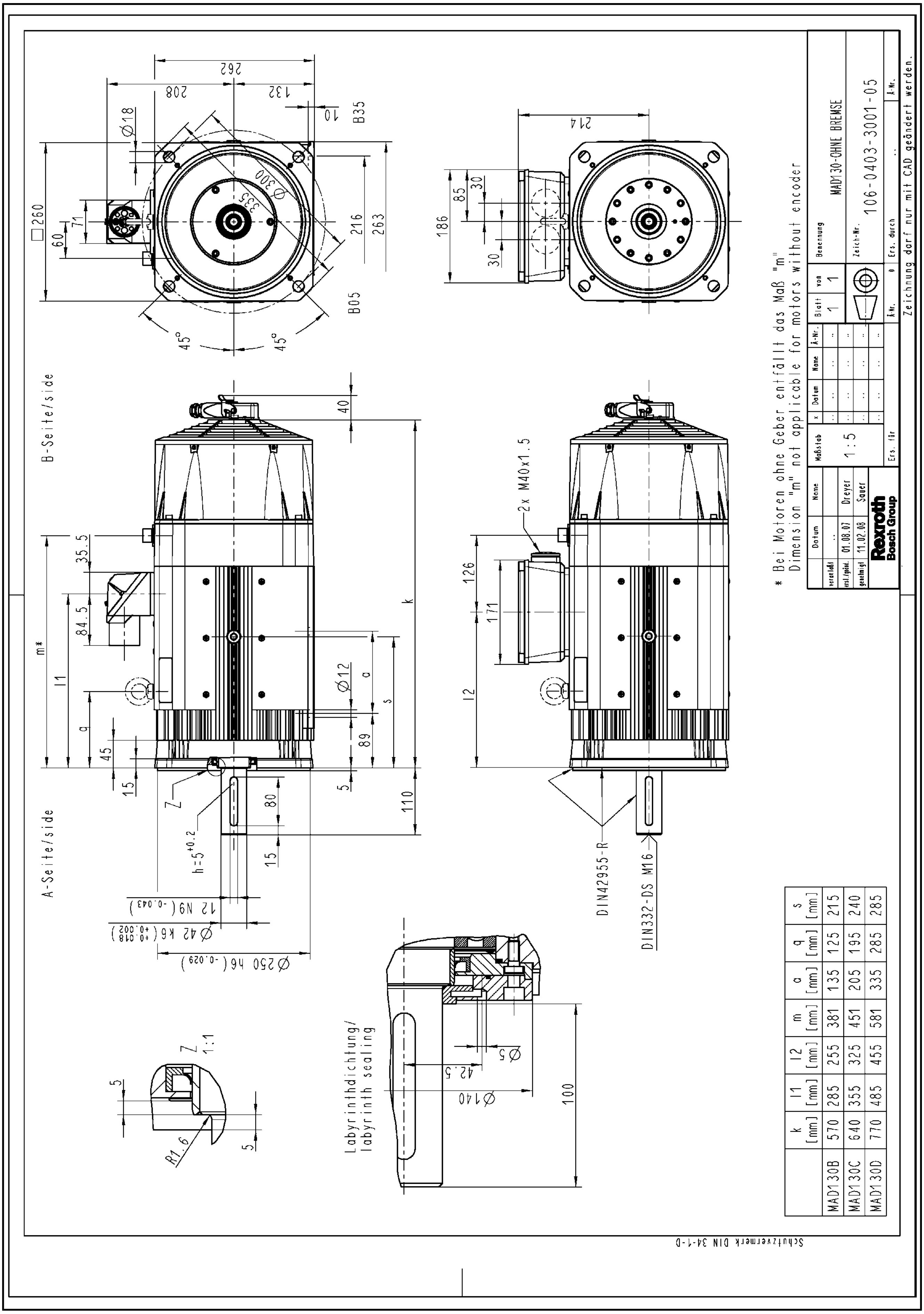



*Fig.5-14: Dimension sheet MAD130 without brake*

## 5.2.3 MAD130 with Brake 1 or 5 (Terminal Box Rotatable)

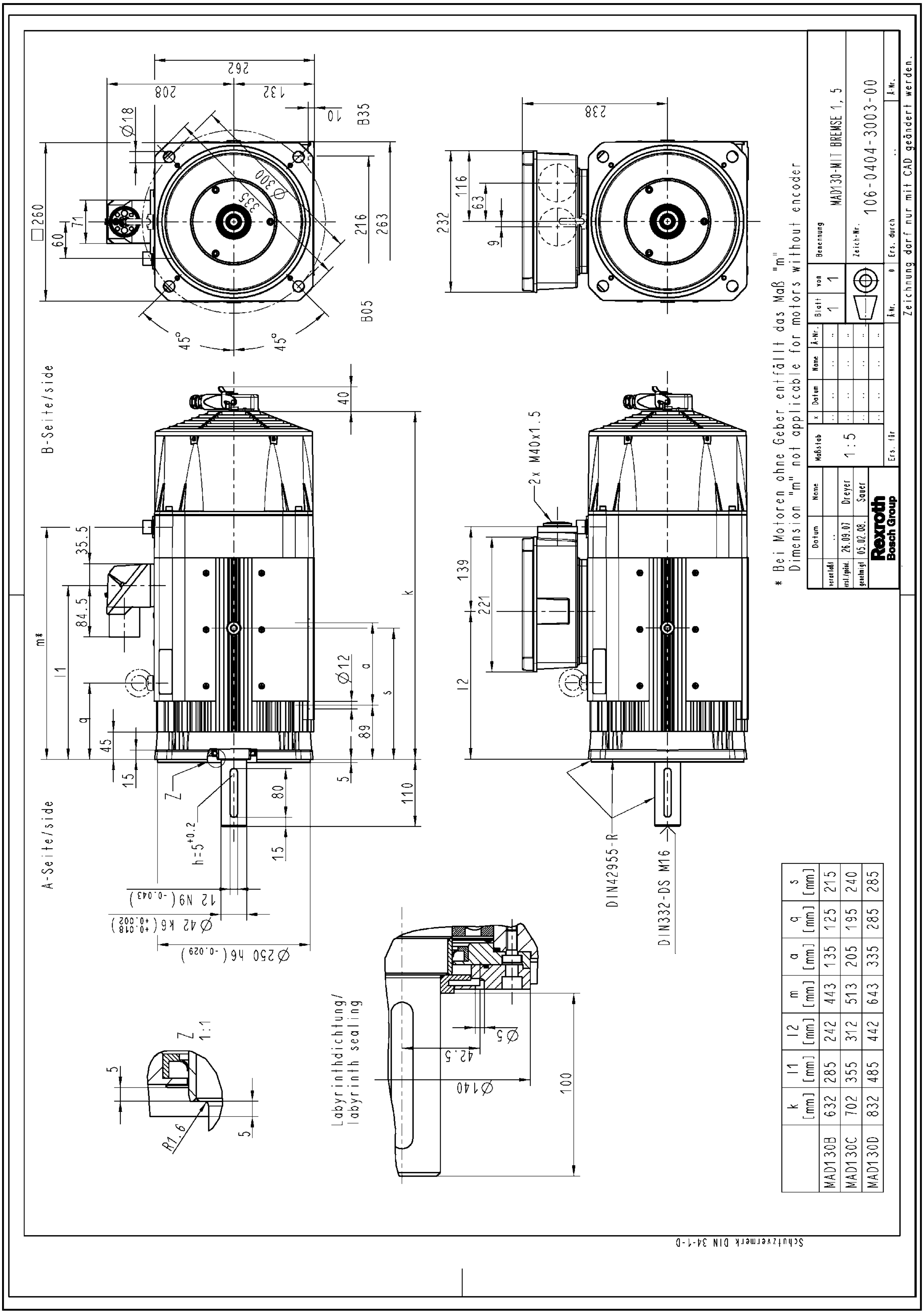
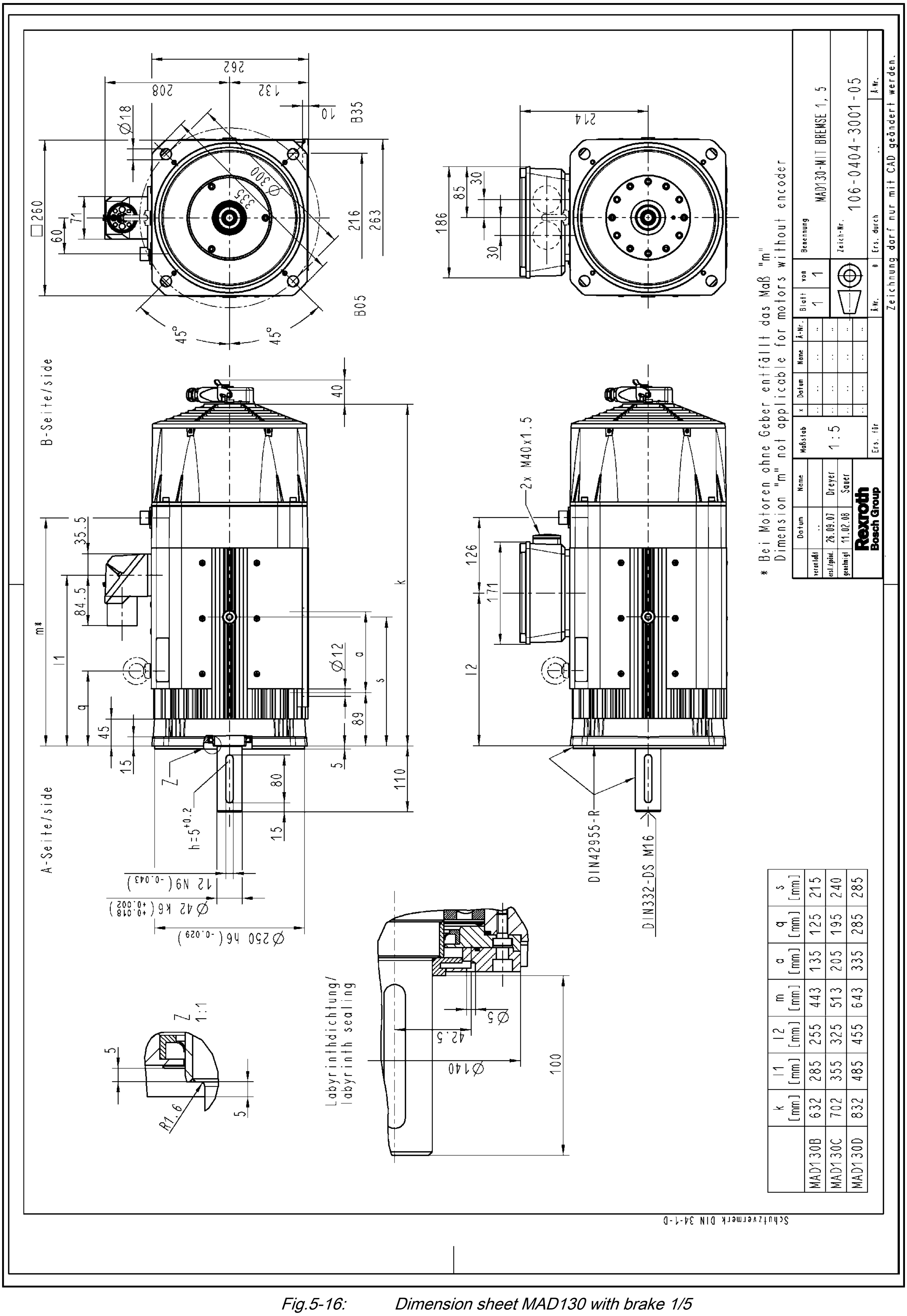



*Fig.5-15: MAD130 with brake 1/5 (terminal box rotatable)*

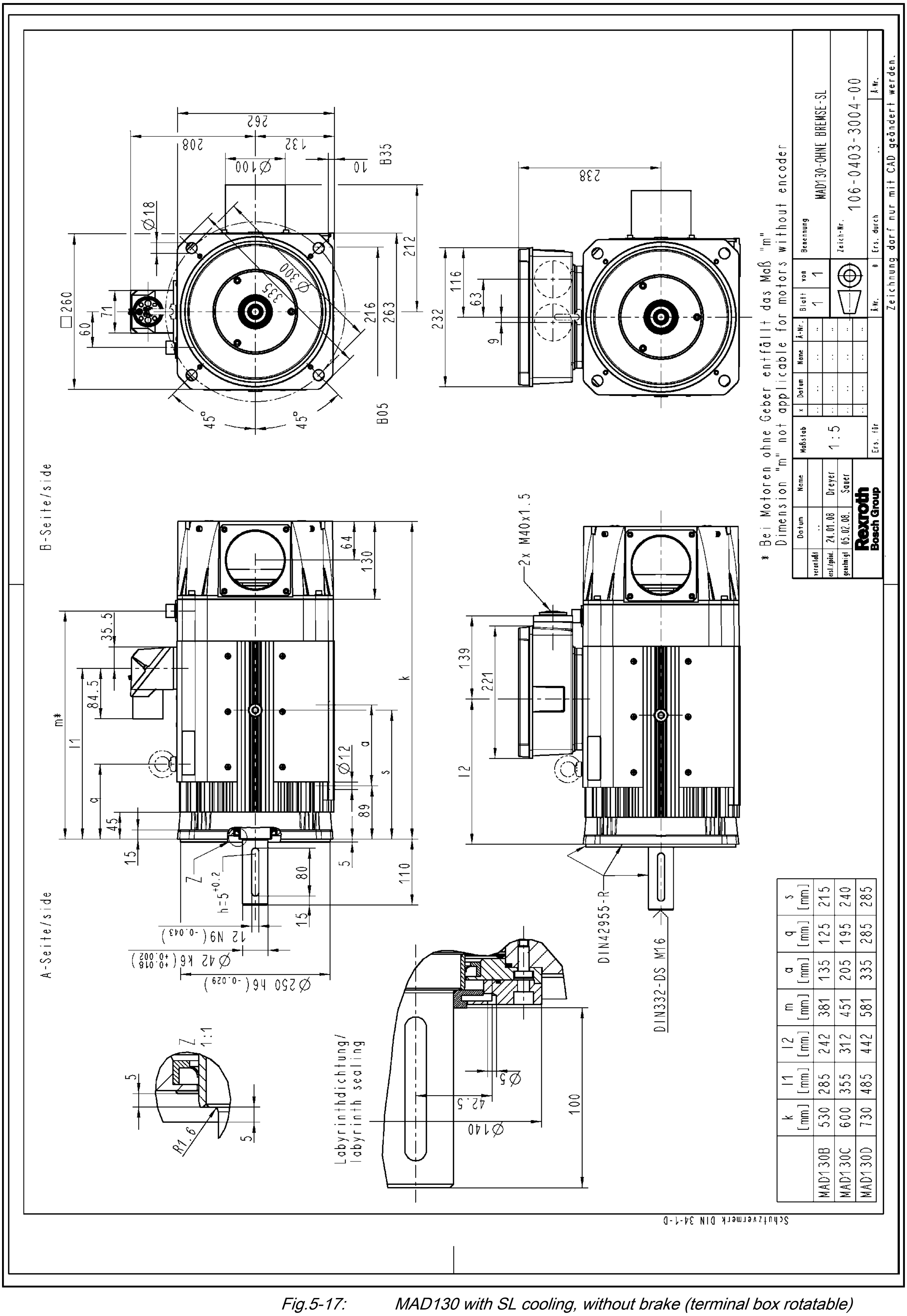
## 5.2.4 MAD130 with Brake 1 or 5



| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|---|
| MAD130B | 632 | 285 | 255 | 443 | 135 | 125 | 215 |
| MAD130C | 702 | 355 | 325 | 513 | 205 | 195 | 240 |
| MAD130D | 832 | 485 | 455 | 643 | 335 | 285 | 285 |

*Fig.5-16: Dimension sheet MAD130 with brake 1/5*

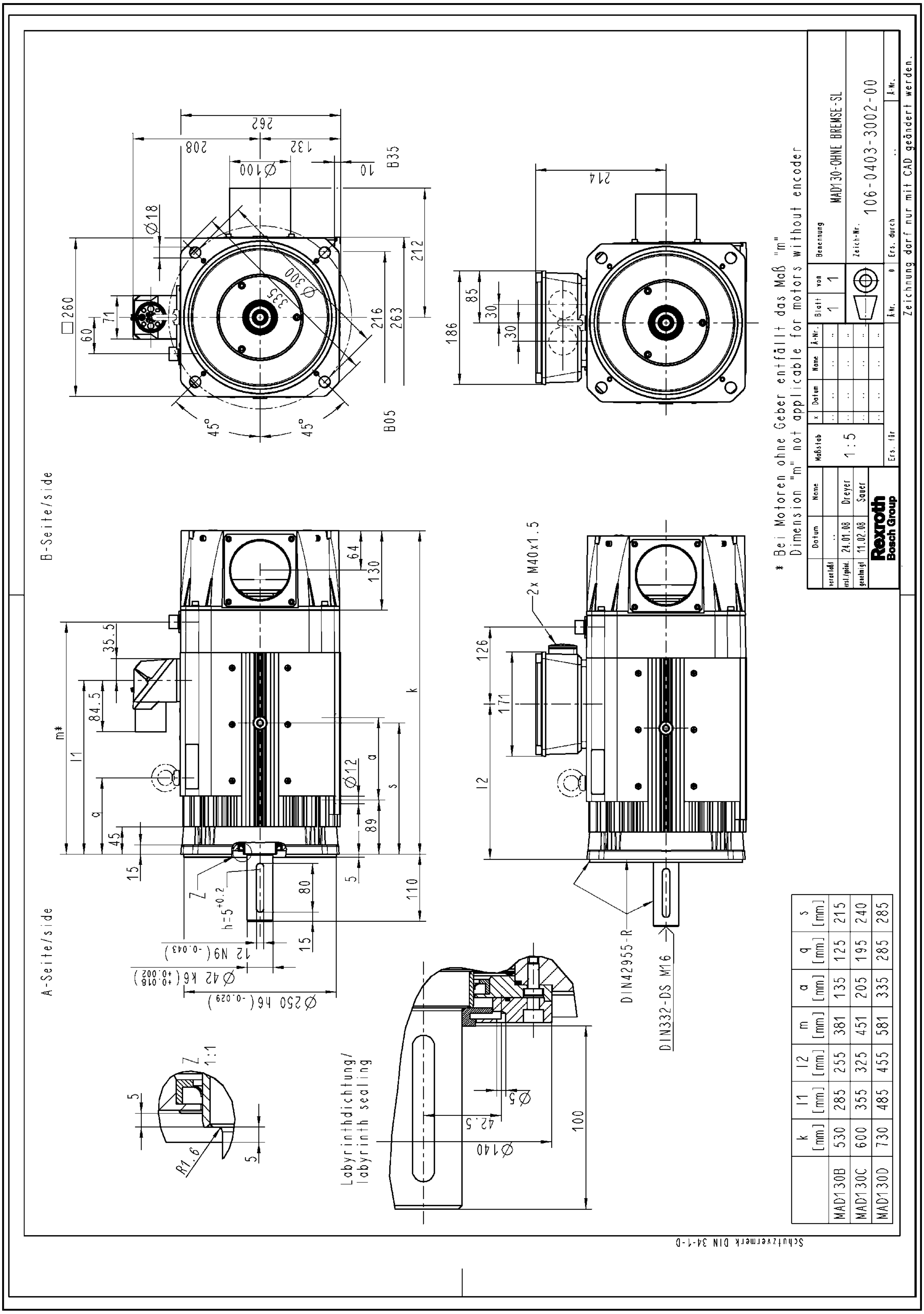
### 5.2.5 MAD130 with Fan Adapter, without Brake (Terminal Box Rotatable)




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|---|
| MAD130B | 530 | 285 | 242 | 381 | 135 | 125 | 215 |
| MAD130C | 600 | 355 | 312 | 451 | 205 | 195 | 240 |
| MAD130D | 730 | 485 | 442 | 581 | 335 | 285 | 285 |

*Fig.5-17: MAD130 with SL cooling, without brake (terminal box rotatable)*

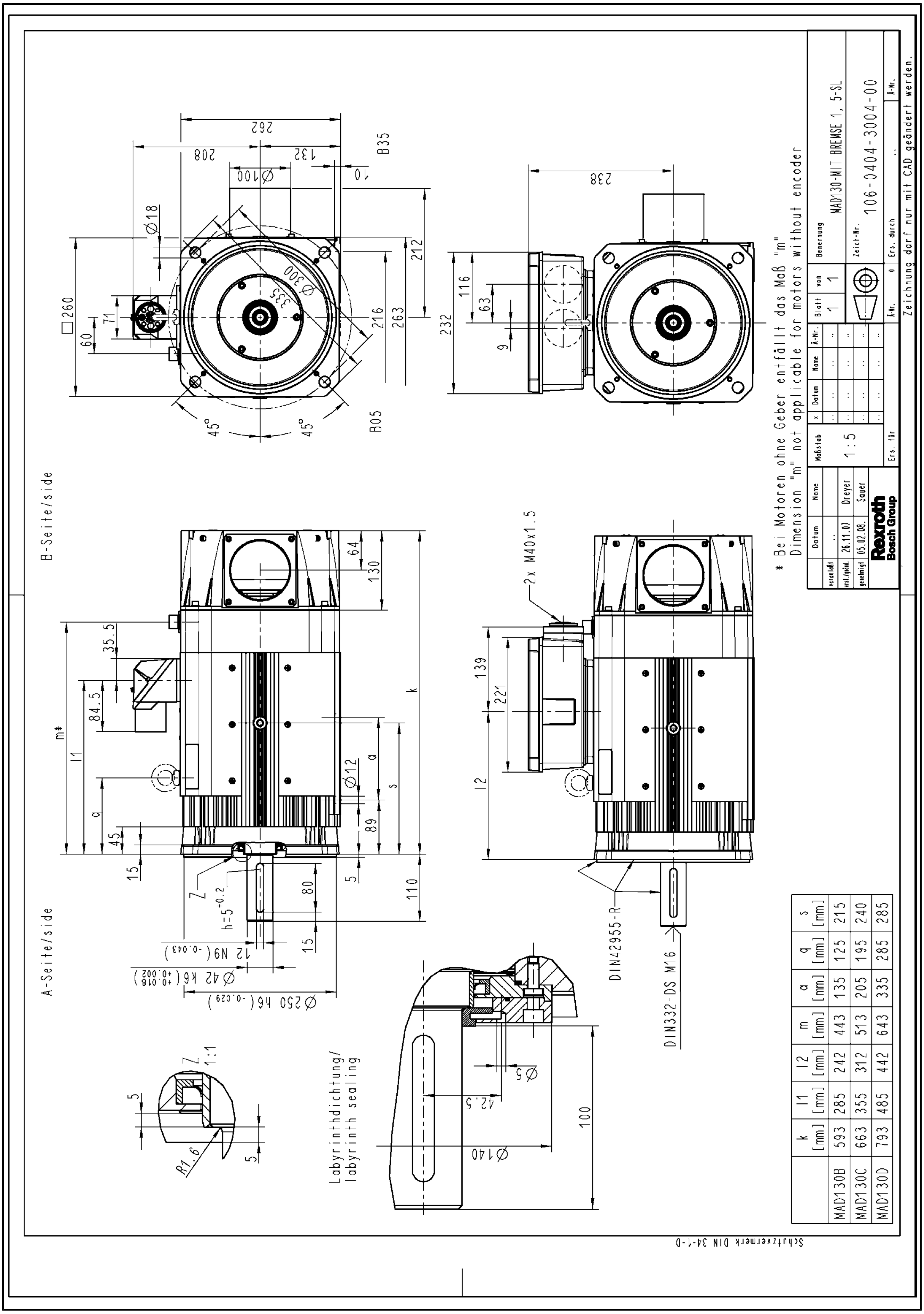
## 5.2.6 MAD130 with Fan Adapter, without Brake




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|---|
| MAD130B | 530 | 285 | 255 | 381 | 135 | 125 | 215 |
| MAD130C | 600 | 355 | 325 | 451 | 205 | 195 | 240 |
| MAD130D | 730 | 485 | 455 | 581 | 335 | 285 | 285 |

*Fig.5-18: MAD130 with SL cooling, without brake*

## 5.2.7 MAD130 with Fan Adapter, Brake 1 or 5 (Terminal Box Rotatable)

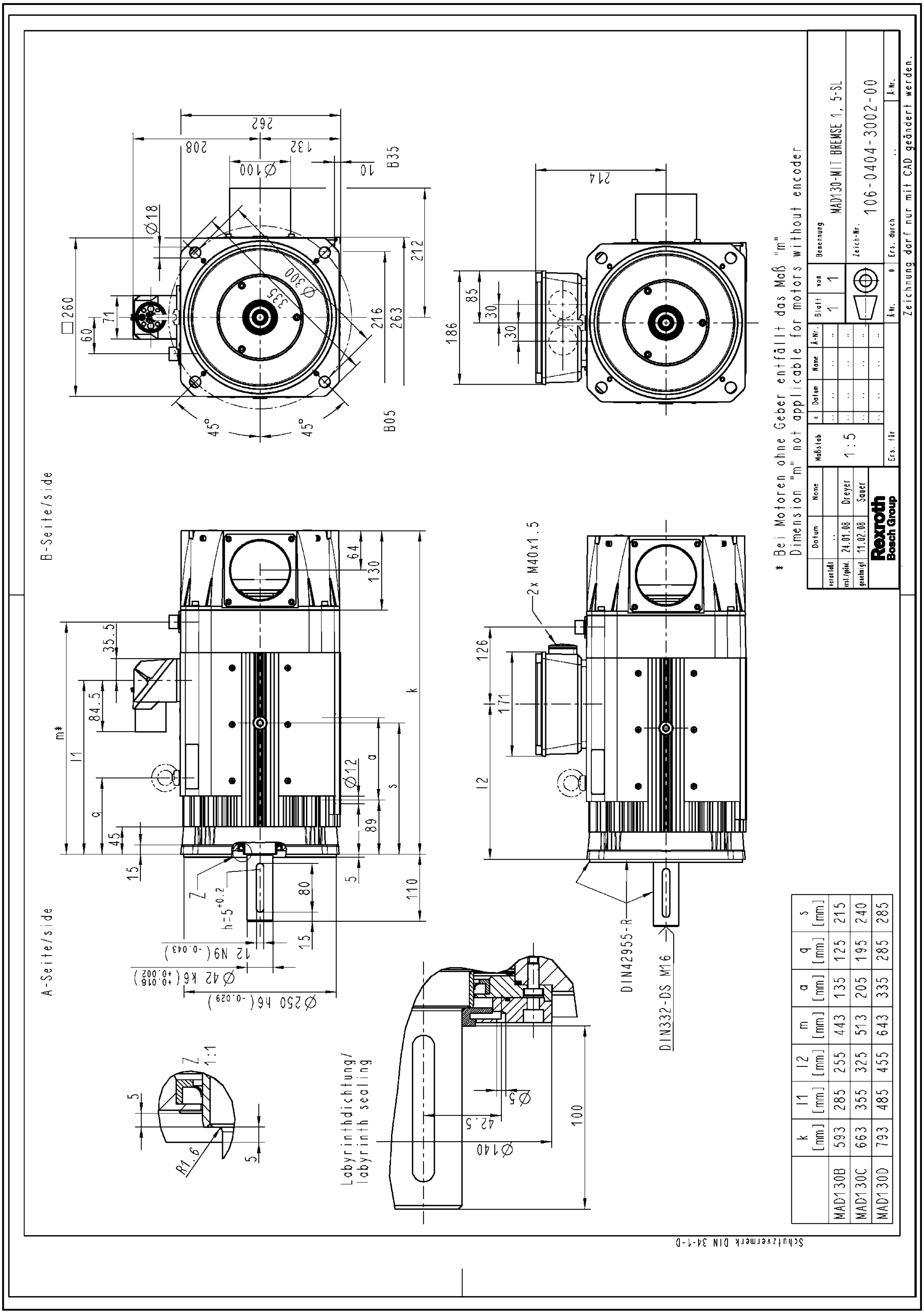


| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|---|
| MAD130B | 593 | 285 | 242 | 443 | 135 | 125 | 215 |
| MAD130C | 663 | 355 | 312 | 513 | 205 | 195 | 240 |
| MAD130D | 793 | 485 | 442 | 643 | 335 | 285 | 285 |

*Fig.5-19: MAD130 with SL cooling, brake 1/5 (terminal box rotatable)*

Dimension Sheets IndraDyn A

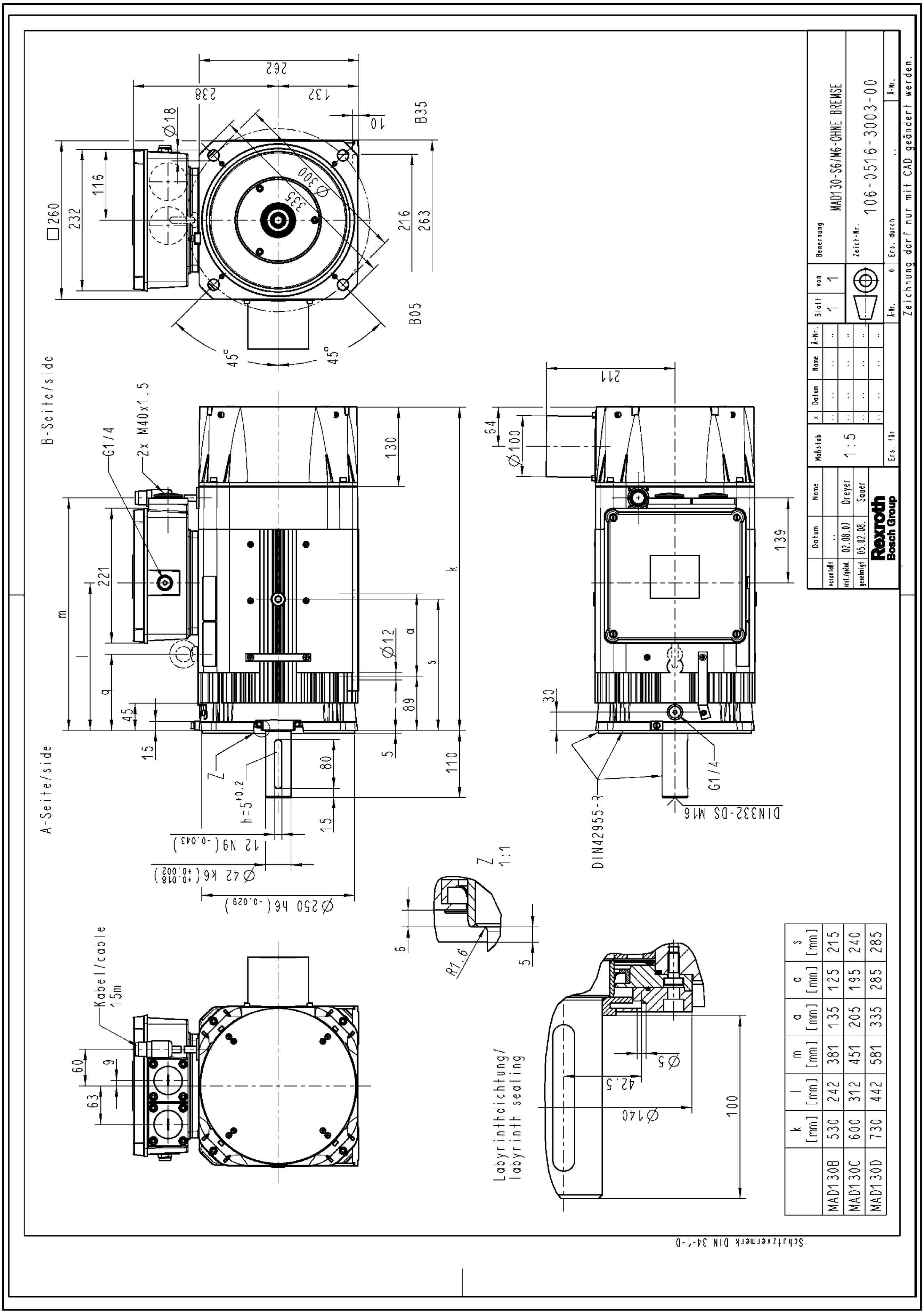
## 5.2.8 MAD130 with Fan Adapter and Brake 1 or 5




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|---|
| MAD130B | 593 | 285 | 255 | 443 | 135 | 125 | 215 |
| MAD130C | 663 | 355 | 325 | 513 | 205 | 195 | 240 |
| MAD130D | 793 | 485 | 455 | 643 | 335 | 285 | 285 |

*Fig.5-20: MAD130 with SL cooling and brake 1/5*

## 5.2.9 MAD130 in ATEX Design with Encoder M6 or S6, without Brake (Terminal Box Rotatable)




| | k [mm] | l [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAD130B | 530 | 242 | 381 | 135 | 125 | 215 |
| MAD130C | 600 | 312 | 451 | 205 | 195 | 240 |
| MAD130D | 730 | 442 | 581 | 335 | 285 | 285 |

Fig.5-21: MAD130 with encoder M6/S6, without brake (terminal box rotatable)

Dimension Sheets IndraDyn A

### 5.2.10 MAD130 in ATEX Design with Encoder M6 or S6, without Brake

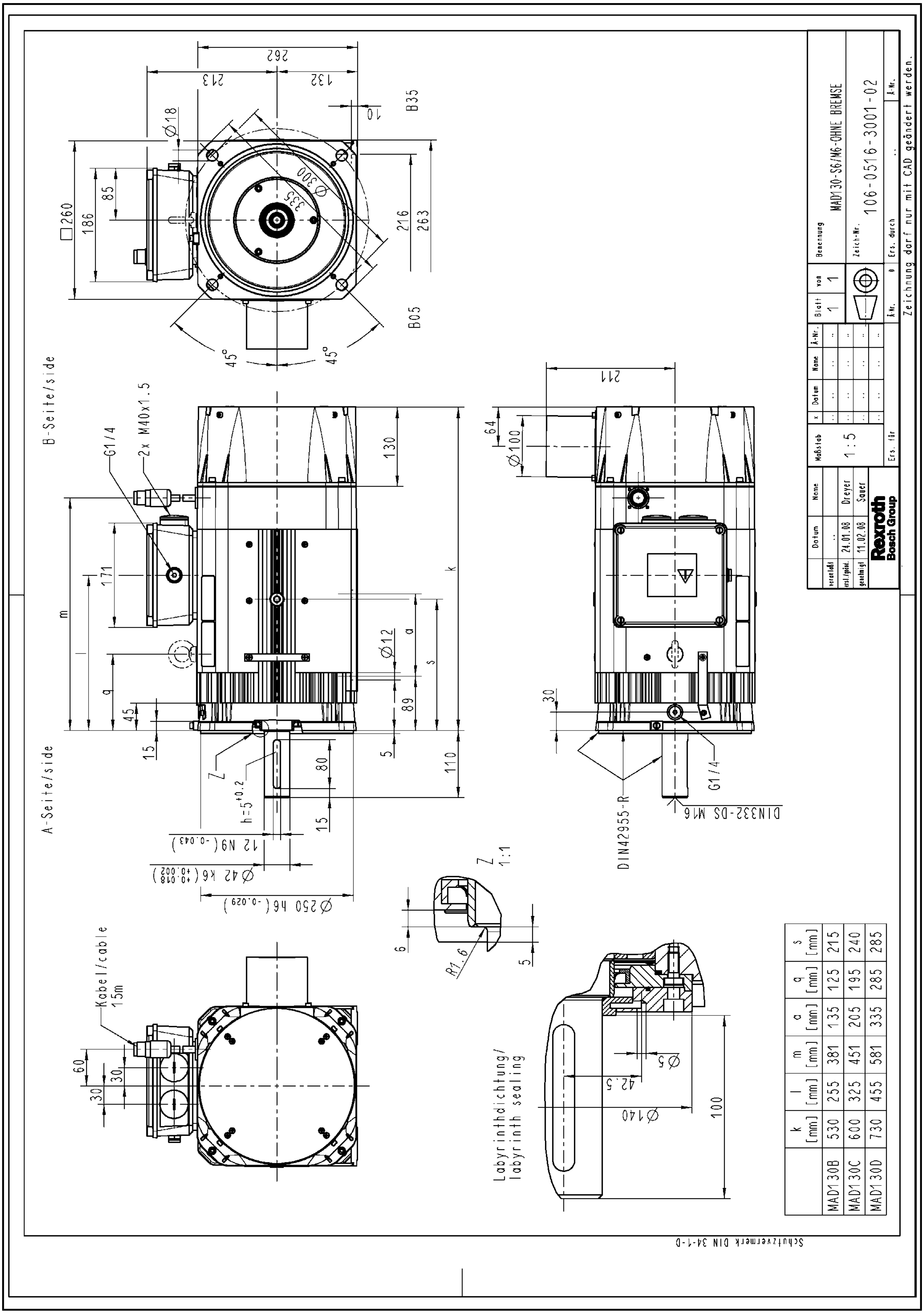
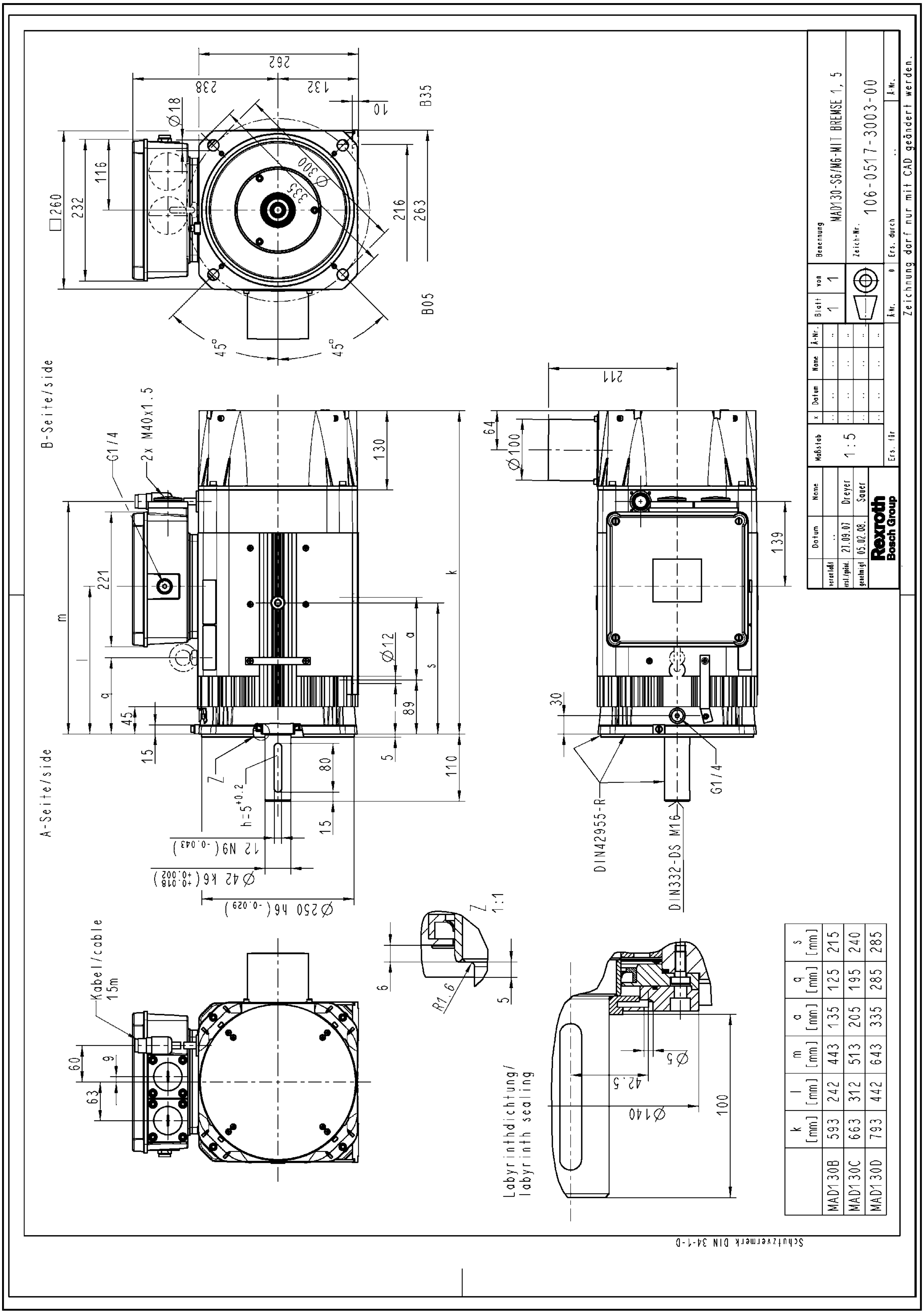



*Fig.5-22: Dimension sheet MAD130 with encoder M6 or S6, without brake*

## 5.2.11 MAD130 in ATEX Design with Encoder M6 or S6, Brake 1 or 5 (Terminal Box Rotatable)




| | k [mm] | l [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAD130B | 593 | 242 | 443 | 135 | 125 | 215 |
| MAD130C | 663 | 312 | 513 | 205 | 195 | 240 |
| MAD130D | 793 | 442 | 643 | 335 | 285 | 285 |

Fig.5-23: MAD130 with encoder M6/S6, brake 1/5 (terminal box rotatable)

### 5.2.12 MAD130 in ATEX Design with Encoder M6 or S6, Brake 1 or 5

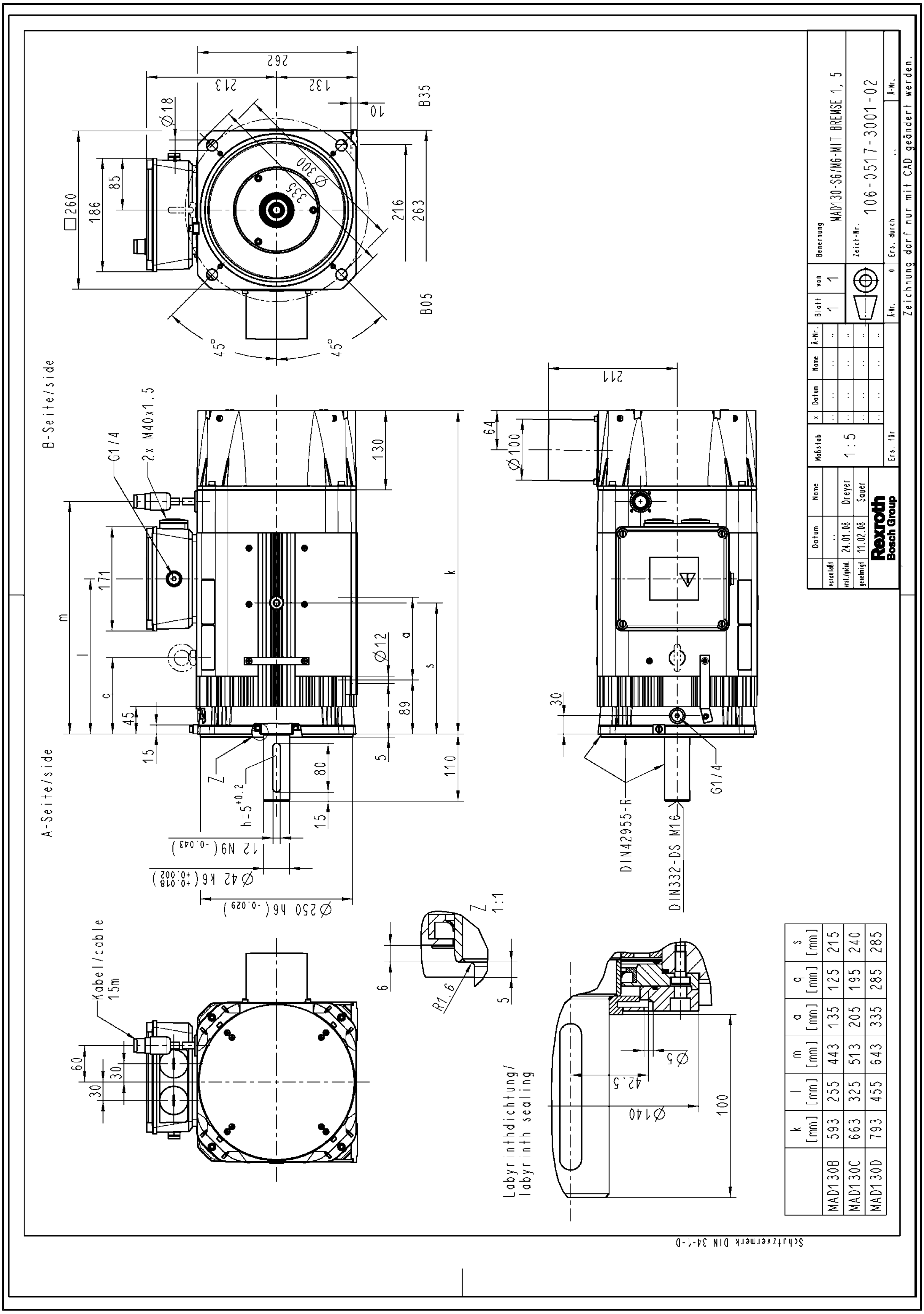
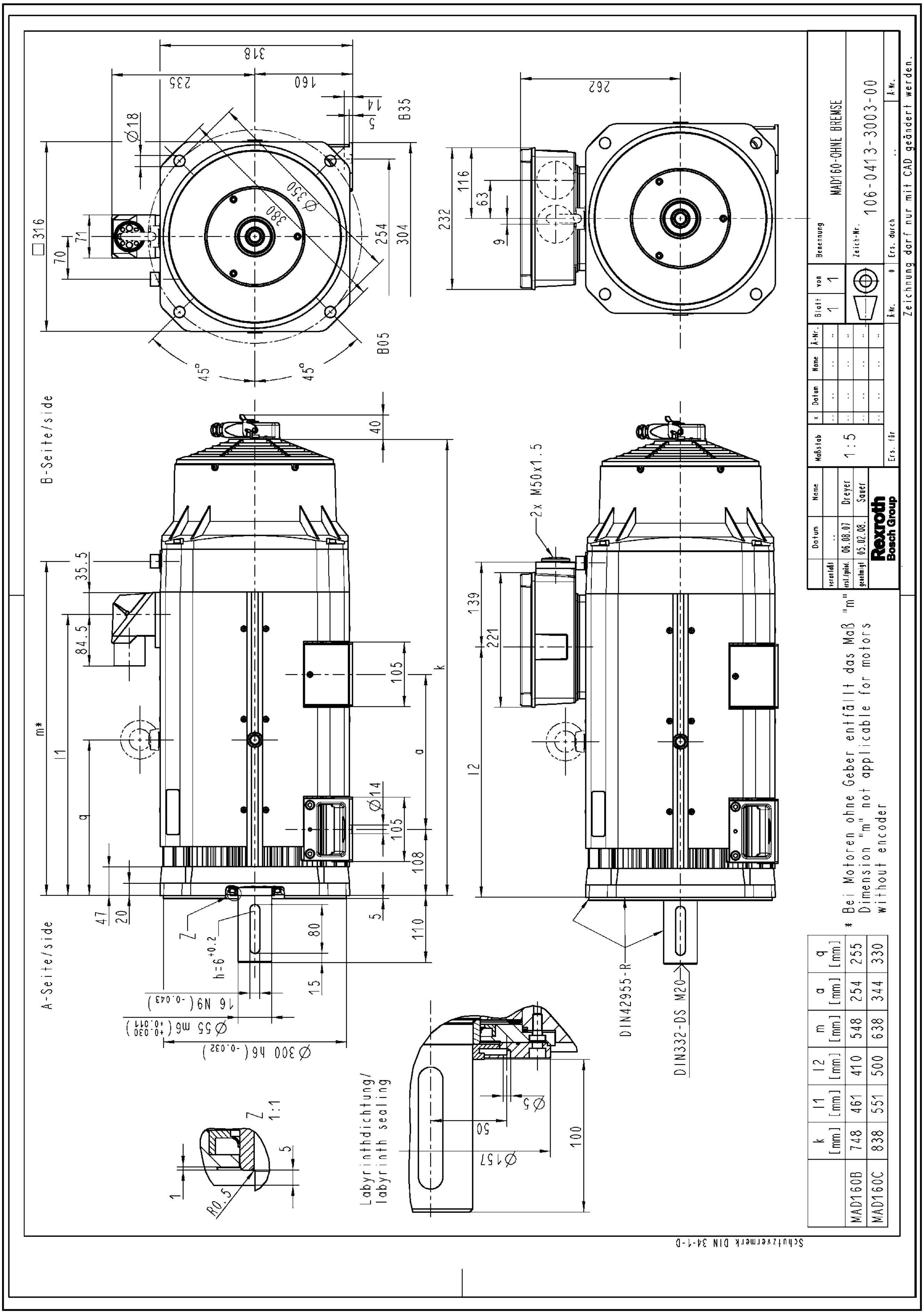



*Fig.5-24: Dimension sheet MAD130 with encoder M6/S6, brake 1/5*

# 5.3 Frame Size MAD160

## 5.3.1 MAD160 without Brake (Terminal Box Rotatable)




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] |
|---|---|---|---|---|---|---|
| MAD160B | 748 | 461 | 410 | 548 | 254 | 255 |
| MAD160C | 838 | 551 | 500 | 638 | 344 | 330 |

## 5.3.2 MAD160 without Brake

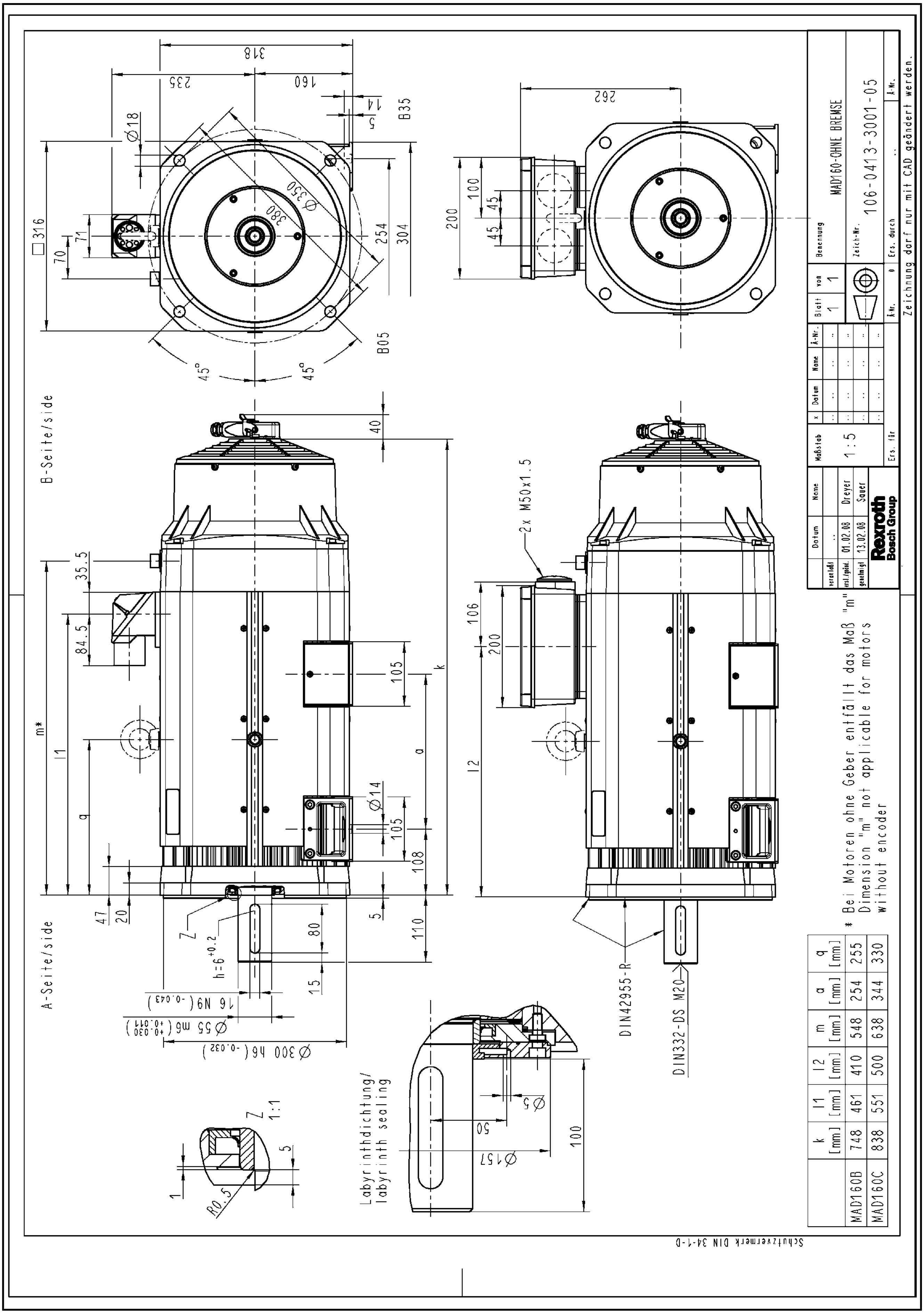
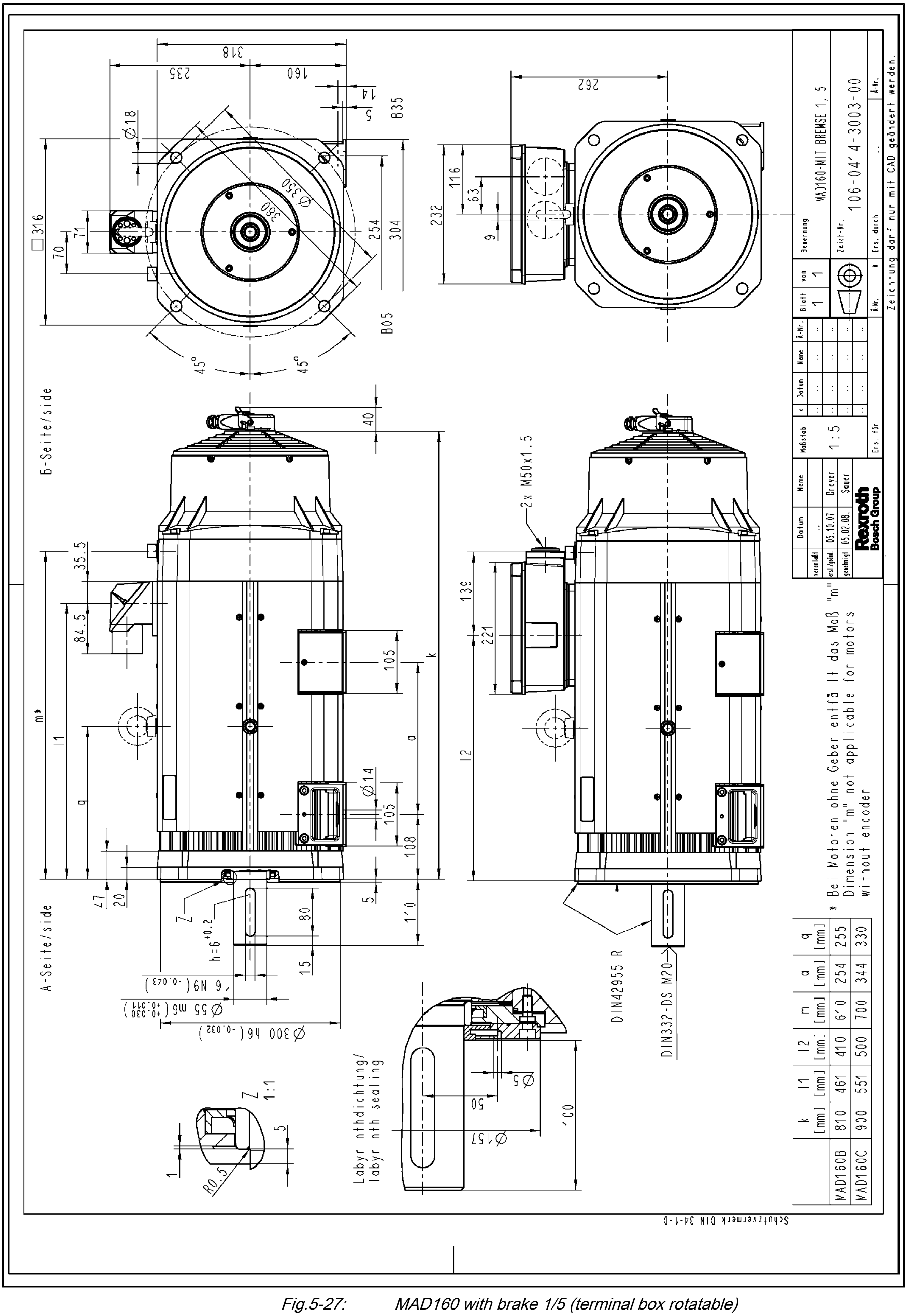



*Fig.5-26: Dimension sheet MAD160 without brake*

## 5.3.3 MAD160 with Brake 1 or 5 (Terminal Box Rotatable)




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] |
|---|---|---|---|---|---|---|
| MAD160B | 810 | 461 | 410 | 610 | 254 | 255 |
| MAD160C | 900 | 551 | 500 | 700 | 344 | 330 |

*Fig.5-27: MAD160 with brake 1/5 (terminal box rotatable)*

Dimension Sheets IndraDyn A

## 5.3.4 MAD160 with Brake 1 or 5

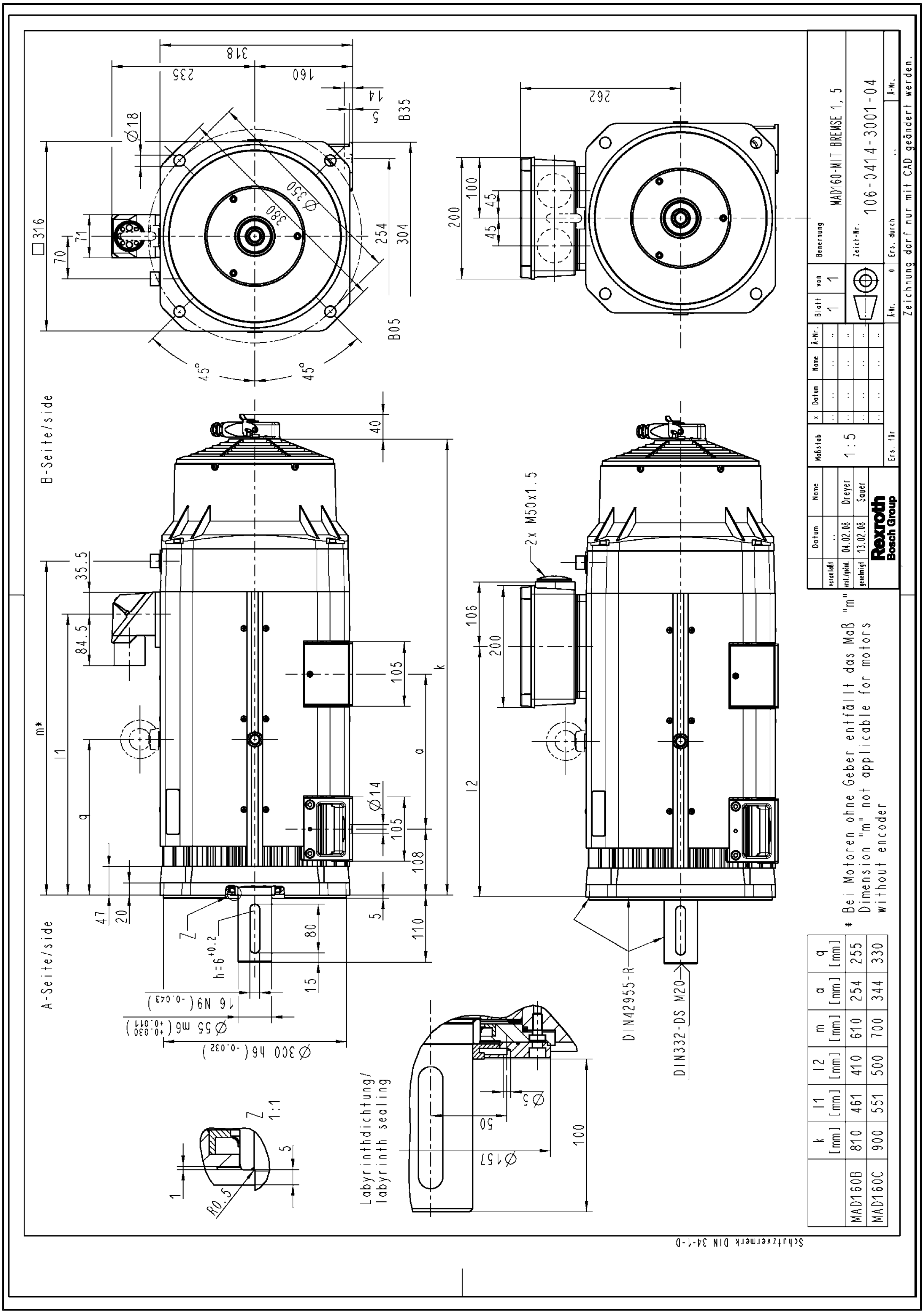



*Fig.5-28: Dimension sheet MAD160 with brake 1/5*

### 5.3.5 MAD160 with Brake 3 (Terminal Box Rotatable)

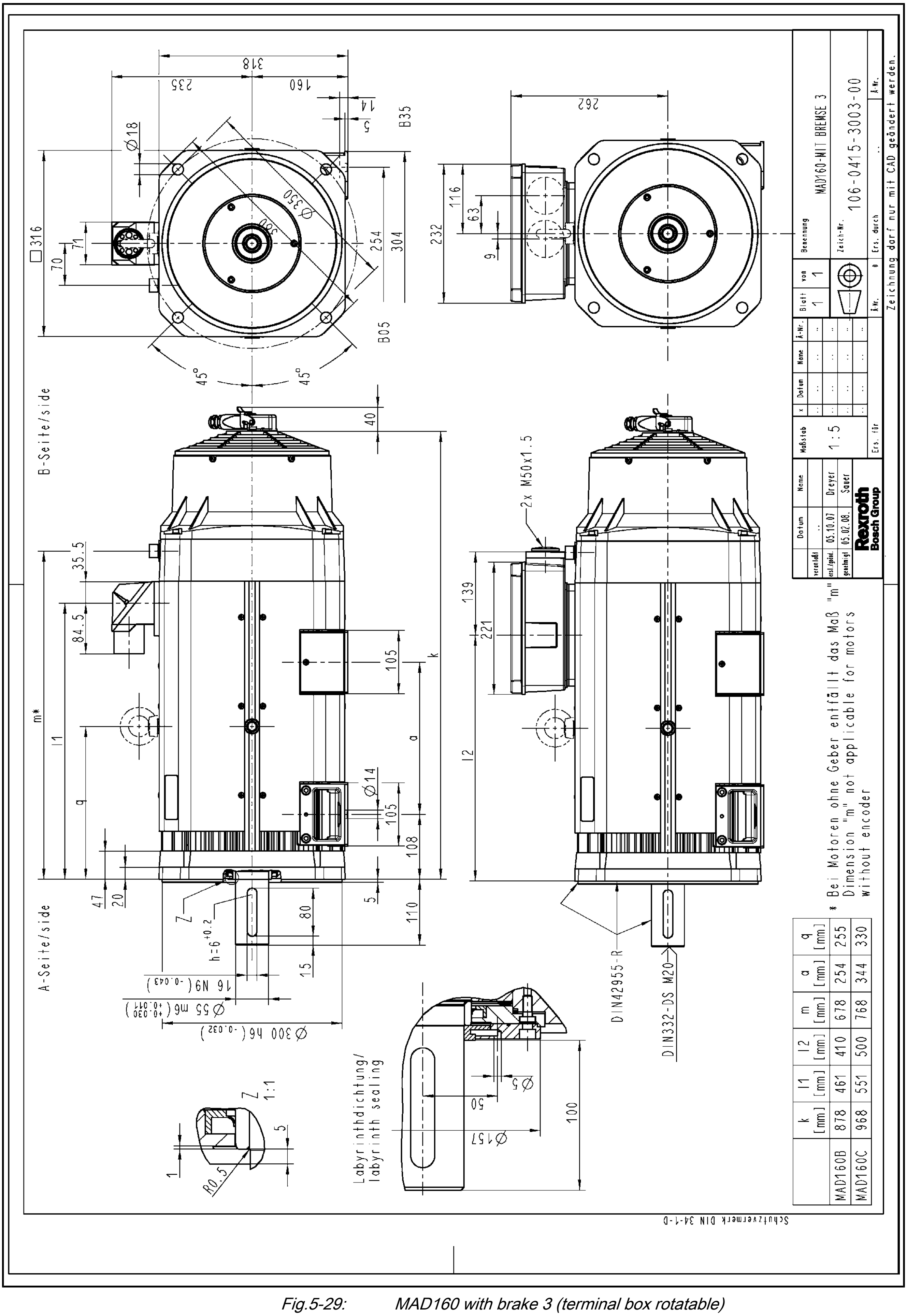



*Fig.5-29: MAD160 with brake 3 (terminal box rotatable)*

Dimension Sheets IndraDyn A

## 5.3.6 MAD160 with Brake 3

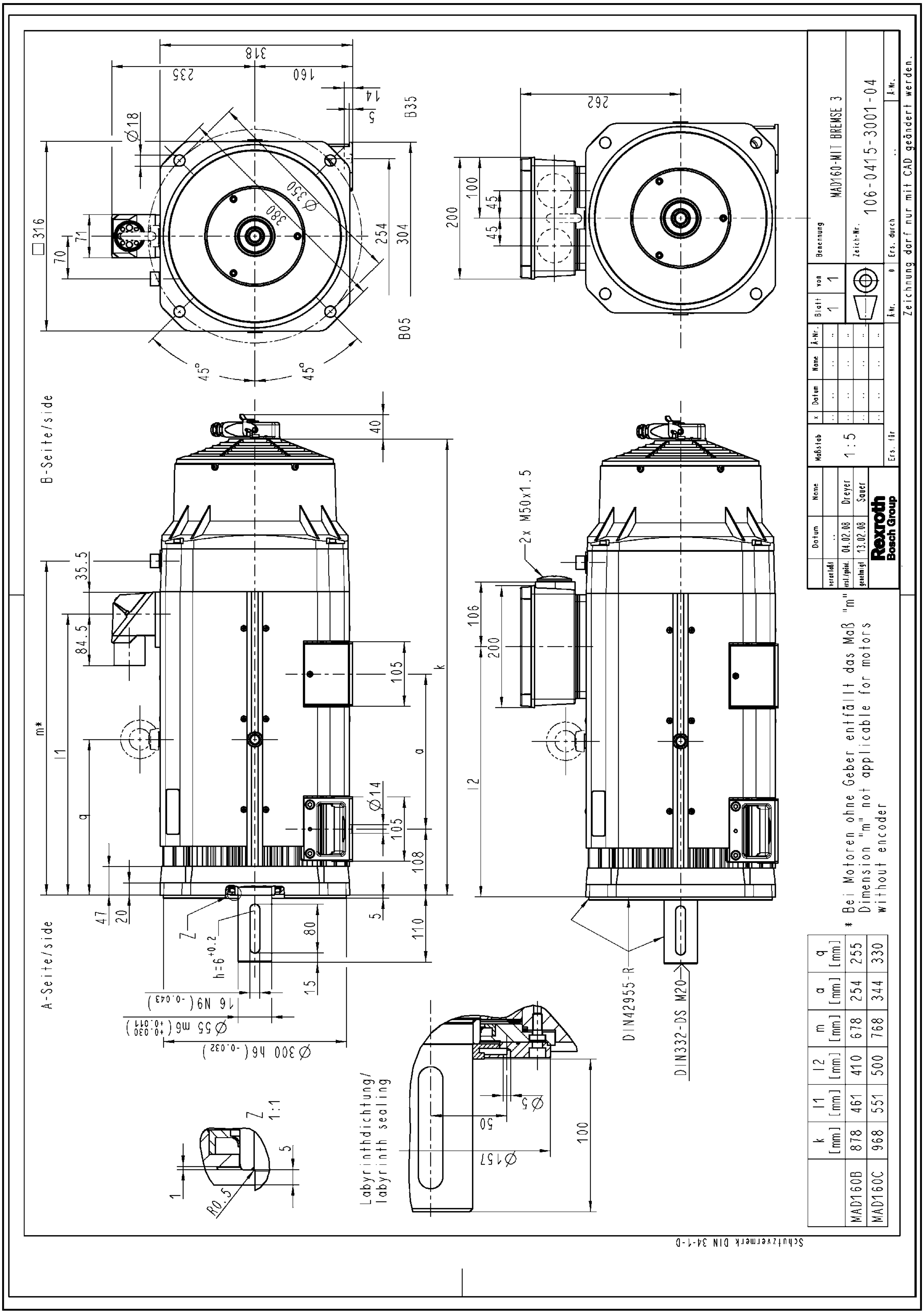



*Fig.5-30: Dimension sheet MAD160 with brake 3*

## 5.3.7 MAD160 with Fan Adapter, without Brake (Terminal Box Rotatable)

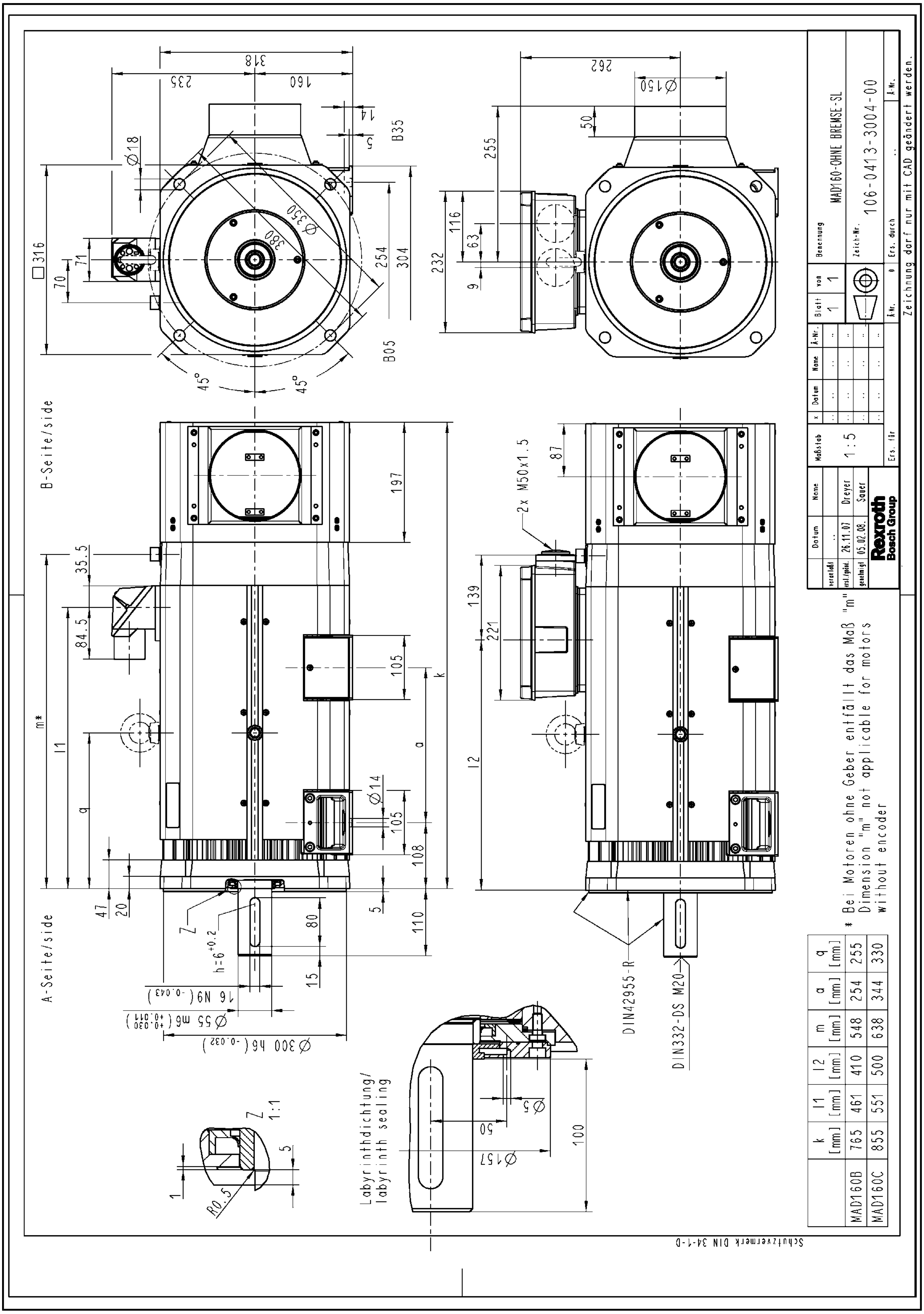


*Fig.5-31: MAD160 with SL cooling, without brake (terminal box rotatable)*

Dimension Sheets IndraDyn A

## 5.3.8 MAD160 with Fan Adapter, without Brake

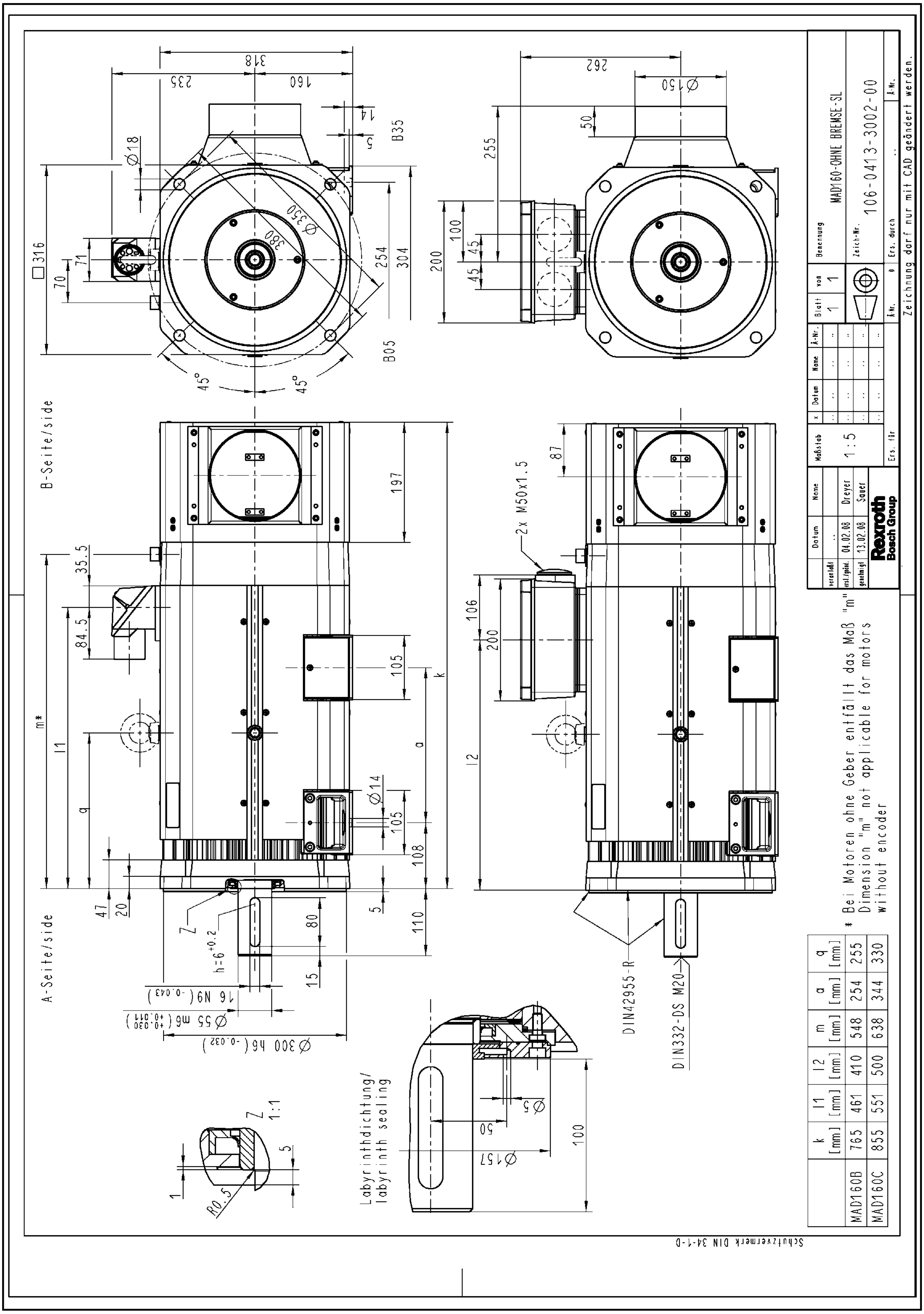



*Fig.5-32: MAD160 with SL cooling, without brake*

## 5.3.9 MAD160 with Fan Adapter, Brake 1 or 5 (Terminal Box Rotatable)

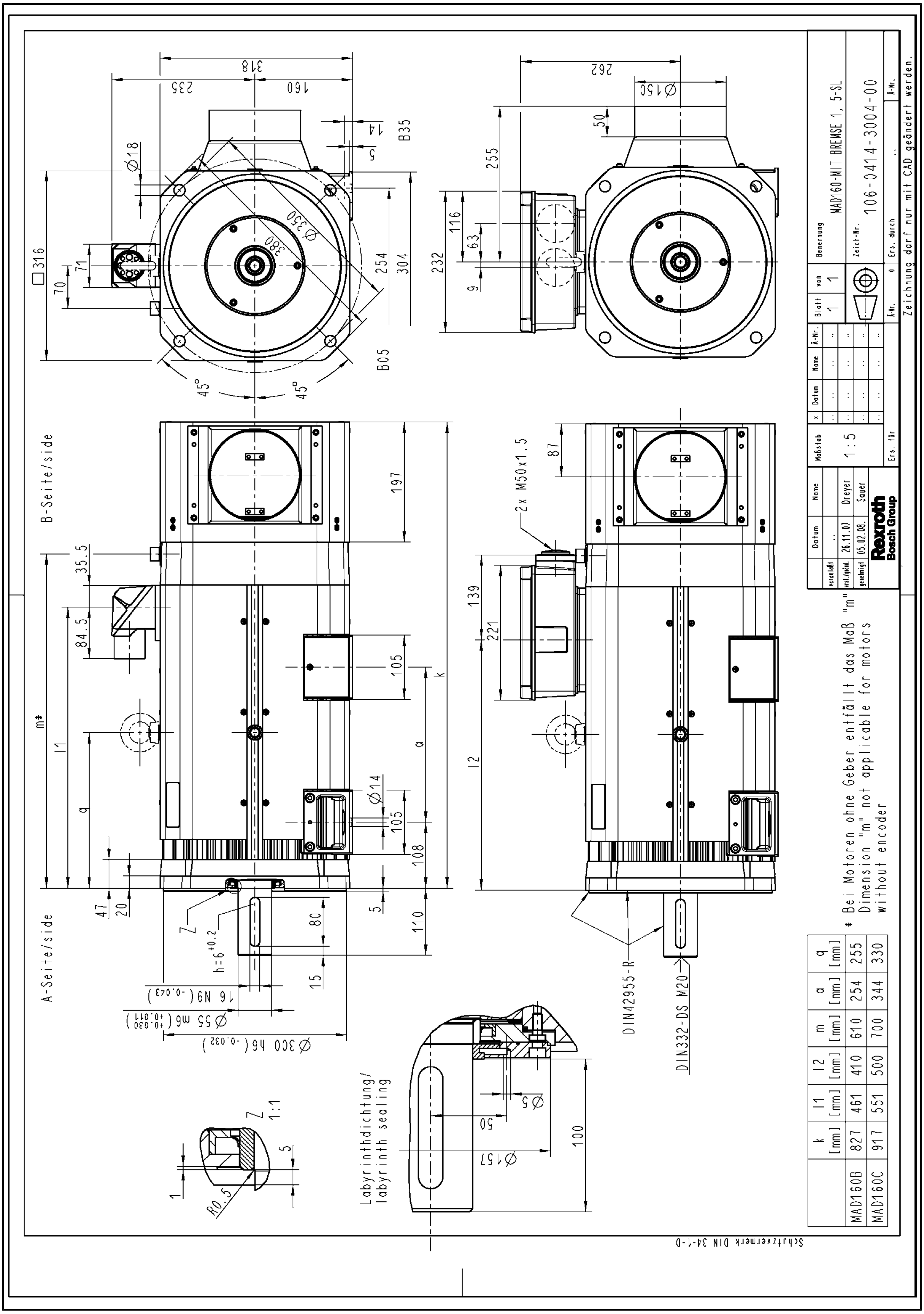



*Fig.5-33: MAD160 with SL cooling, brake 1/5 (terminal box rotatable)*

Dimension Sheets IndraDyn A

## 5.3.10 MAD160 with Fan Adapter and Brake 1 or 5

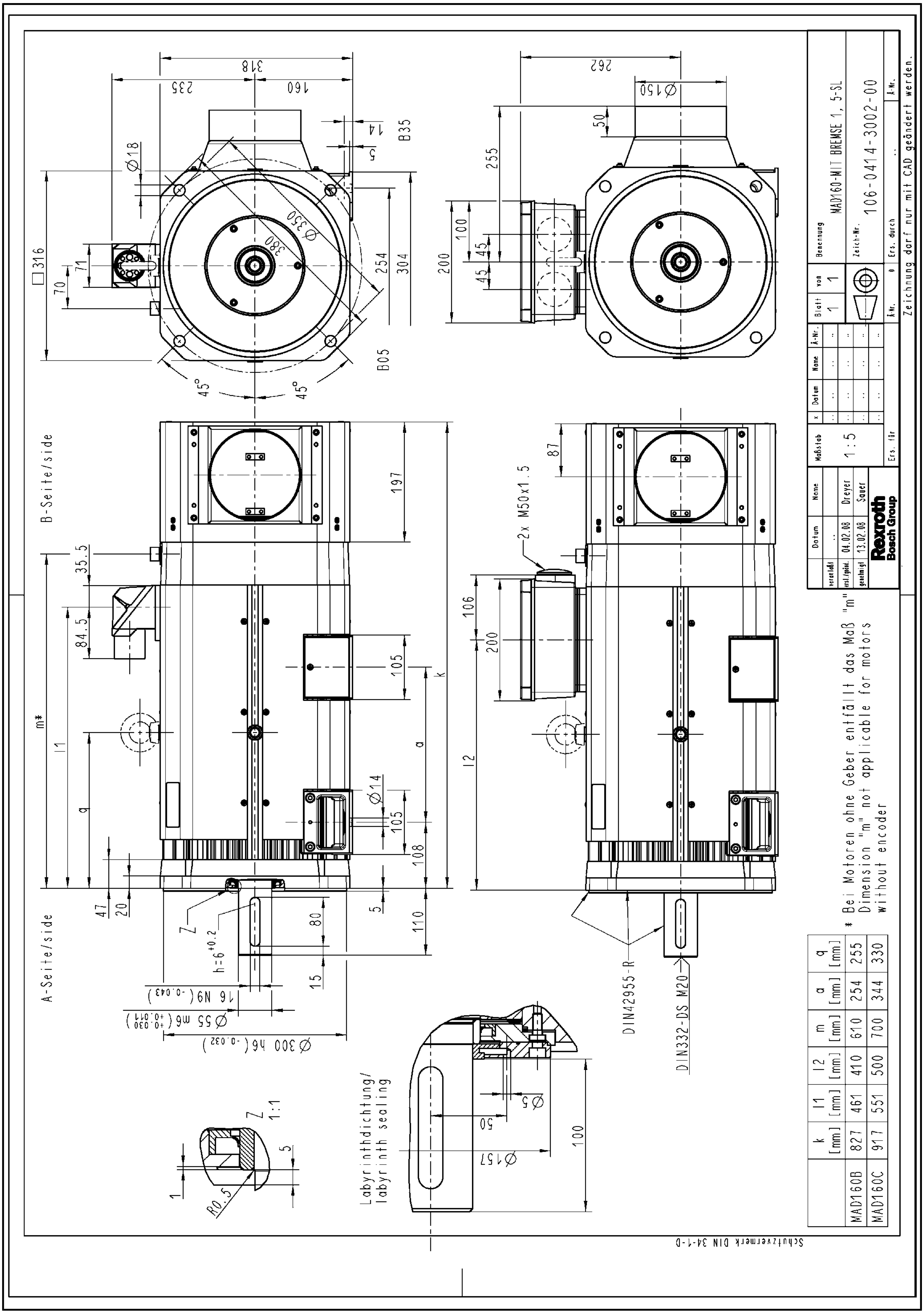



*Fig.5-34: MAD160 with SL cooling, brake 1/5*

## 5.3.11 MAD160 with Fan Adapter and Brake 3 (Terminal Box Rotatable)

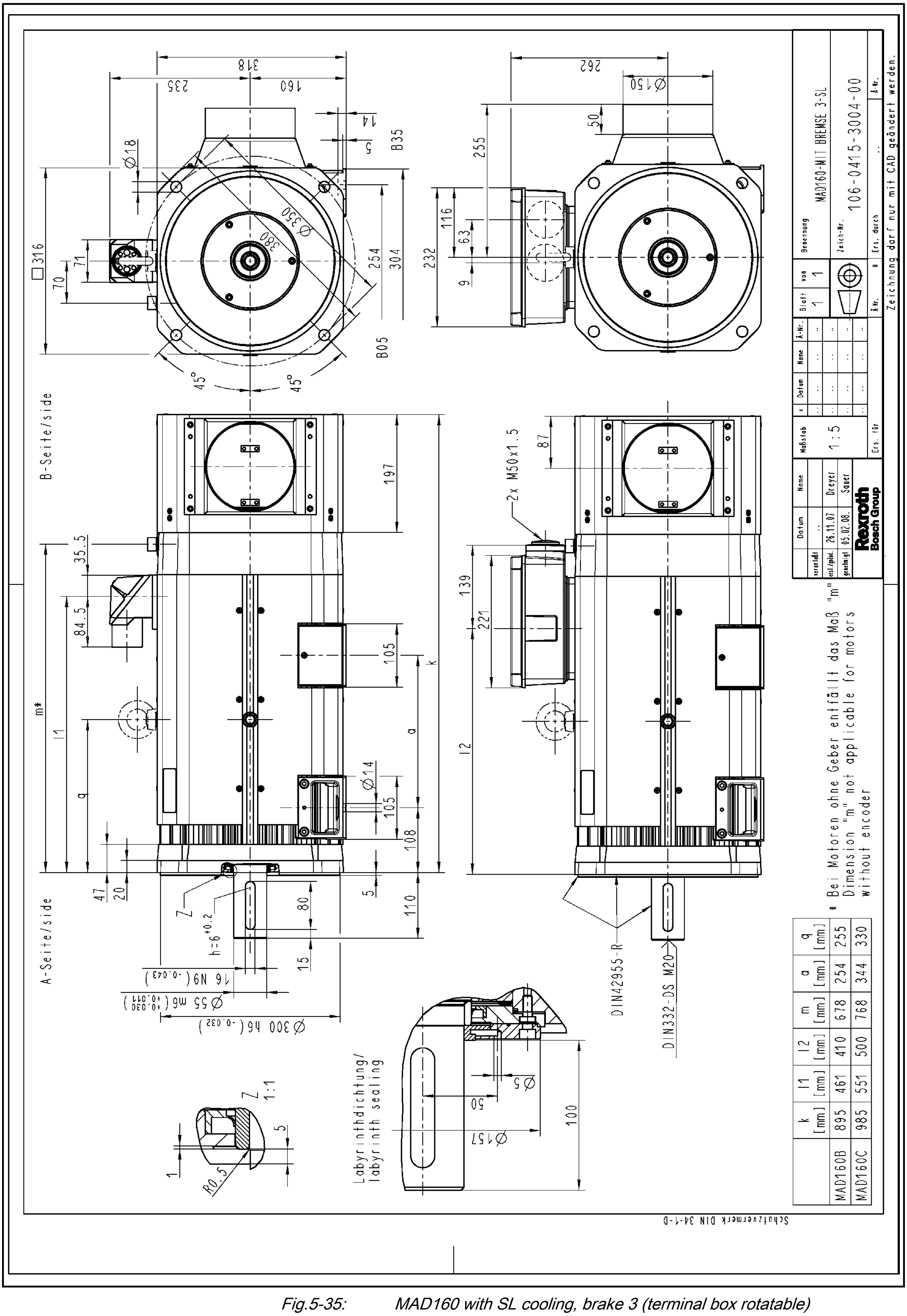


*Fig.5-35: MAD160 with SL cooling, brake 3 (terminal box rotatable)*

## 5.3.12 MAD160 with Fan Adapter and Brake 3

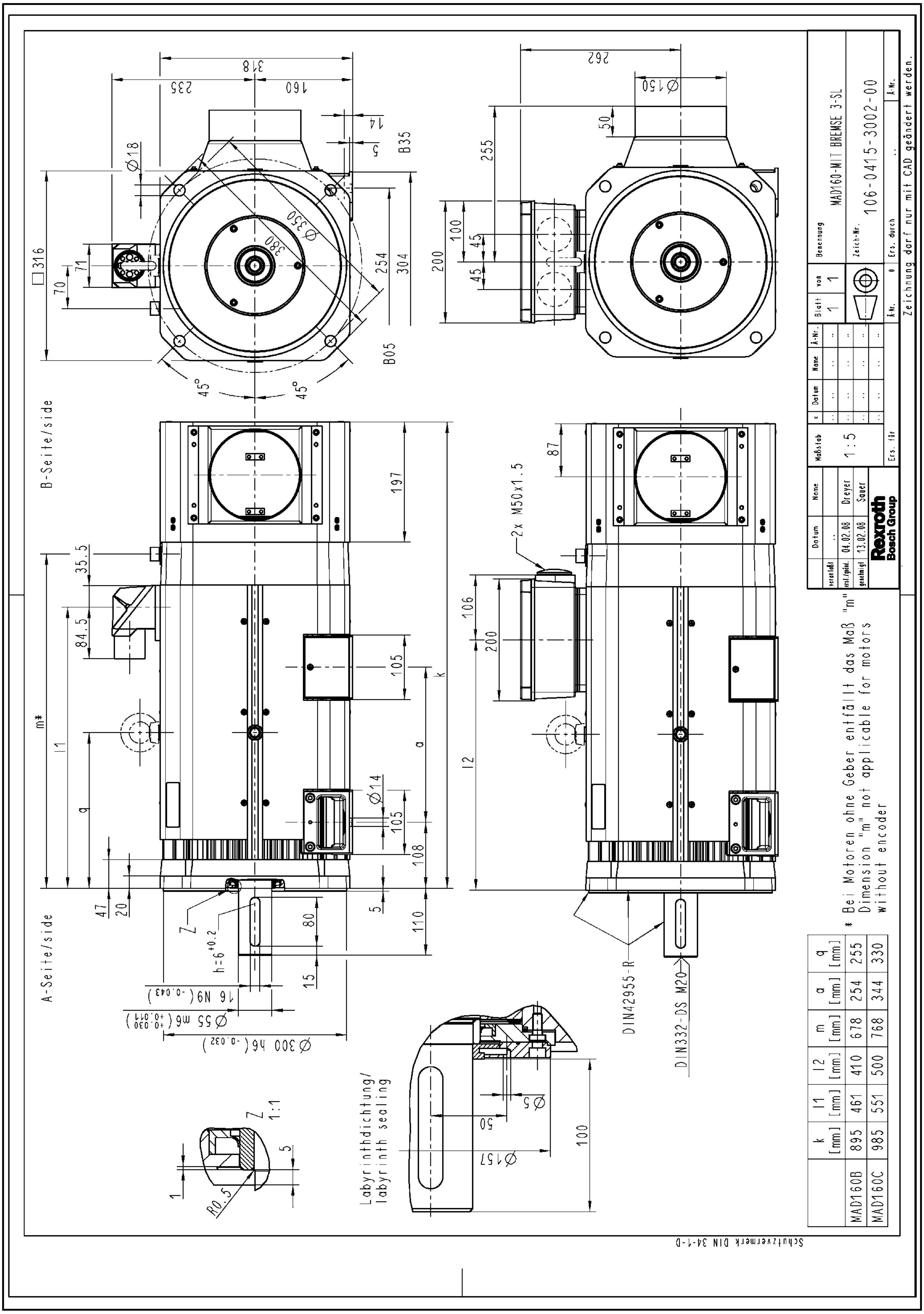



*Fig.5-36: MAD160 with SL cooling, brake 3*

### 5.3.13 MAD160 in ATEX Design with Encoder M6 or S6, without Brake (Terminal Box Rotatable)

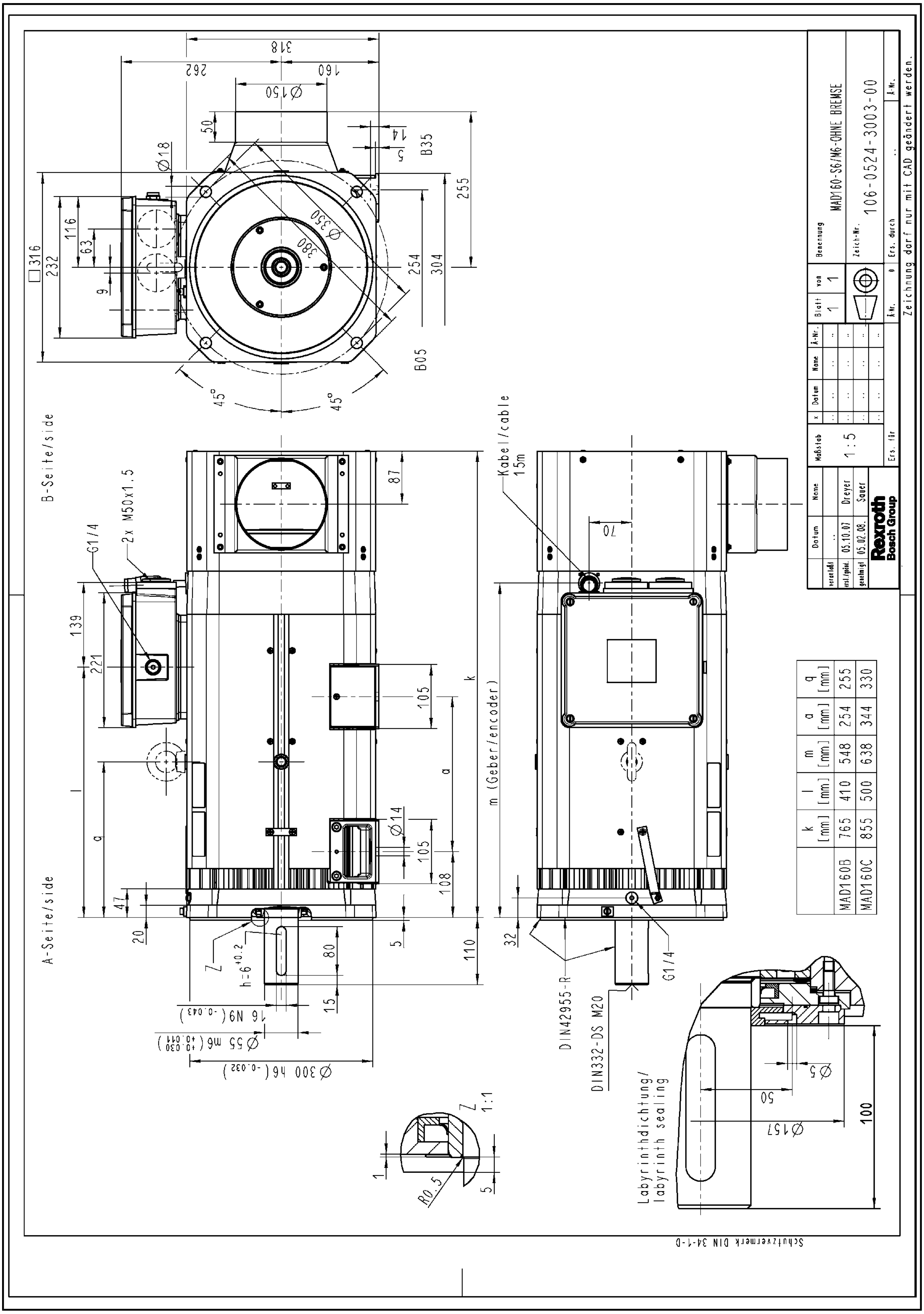



*Fig.5-37: MAD160 with encoder M6/S6, without brake (terminal box rotatable)*

## 5.3.14 MAD160 in ATEX Design with Encoder M6 or S6, without Brake

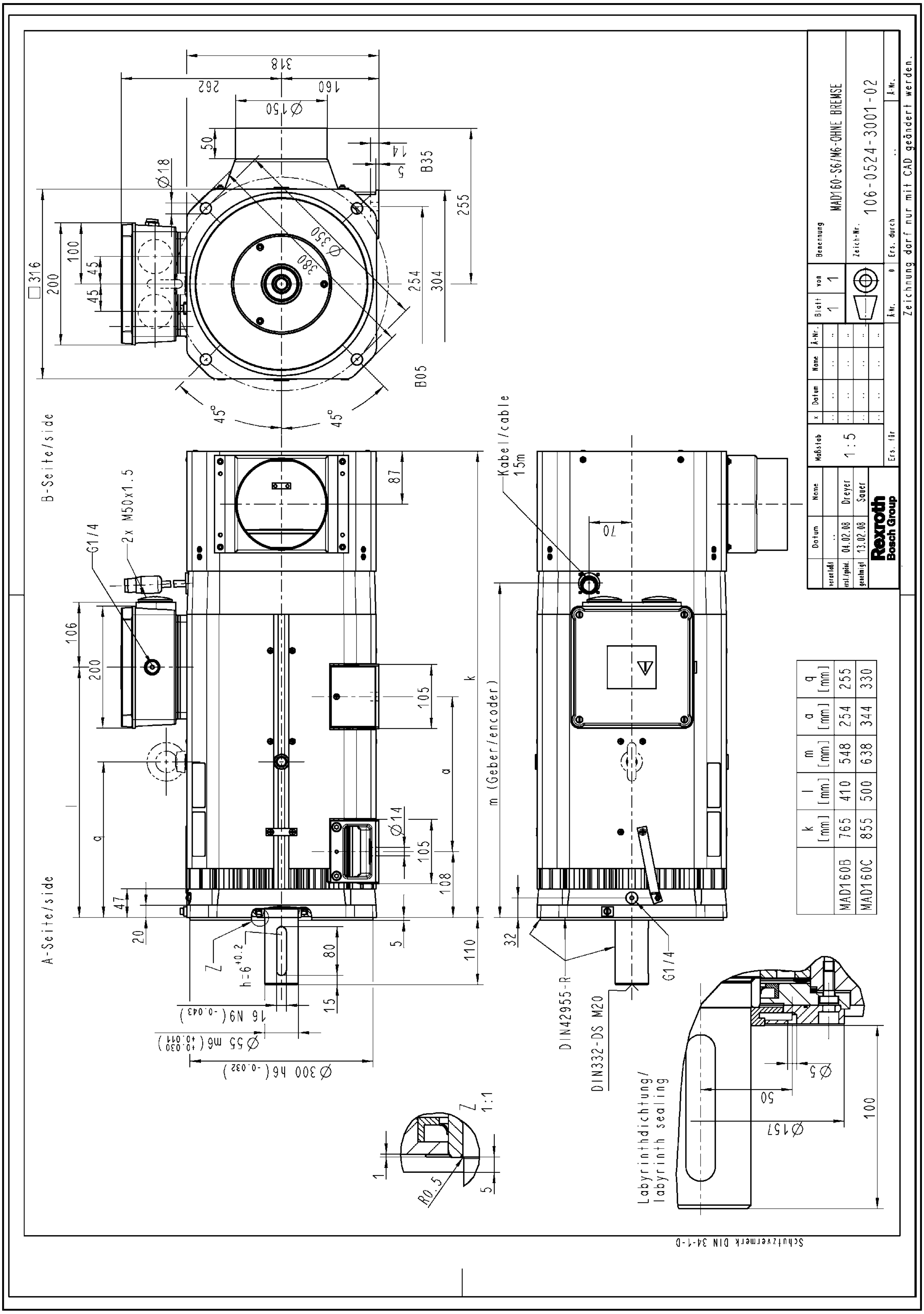



*Fig.5-38: Dimension sheet MAD160 with encoder M6 or S6, without brake*

### 5.3.15 MAD160 in ATEX Design with Encoder M6 or S6, Brake 1 or 5 (Terminal Box Rotatable)

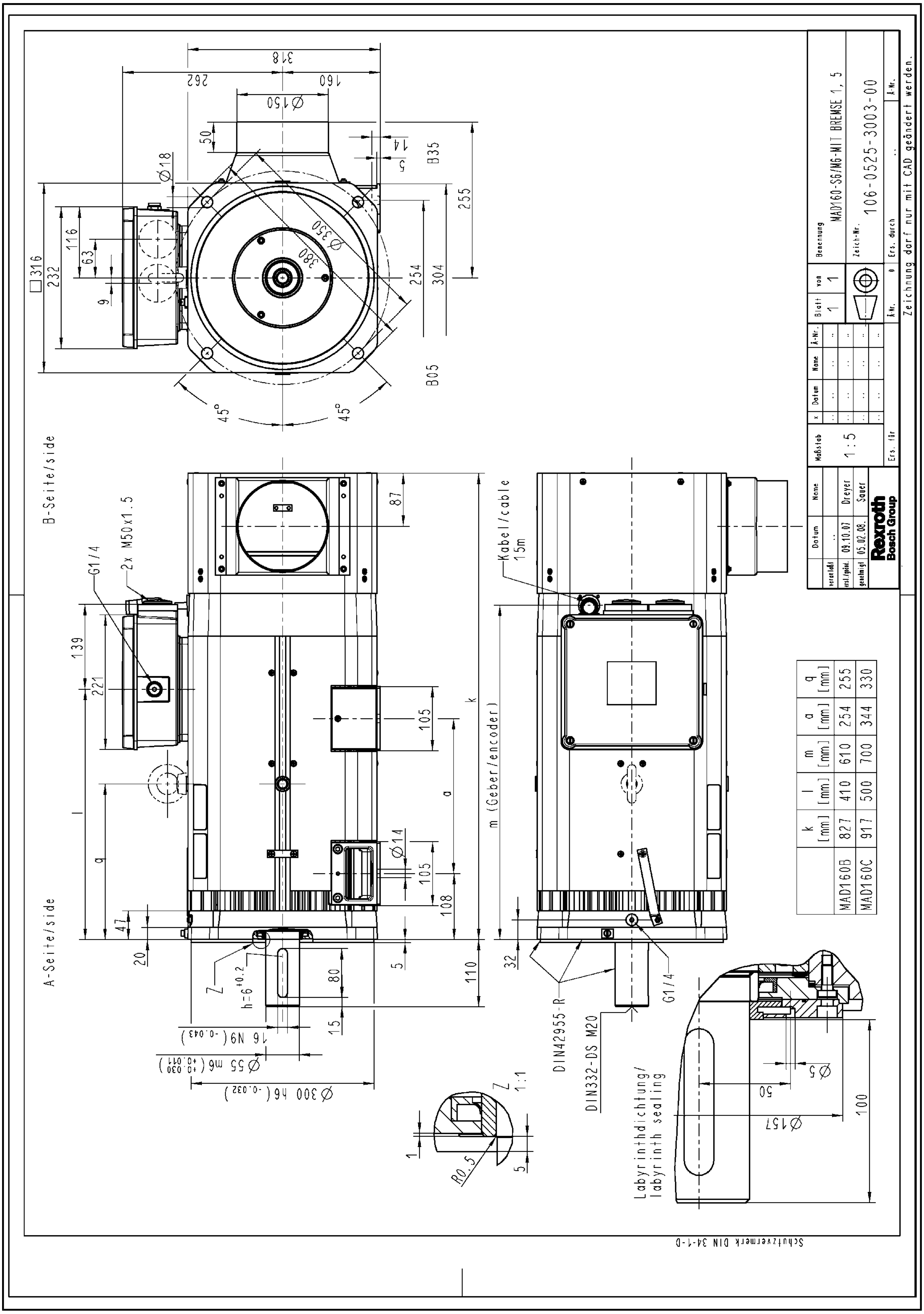



Fig.5-39: MAD160 with encoder M6/S6, brake 1/5 (terminal box rotatable)

## 5.3.16 MAD160 in ATEX Design with Encoder M6 or S6, Brake 1 or 5

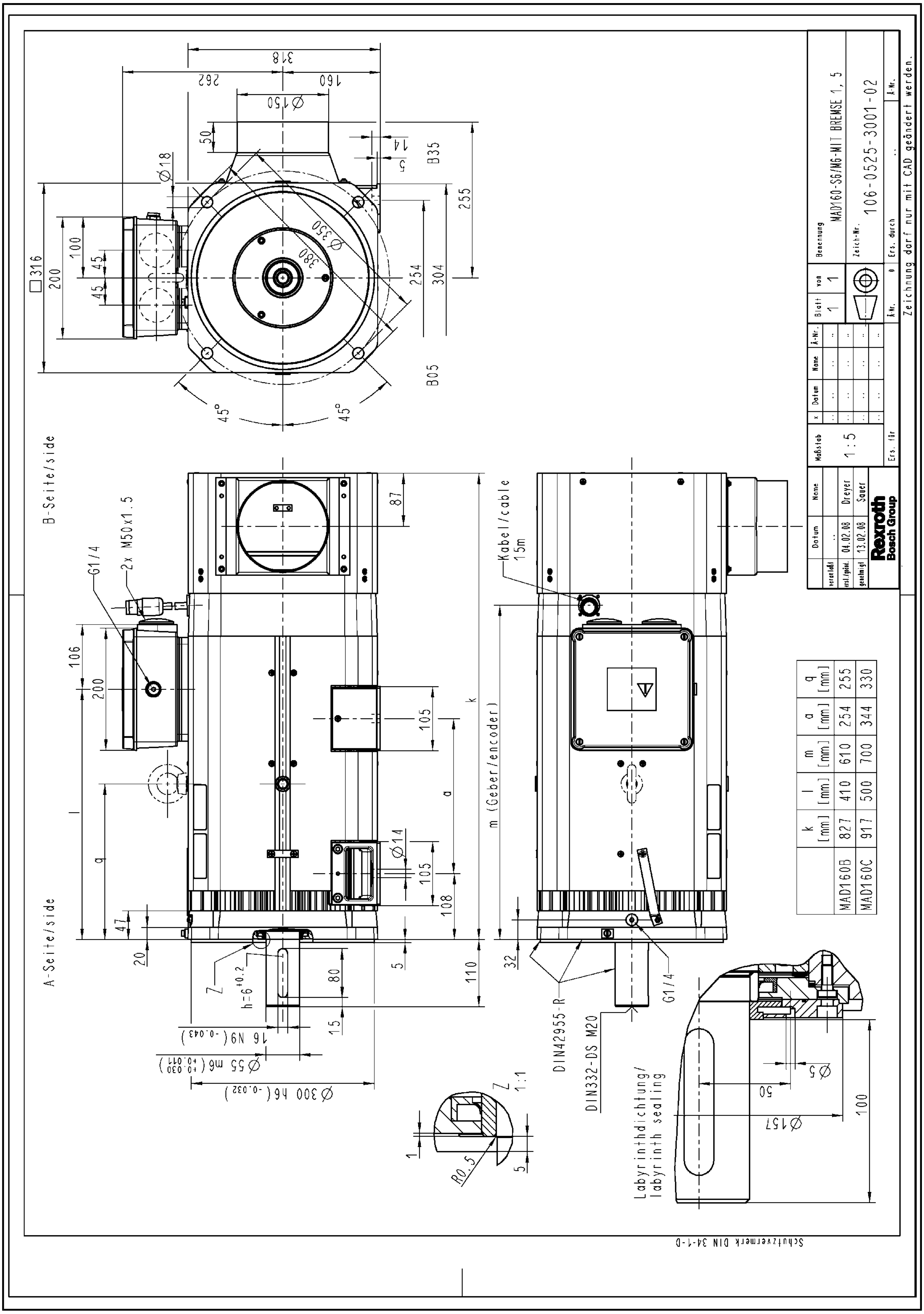
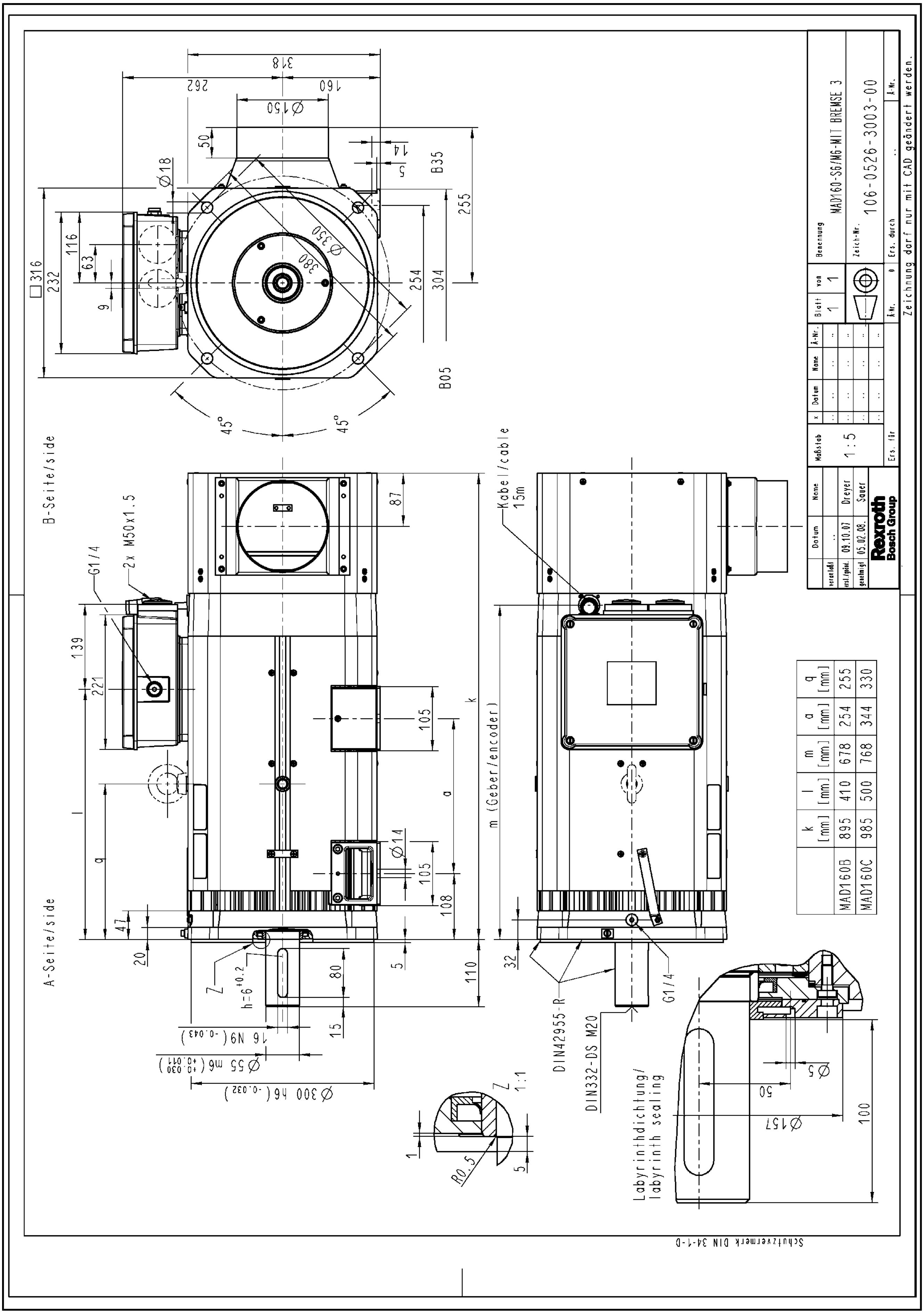



*Fig.5-40: Dimension sheet MAD160 with encoder M6/S6, brake 1/5*

### 5.3.17 MAD160 in ATEX Design with Encoder M6 or S6, Brake 3 (Terminal Box Rotatable)




| | k [mm] | l [mm] | m [mm] | a [mm] | q [mm] |
|---|---|---|---|---|---|
| MAD160B | 895 | 410 | 678 | 254 | 255 |
| MAD160C | 985 | 500 | 768 | 344 | 330 |

Fig.5-41: MAD160 with encoder M6/S6, brake 3 (terminal box rotatable)

Dimension Sheets IndraDyn A

## 5.3.18 MAD160 in ATEX Design with Encoder M6 or S6, Brake 3

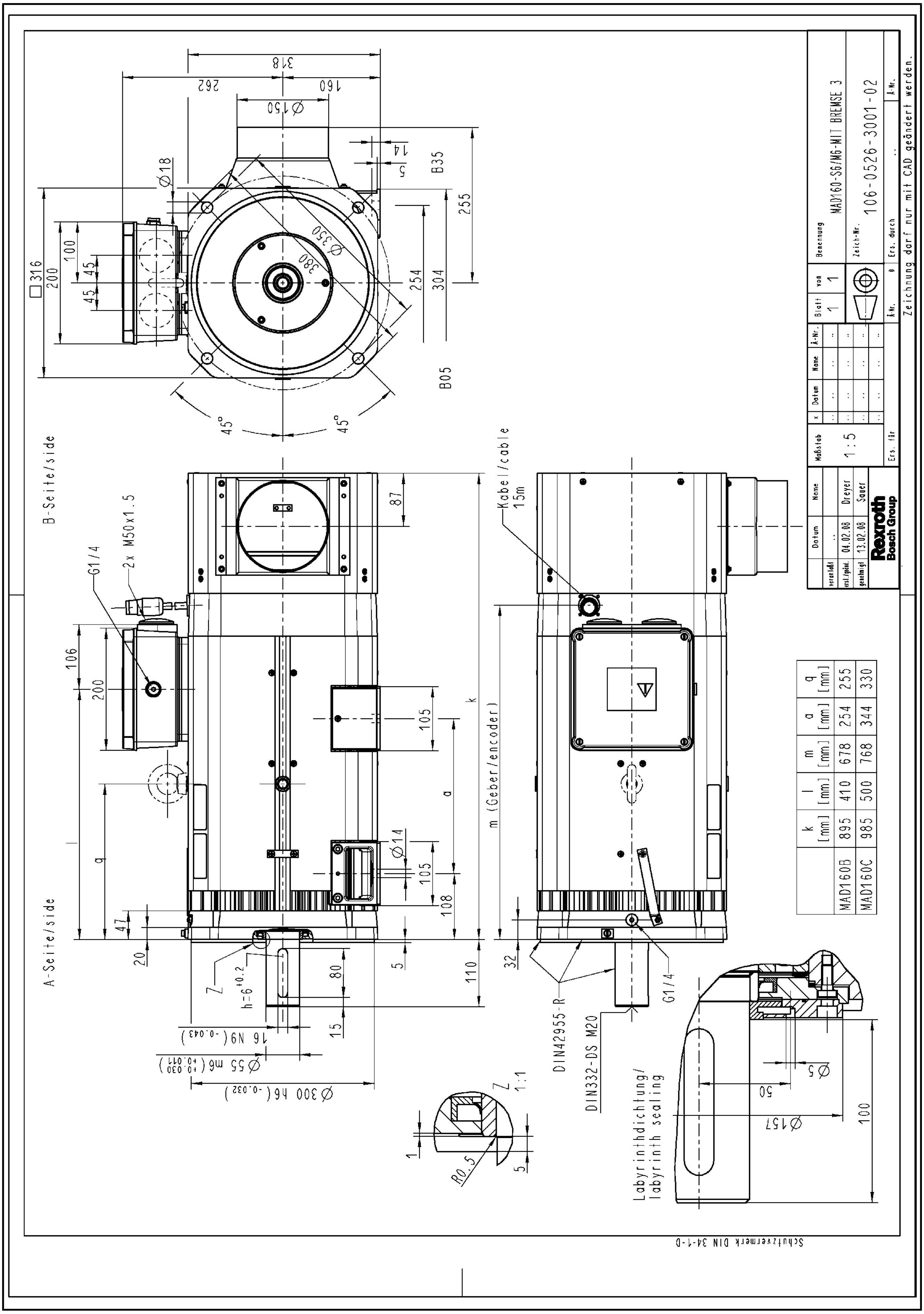
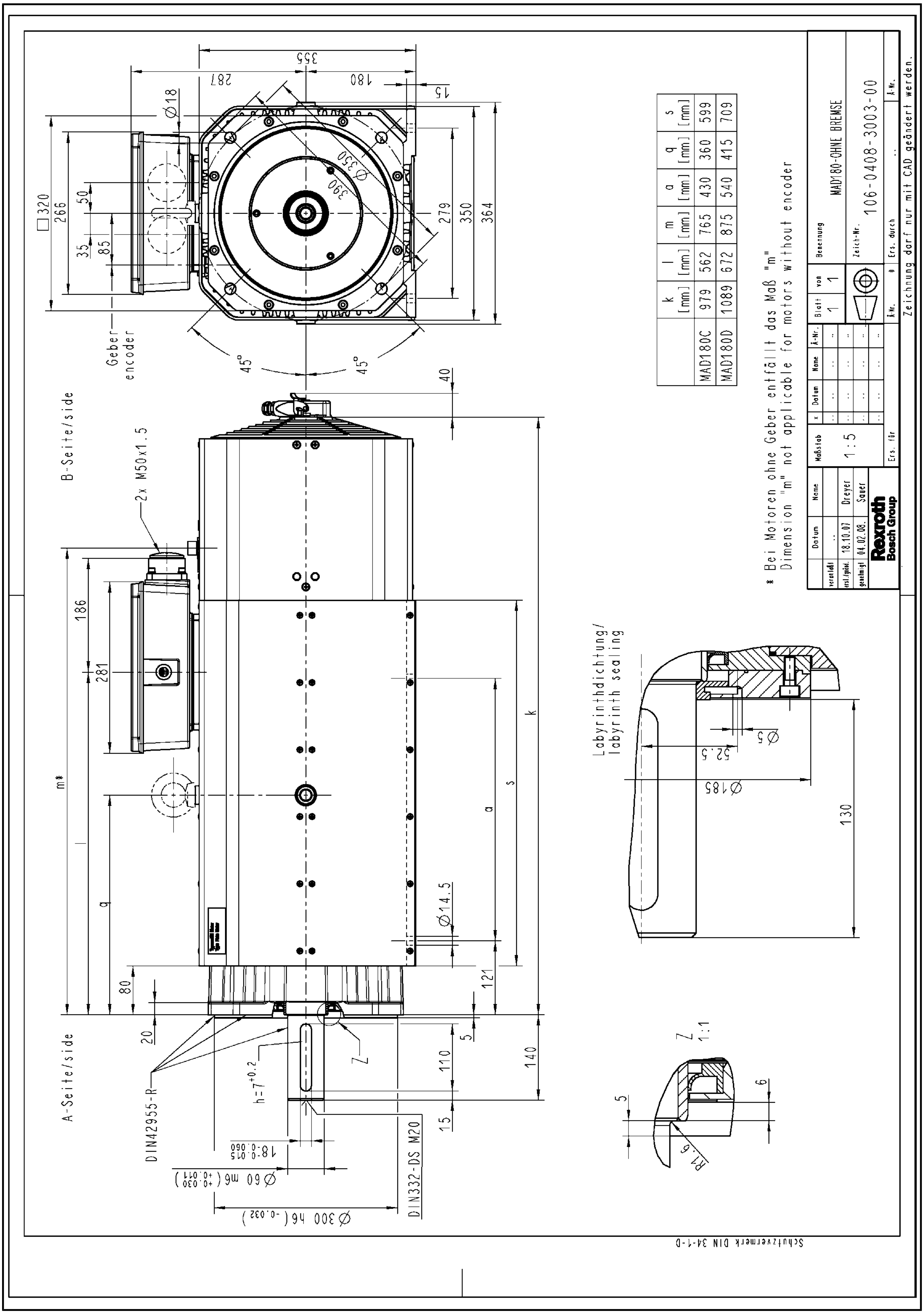



*Fig.5-42: Dimension sheet MAD160 with encoder M6 or S6, brake 3*

# 5.4 Frame Size MAD180

## 5.4.1 MAD180 without Brake (Terminal Box Rotatable)




| | k [mm] | l [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAD180C | 979 | 562 | 765 | 430 | 360 | 599 |
| MAD180D | 1089 | 672 | 875 | 540 | 415 | 709 |

Dimension Sheets IndraDyn A

## 5.4.2 MAD180 without Brake

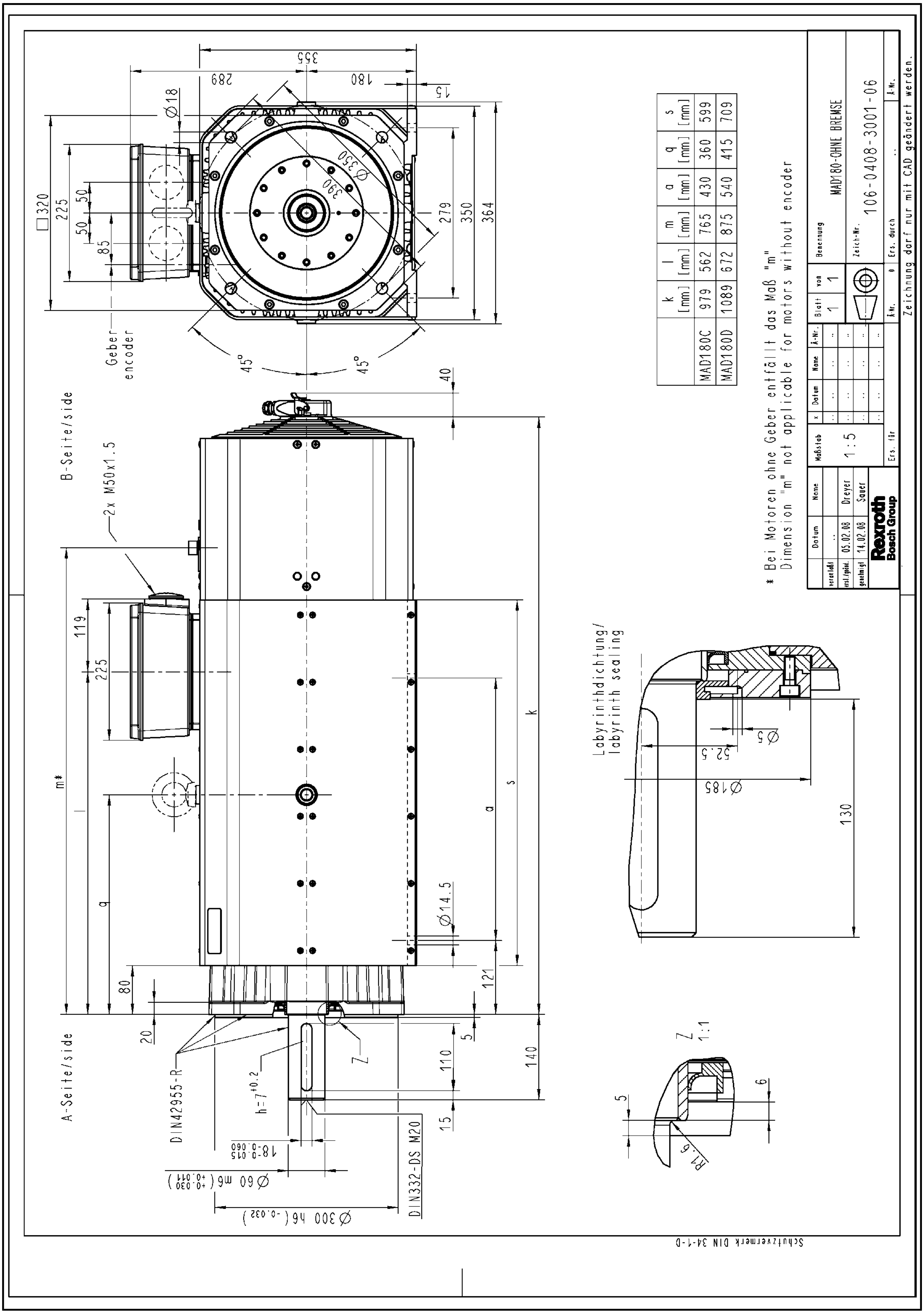



*Fig.5-44: Dimension sheet MAD130 without brake*

### 5.4.3 MAD180 with Brake 2 or 5 (Terminal Box Rotatable)

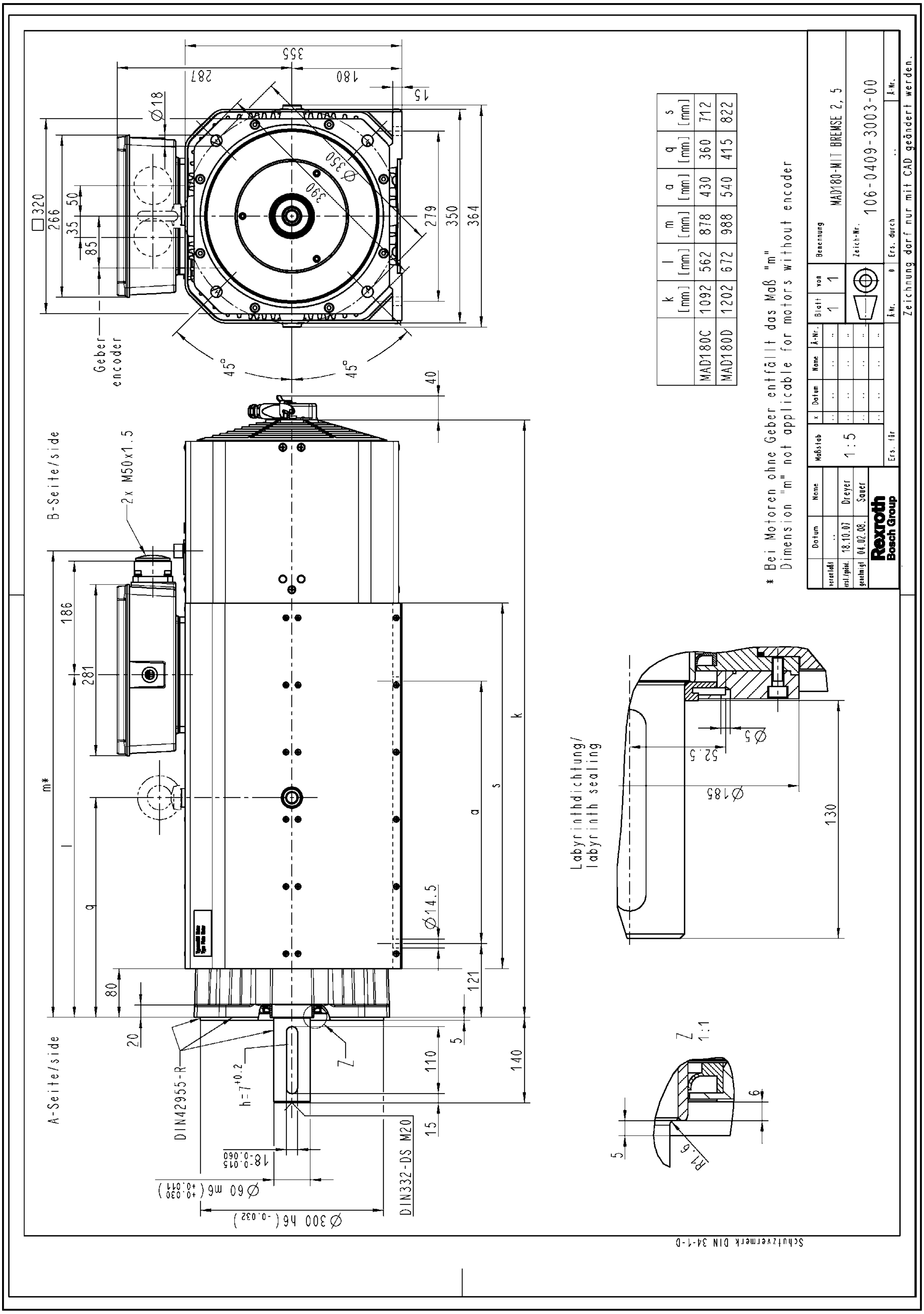



Fig.5-45: MAD180 with brake 2 or 5 (terminal box rotatable)

## 5.4.4 MAD180 with Brake 2 or 5

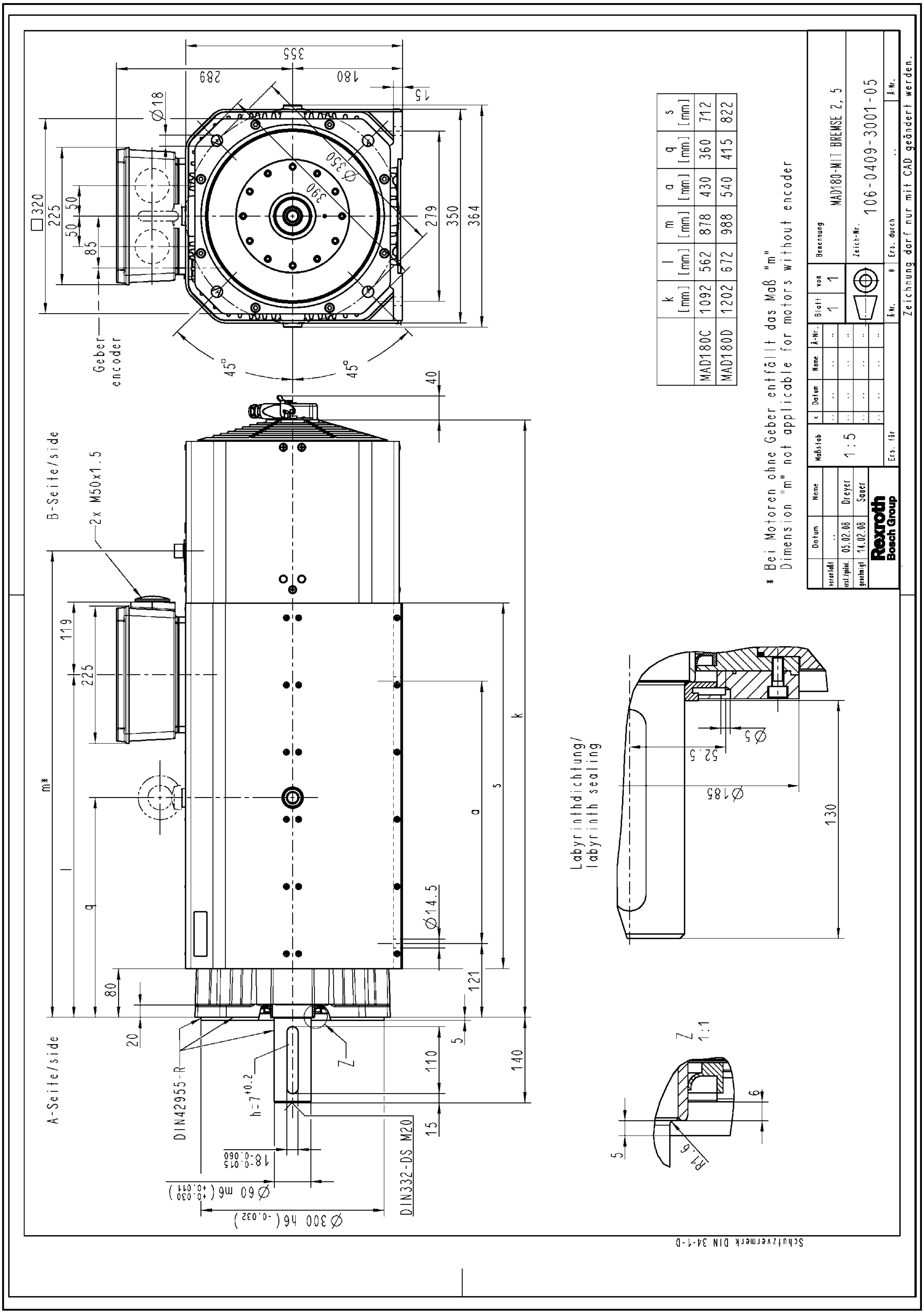


*Fig.5-46: Dimension sheet MAD180 with brake 2 or 5*

## 5.4.5 MAD180 with Fan Adapter, without Brake (Terminal Box Rotatable)

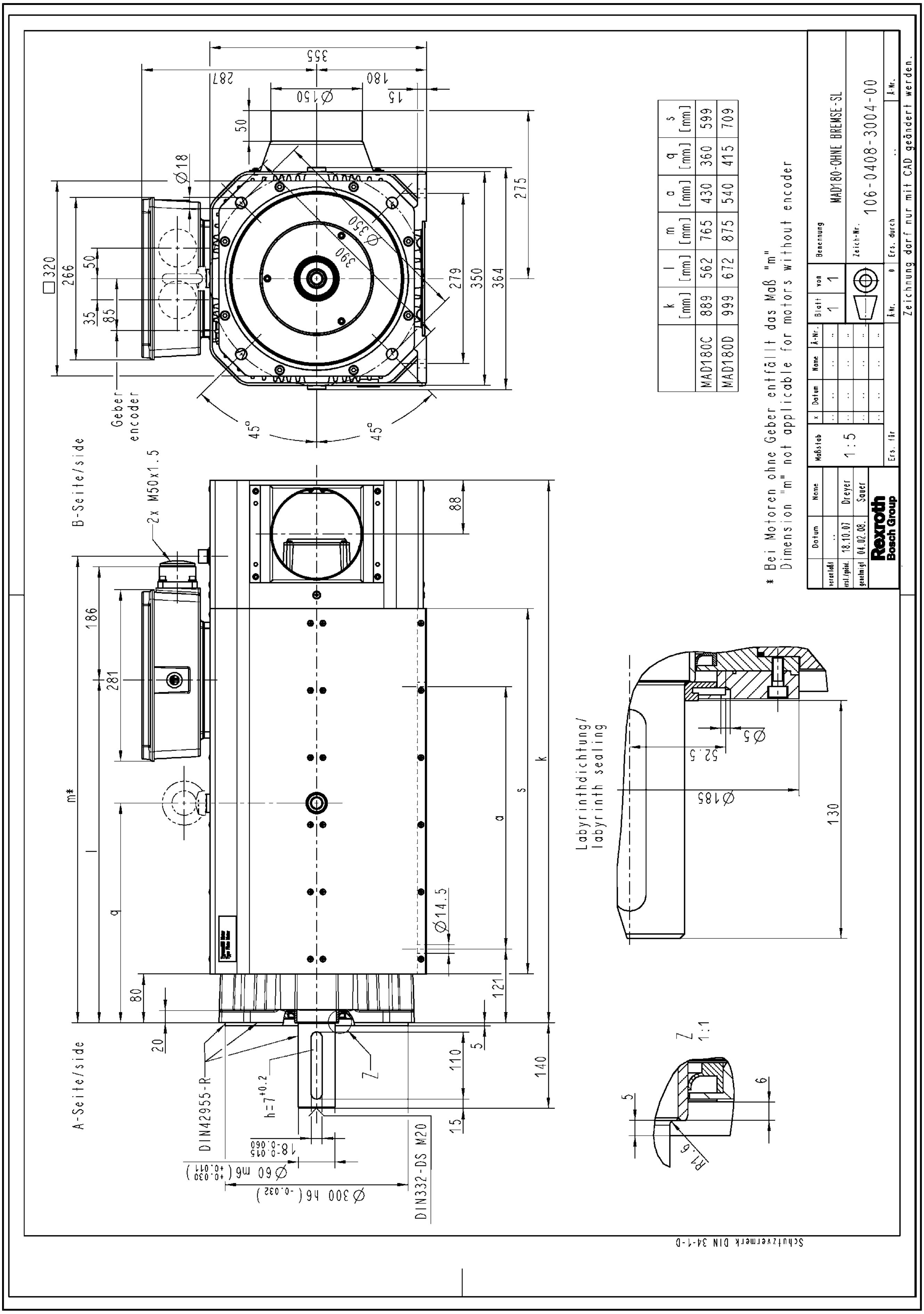


Fig.5-47: MAD180 with SL cooling, without brake (terminal box rotatable)

Dimension Sheets IndraDyn A

## 5.4.6 MAD180 with Fan Adapter, without Brake

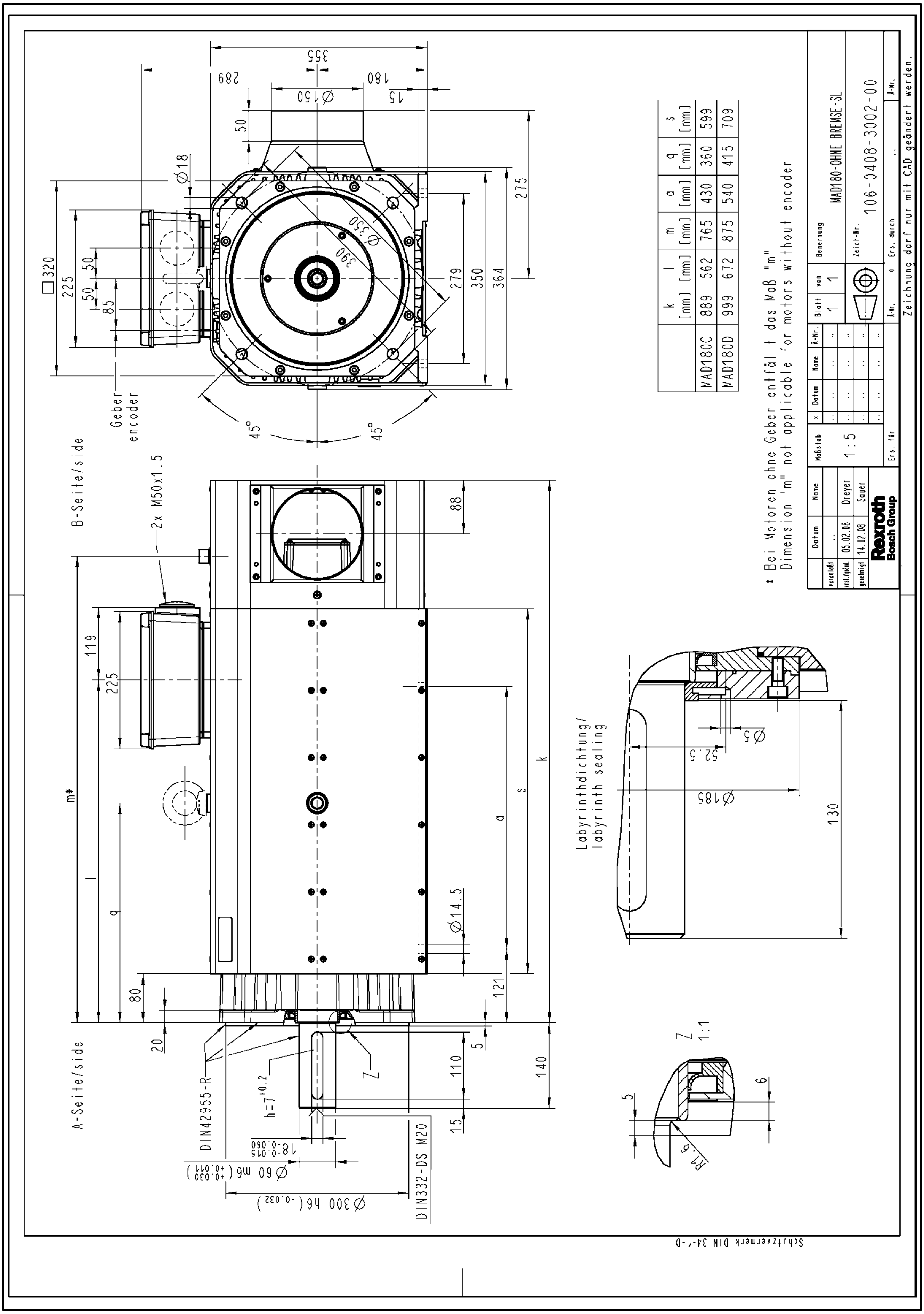


*Fig.5-48: MAD180 with SL cooling, without brake*

## 5.4.7 MAD180 with Fan Adapter, Brake 2 or 5 (Terminal Box Rotatable)

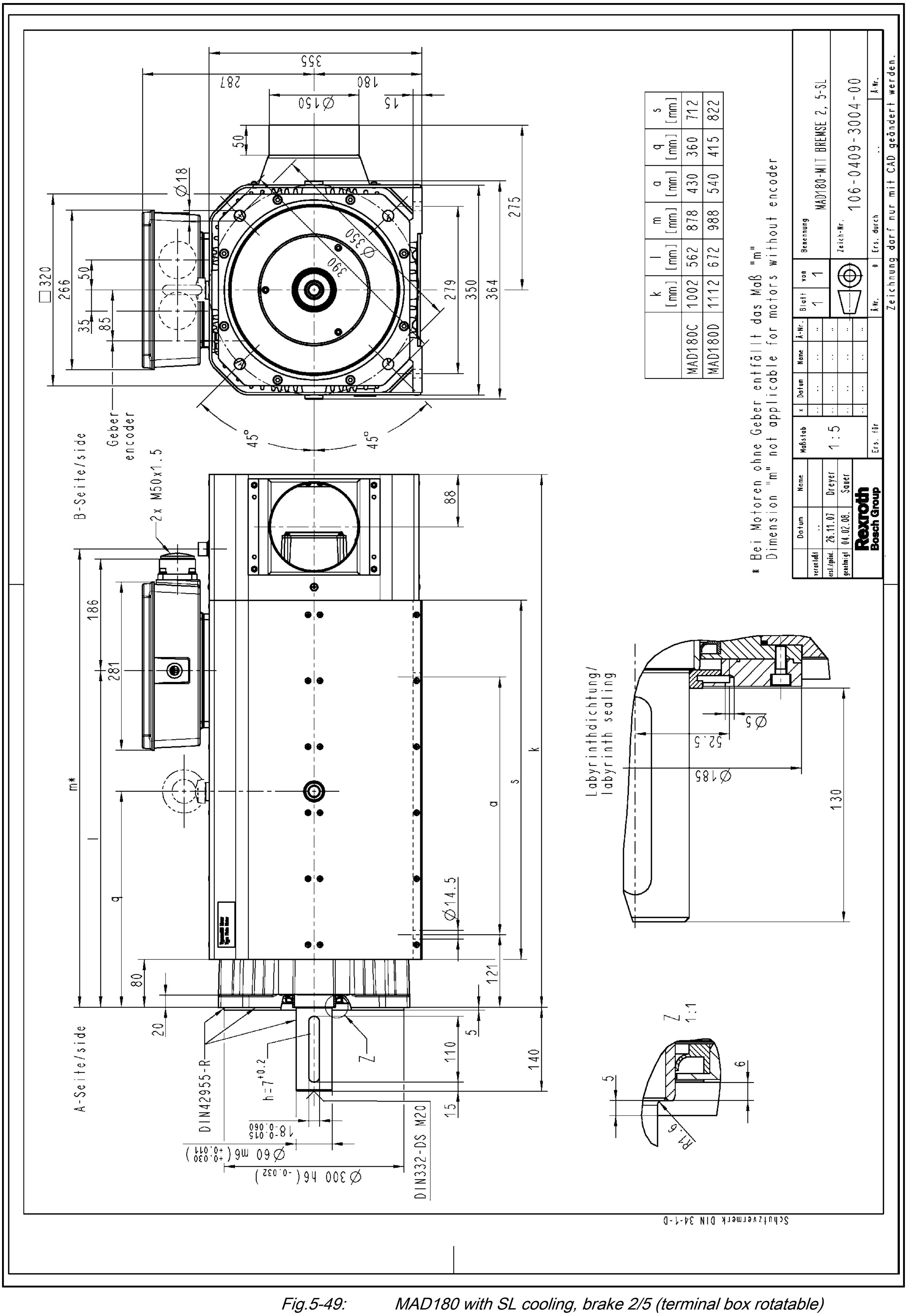



Fig.5-49: MAD180 with SL cooling, brake 2/5 (terminal box rotatable)

## 5.4.8 MAD180 with Fan Adapter and Brake 2 or 5

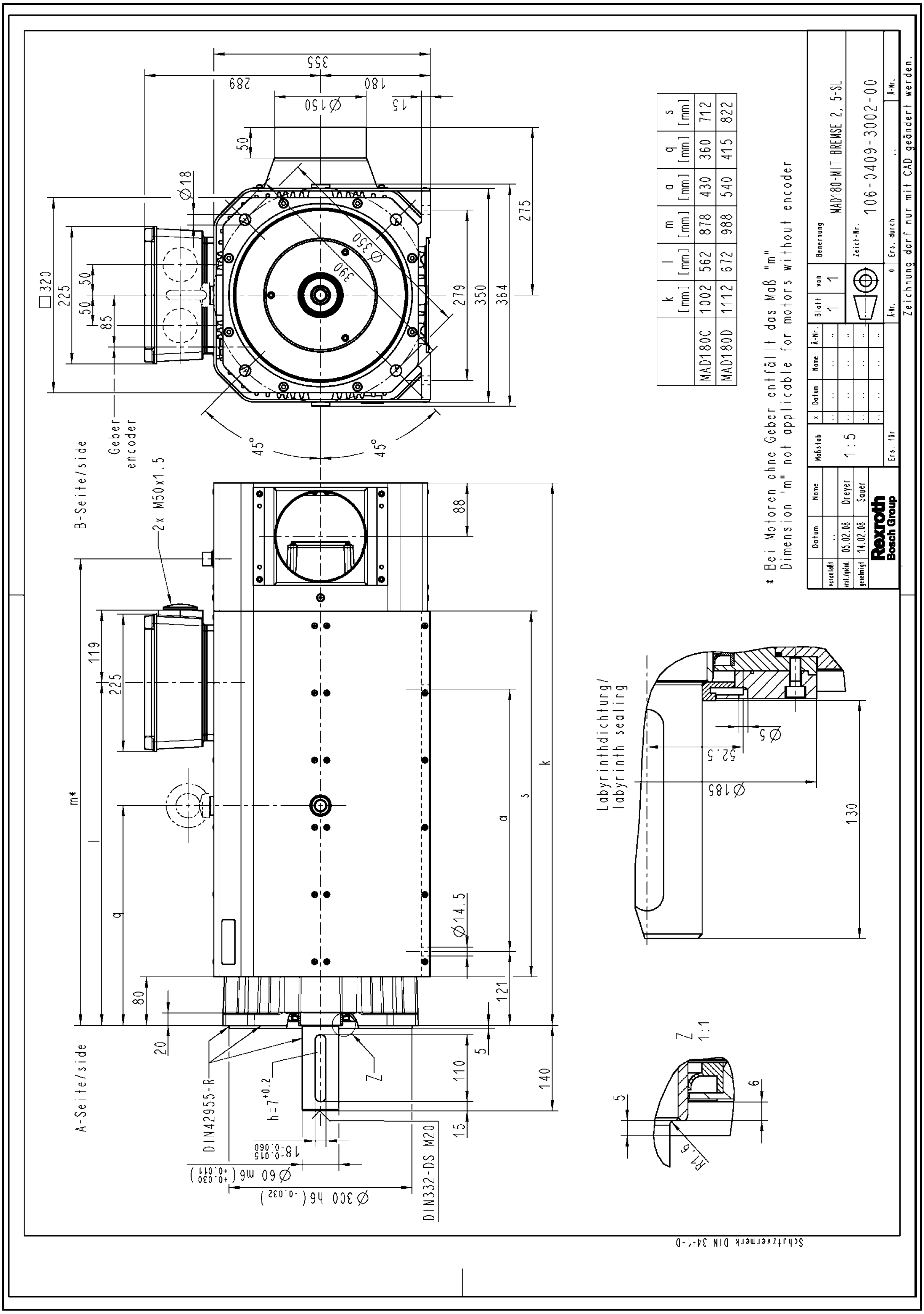
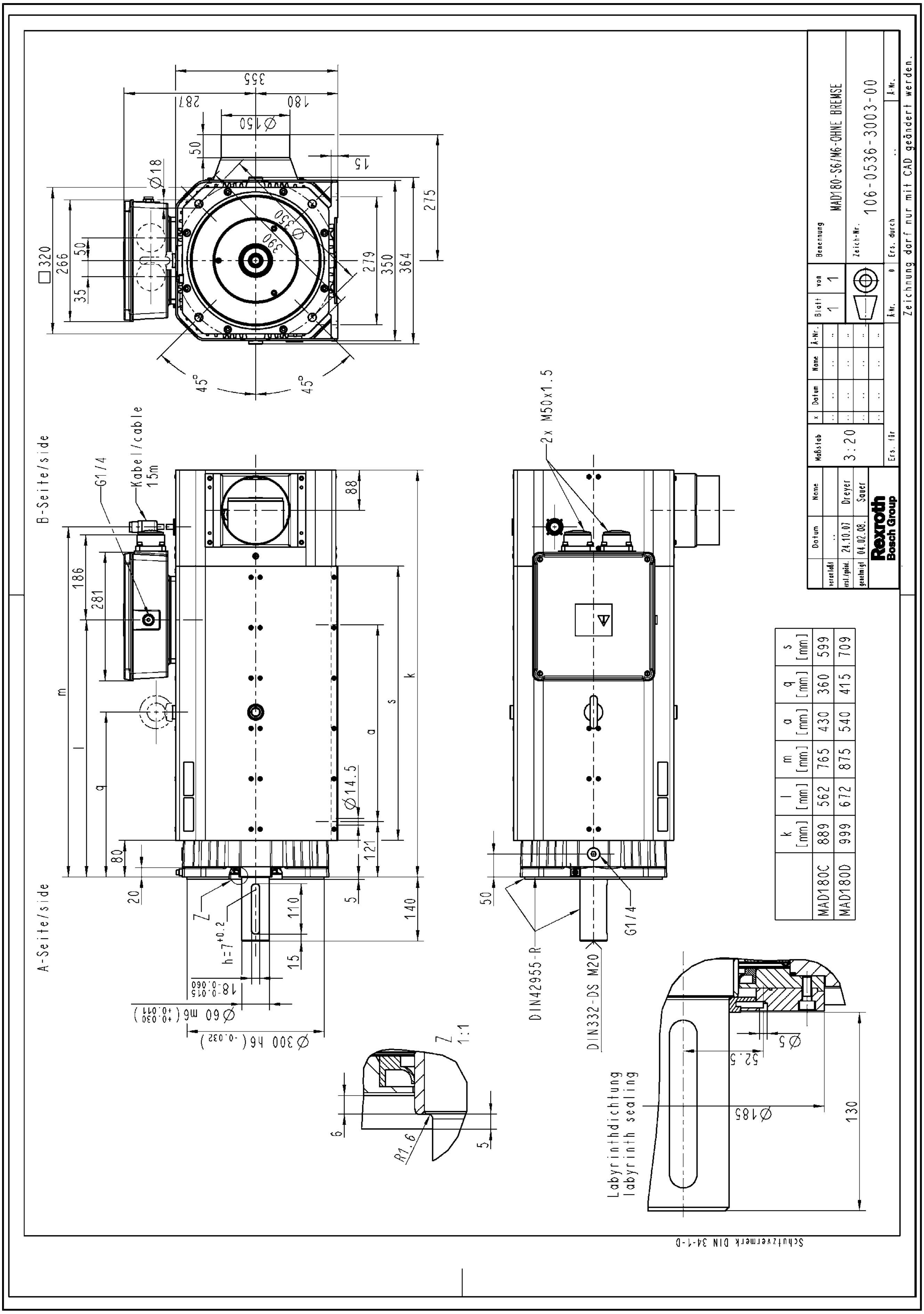



*Fig.5-50: MAD180 with SL cooling and brake 2/5*

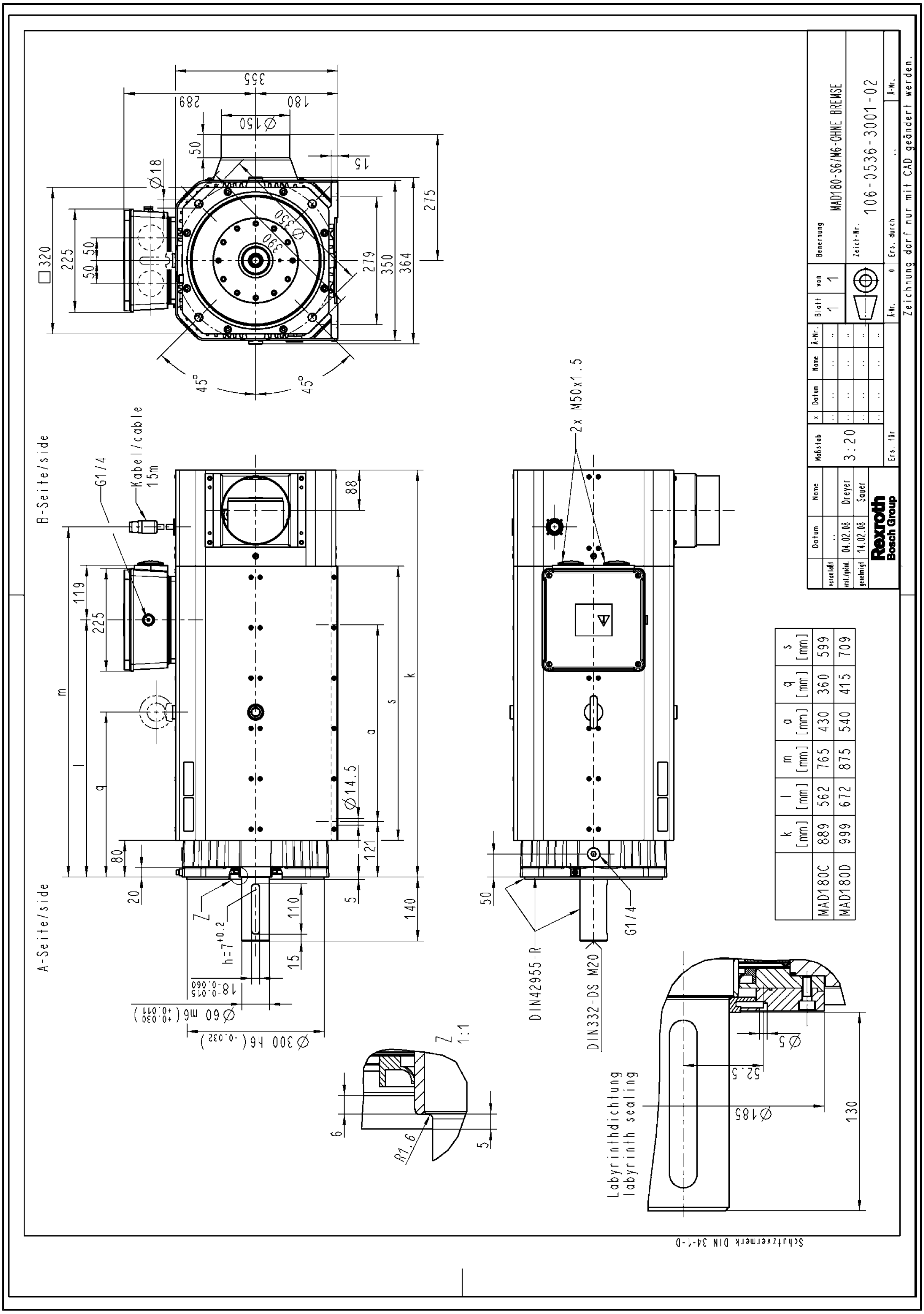
### 5.4.9 MAD180 in ATEX Design with Encoder M6 or S6, without Brake (Terminal Box Rotatable)




| | k [mm] | l [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAD180C | 889 | 562 | 765 | 430 | 360 | 599 |
| MAD180D | 999 | 672 | 875 | 540 | 415 | 709 |

Fig.5-51: MAD180 with encoder M6/S6, without brake (terminal box rotatable)

### 5.4.10 MAD180 in ATEX Design with Encoder M6 or S6, without Brake




| | k [mm] | l [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAD180C | 889 | 562 | 765 | 430 | 360 | 599 |
| MAD180D | 999 | 672 | 875 | 540 | 415 | 709 |

*Fig.5-52: Dimension sheet MAD180 with encoder M6 or S6, without brake*

### 5.4.11 MAD180 in ATEX Design with Encoder M6 or S6, Brake 2 or 5 (Terminal Box Rotatable)

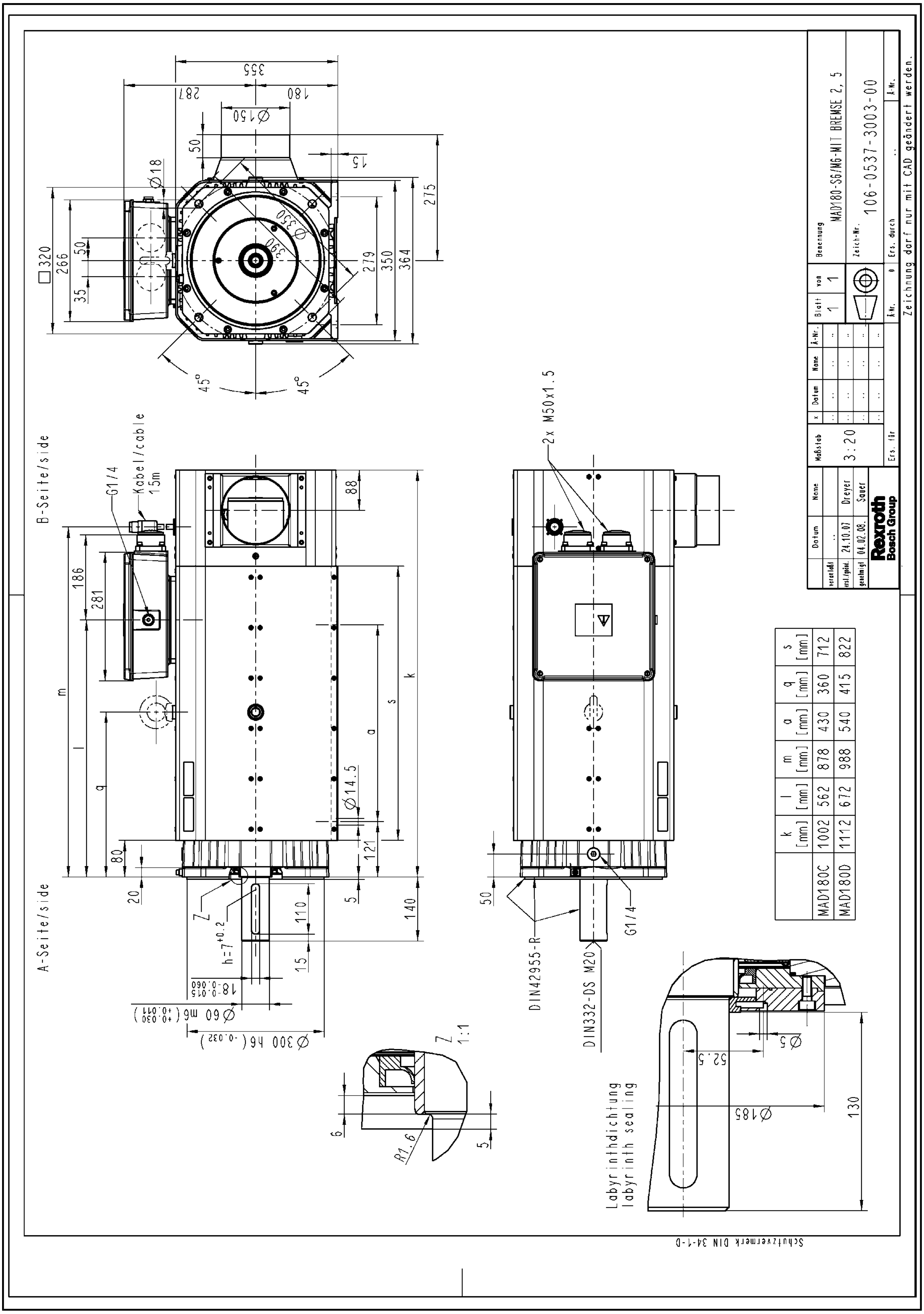
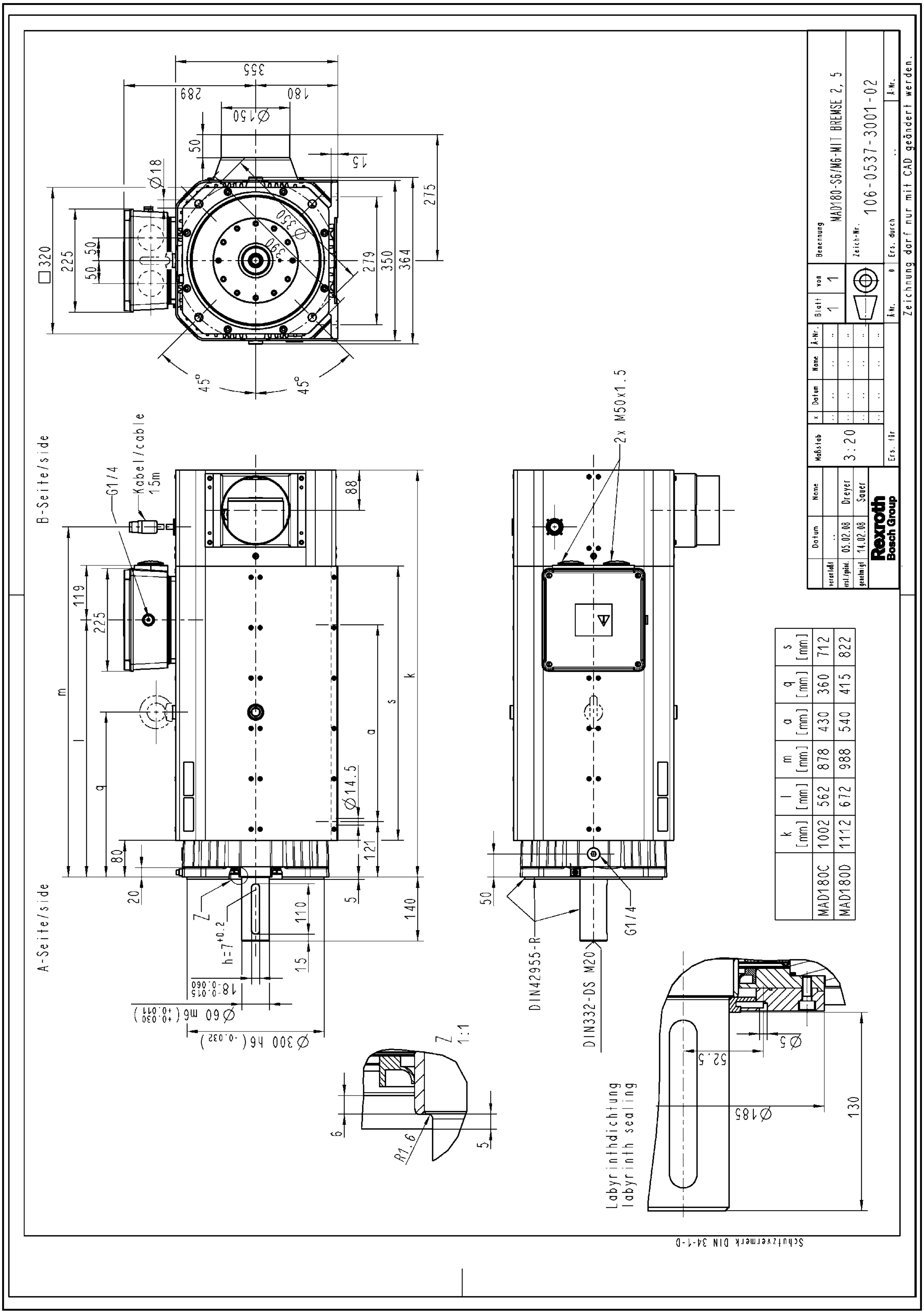



*Fig.5-53: MAD180 with encoder M6/S6, brake 2/5 (terminal box rotatable)*

Dimension Sheets IndraDyn A

## 5.4.12 MAD180 in ATEX Design with Encoder M6 or S6, Brake 2 or 5

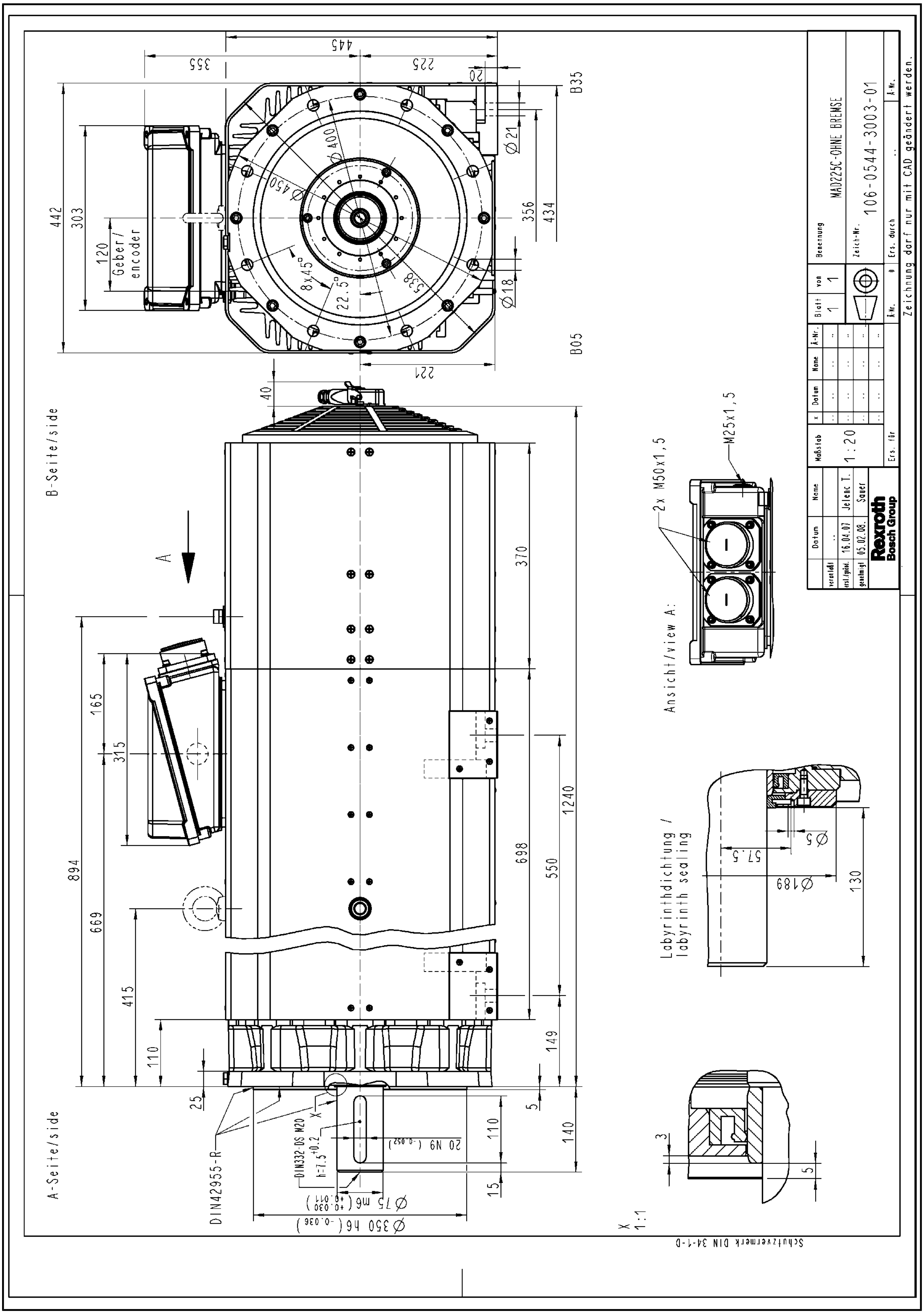



| | k [mm] | l [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAD180C | 1002 | 562 | 878 | 430 | 360 | 712 |
| MAD180D | 1112 | 672 | 988 | 540 | 415 | 822 |

*Fig.5-54: Dimension sheet MAD180 with encoder M6/S6 and brake 2/5*

# 5.5 Frame Size MAD225

## 5.5.1 MAD225 without Brake (Terminal Box Rotatable)



Dimension Sheets IndraDyn A

## 5.5.2 MAD225 without Brake

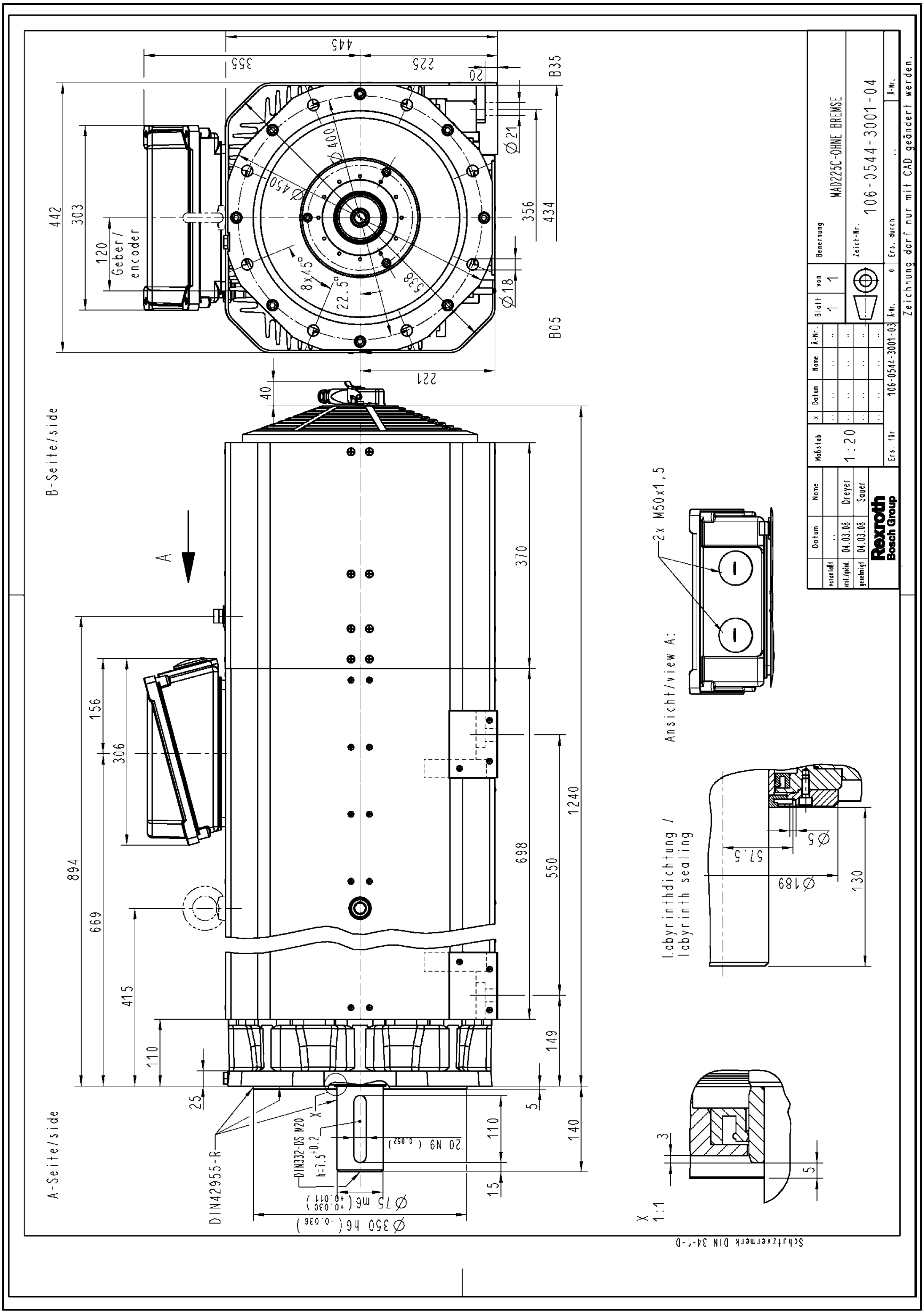


*Fig.5-56: Dimension sheet MAD225 without brake*

### 5.5.3 MAD225 with Fan Adapter without Brake (Terminal Box Rotatable)

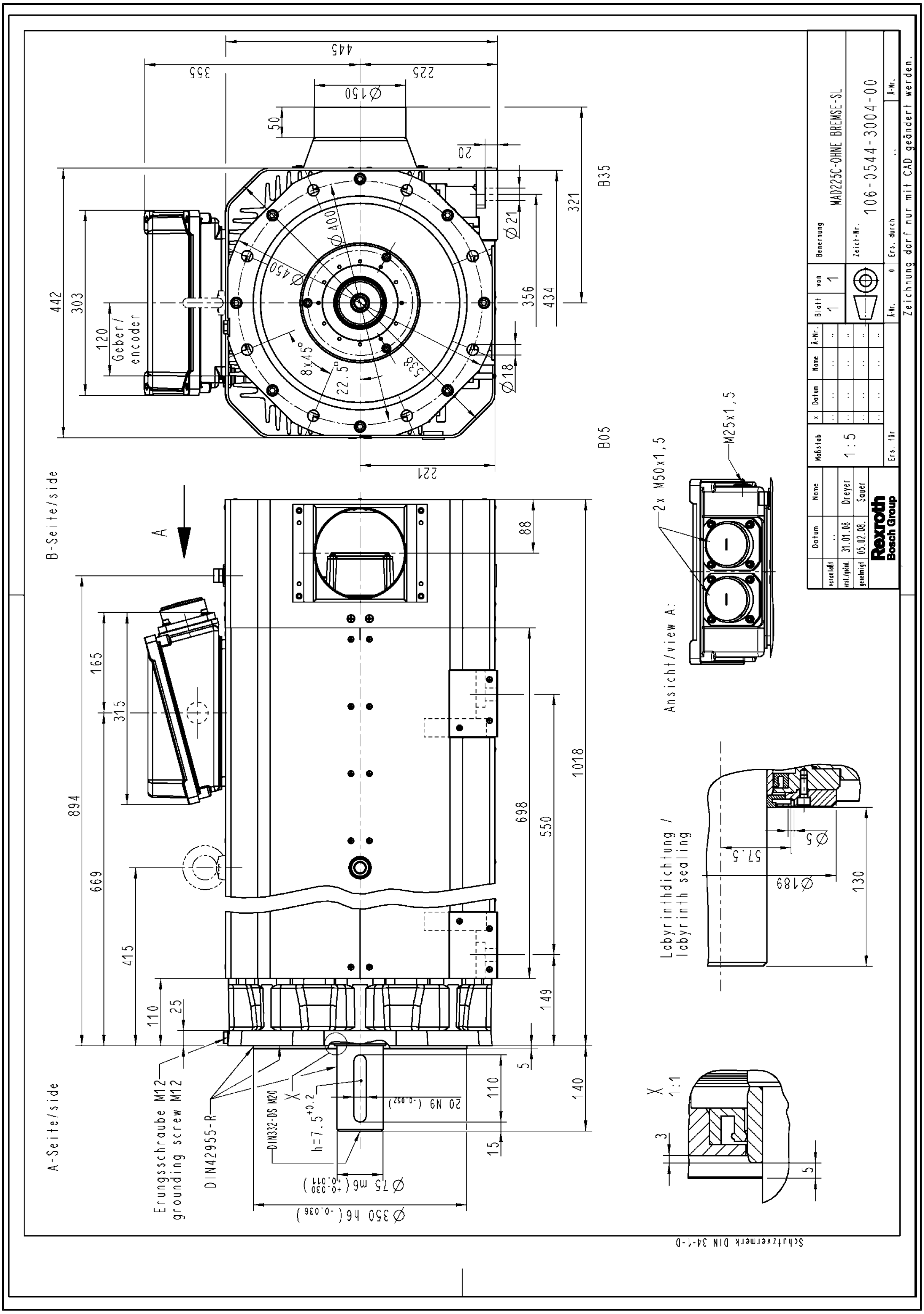


Fig.5-57: MAD225 with SL cooling, without brake (terminal box rotatable)

Dimension Sheets IndraDyn A

## 5.5.4 MAD225 with Fan Adapter without Brake

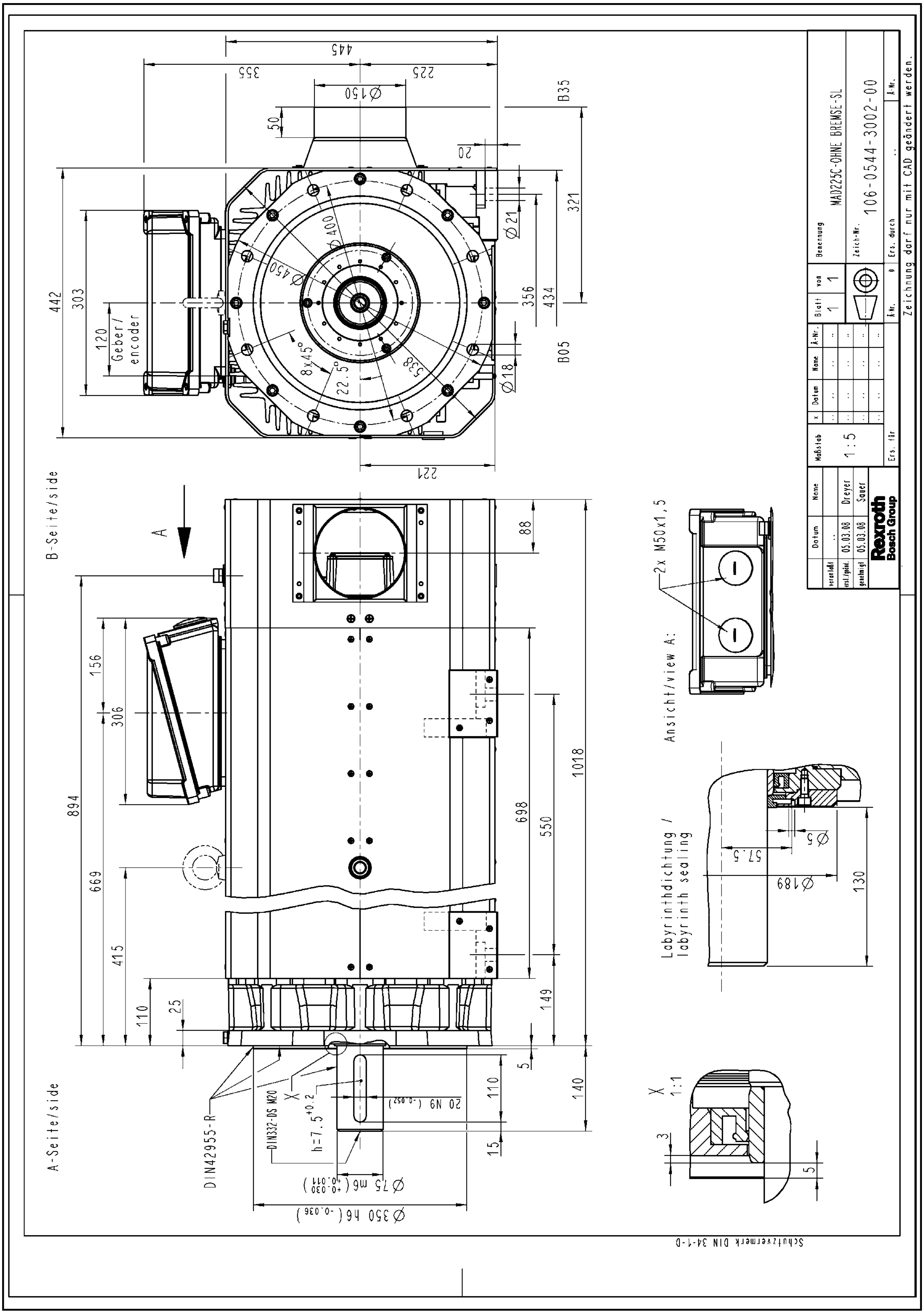


*Fig.5-58: MAD225 with SL cooling without brake*

## 5.5.5 MAD225 in ATEX Design, Encoder M6 or S6, without Brake (Terminal Box Rotatable)

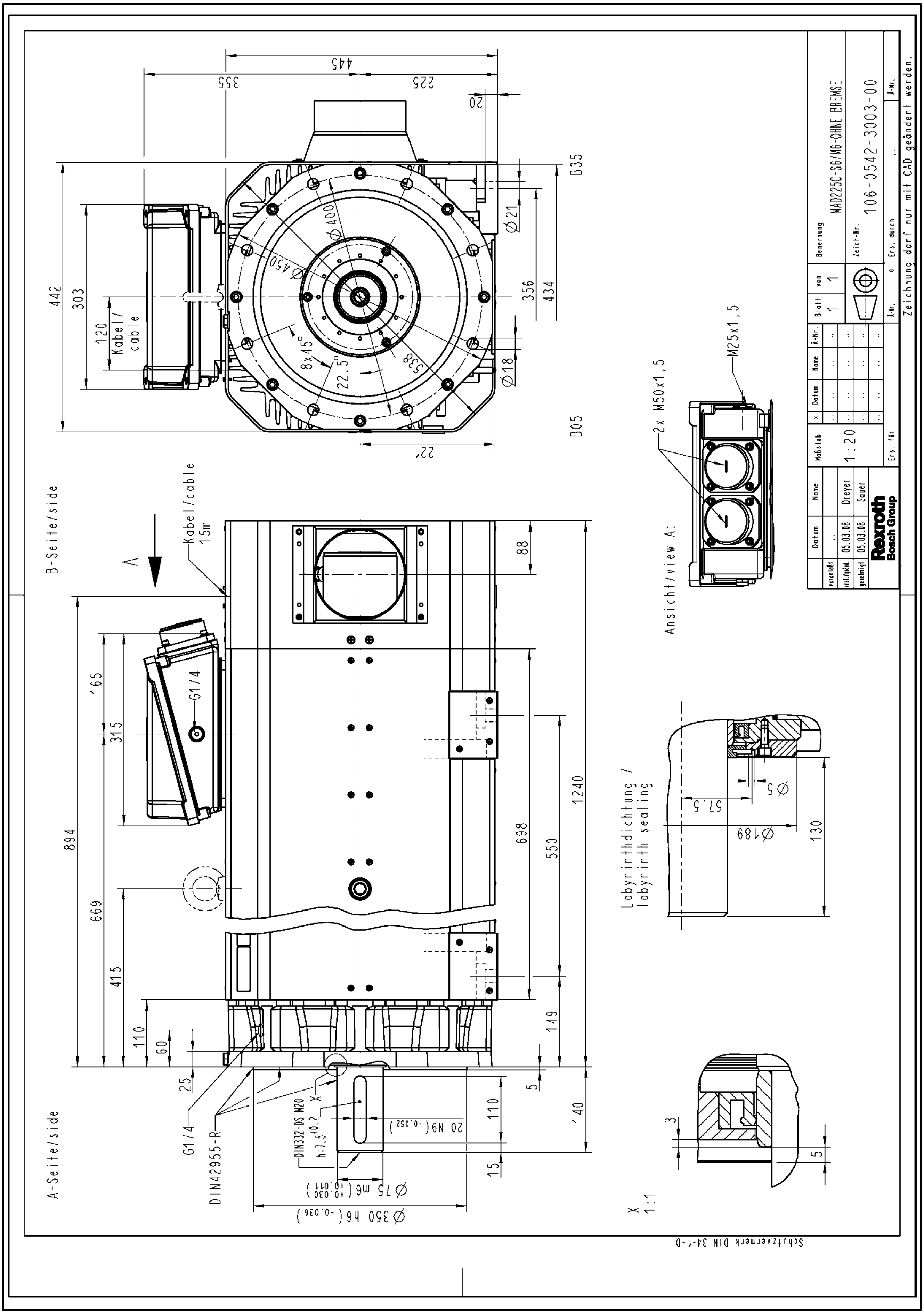



Fig.5-59: MAD225 with encoder M6/S6, without brake (terminal box rotatable)

Dimension Sheets IndraDyn A

### 5.5.6 MAD225 in ATEX Design with Encoder M6 or S6, without Brake

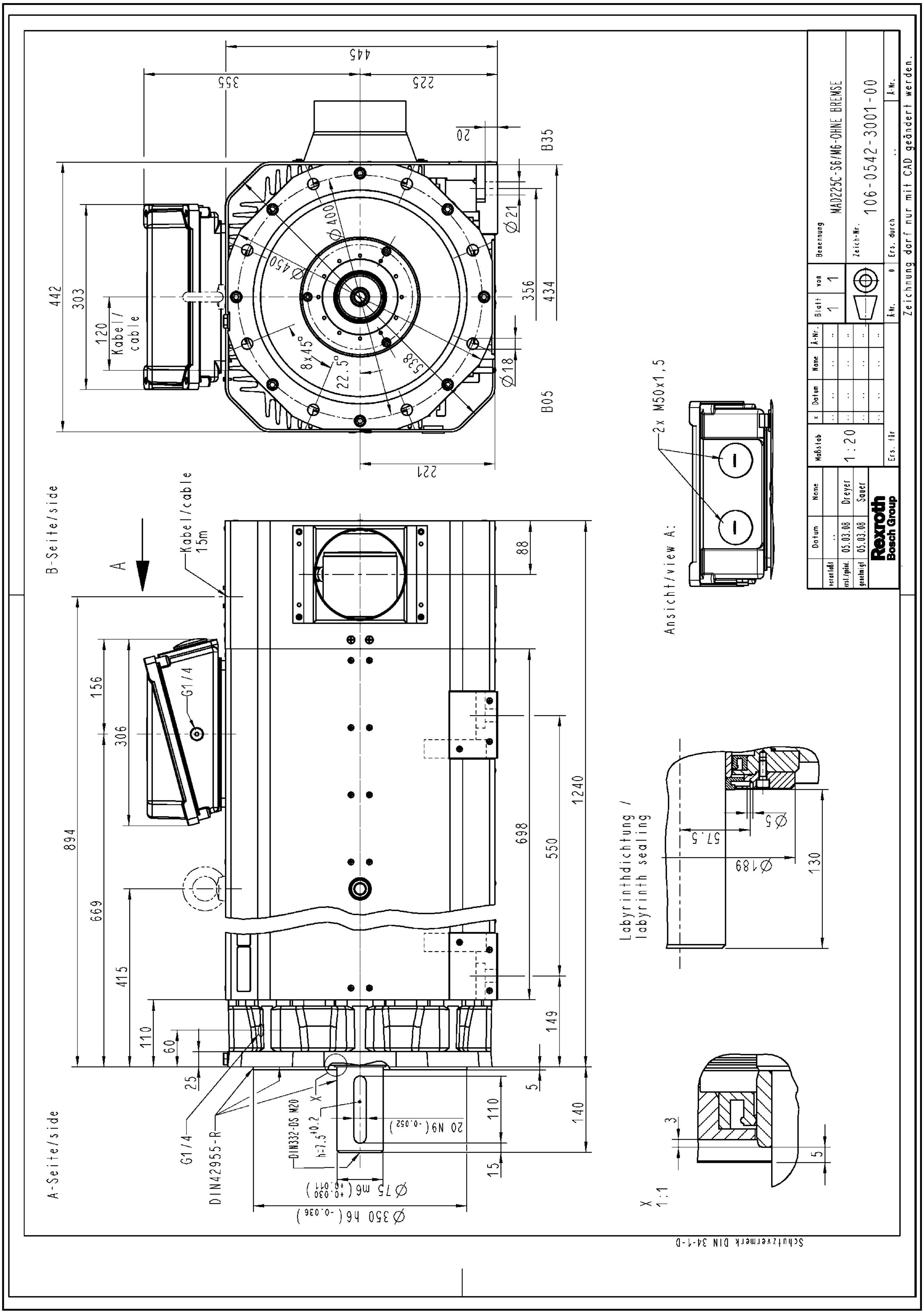
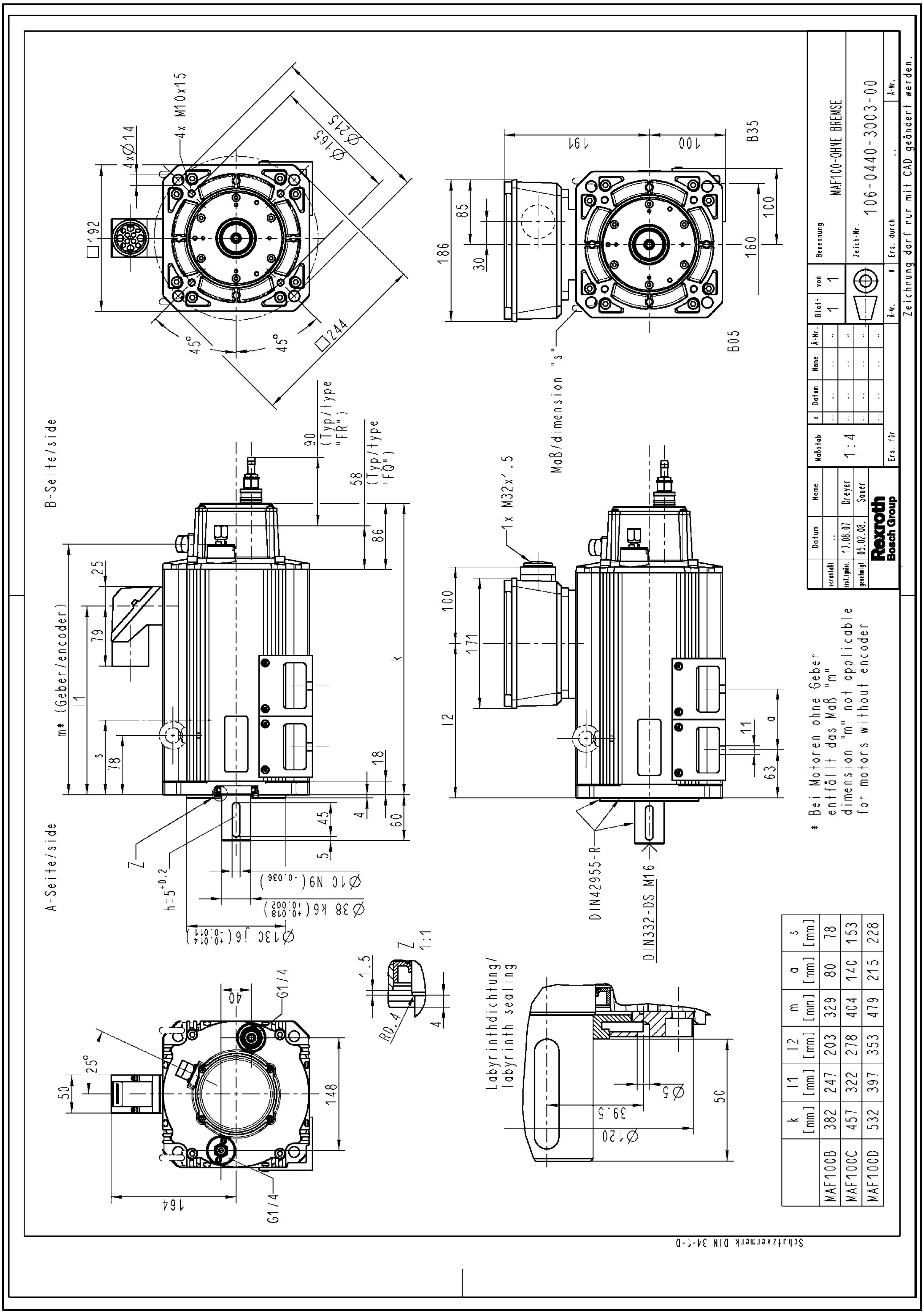


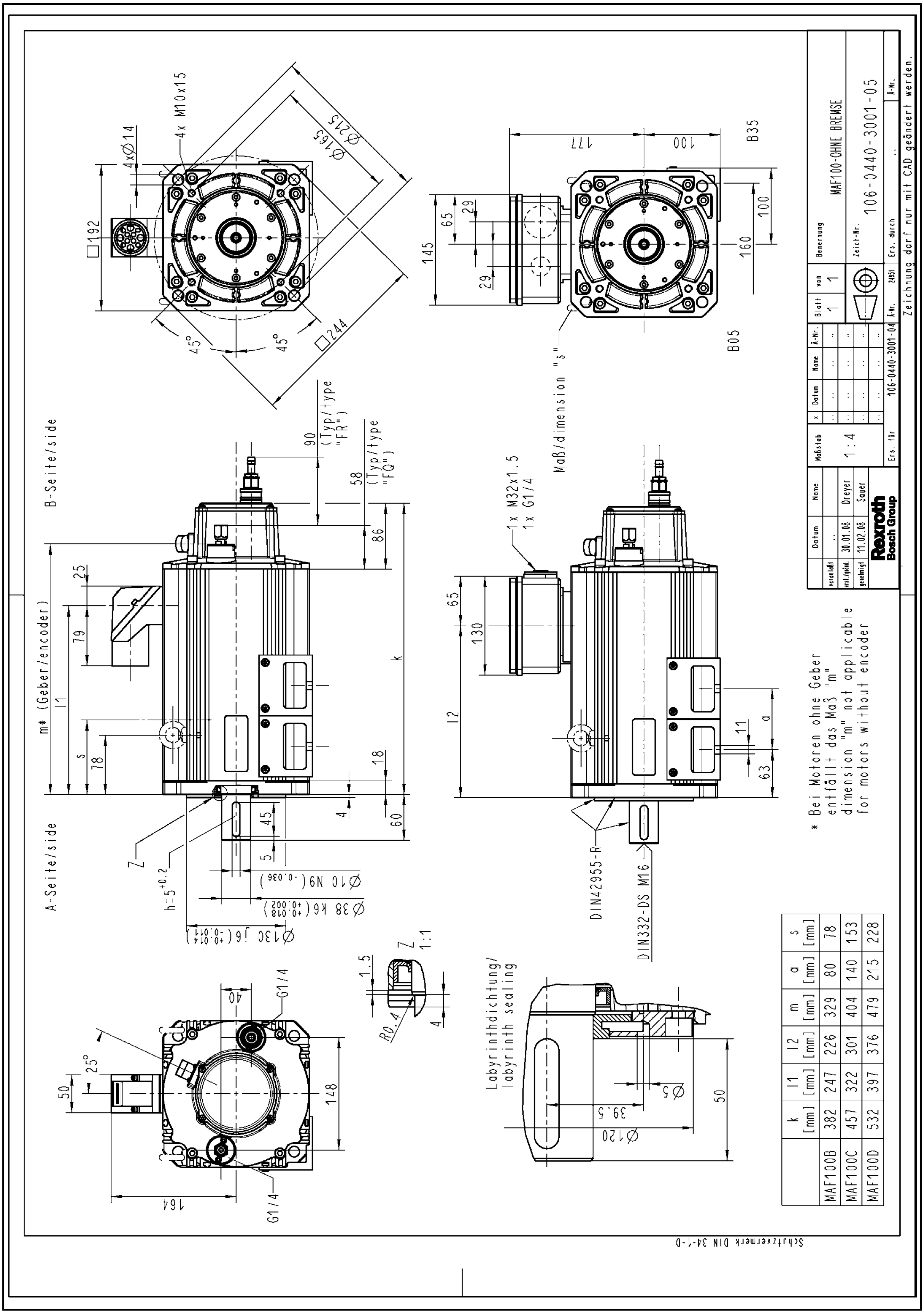

*Fig.5-60: MAD225 with encoder M6 or S6, without brake*

# 5.6 Frame Size MAF100

## 5.6.1 MAF100 without Brake (Terminal Box Rotatable)



## 5.6.2 MAF100 without Brake




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAF100B | 382 | 247 | 226 | 329 | 80 | 78 |
| MAF100C | 457 | 322 | 301 | 404 | 140 | 153 |
| MAF100D | 532 | 397 | 376 | 479 | 215 | 228 |

*Fig.5-62: Dimension sheet MAF100 without brake*

## 5.6.3 MAF100 with Brake 1 or 5 (Terminal Box Rotatable)

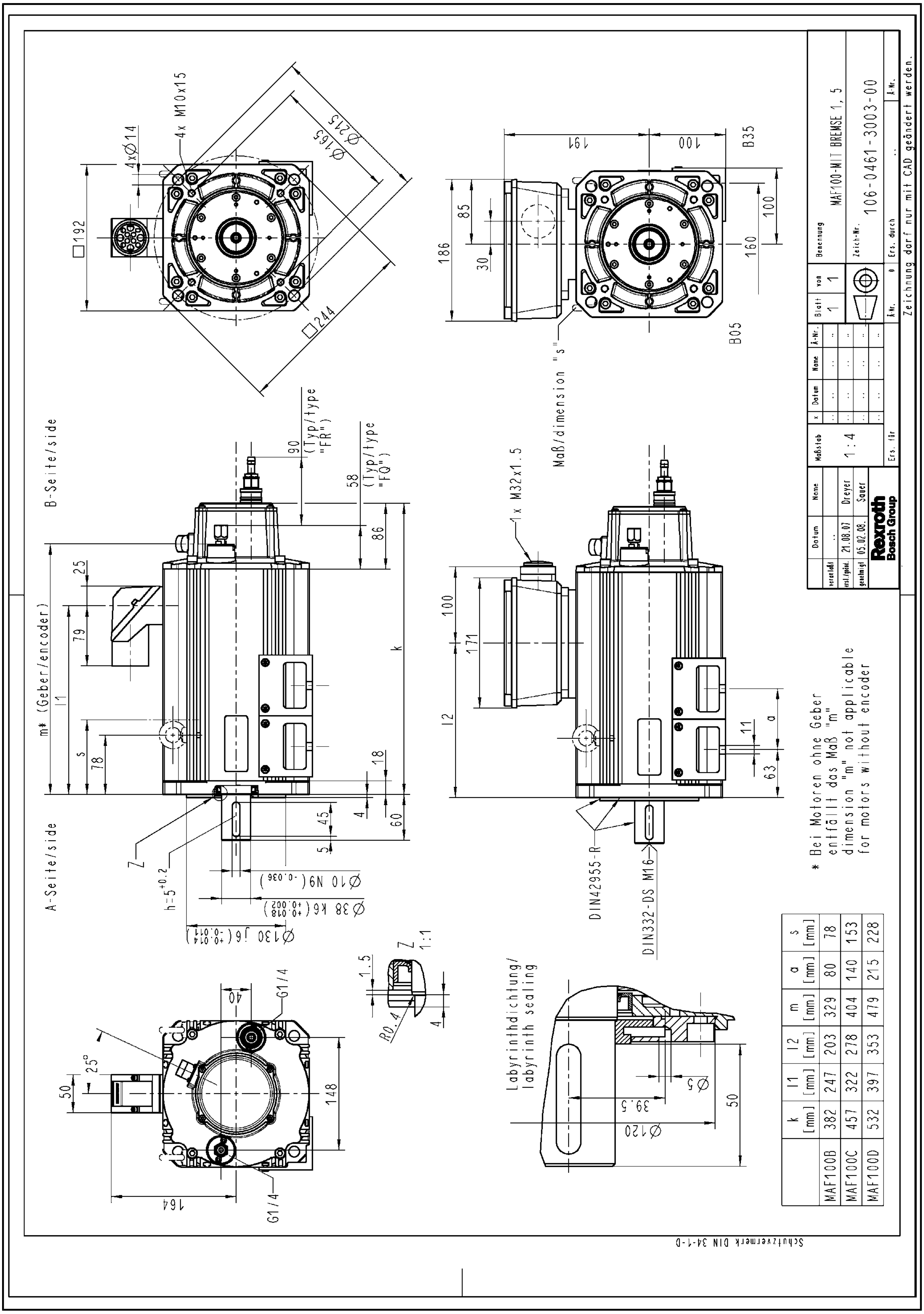



*Fig.5-63: MAF100 with brake 1 or 5 (terminal box rotatable)*

## 5.6.4 MAF100 with Brake 1 or 5

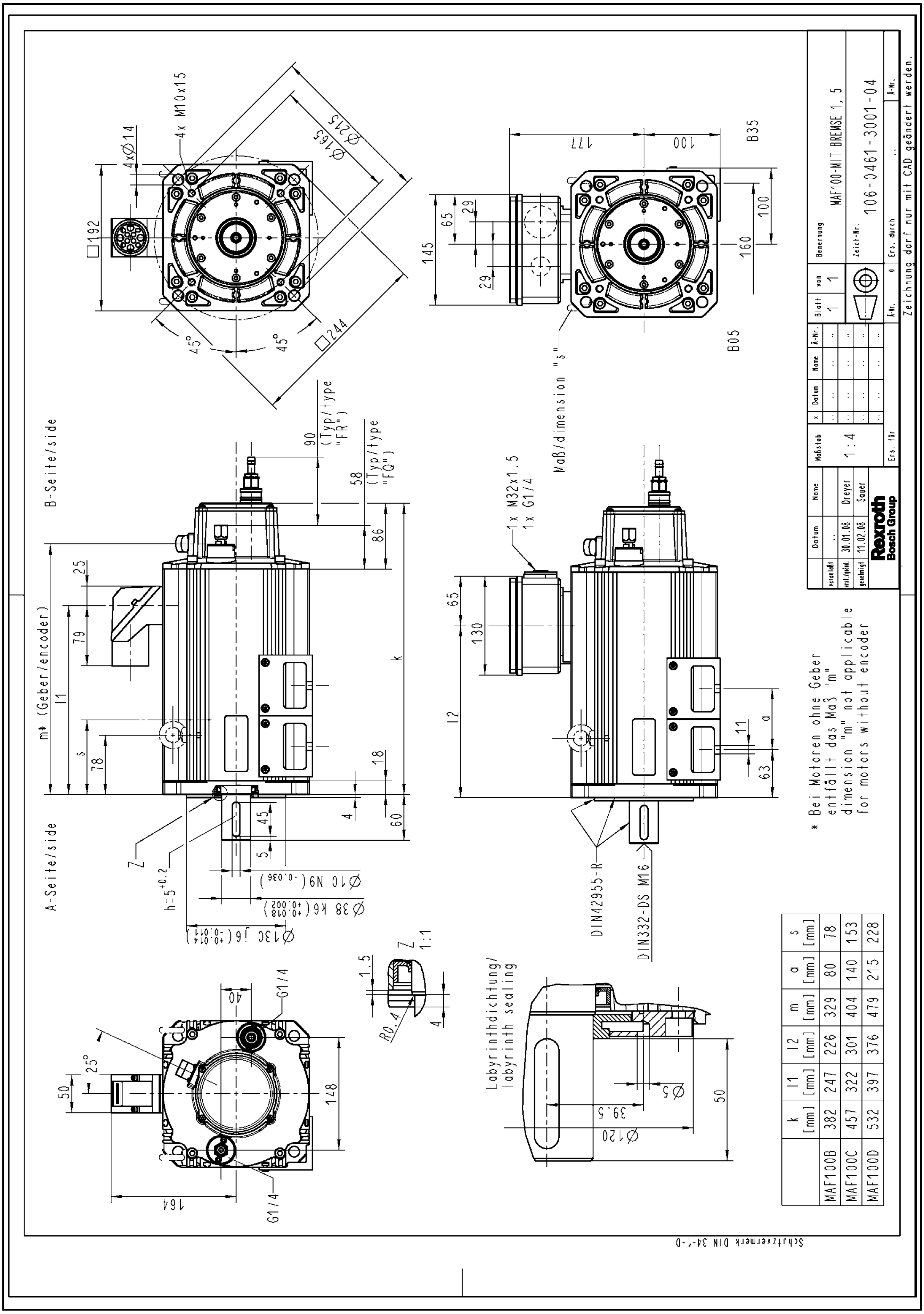



*Fig.5-64: Dimension sheet MAF100 with brake 1 or 5*

## 5.6.5 MAF100 in ATEX Design with Encoder M6 or S6, without Brake (Terminal Box Rotatable)

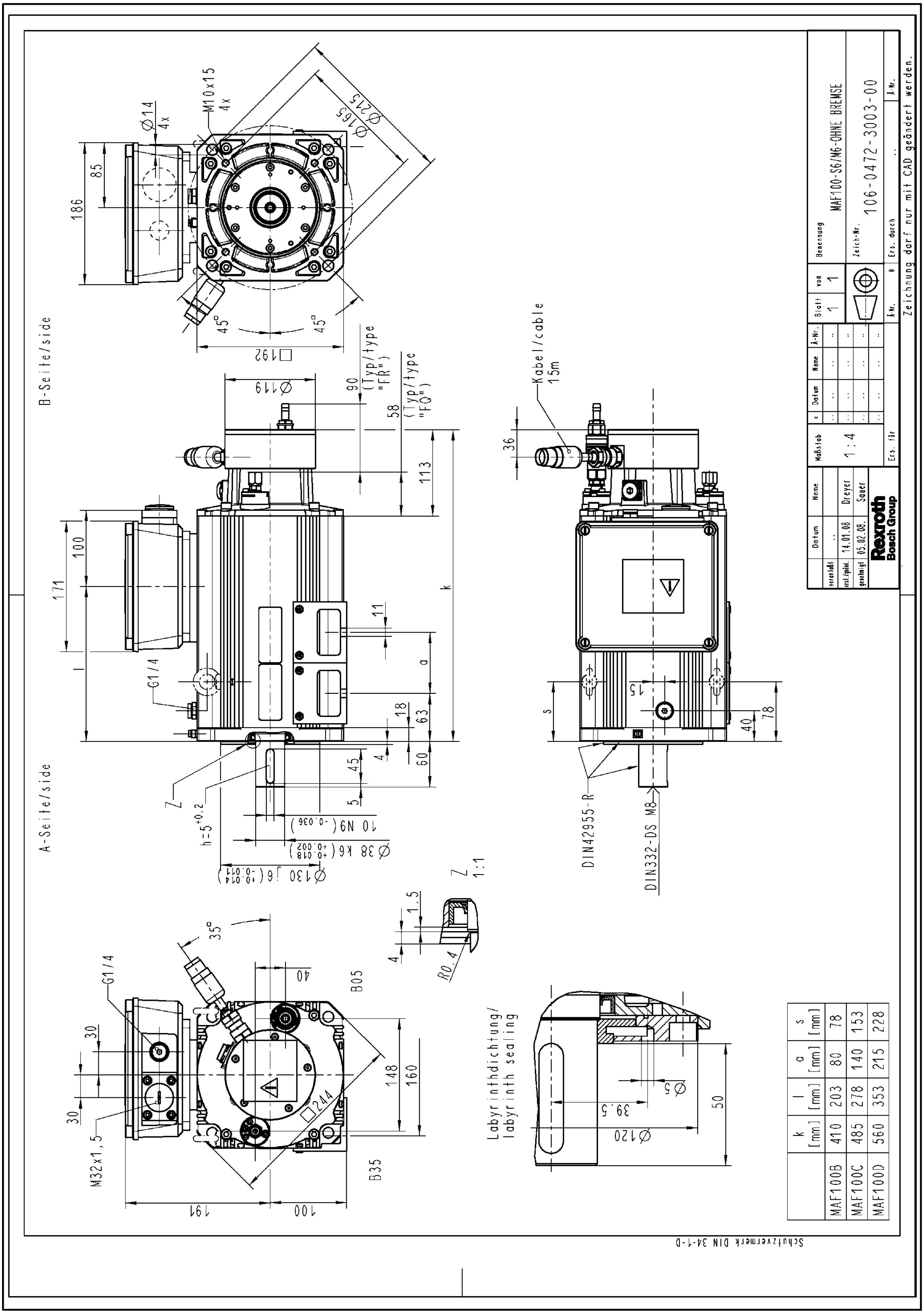



*Fig.5-65: MAF100 with encoder M6/S6, without brake (terminal box rotatable)*

## 5.6.6 MAF100 in ATEX Design with Encoder M6 or S6, without Brake

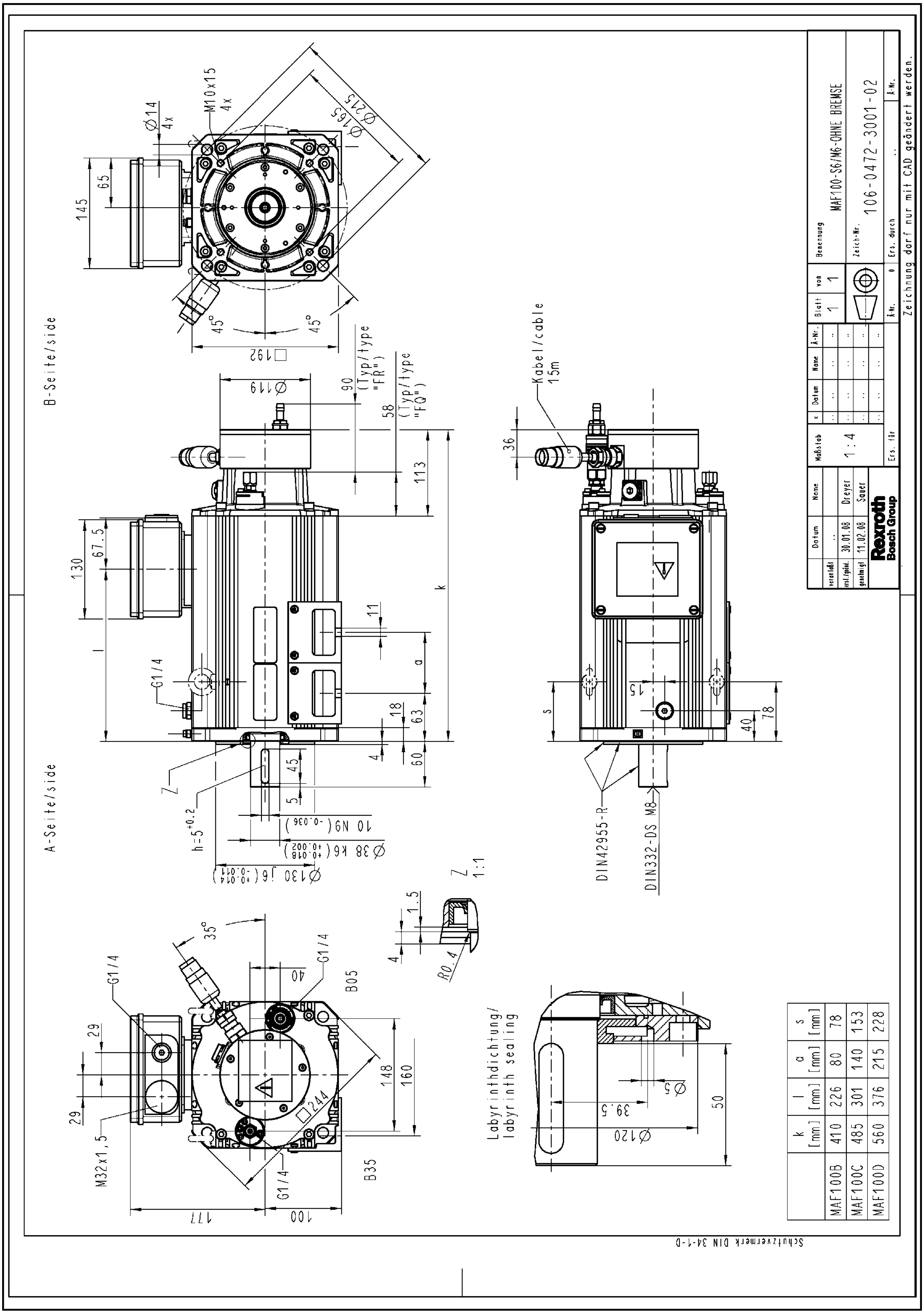



*Fig.5-66: Dimension sheet MAF100 with encoder M6 or S6, without brake*

## 5.6.7 MAF100 in ATEX Design with Encoder M6 or S6, Brake 1 or 5 (Terminal Box Rotatable)

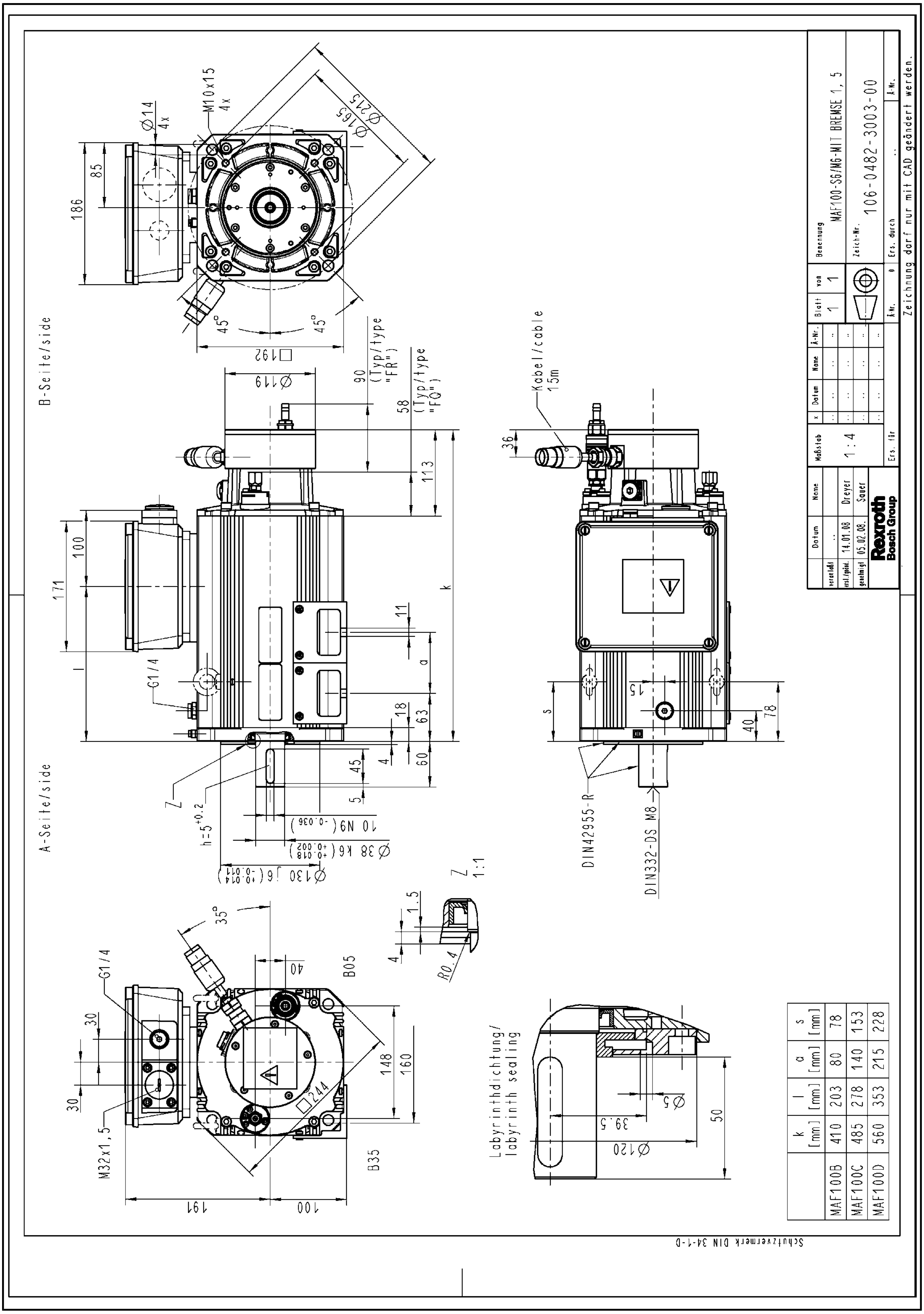



Fig.5-67: MAF100 with encoder M6/S6, brake 1/5 (terminal box rotatable)

## 5.6.8 MAF100 in ATEX Design with Encoder M6 or S6, Brake 1 or 5

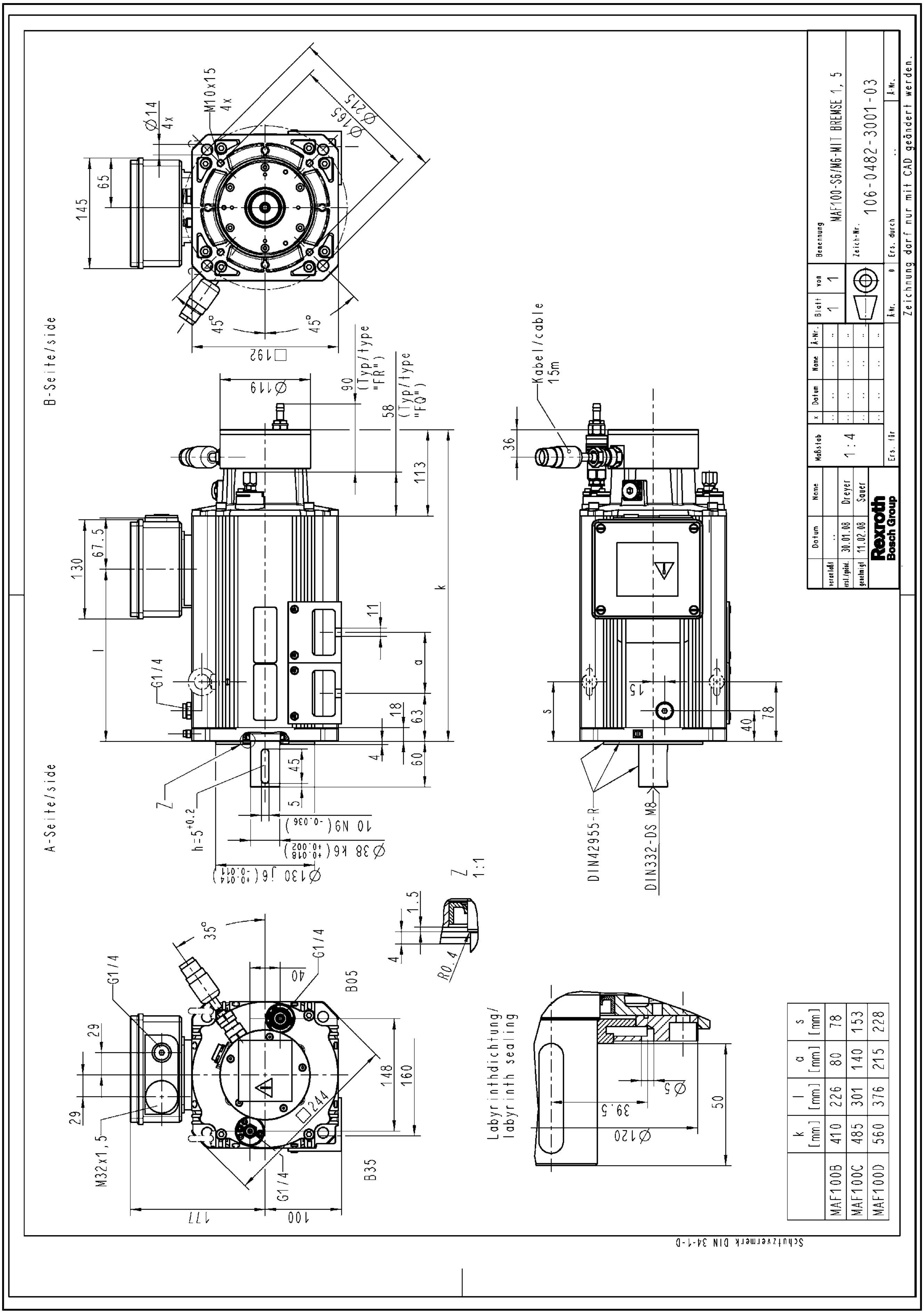
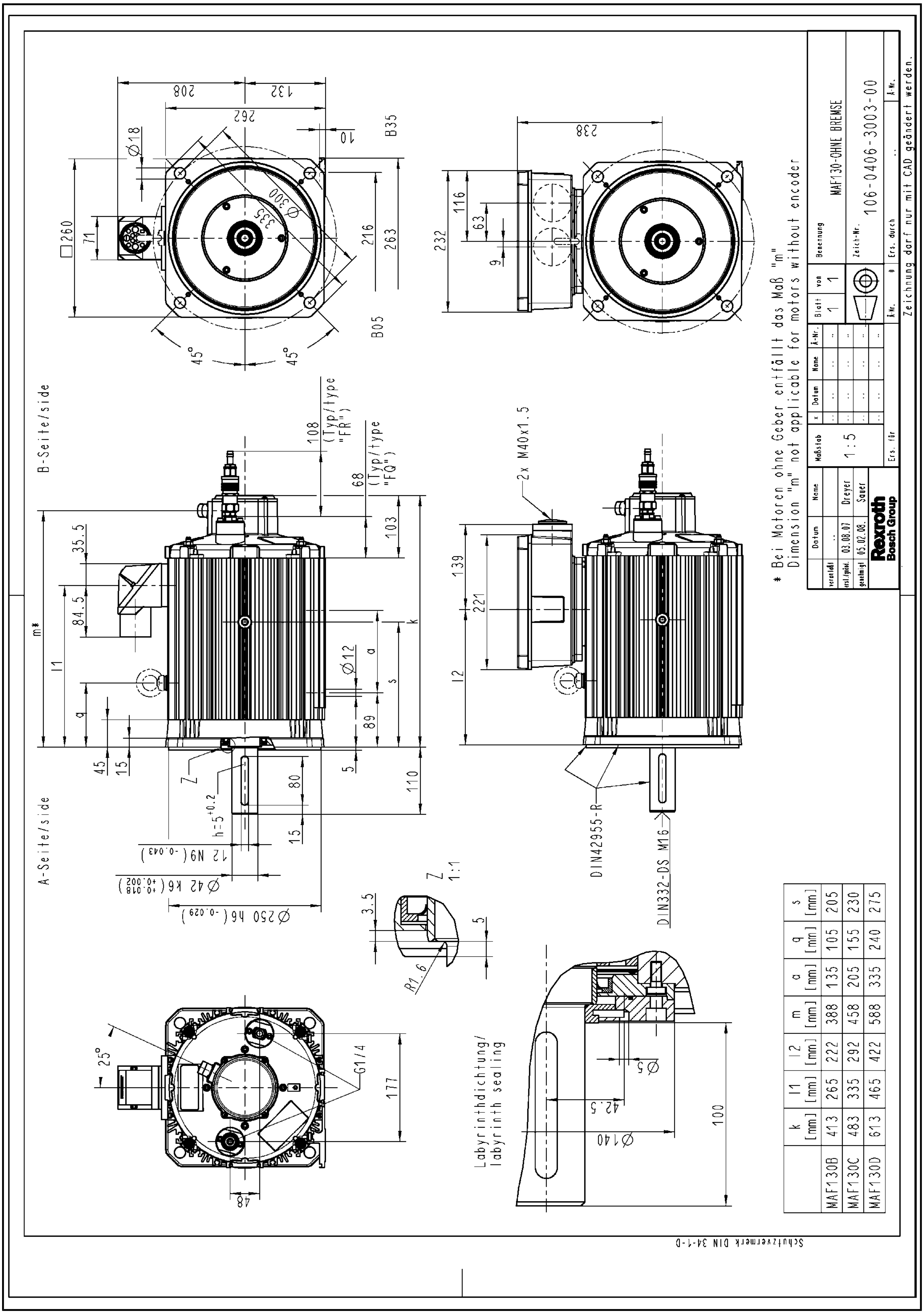



*Fig.5-68: Dimension sheet MAD180 with encoder M6/S6 and brake 1/5*

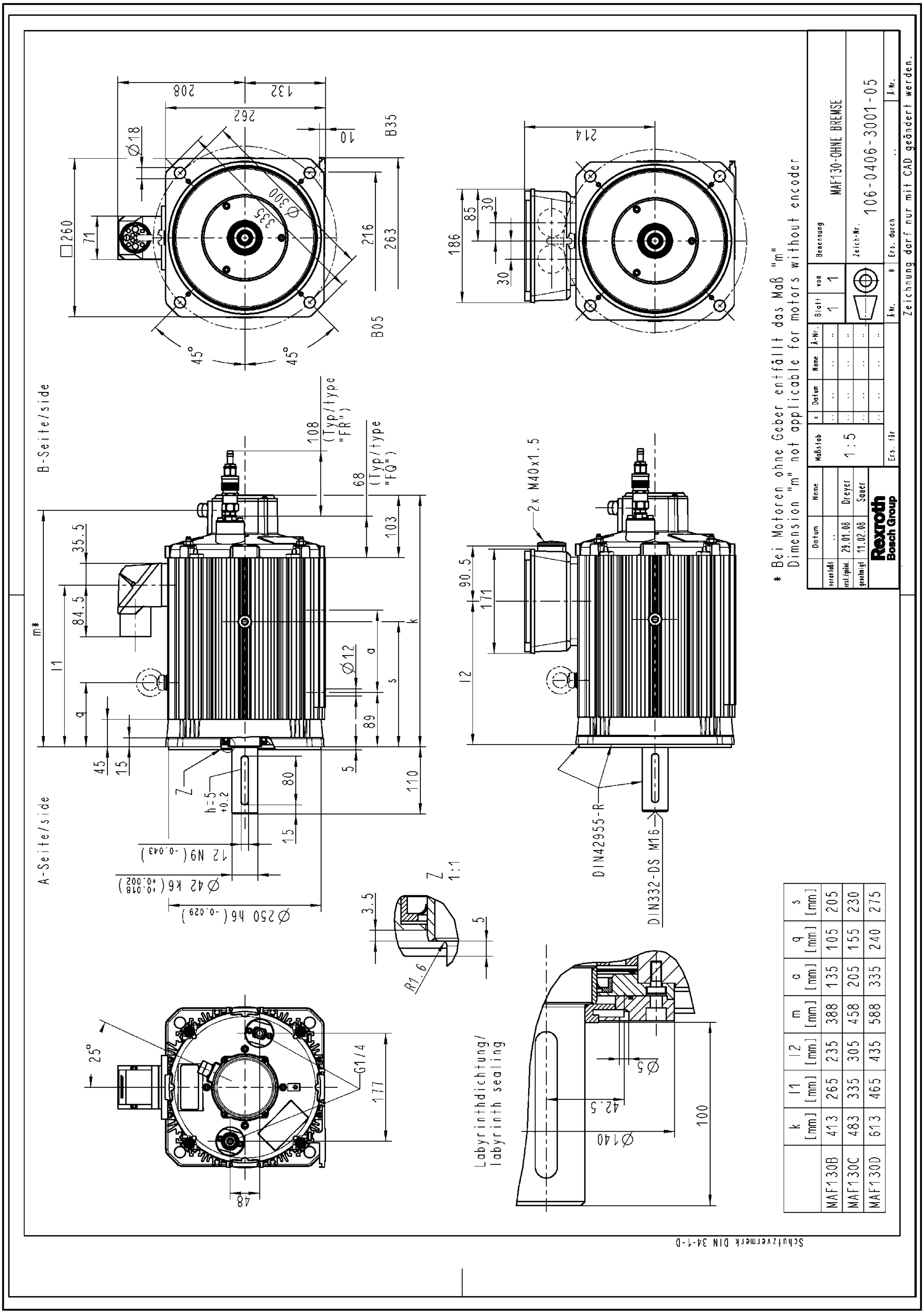
# 5.7 Frame Size MAF130

## 5.7.1 MAF130 without Brake (Terminal Box Rotatable)




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|---|
| MAF130B | 413 | 265 | 222 | 388 | 135 | 105 | 205 |
| MAF130C | 483 | 335 | 292 | 458 | 205 | 155 | 230 |
| MAF130D | 613 | 465 | 422 | 588 | 335 | 240 | 275 |

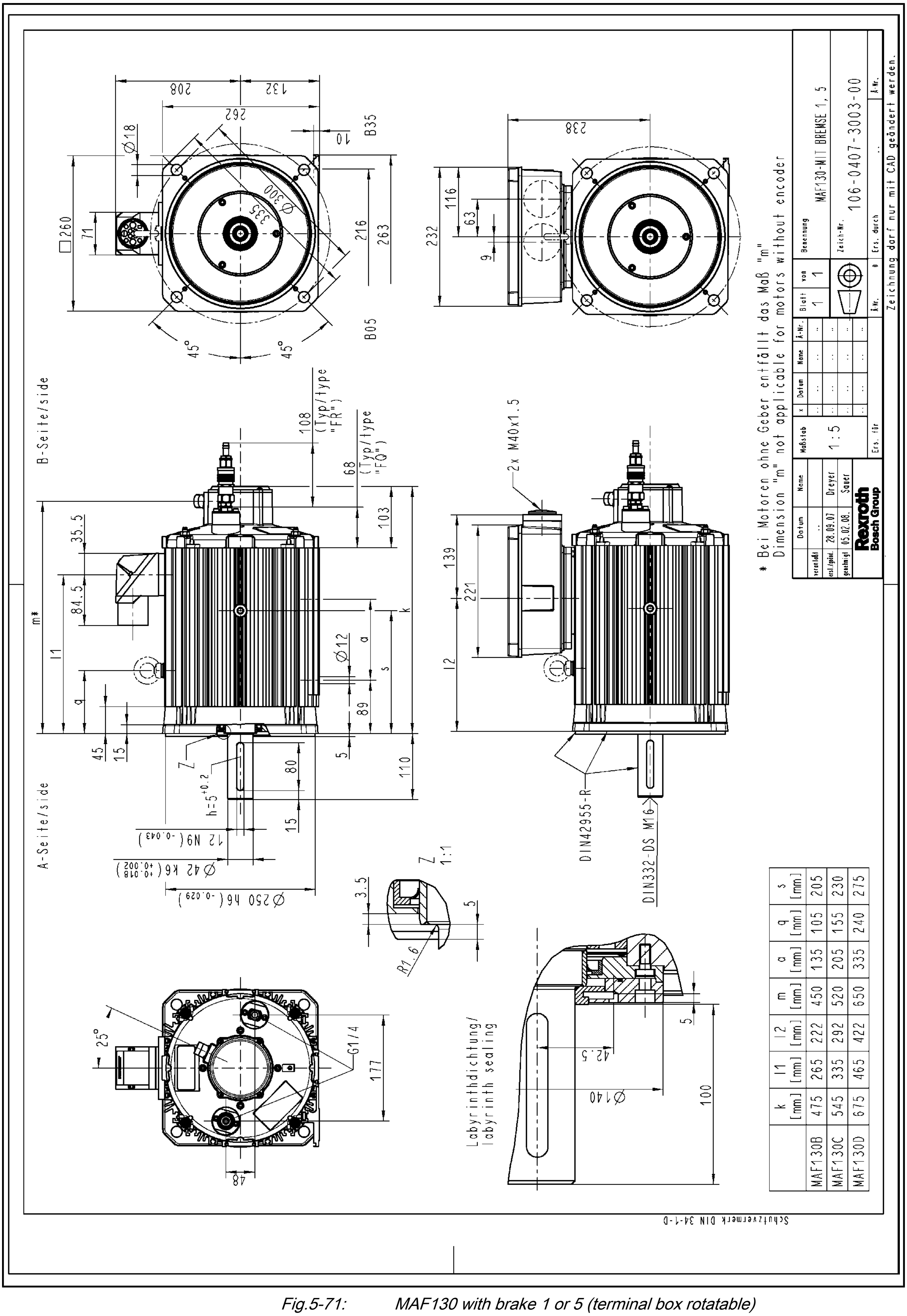
## 5.7.2 MAF130 without Brake




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|---|
| MAF130B | 413 | 265 | 235 | 388 | 135 | 105 | 205 |
| MAF130C | 483 | 335 | 305 | 458 | 205 | 155 | 230 |
| MAF130D | 613 | 465 | 435 | 588 | 335 | 240 | 275 |

*Fig.5-70: Dimension sheet MAF130 without brake*

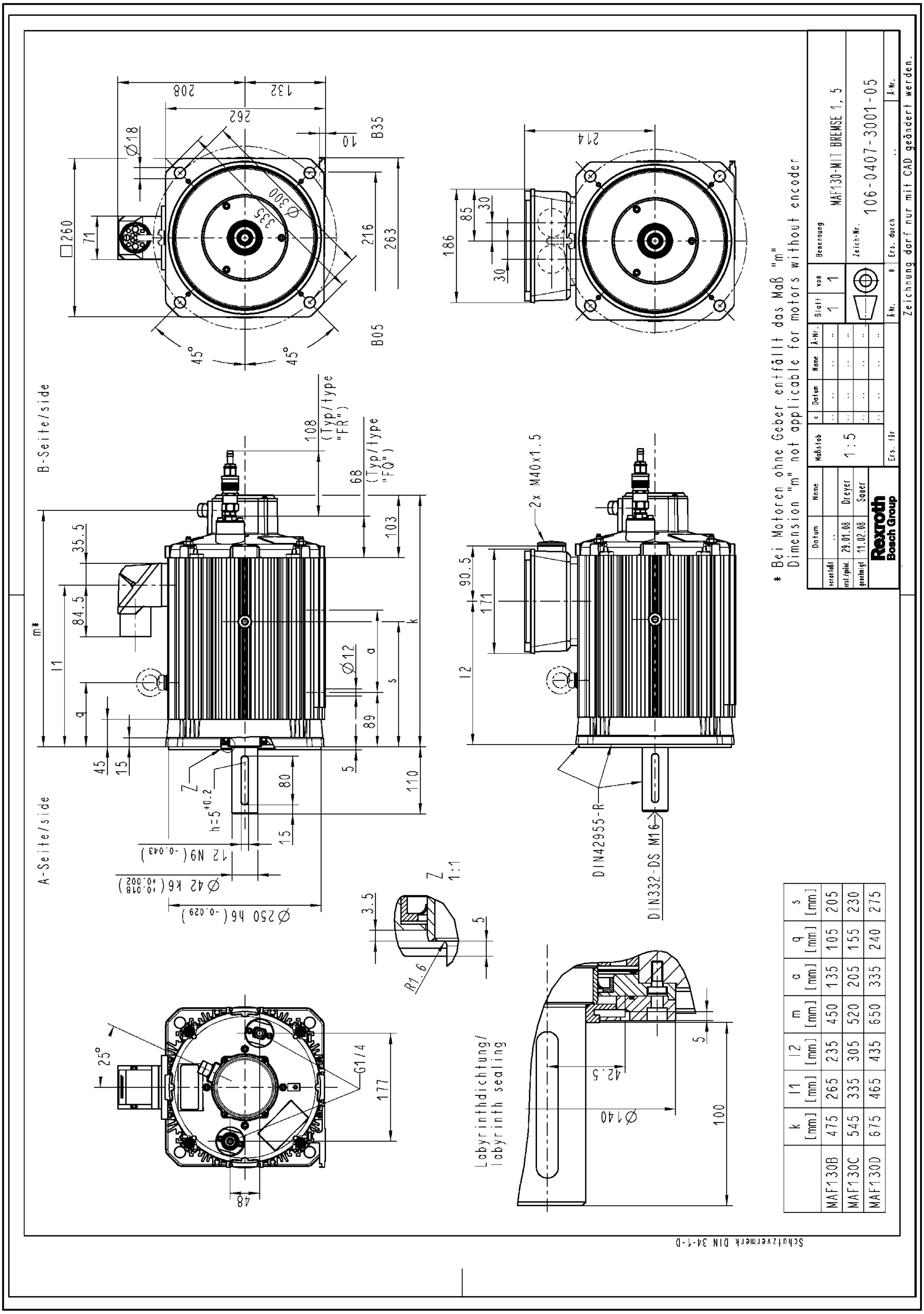
## 5.7.3 MAF130 with Brake 1 or 5 (Terminal Box Rotatable)




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|---|
| MAF130B | 475 | 265 | 222 | 450 | 135 | 105 | 205 |
| MAF130C | 545 | 335 | 292 | 520 | 205 | 155 | 230 |
| MAF130D | 675 | 465 | 422 | 650 | 335 | 240 | 275 |

*Fig.5-71: MAF130 with brake 1 or 5 (terminal box rotatable)*

## 5.7.4 MAF130 with Brake 1 or 5




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|---|
| MAF130B | 475 | 265 | 235 | 450 | 135 | 105 | 205 |
| MAF130C | 545 | 335 | 305 | 520 | 205 | 155 | 230 |
| MAF130D | 675 | 465 | 435 | 650 | 335 | 240 | 275 |

*Fig.5-72: Dimension sheet MAF130 with brake 1 or 5*

## 5.7.5 MAF130 in ATEX Design with Encoder M6 or S6, without Brake (Terminal Box Rotatable)

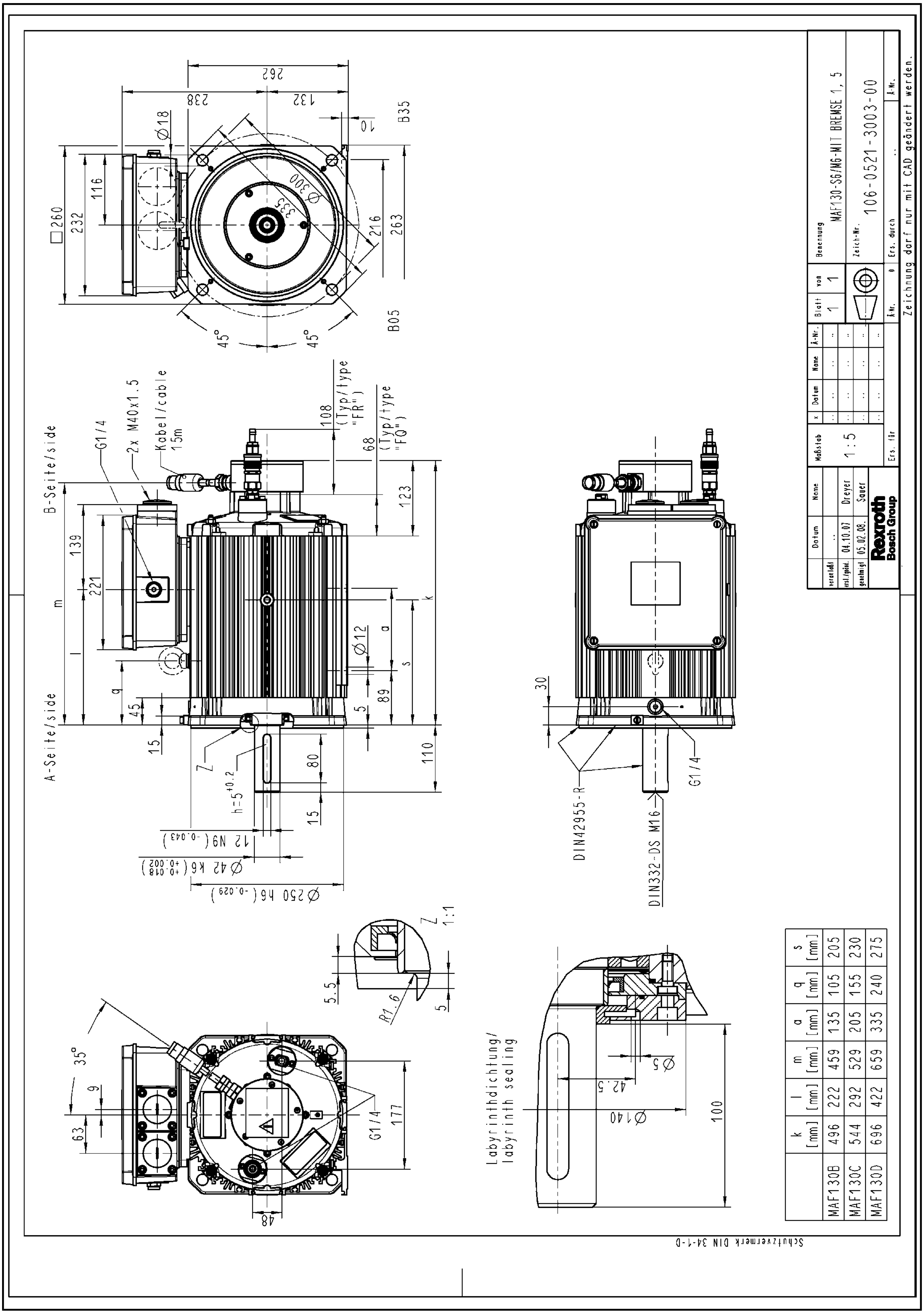



Fig.5-73: MAF130 with encoder M6/S6, without brake (terminal box rotatable)

Dimension Sheets IndraDyn A

## 5.7.6 MAF130 in ATEX Design with Encoder M6 or S6, without Brake

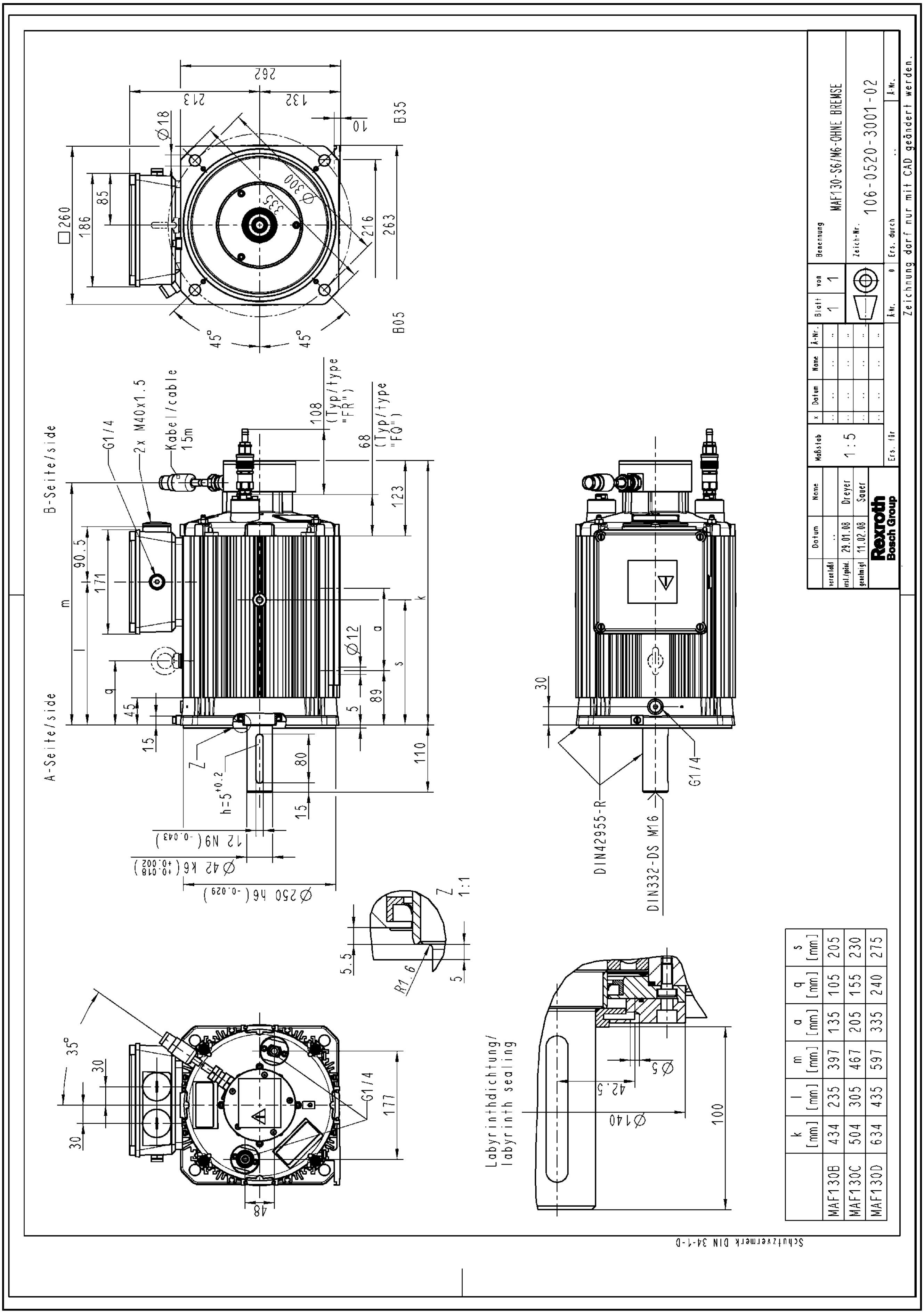



*Fig.5-74: Dimension sheet MAF130 with encoder M6 or S6, without brake*

## 5.7.7 MAF130 in ATEX Design with Encoder M6 or S6, Brake 1 or 5 (Terminal Box Rotatable)

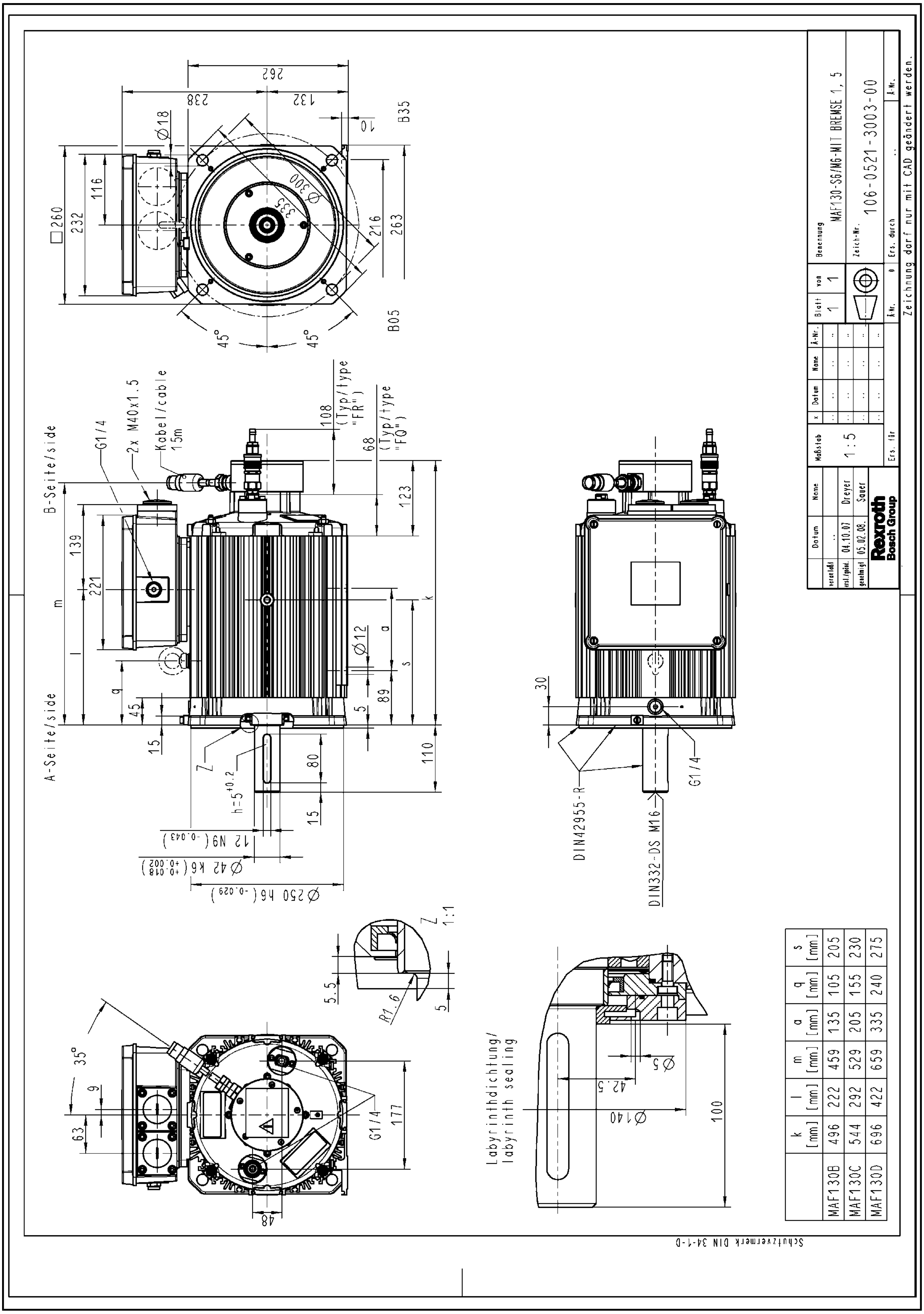
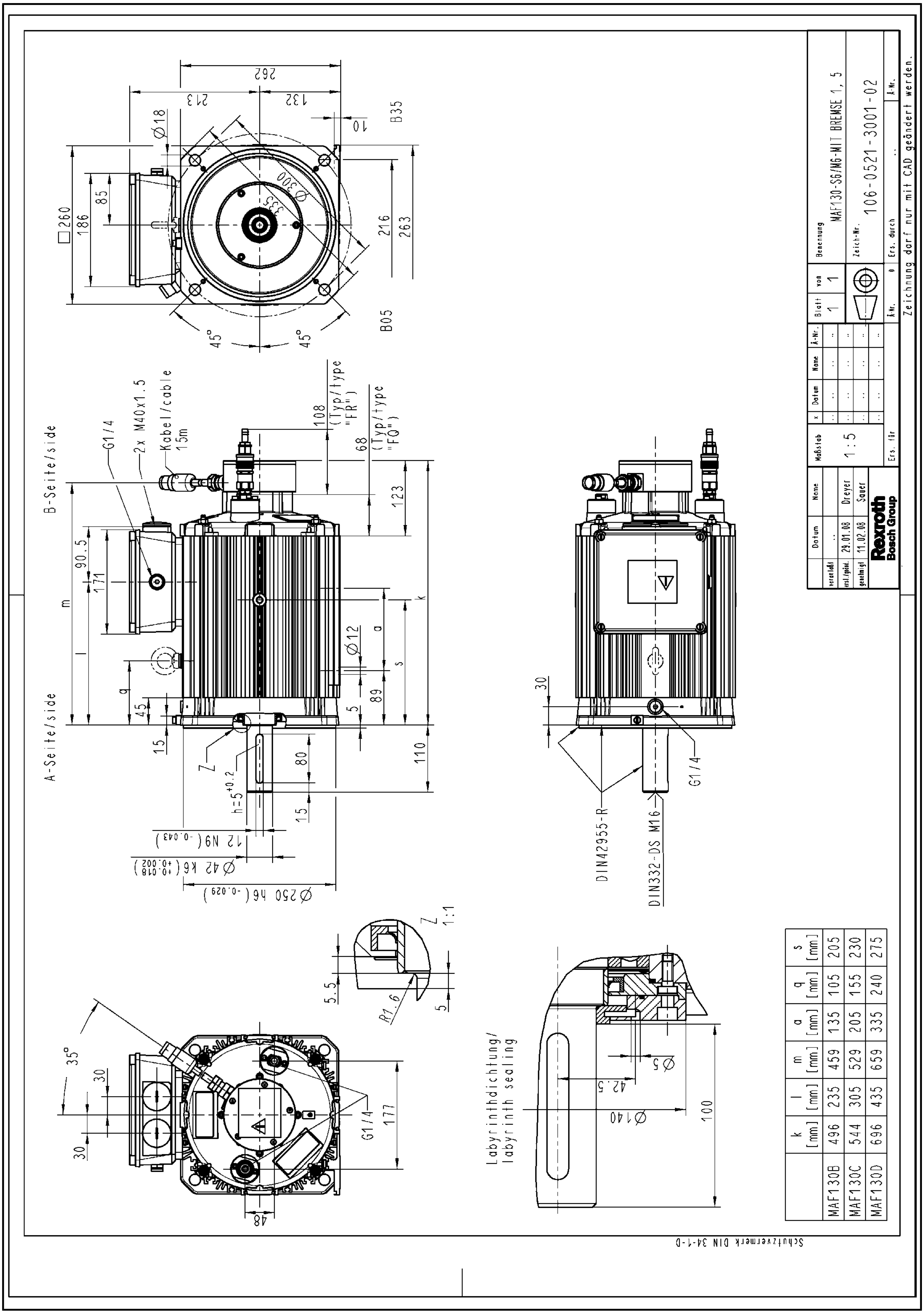



Fig.5-75: MAF100 with encoder M6/S6 and brake 1/5 (terminal box rotatable)

Dimension Sheets IndraDyn A

## 5.7.8 MAF130 in ATEX Design with Encoder M6 or S6, Brake 1 or 5

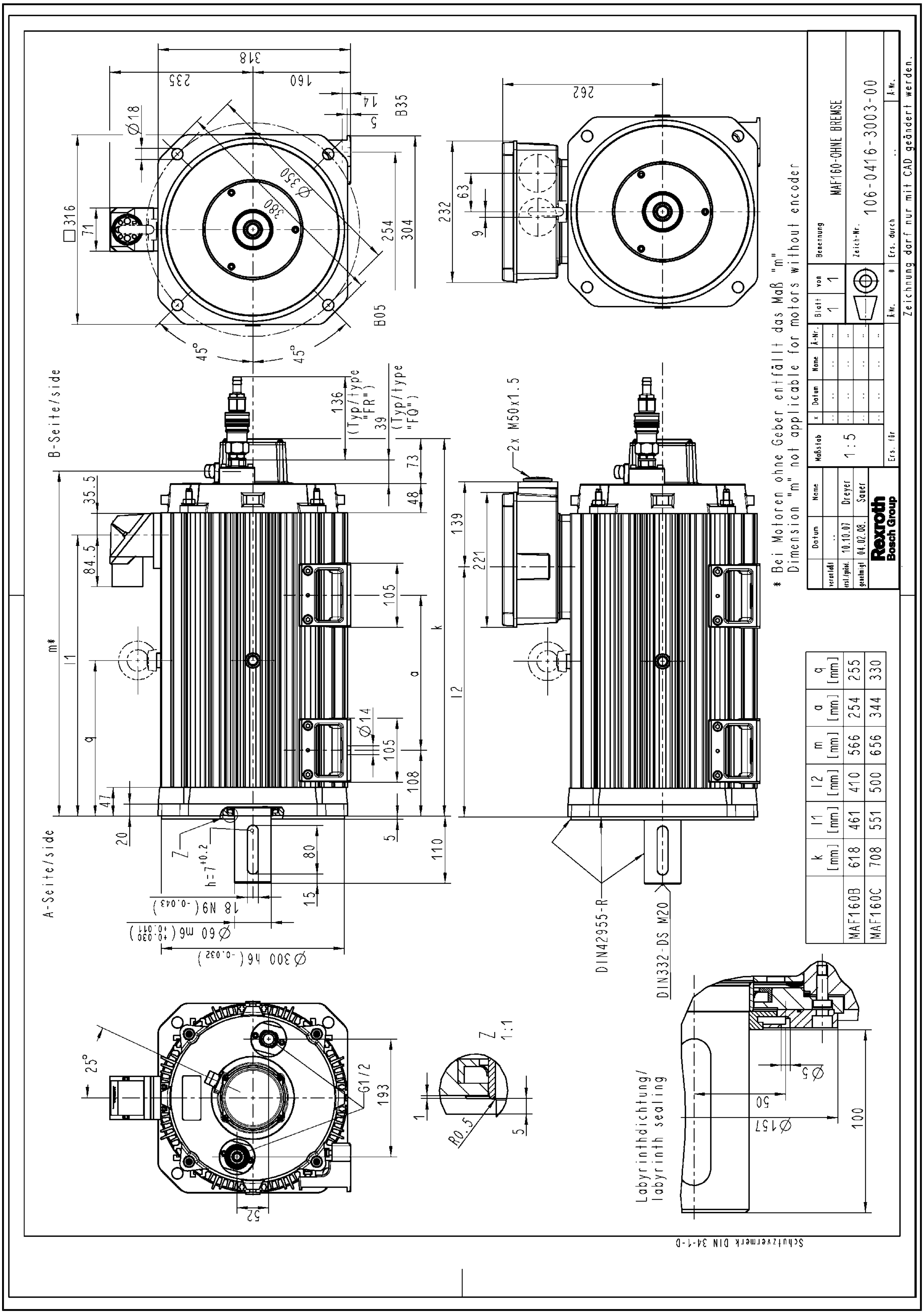



| | k [mm] | l [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAF130B | 496 | 235 | 459 | 135 | 105 | 205 |
| MAF130C | 544 | 305 | 529 | 205 | 155 | 230 |
| MAF130D | 696 | 435 | 659 | 335 | 240 | 275 |

*Fig.5-76: Dimension sheet MAF130 with encoder M6/S6 and brake 1/5*

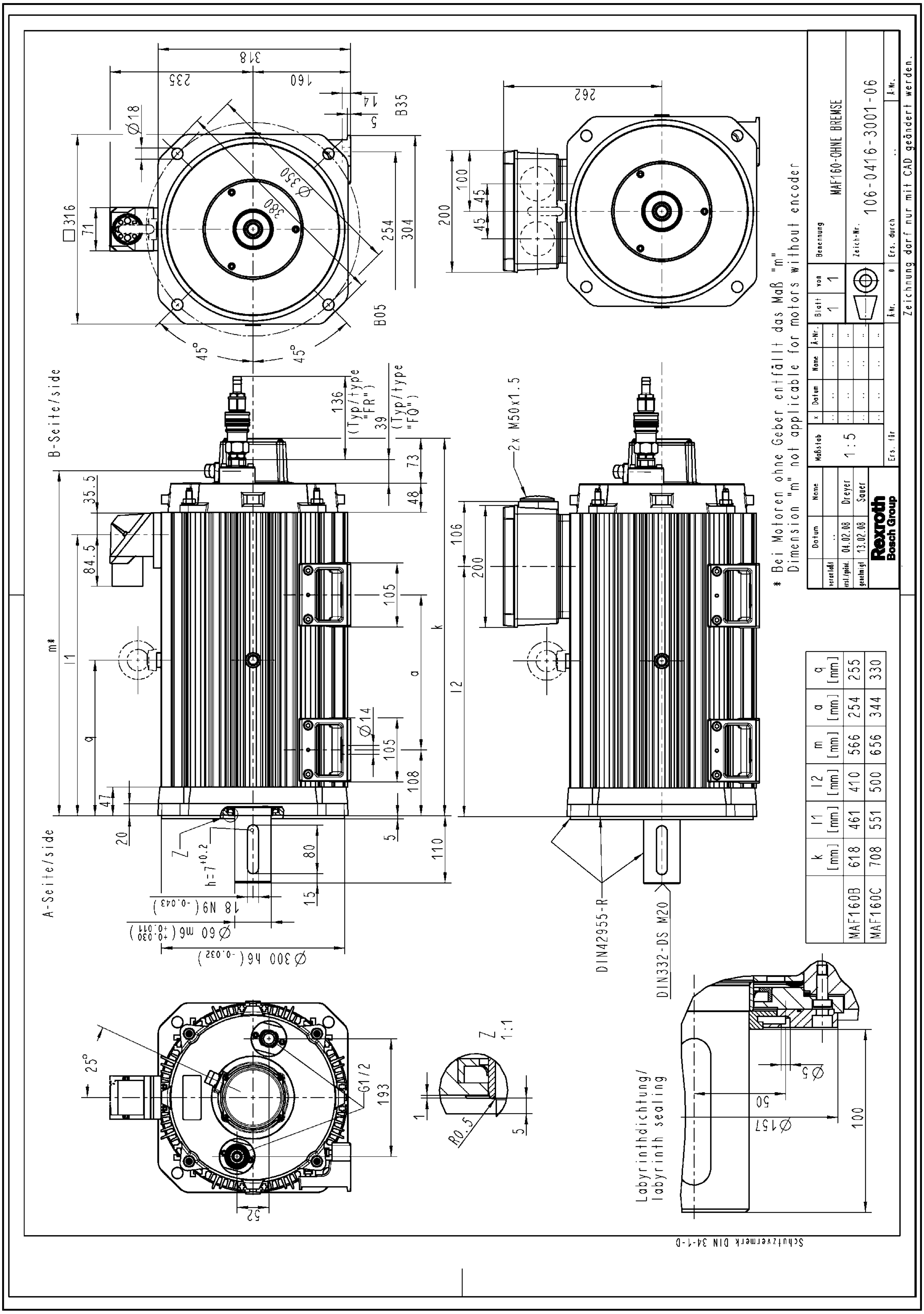
# 5.8 Frame Size MAF160

## 5.8.1 MAF160 without Brake (Terminal Box Rotatable)




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] |
|---|---|---|---|---|---|---|
| MAF160B | 618 | 461 | 410 | 566 | 254 | 255 |
| MAF160C | 708 | 551 | 500 | 656 | 344 | 330 |

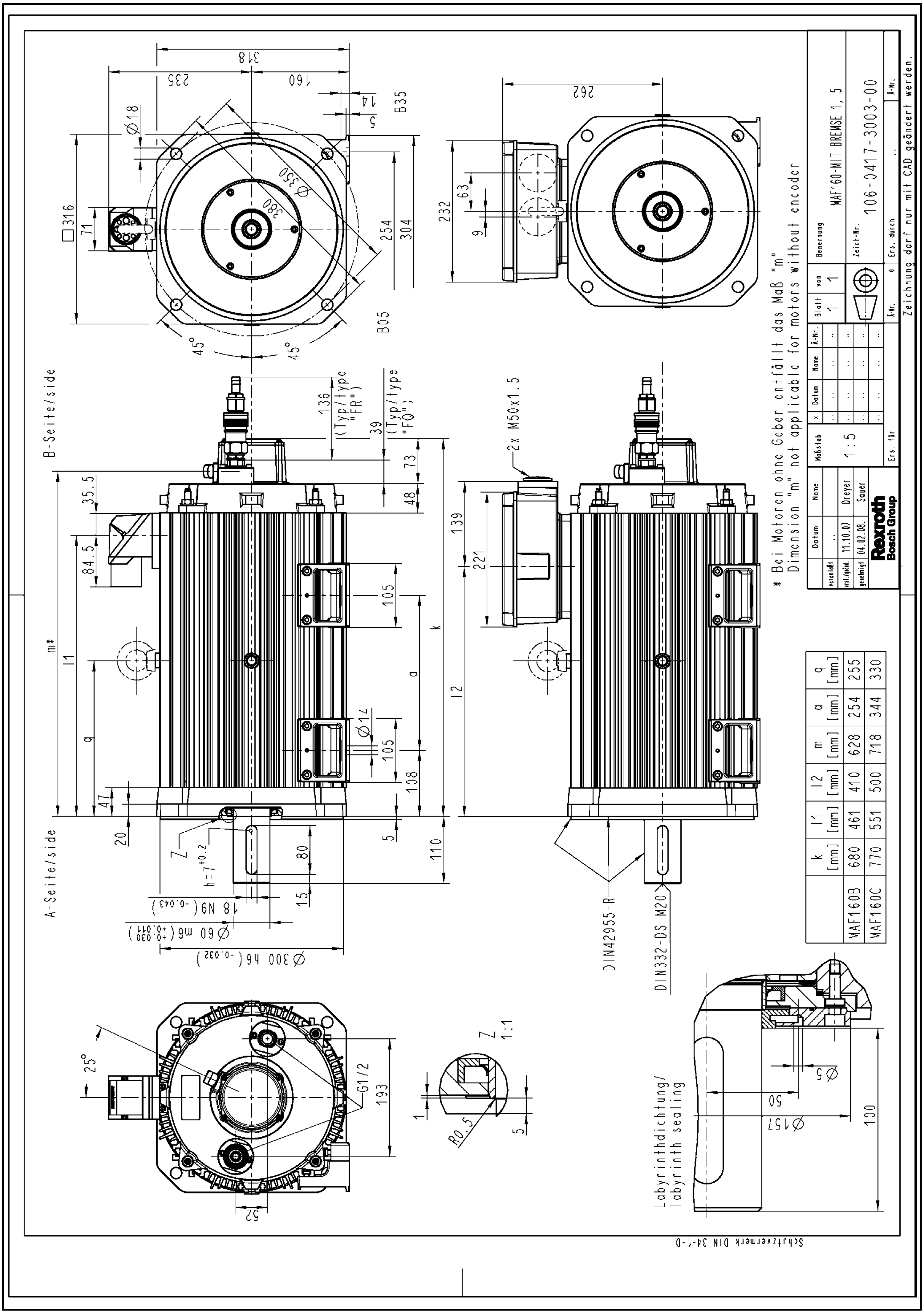
## 5.8.2 MAF160 without Brake




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] |
|---|---|---|---|---|---|---|
| MAF160B | 618 | 461 | 410 | 566 | 254 | 255 |
| MAF160C | 708 | 551 | 500 | 656 | 344 | 330 |

*Fig.5-78: Dimension sheet MAF160 without brake*

## 5.8.3 MAF160 with Brake 1 or 5 (Terminal Box Rotatable)




| | k [mm] | l1 [mm] | l2 [mm] | m [mm] | a [mm] | q [mm] |
|---|---|---|---|---|---|---|
| MAF160B | 680 | 461 | 410 | 628 | 254 | 255 |
| MAF160C | 770 | 551 | 500 | 718 | 344 | 330 |

*Fig.5-79: MAF160 with brake 1 or 5 (terminal box rotatable)*

Dimension Sheets IndraDyn A

## 5.8.4 MAF160 with Brake 1 or 5

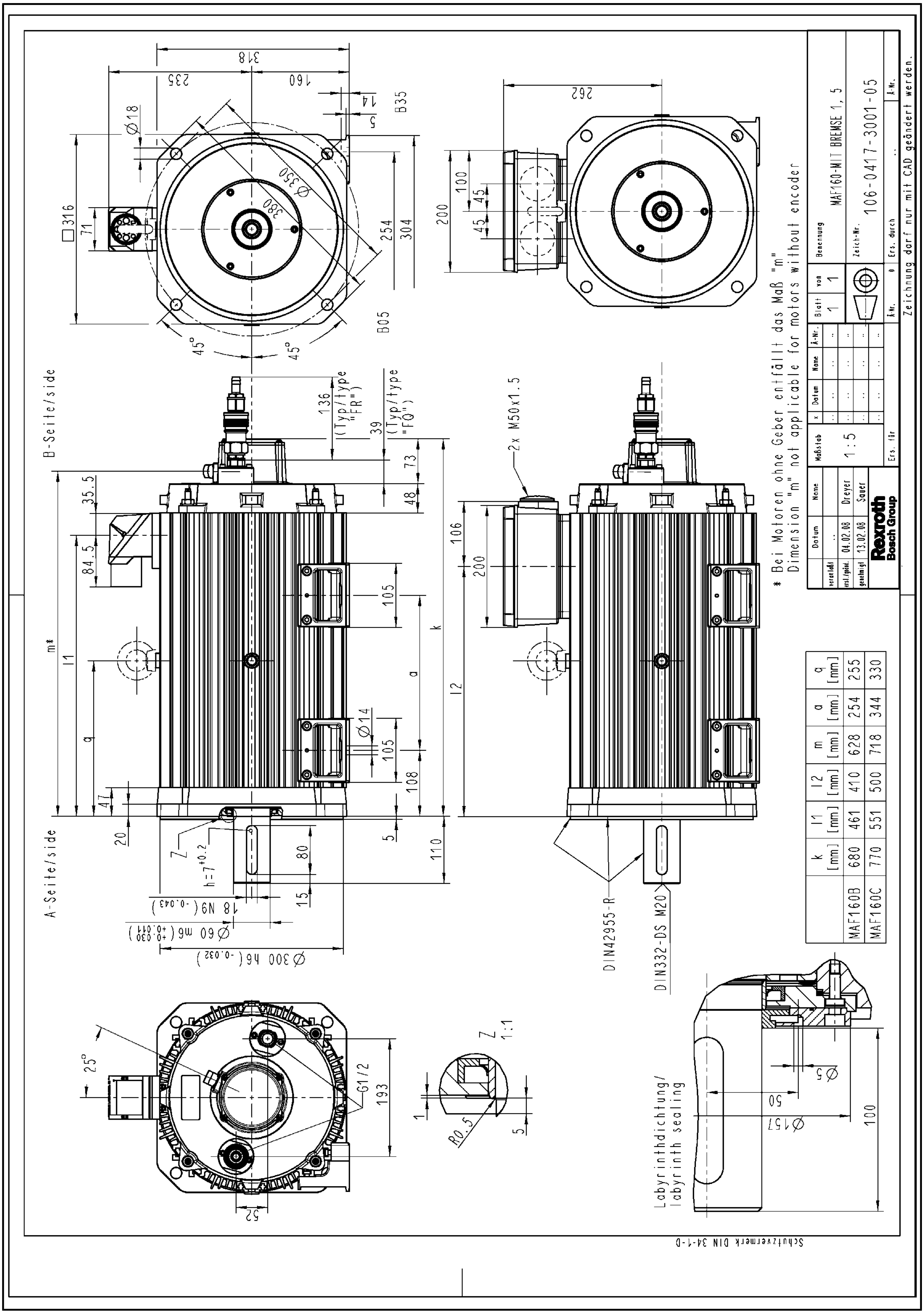



*Fig.5-80: Dimension sheet MAF160 with brake 1 or 5*

## 5.8.5 MAF160 in ATEX Design with Encoder M6 or S6, without Brake (Terminal Box Rotatable)

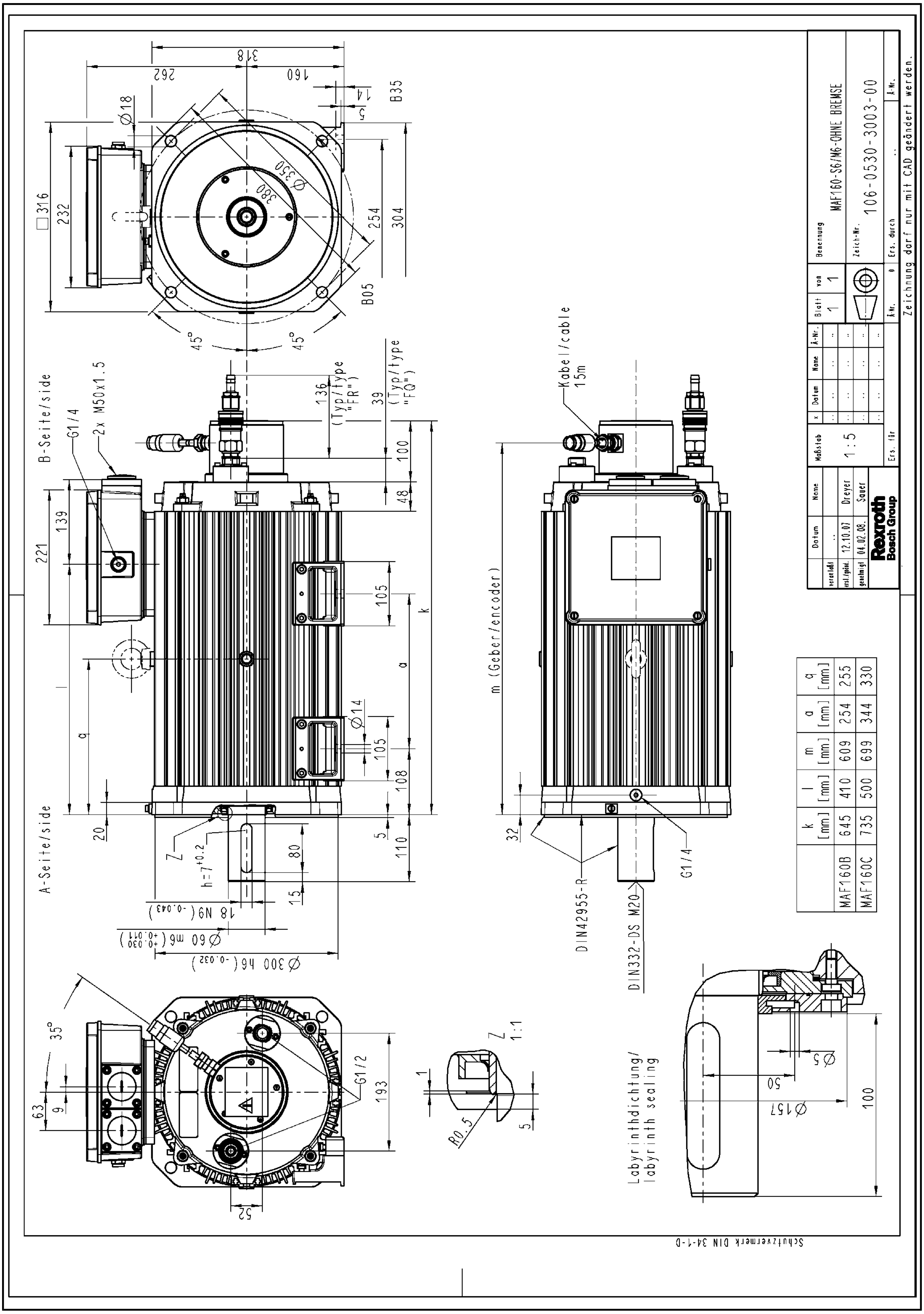
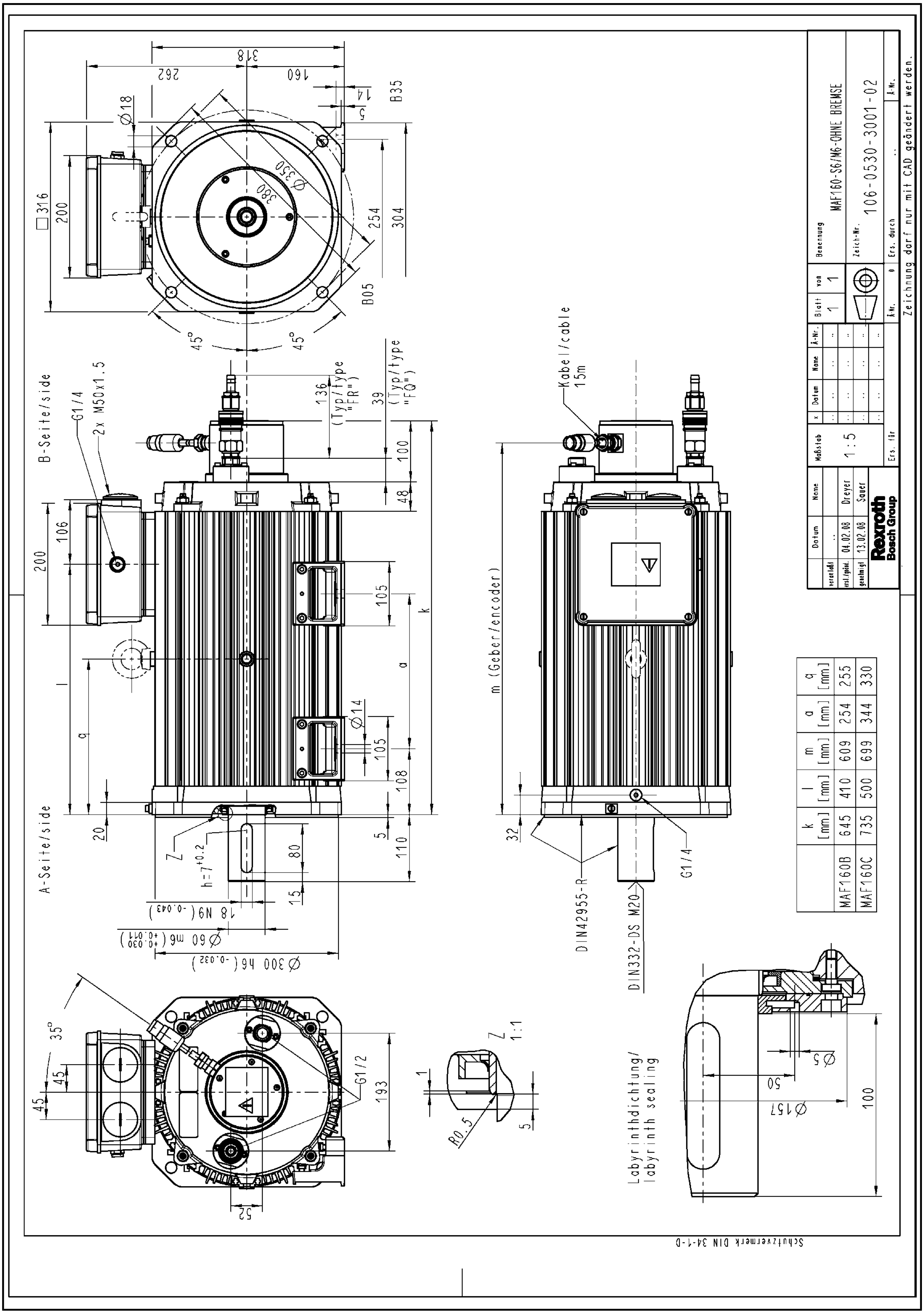



Fig.5-81: MAF160 with encoder M6/S6, without brake (terminal box rotatable)

## 5.8.6 MAF160 in ATEX Design with Encoder M6 or S6, without Brake



| | k [mm] | l [mm] | m [mm] | a [mm] | q [mm] |
|---|---|---|---|---|---|
| MAF160B | 645 | 410 | 609 | 254 | 255 |
| MAF160C | 735 | 500 | 699 | 344 | 330 |

*Fig.5-82: Dimension sheet MAF160 with encoder M6 or S6, without brake*

## 5.8.7 MAF160 in ATEX Design with Encoder M6 or S6, Brake 1 or 5 (Terminal Box Rotatable)

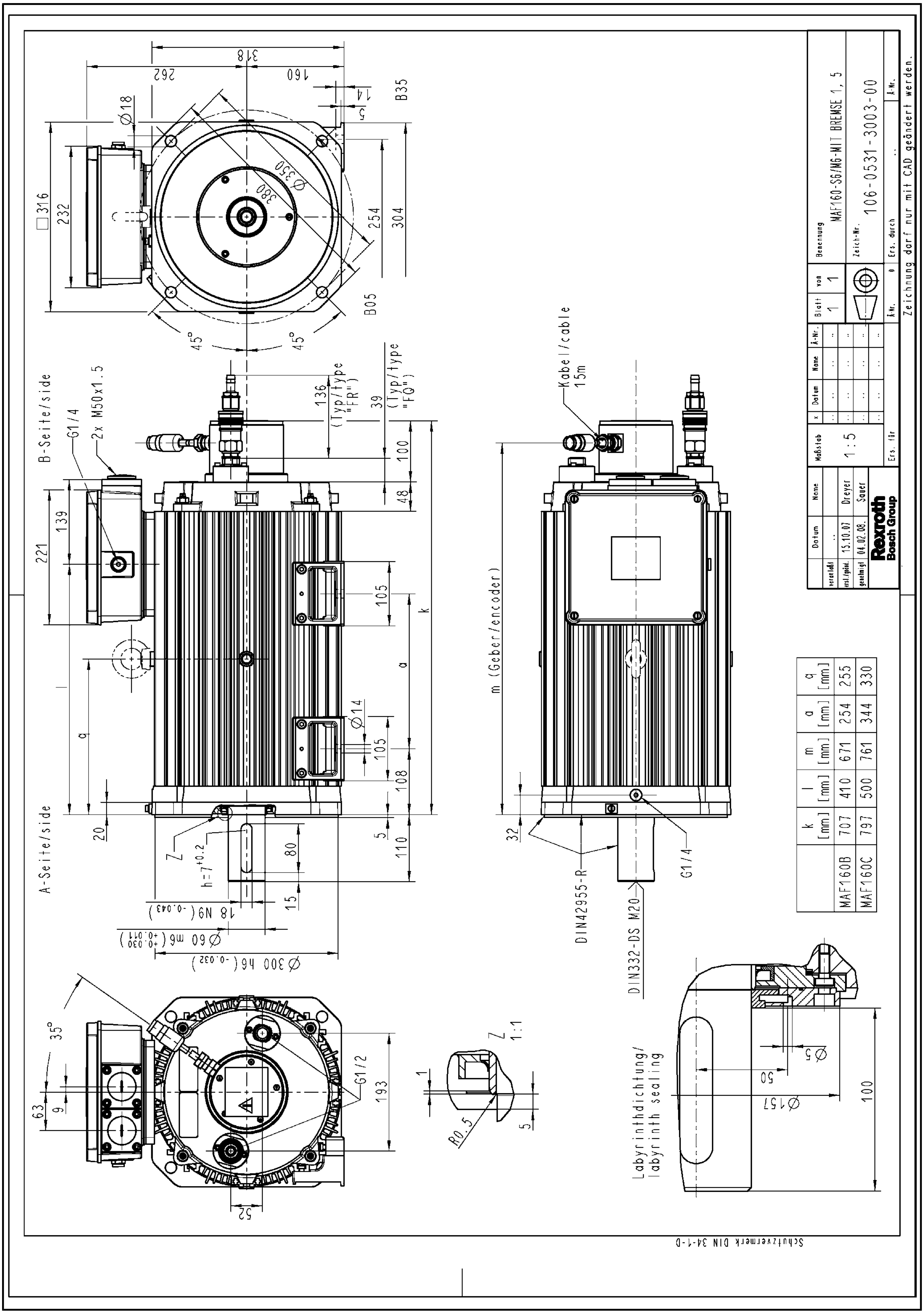



Fig.5-83: MAF160 with encoder M6/S6, brake 1/5 (terminal box rotatable)

Dimension Sheets IndraDyn A

## 5.8.8 MAF160 in ATEX Design with Encoder M6 or S6, Brake 1 or 5

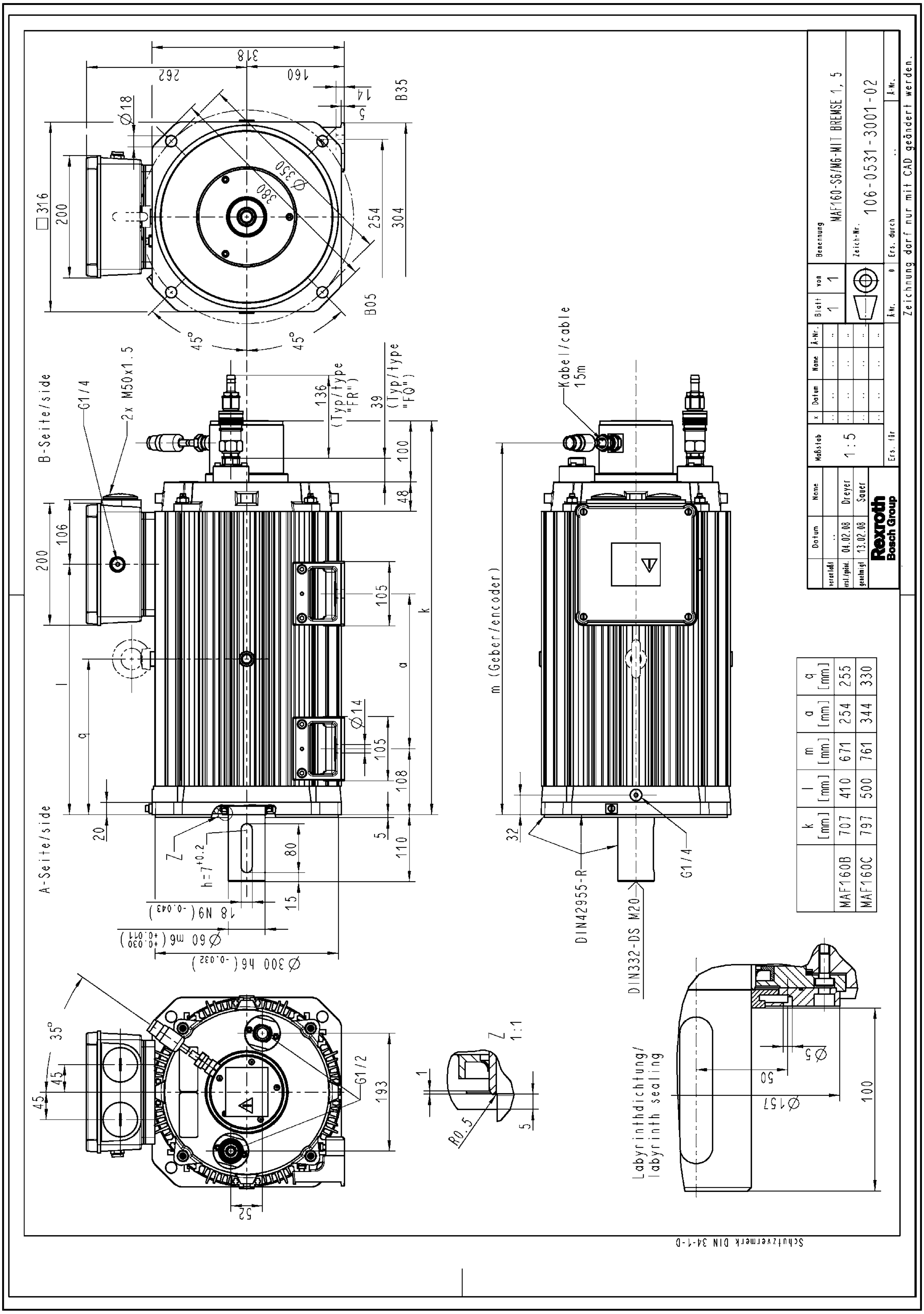



*Fig.5-84: Dimension sheet MAF160 with encoder M6/S6 and brake 1/5*

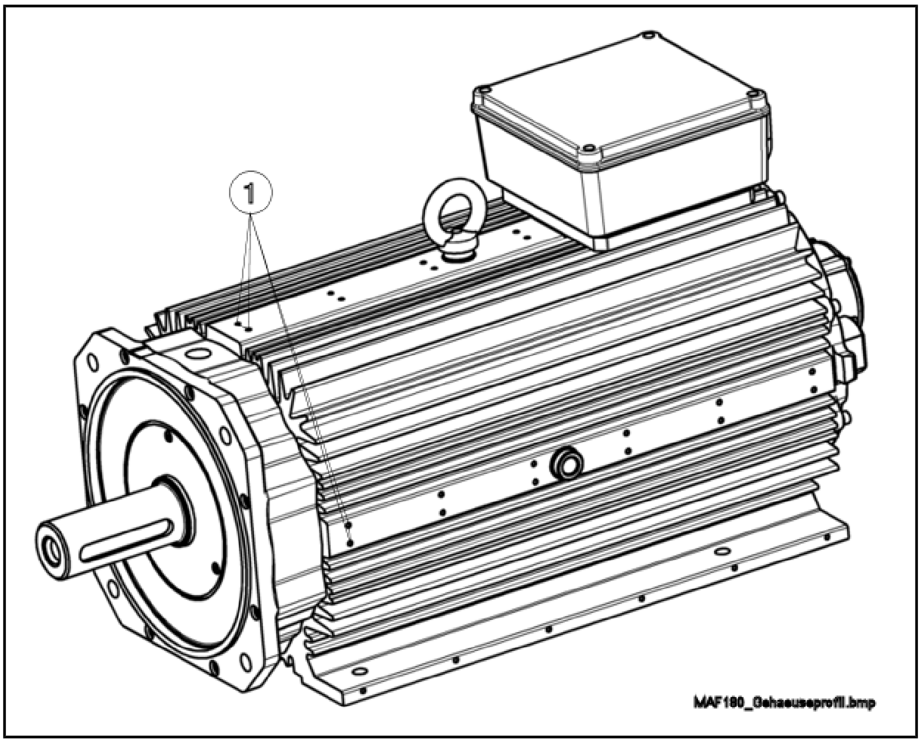
# 5.9 Frame Size MAF180

## 5.9.1 Threaded Holes in the Motor Housing

The MAF180 is equipped with M5 threaded holes along the longitudinal sides on the motor housing. If required, the user may use them further after having mounted the motor.

Therefore, please note the following restrictions:

- The admissible screw-in depth is 10mm at a maximum.
- The maximum admissible tightening torque is 5.5...6Nm (at a screw-in depth of 8-10mm and screws of property class 8.8).

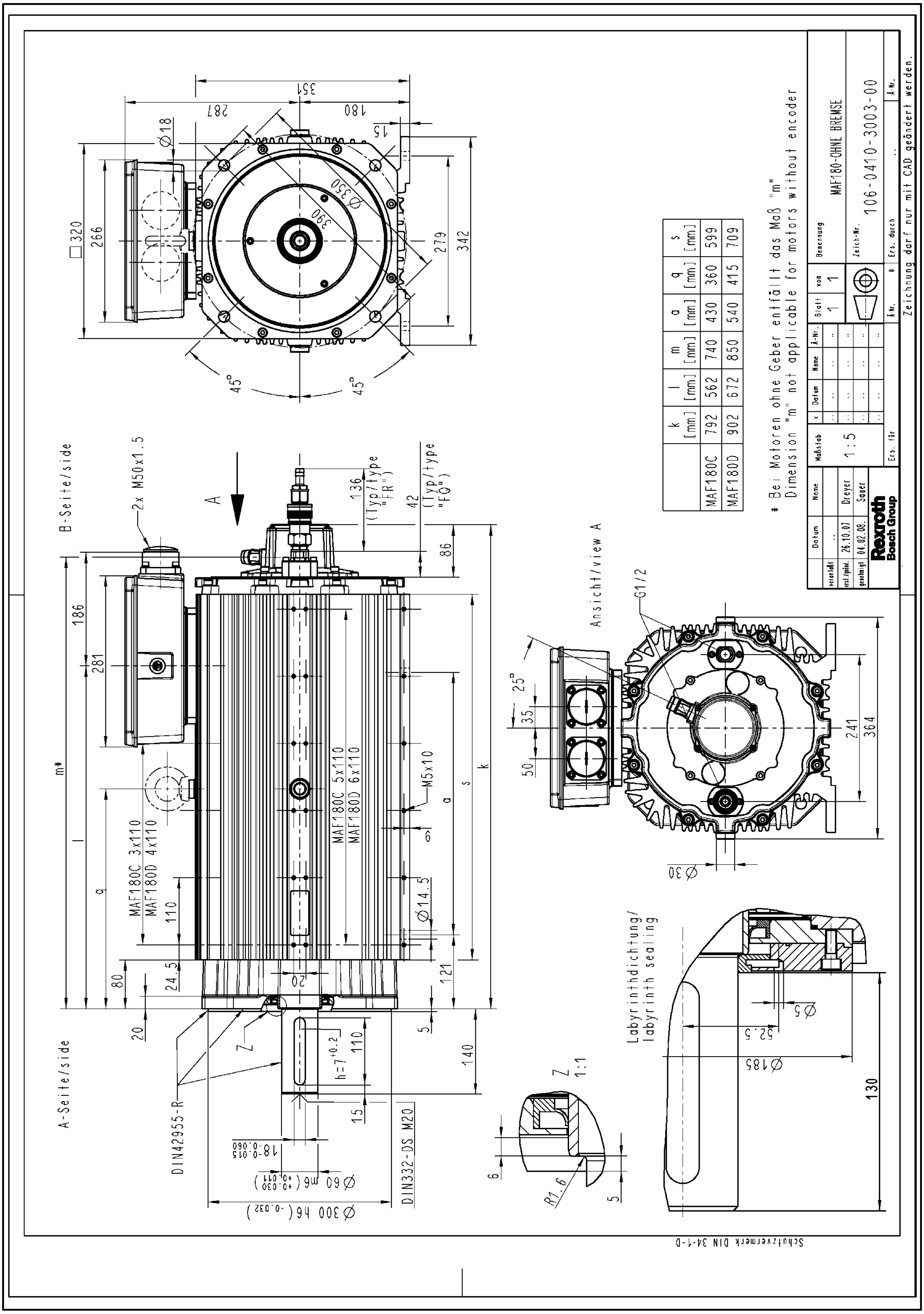



① Threaded holes M5

*Fig.5-85: Threaded holes on the motor housing MAF180*

Dimension Sheets IndraDyn A

## 5.9.2 MAF180 without Brake (Terminal Box Rotatable)



| | k [mm] | l [mm] | m [mm] | a [mm] | q [mm] | s [mm] |
|---|---|---|---|---|---|---|
| MAF180C | 792 | 562 | 740 | 430 | 360 | 599 |
| MAF180D | 902 | 672 | 850 | 540 | 415 | 709 |

* Bei Motoren ohne Geber entfällt das Maß "m"
Dimension "m" not applicable for motors without encoder

*Fig.5-86: MAF180 without brake (terminal box rotatable)*

### 5.9.3 MAF180 without Brake

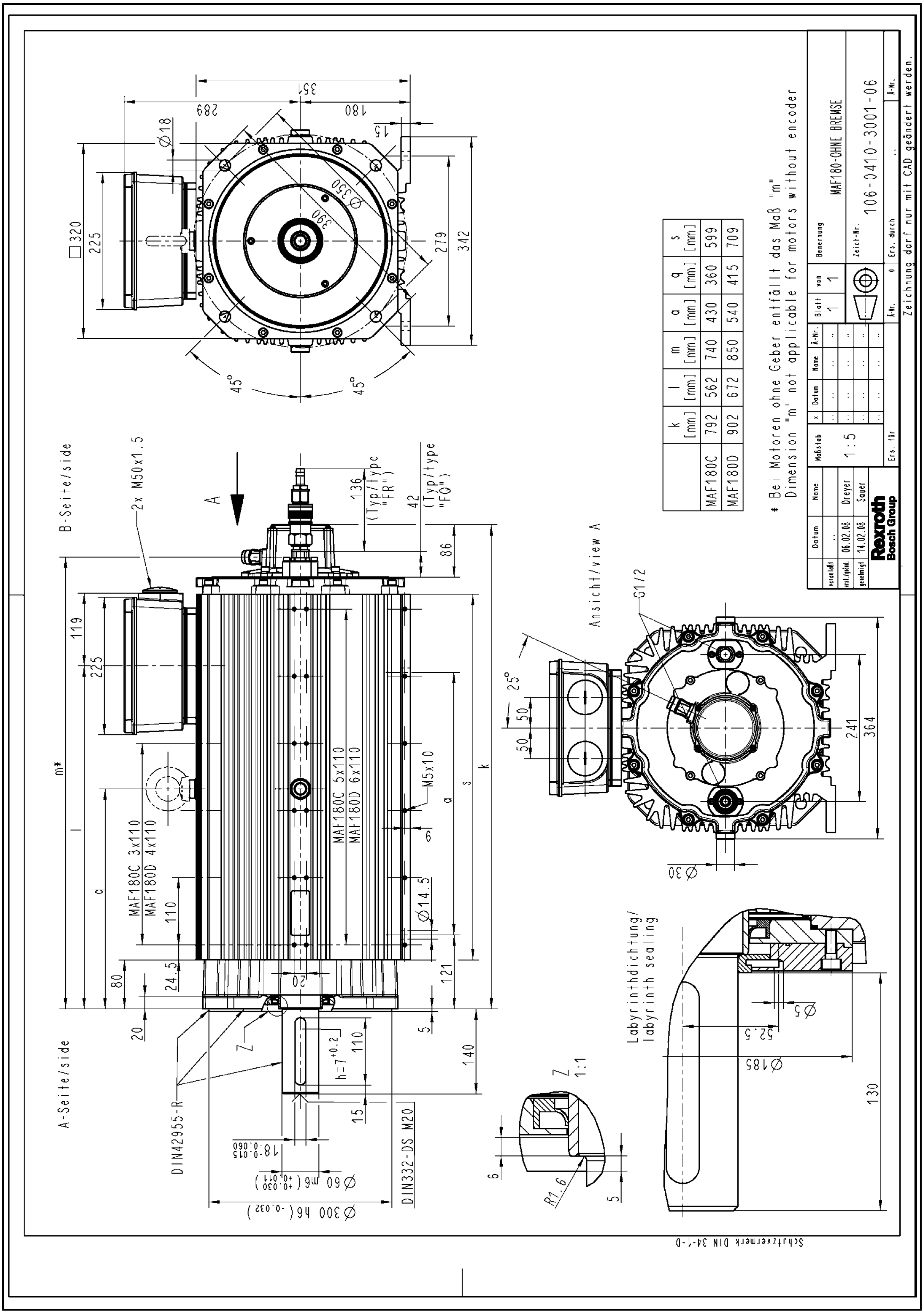



*Fig.5-87: Dimension sheet MAF180 without brake*

## 5.9.4 MAF180 with Brake 2 or 5 (Terminal Box Rotatable)

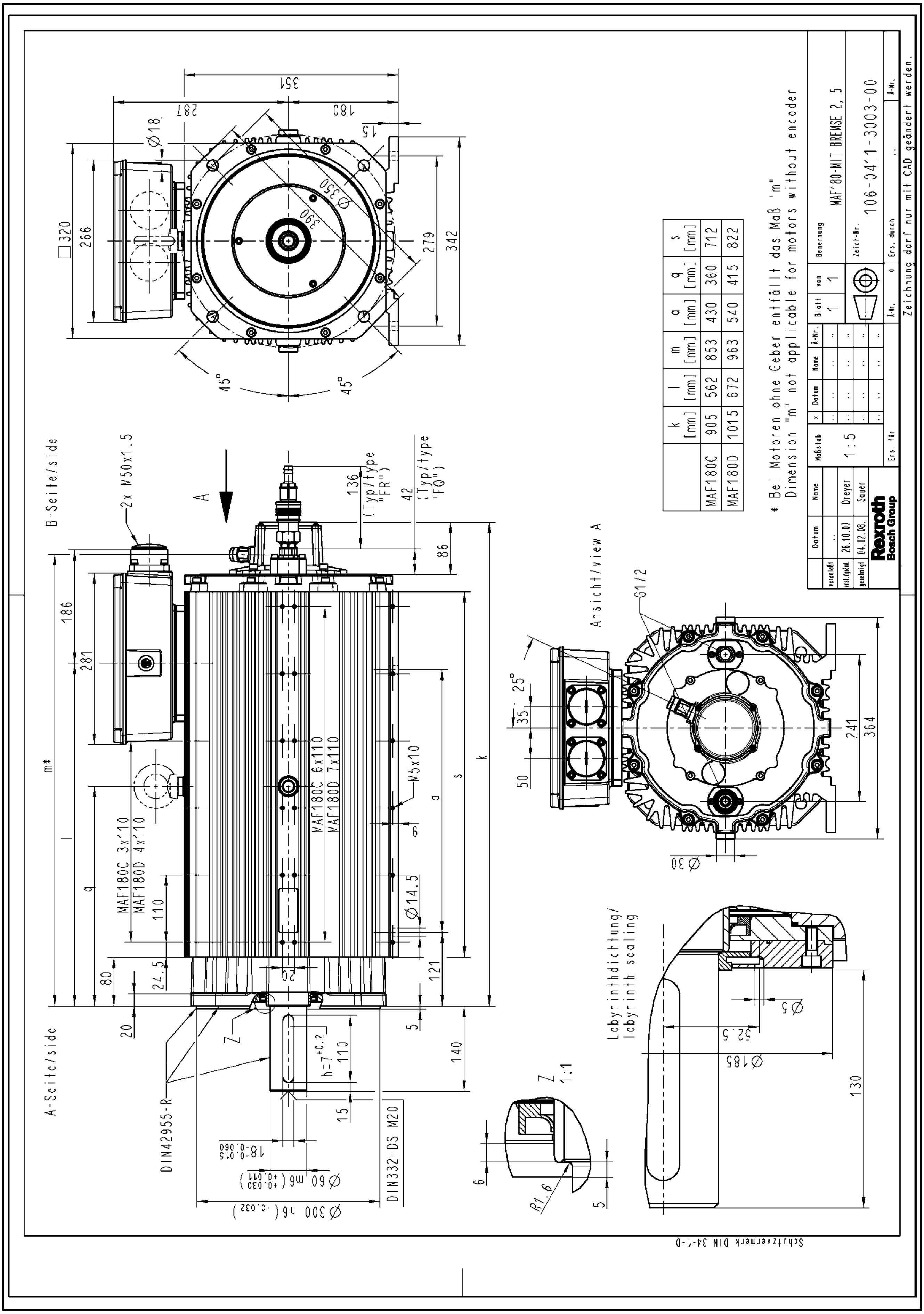



*Fig.5-88: MAF180 with brake 2 or 5 (terminal box rotatable)*

## 5.9.5 MAF180 with Brake 2 or 5

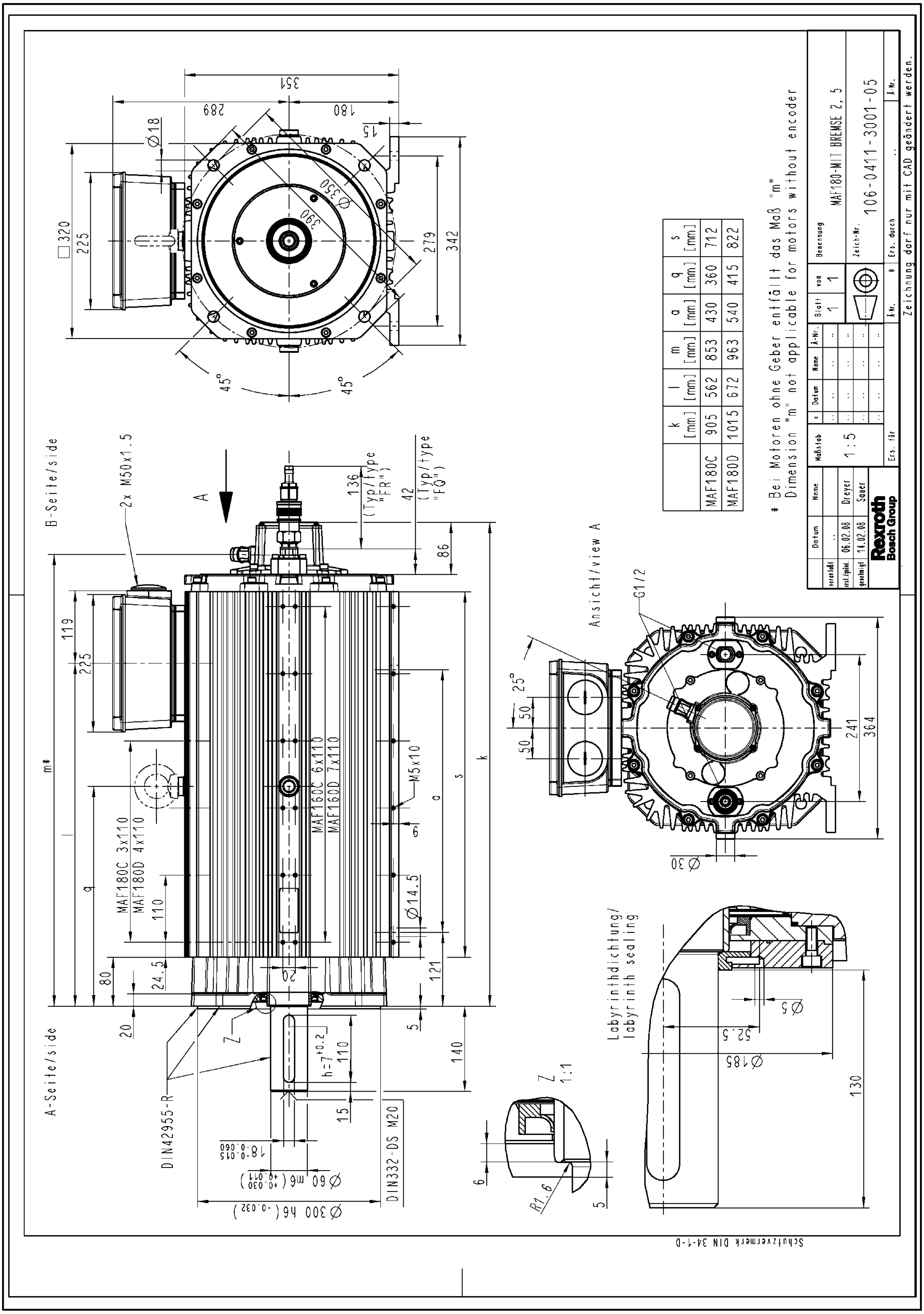



*Fig.5-89: Dimension sheet MAF180 with brake 2 or 5*

Dimension Sheets IndraDyn A

## 5.9.6 MAF180 in ATEX Design with Encoder M6 or S6, without Brake (Terminal Box Rotatable)

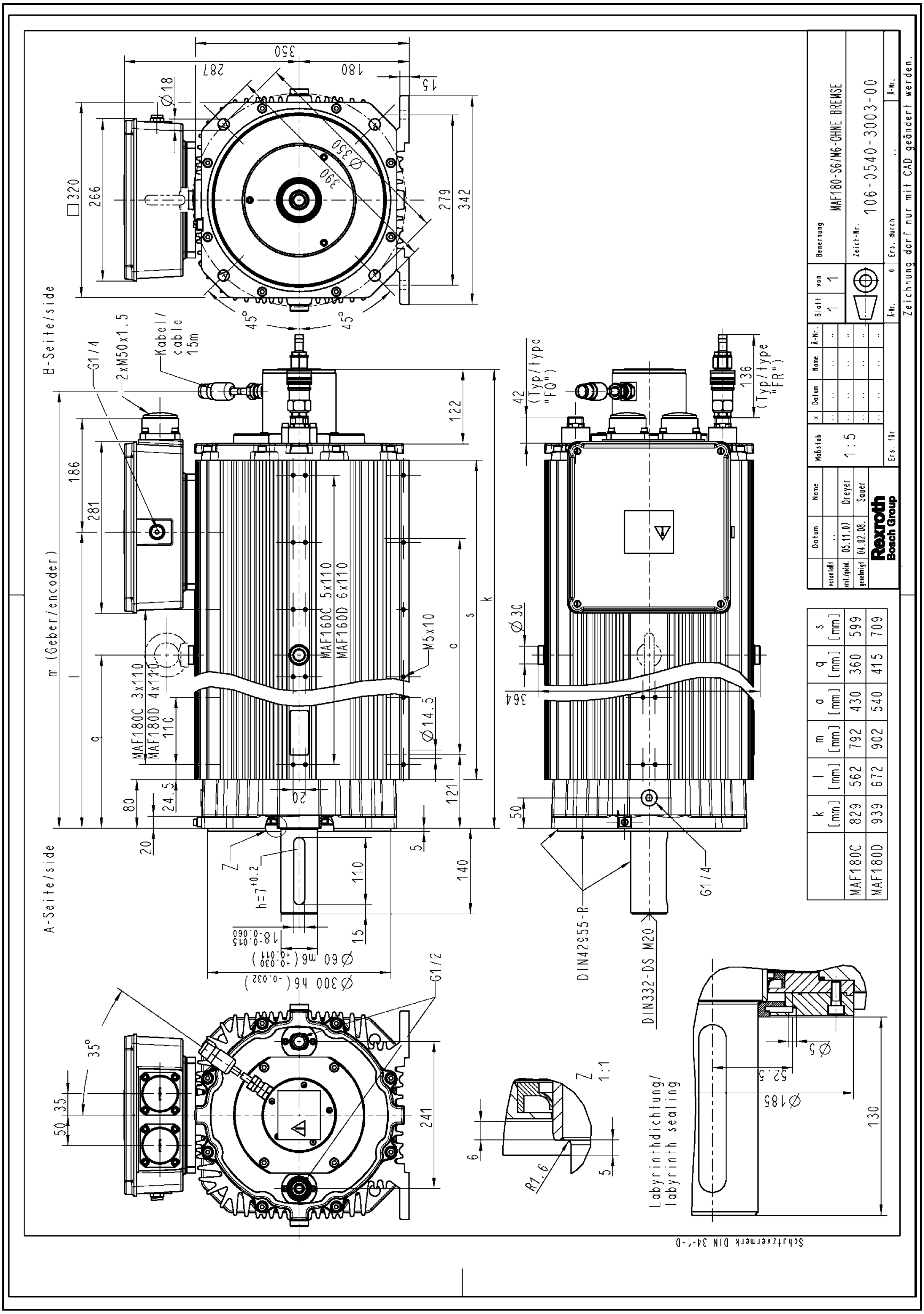



*Fig.5-90: MAF180 with encoder M6/S6, without brake (terminal box rotatable)*

## 5.9.7 MAF180 in ATEX Design with Encoder M6 or S6, without Brake

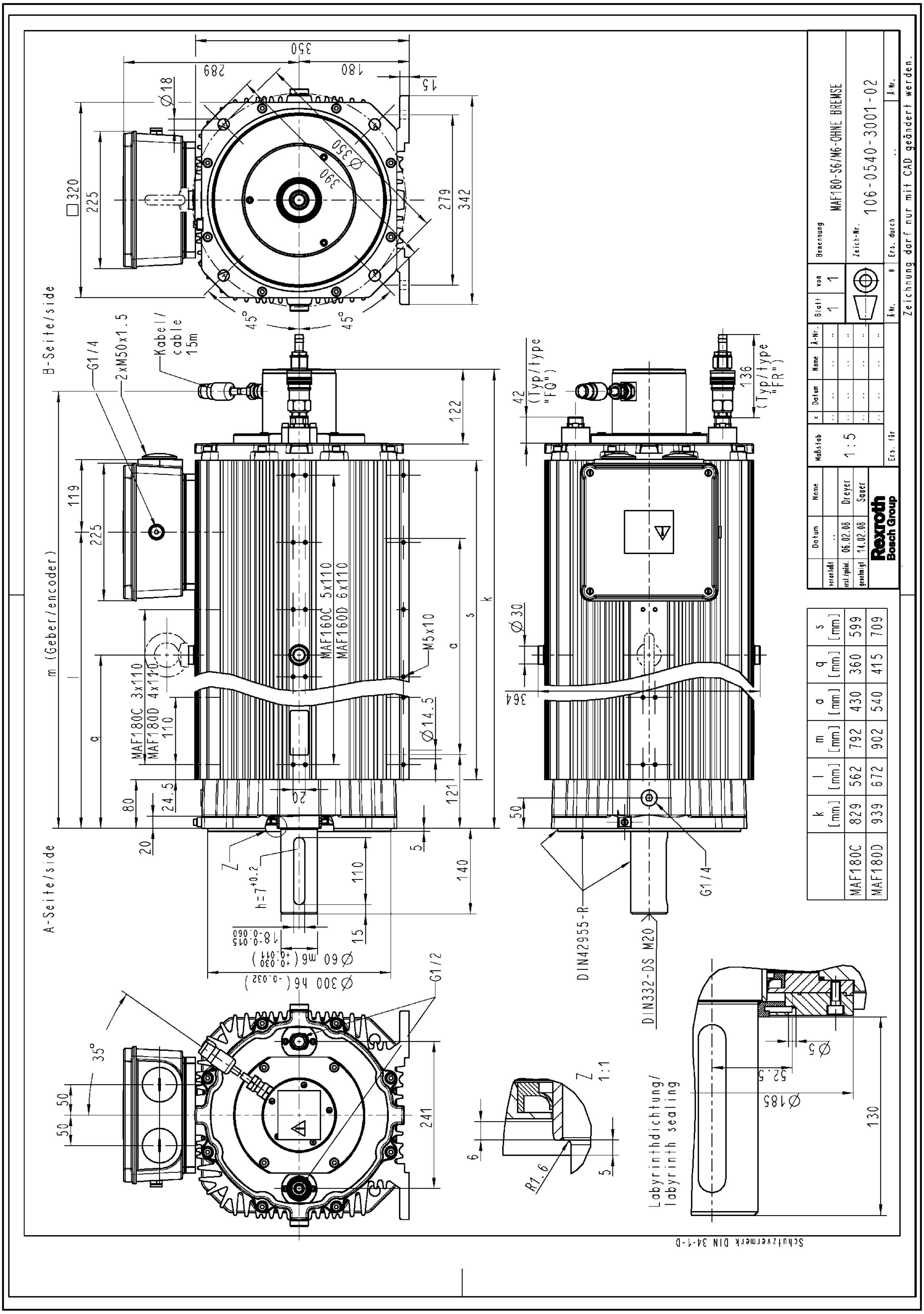


Fig.5-91: Dimension sheet MAF180 with encoder M6 or S6, without brake

Dimension Sheets IndraDyn A

### 5.9.8 MAF180 in ATEX Design with Encoder M6 or S6, Brake 2 or 5 (Terminal Box Rotatable)

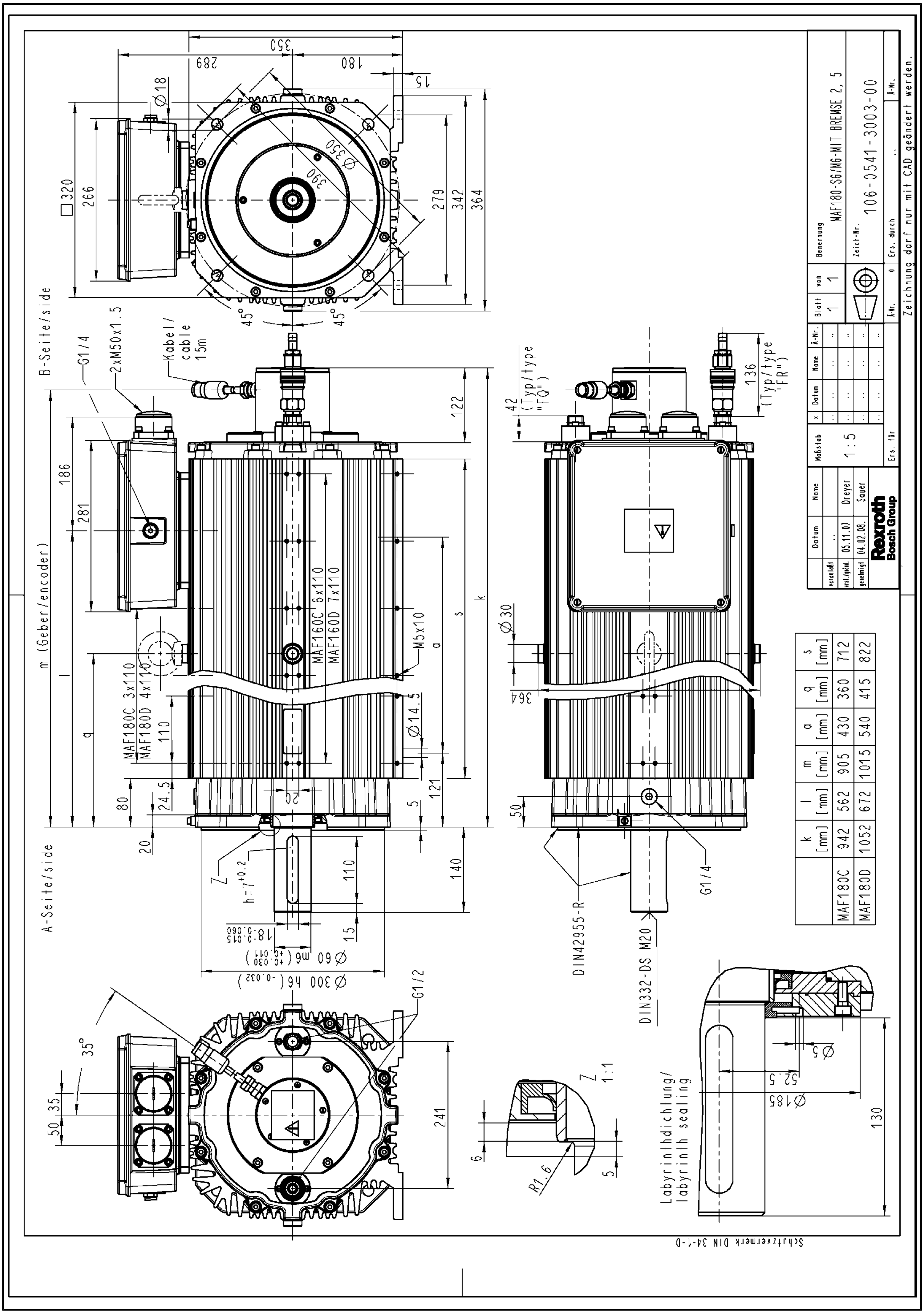



*Fig.5-92: MAF180 with encoder M6/S6, brake 2/5 (terminal box rotatable)*

## 5.9.9 MAF180 in ATEX Design with Encoder M6 or S6, Brake 2 or 5

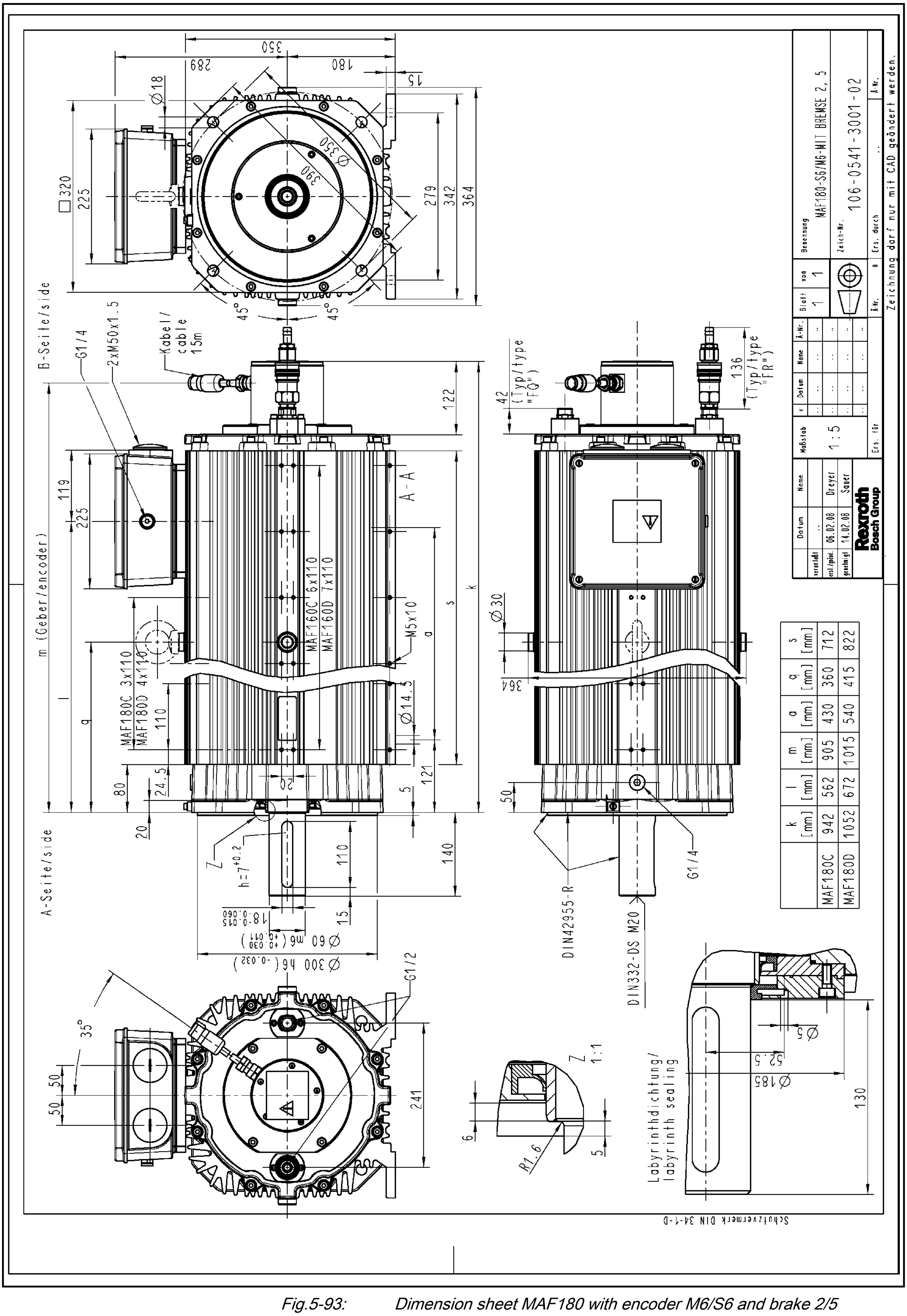
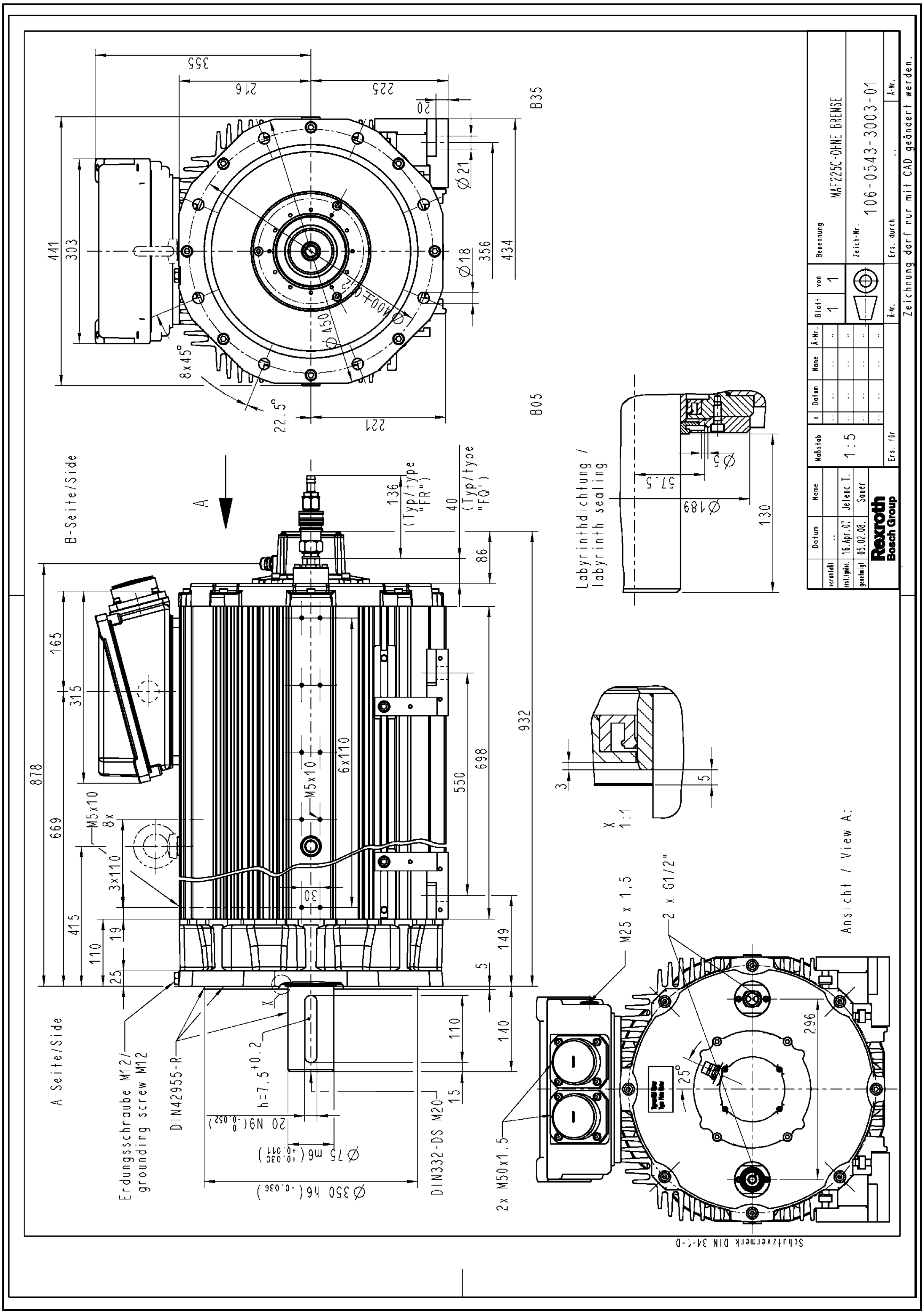



*Fig.5-93: Dimension sheet MAF180 with encoder M6/S6 and brake 2/5*

Dimension Sheets IndraDyn A

# 5.10 Frame Size MAF225

## 5.10.1 MAF225C without Brake (Terminal Box Rotatable)



## 5.10.2 MAD225C without Brake

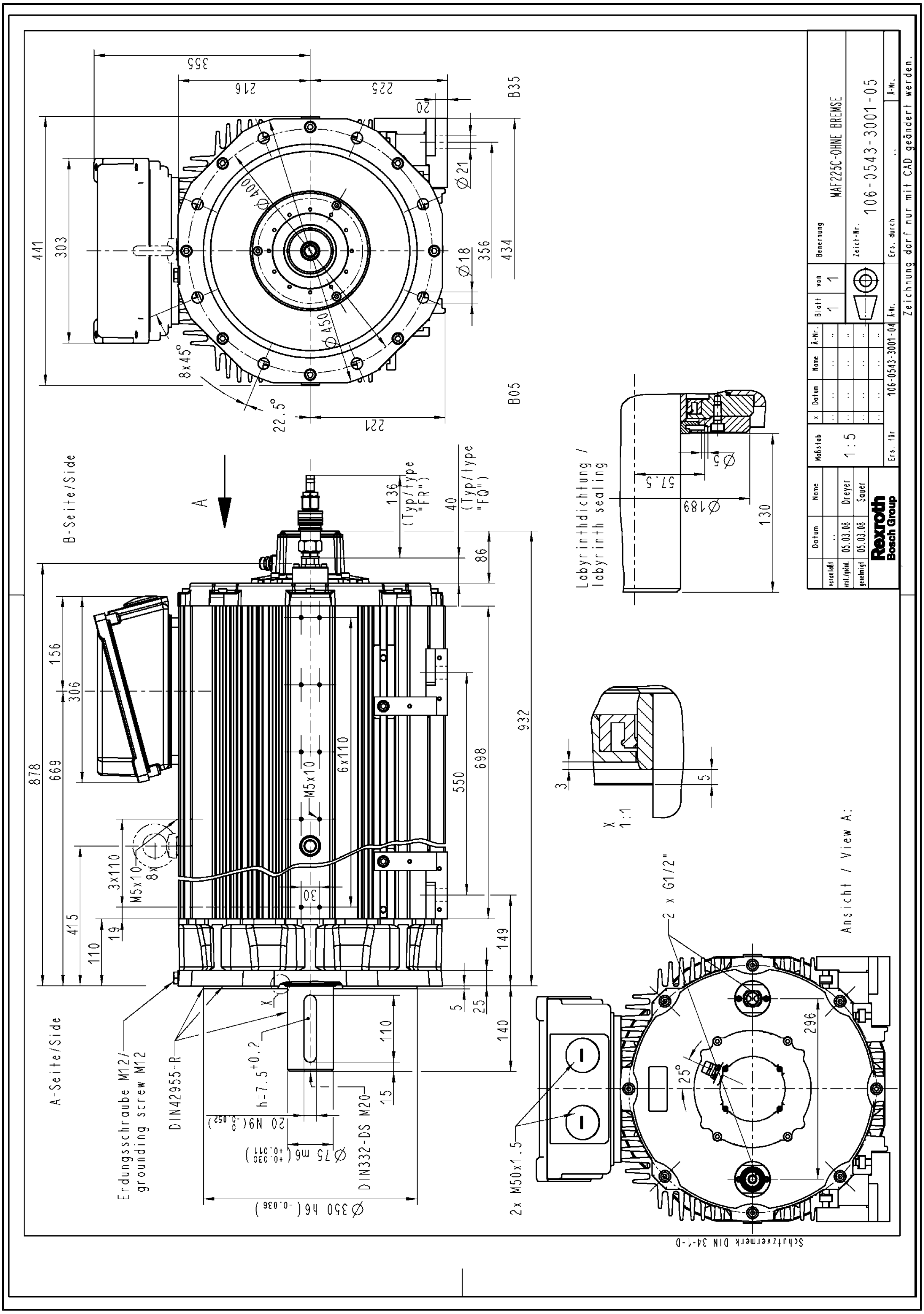


*Fig.5-95: Dimension sheet MAF225 without brake*

Dimension Sheets IndraDyn A

### 5.10.3 MAF225 in ATEX Design with Encoder M6 or S6, without Brake (Terminal Box Rotatable)

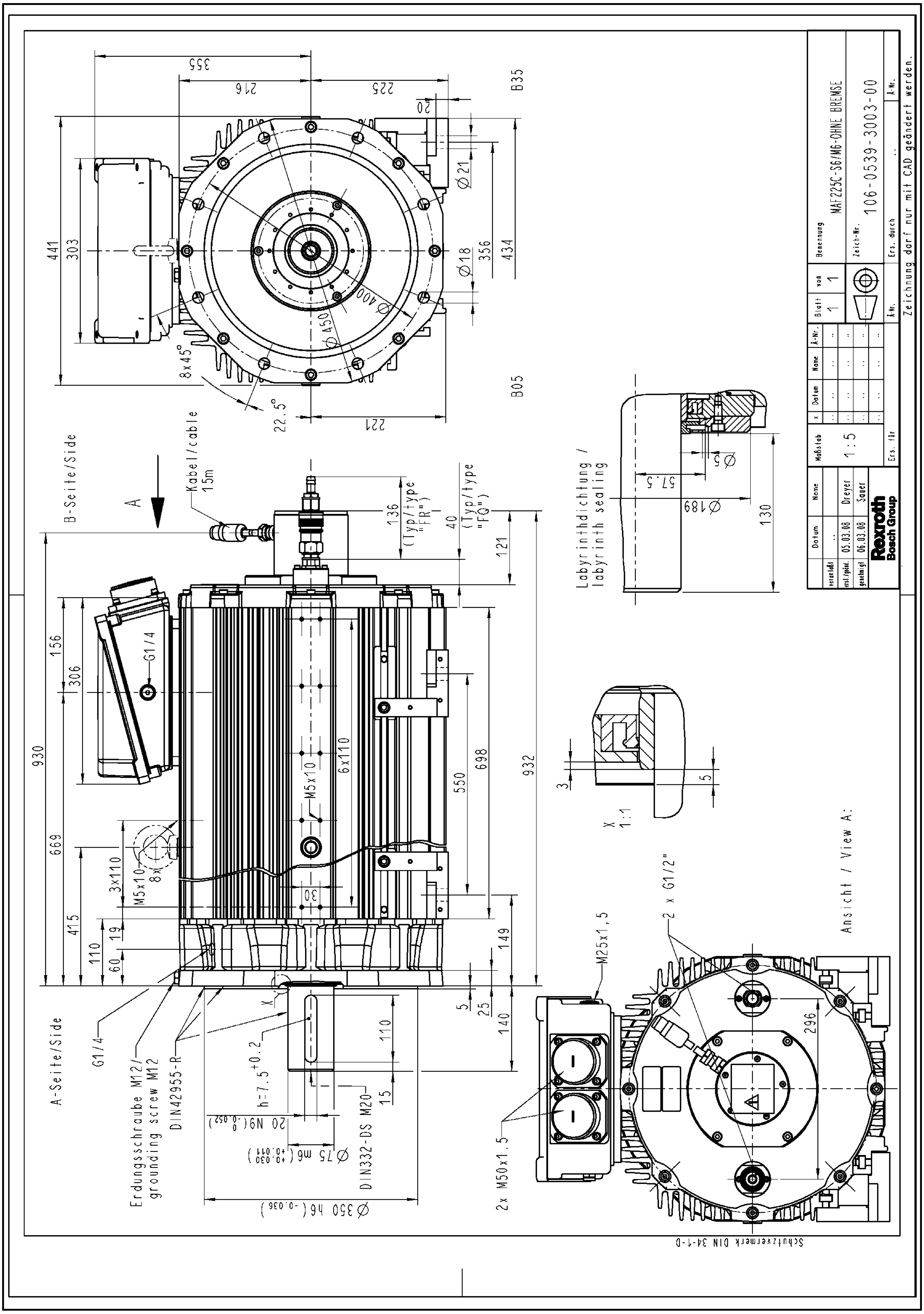


Fig.5-96: MAF225 with encoder M6/S6, without brake (terminal box rotatable)

## 5.10.4 MAF225 in ATEX Design with Encoder M6 or S6, without Brake

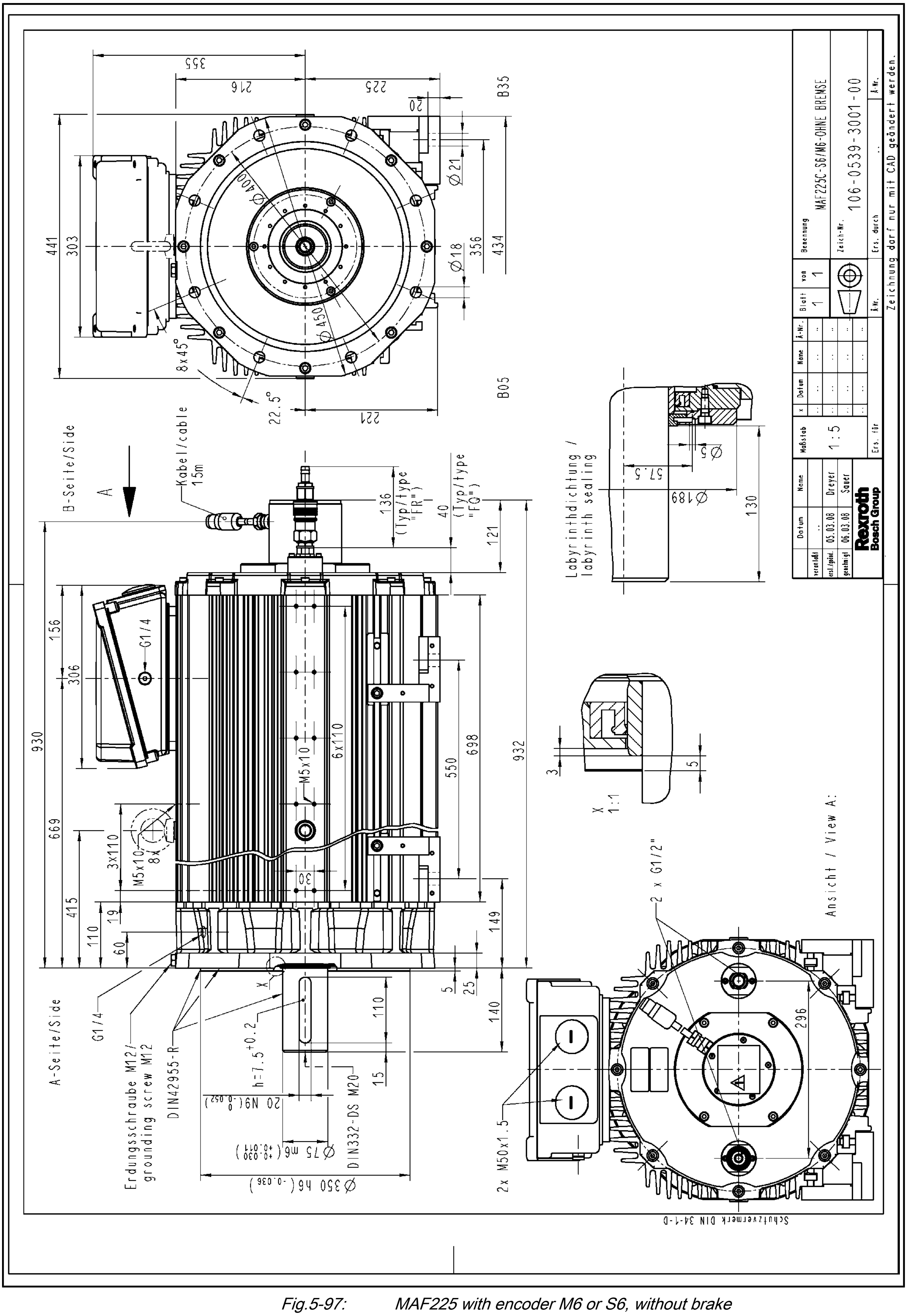


*Fig.5-97: MAF225 with encoder M6 or S6, without brake*

# 6 Type Codes IndraDyn A

## 6.1 Introduction

### 6.1.1 General Information

IndraDyn A is the general product name for all new asynchronous housing motors by REXROTH.

The type code describes the available motor variants; it is the basis for selecting and ordering products from BOSCH REXROTH. This applies to new products as well as to spare parts and repairs.

The following descriptions provide an overview of the separate columns of the type code (”abbrev. column”) and their meaning.

☞ When selecting a product, always consider the detailed specifications in chapter 4 ”Technical Data”, chapter 9 ”Notes regarding Application”, and chapter 13 "Motors for Explosive Areas".

### 6.1.2 Definition

#### 1. Product

**Abbrev. Column 1-2-3**

**MAD** is the description of the series of air-cooled asynchronous housing motors.

**MAF** is the description of the series of liquid-cooled asynchronous housing motors.

#### 2. Motor Frame Size

**Abbrev. Column 4-5-6**

The motor frame size is derived from the dimensions of the flange at the output end and represents different power ranges.

#### 3. Motor Frame Length

**Abbrev. Column 7**

Within a series, the graduation of increasing motor frame length is indicated by ID letters in alphabetic order.

Frame lengths are e.g. **B**, **C** and **E**.

#### 4. Winding Code

**Abbrev. Column 9 -10 -11 -12**

The four-digit sequence of figures identifies the rated speed applicable for the respective type of winding. The last figure is omitted. Example: The winding code 0200 means a rated speed of 2000 $min^{-1}$.

#### 5. Cooling System

**Abbrev. Column 14-15**

**MAD motors** always have to be operated with a fan whose air currents are guided from the fan shroud over the surface of the motor ("surface ventilation").

Operation without ventilation is not permissible.

There are two options for cooling MAD motors.

- Option "**SA**": Cooling using the mounted axial fan. The air current is defined as "blowing" according to the following figure.

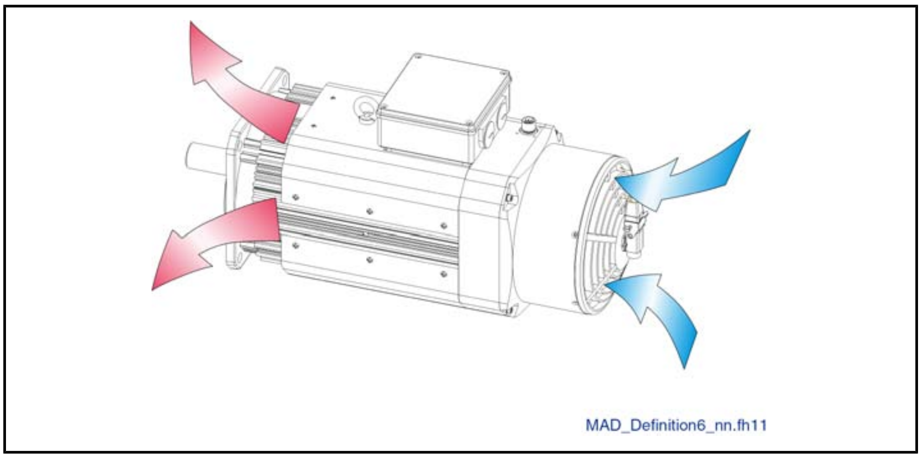



*Fig.6-1: MAD, axial fan blowing*

The fan unit can be removed for maintenance.

- Option "**SL**": For certain applications (e.g. using the motors on strongly contaminated environments), MAD motors may also be operated with an external fan (chapter 9.8 "Motor Cooling " on page 261). To this effect, the motors are equipped with a fan cover and a fan adapter to connect an air hose.

**MAF motors** may only be operated in connection with an external cooling system (not covered by the scope of delivery of Rexroth).

MAF motors are equipped with two possible connections to connect the cooling system:

- Option "**FQ**": Cooling connection using both connecting threads at the motor (dimensions see data plate or dimension sheet)
- Option "**FR**": Cooling connection using supplied quick coupler.

  If you select the quick coupler (option "FR"), this has to be screwed to the cooling connection threads at the motor beforehand. Please, observe the notes in chapter 8.11.2 "Coolant Connection " on page 249.

# 6. Motor Encoder

**Abbrev. Column 17-18** IndraDyn A motors are available with integrated rotary encoders .

| Option | Type | Periods | Signal [1]) | Interface | Supply voltage |
|---|---|---|---|---|---|
| **S2** | Singleturn absolute encoder | 2048 | 1 $V_{ss}$ | EnDat2.1 | 7...12 V |
| **M2** | Multiturn absolute encoder | 2048 | 1 $V_{ss}$ | EnDat2.1 | 7...12 V |
| **S6** | Singleturn absolute encoder for ATEX motors (length of cable set: 15 m) | 2048 | 1 $V_{ss}$ | EnDat2.1 | 7...12 V |
| **M6** | Multiturn absolute encoder for ATEX motors (length of cable set: 15 m) | 2048 | 1 $V_{ss}$ | EnDat2.1 | 7...12 V |
| **C0** | Incremental encoder | 2048 | 1 $V_{ss}$ | - | 5 V |
| **S0** | Singleturn absolute encoder | 512 | 1 $V_{ss}$ | I²C | 7..0.8 V |
| **M0** | Multiturn absolute encoder | 512 | 1 $V_{ss}$ | I²C | 7..0.8 V |
| **N0** | The motor is supplied without a factory-attached encoder unit. The rear of the motor is blocked by a cover. | | | | |
| [1]) All encoder signals are sinusoidal. | | | | | |

*Fig.6-2: IndraDyn A motor encoder*

## 7. Electrical Connection

**Abbrev. Column 20**

The motors of frame size 100..160 can be electrically connected optionally via flange socket or via terminal box. Motors of frame size 180…225 and ATEX version motors can only be connected by means of terminal box.

For more information, see the type code of the motor and chapter 8, "Connection Techniques".

## 8. Output Shaft

**Abbrev. Column 21**

In order to connect the machine elements to be driven to the motor shafts, the following options are available for all IndraDyn A motors:

| Output shaft | | | |
|---|---|---|---|
| | Plain shaft | With keyway | |
| | | Balanced with complete key | Balanced with half key |
| Without shaft sealing ring | **H** | **Q** | **L** |
| With shaft sealing ring | **G** | **P** | **K** |
| With labyrinth seal | **F** | **R** | **---** |

*Fig.6-3: Output shaft options*

Motors with keyway are always delivered with key.

The motor drive shafts of frame sizes 130…225 have threaded centering holes on the end face in "DS" version in accordance with DIN 332, sheet 2.

Please observe the supplementary notes about shaft sealing ring, drive shaft, and labyrinth seal in chapter 9.12 "Output shaft " on page 273.

Type Codes IndraDyn A

## 9. Holding Brake

**Abbrev. Column 22**

Up to frame size 180, IndraDyn A motors are optionally available with integrated holding brake and different holding torques. Depending on the application, an "**electrically-clamped**" or "**electrically-releasing**" holding brake can be selected.

The motor holding brake is not suitable for the protection of personnel or as a service brake! Please read the notes on holding brakes in chapter 9.10 "Holding Brake (Option)" on page 268 and chapter 12.4.5 "Maintenance and Setup of Holding Brakes " on page 313.

## 10. Frame shape

**Abbrev. Column 24-25**

IndraDyn A motors are available in the design **05** (flange mounting) or design **35** (flange and foot installation). The permitted conditions of installation are explained in chapter 9 "Notes Regarding Application".

## 11. Bearing

**Abbrev. Column 27**

The standard bearing (option "**N**") consists of deep-groove ball bearings in all IndraDyn A motors.

The fixed bearing A-side (option "**A**") consists of deep-groove ball bearings like the standard bearing.

The particularity of this bearing variant is that the fixed bearing is attached to the A side as opposed to the other bearing variants.

Thus, bearing variant "A" is suited very well if circumferential radial forces are to be assumed in operation or if more attachment parts are to be connected to the motor shaft using a coupler. As opposed to bearing type "R", there is no length extension (customer side) of the motor shaft caused by thermal conditions and the speed of the motor is unlimited.

Reinforced bearings (option "**V**") can be used to absorb high radial forces. With reinforced bearings, there is an additional cylindrical-roller bearing at the drive side next to the deep-groove ball bearing.

The high speed suspension (option "**H**") allows for higher speeds at a reduced axial and radial load-bearing capacity.

The bearing for the coupler connection (option "**R**") consists of deep-groove ball bearings. This bearing variant has a special bearing position on the A side to be able to absorb increased circumferential radial forces at reduced motor speeds.

Please observe the additional notes on bearing variants in the motor data sheet in chapter 4 "Technical Data" on page 17 and chapter 9.13 "Bearings and Shaft Stress" on page 277.

### 12. Oscillating Quantity Level

**Abbrev. Column 28**

IndraDyn A motors are dynamically balanced in accordance with the requirements of EN 60034-14:2004. Standard oscillating quantity level of the motors is level "**A**". For several motor frame sizes you can also select oscillating quantity level "**B**" or "**C**". You will find further information on the oscillating quantity level of the motor in chapter 9.17 "Oscillating Quantity Level" on page 295.

## 6.2 Type Code MAD100

Abbrev. Column → 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Example: MAD100C-0100-SA-S0-BH0-05-N1

**Product**
MAD ....... = MAD

**Size**
100 .............. = 100

**Length**
Lengths ............ = B, C, D

**Winding**
MAD100B = 0050, 0100, 0150, 0200, 0250
MAD100C = 0050, 0100, 0150, 0200, 0250
MAD100D = 0050, 0100, 0150, 0200, 0250

**Cooling**
Axial fan, blowing ..................... = SA
Fan top with fan cowl .................. = SL

**Encoder**
Singleturn absolute encoder with 512 increments = S0
Singleturn absolute encoder, EnDat2.1, with 2048 increments .......................... = S2
Singleturn absolute encoder, EnDat2.1, with 2048 increments, for potentially explosive atmospheres = S6 1
Multiturn absolute encoder with 512 increments = M0
Multiturn absolute encoder, EndDat2.1, with 2048 increments .......................... = M2
Multiturn absolute encoder, EndDat2.1, with 2048 increments, for potentially explosive atmospheres = M6 1
Incremental encoder with 2048 increments ...... = C0
without motor encoder ...................... = N0

*Fig.6-4: Type code MAD100 (1/2)*

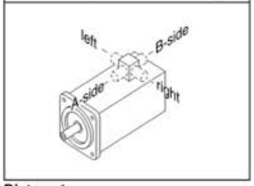
Type Codes IndraDyn A

| Abbrev. | | | | | | | | | 1 | | | | | | | | | | 2 | | | | | | | | | | 3 | | | | | | | | | | 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Column → | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |
| Example: | M | A | D | 1 | 0 | 0 | C | - | 0 | 1 | 0 | 0 | - | S | A | - | S | 0 | - | B | H | 0 | - | 0 | 5 | - | N | 1 | | | | | | | | | | | | |

**Electrical connection see picture 1**

| | Connector | Terminal box | Terminal box, ② turnable |
|---|---|---|---|
| A-Side | A | F | E |
| B-Side | B | K | H |
| Right | R | S | D |
| Left | L | T | G |

Position of power connection – top




Picture 1

**Shaft ③**

| | plain shaft | with key balanced with entire key | balanced with half key |
|---|---|---|---|
| Without shaft sealing ring | H | Q | L |
| With shaft sealing ring | G | P | K |
| With labyrinth seal | F | R | - |

**Holding brake**

Without holding brake . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 0
Electrically-released, 24 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 1
Electrically-clamped, 30 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 5

**Mounting style**

Flange mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 05
Flange and foot mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 35

**Bearing ④**

Fixed bearing A-side . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = A
Standard . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = N
High Speed . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = H
For coupling mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = R

**Vibration severity**

A, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 1
B, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 3
C, specification according to IndraDyn A - documentation . . . . . . . . . . . . . . . . = 4 ⑤

**Note:**

① Ex type for cluster II 2G EEx pd IIB T3 according to DIN EN 60079 ff. Encoder "S6" and "M6" are only available with cooling "SL", not with el. connection "A", "B", "R" and "L" and only with shaft "G", "P" and "K" and bearing "N"
② According to DIN IEC 60204-1 and DIN IEC 60364-5-52
③ Shaft "F" and "R" always available with shaft sealing ring
④ Bearing "A" is only available with holding brake "0" and vibration severity "1"
Bearing "H" is not available with encoder "S6" and "M6" and only with shaft "H" and holding brake "0"
Bearing "R" is only available with vibration severity "1"
⑤ Vibration severity "4" is only available with length "B" and "C" and bearing "N" and "H"

**Standard reference**

| Standard | Edition | Title |
|---|---|---|
| DIN EN 60034-14 | 2004-09 | Rotating electrical machines - Part 14 |
| DIN EN 60079 ff | - | Electrical apparatus for explosive gas atmospheres (ATEX) |
| DIN IEC 60204-1 | 2002-09 | Safety of machinery - Electrical equipment of machines - Part 1 |
| DIN IEC 60364-5-52 | 2004-07 | Erection of low voltage installation - Part 5 |

*Fig.6-5: Type code MAD100 (2/2)*

## 6.3 Type Code MAD130

Abbrev. Column → 1 … 40

Example: MAD130B-0150-SA-S0-AG0-05-N1

**Product**
MAD ....... = MAD

**Size**
130 .............. = 130

**Length**
Lengths ............ = B, C, D

**Winding**
MAD130B = 0050, 0100, 0150, 0200, 0250
MAD130C = 0050, 0100, 0150, 0200, 0250
MAD130D = 0050, 0100, 0150, 0200, 0250

**Cooling**
Axial fan, blowing ..................... = SA
Fan top with fan cowl .................. = SL

**Encoder**
Singleturn absolute encoder with 512 increments = S0
Singleturn absolute encoder, EnDat2.1, with 2048 increments .......................... = S2
Singleturn absolute encoder, EnDat2.1, with 2048 increments, for potentially explosive atmospheres = S6 (1)
Multiturn absolute encoder with 512 increments = M0
Multiturn absolute encoder, EndDat2.1, with 2048 increments .......................... = M2
Multiturn absolute encoder, EndDat2.1, with 2048 increments, for potentially explosive atmospheres = M6 (1)
Incremental encoder with 2048 increments ...... = C0
Without motor encoder ..................... = N0

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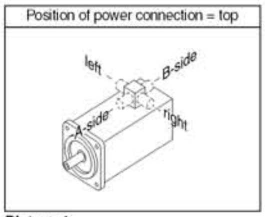
*Fig.6-6: Type code MAD130 (1/2)*

Type Codes IndraDyn A

| Abbrev. Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 20 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 30 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | D | 1 | 3 | 0 | B | - | 0 | 1 | 5 | 0 | - | S | A | - | S | 0 | - | A | G | 0 | - | 0 | 5 | - | N | 1 | | | | | | | | | | | | |

**Electrical connection see picture 1**

| | Connector | Terminal box | Terminal box, ② turnable |
|---|---|---|---|
| A-Side | A | F | E |
| B-Side | B | K | H |
| Right | R | S | D |
| Left | L | T | G |



Picture 1

**Shaft ③**

| | plain shaft | with key: balanced with entire key | with key: balanced with half key |
|---|---|---|---|
| Without shaft sealing ring | H | Q | L |
| With shaft sealing ring | G | P | K |
| With labyrinth seal | F | R | - |

**Holding brake**

Without holding brake ................................ = 0
Electrically-released, 80 Nm .......................... = 1
Electrically-clamped, 100 Nm .......................... = 5

**Mounting style**

Flange mounting ........................................ = 05
Flange and foot mounting ................................ = 35

**Bearing ④**

Fixed bearing A-side ...................................... = A
Standard ................................................ = N
High Speed .............................................. = H
For coupling mounting ..................................... = R
Reinforced bearing ....................................... = V

**Vibration severity**

A, according to DIN EN 60034-14 ................................ = 1
B, according to DIN EN 60034-14 ................................ = 3
C, specification according to IndraDyn A - documentation ............... = 4 ⑤

**Note:**

① Ex type for cluster II 2G EEx pd IIB T3 according to DIN EN 60079 ff. Encoder "S6" and "M6" are only available with cooling "SL", not with el. connection "A", "B", "R" and "L" and only with shaft "G", "P" and "K" and bearing "N" and "V"
② According to DIN IEC 60204-1 and DIN IEC 60364-5-52
Electrical connection "E" is only available with length "D"
③ Shaft "F" and "R" always available with shaft sealing ring
④ Bearing "A" is only available with holding brake "0" and vibration severity "1"
Bearing "H" is not available with encoder "S6" and "M6" and only with shaft "H" and holding brake "0"
Bearing "R" is only available with vibration severity "1"
⑤ Vibration severity "4" is only available with length "B" and "C" and bearing "N" and "H"

**Standard reference**

| Standard | Edition | Title |
|---|---|---|
| DIN EN 60034-14 | 2004-09 | Rotating electrical machines - Part 14 |
| DIN EN 60079 ff | - | Electrical apparatus for explosive gas atmospheres (ATEX) |
| DIN IEC 60204-1 | 2002-09 | Safety of machinery - Electrical equipment of machines - Part 1 |
| DIN IEC 60364-5-52 | 2004-07 | Erection of low voltage installation - Part 5 |

*Fig.6-7: Type code MAD130 (2/2)*

## 6.4 Type Code MAD160

| Abbrev. Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 20 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 30 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | D | 1 | 6 | 0 | B | - | 0 | 0 | 5 | 0 | - | S | A | - | C | 0 | - | A | H | 0 | - | 0 | 5 | - | N | 1 | | | | | | | | | | | | |

**Product**
MAD ....... = MAD

**Size**
160 .............. = 160

**Length**
Lengths.............. = B, C

**Winding**
MAD160B ... = 0050, 0100, 0150, 0200
MAD160C ... = 0050, 0100, 0150, 0200

**Cooling**
Axial fan, blowing ...................... = SA
Fan top with fan cowl .................. = SL

**Encoder**
Singleturn absolute encoder with 512 increments = S0
Singleturn absolute encoder, EnDat2.1, with
2048 increments ........................... = S2
Singleturn absolute encoder, EnDat2.1, with
2048 increments, for potentially explosive atmospheres = S6 ①
Multiturn absolute encoder with 512 increments = M0
Multiturn absolute encoder, EndDat2.1, with
2048 increments ........................... = M2
Multiturn absolute encoder, EndDat2.1, with
2048 increments, for potentially explosive atmospheres = M6 ①
Incremental encoder with 2048 increments ...... = C0
Without motor encoder ...................... = N0

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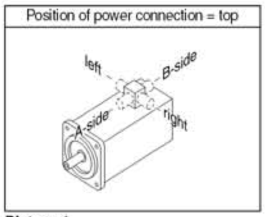
*Fig.6-8: Type code MAD160 (1/2)*

Type Codes IndraDyn A

| Abbrev. Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | D | 1 | 6 | 0 | B | - | 0 | 0 | 5 | 0 | - | S | A | - | C | 0 | - | A | H | 0 | - | 0 | 5 | - | N | 1 | | | | | | | | | | | | |

**Electrical connection see picture 1**

| | Connector | Terminal box | Terminal box, ② turnable |
|---|---|---|---|
| A-Side | A | F | E |
| B-Side | B | K | H |
| Right | R | S | D |
| Left | L | T | G |




Picture 1

**Shaft** ③

| | plain shaft | with key: balanced with entire key | with key: balanced with half key |
|---|---|---|---|
| Without shaft sealing ring | H | Q | L |
| With shaft sealing ring | G | P | K |
| With labyrinth seal | F | R | - |

**Holding brake**

Without holding brake . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 0
Electrically-released, 100 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . = 1
Electrically-released, 240 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . = 3
Electrically-clamped, 100 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . = 5

**Mounting style**

Flange mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 05
Flange and foot mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 35

**Bearing** ④

Fixed bearing A-side . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = A
Standard . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = N
High Speed . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = H
For coupling mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = R
Reinforced bearing . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = V

**Vibration severity**

A, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 1
B, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 3
C, specification according to IndraDyn A - documentation . . . . . . . . . . . . . . . . = 4 ⑤

**Note:**

① Ex type for cluster II 2G EEx pd IIB T3 according to DIN EN 60079 ff. Encoder "S6" and "M6" are only available with cooling "SL", not with el. connection "A", "B", "R" and "L" and only with shaft "G", "P" and "K" and bearing "N" and "V"
② According to DIN IEC 60204-1 and DIN IEC 60364-5-52
③ Shaft "F" and "R" always available with shaft sealing ring
④ Bearing "A" is only available with holding brake "0" and vibration severity "1"
Bearing "H" is not available with encoder "S6" and "M6" and only with shaft "H" and holding brake "0"
Bearing "R" is only available with vibration severity "1"
⑤ Vibration severity "4" is only available bearing "N"

**Standard reference**

| **Standard** | **Edition** | **Title** |
|---|---|---|
| DIN EN 60034-14 | 2004-09 | Rotating electrical machines - Part 14 |
| DIN EN 60079 ff | - | Electrical apparatus for explosive gas atmospheres (ATEX) |
| DIN IEC 60204-1 | 2002-09 | Safety of machinery - Electrical equipment of machines - Part 1 |
| DIN IEC 60364-5-52 | 2004-07 | Erection of low voltage installation - Part 5 |

*Fig.6-9: Type code MAD160 (2/2)*

# 6.5 Type Code MAD180

| Abbrev. Column → | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 20 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 30 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | D | 1 | 8 | 0 | C | - | 0 | 0 | 5 | 0 | - | S | A | - | C | 0 | - | K | H | 0 | - | 3 | 5 | - | N | 1 | | | | | | | | | | | | |

**Product**
MAD ....... = MAD

**Size**
180 .............. = 180

**Length**
Lengths.............. = C, D

**Winding**
MAD180C ... = 0050, 0100, 0150, 0200
MAD180D ... = 0050, 0100, 0150, 0200

**Cooling**
Axial fan, blowing ..................... = SA
Fan top with fan cowl .................. = SL

**Encoder**
Singleturn absolute encoder with 512 increments = S0
Singleturn absolute encoder, EnDat2.1, with 2048 increments .......................... = S2
Singleturn absolute encoder, EnDat2.1, with 2048 increments, for potentially explosive atmospheres = S6 1
Multiturn absolute encoder with 512 increments = M0
Multiturn absolute encoder, EndDat2.1, with 2048 increments .......................... = M2
Multiturn absolute encoder, EndDat2.1, with 2048 increments, for potentially explosive atmospheres = M6 1
Incremental encoder with 2048 increments ...... = C0
Without motor encoder ...................... = N0

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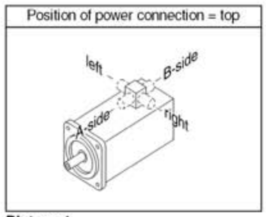
*Fig.6-10: Type code MAD180 (1/2)*

Type Codes IndraDyn A

| Abbrev. Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | D | 1 | 8 | 0 | C | - | 0 | 0 | 5 | 0 | - | S | A | - | C | 0 | - | K | H | 0 | - | 3 | 5 | - | N | 1 | | | | | | | | | | | | |

**Electrical connection see picture 1**

| | Terminal box | Terminal box, turnable ② |
|---|---|---|
| A-Side | F | E |
| B-Side | K | H |
| Right | S | D |
| Left | T | G |




Picture 1

**Shaft ③**

| | plain shaft | with key balanced with entire key | with key balanced with half key |
|---|---|---|---|
| Without shaft sealing ring | H | Q | L |
| With shaft sealing ring | G | P | K |
| With labyrinth seal | F | R | - |

**Holding brake**

Without holding brake . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 0
Electrically-released, 240 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . = 2
Electrically-clamped, 300 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . = 5

**Mounting style**

Flange and foot mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 35

**Bearing ④**

Fixed bearing A-side . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = A
Standard . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = N
For coupling mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = R
Reinforced bearing . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = V

**Vibration severity**

A, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 1
B, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 3
C, specification according to IndraDyn A - documentation . . . . . . . . . . . . . . . = 4 ⑤

**Note:**

① Ex type for cluster II 2G EEx pd IIB T3 according to DIN EN 60079 ff. Encoder "S6" and "M6" are only available with cooling "SL" shaft "G", "P" and "K" and bearings "N" and "V"
② According to DIN IEC 60204-1 and DIN IEC 60364-5-52
③ Shaft "F" and "R" always available with shaft sealing ring
④ Bearing "A" is only available with holding brake "0" and vibration severity "1"
Bearing "R" is only available with vibration severity "1"
⑤ Vibration severity "4" is only available with length "C" and bearing "N"

**Standard reference**

| Standard | Edition | Title |
|---|---|---|
| DIN EN 60034-14 | 2004-09 | Rotating electrical machines - Part 14 |
| DIN EN 60079 ff | - | Electrical apparatus for explosive gas atmospheres (ATEX) |
| DIN IEC 60204-1 | 2002-09 | Safety of machinery - Electrical equipment of machines - Part 1 |
| DIN IEC 60364-5-52 | 2004-07 | Erection of low voltage installation - Part 5 |

*Fig.6-11: Type code MAD180 (2/2)*

## 6.6 Type Code MAD225

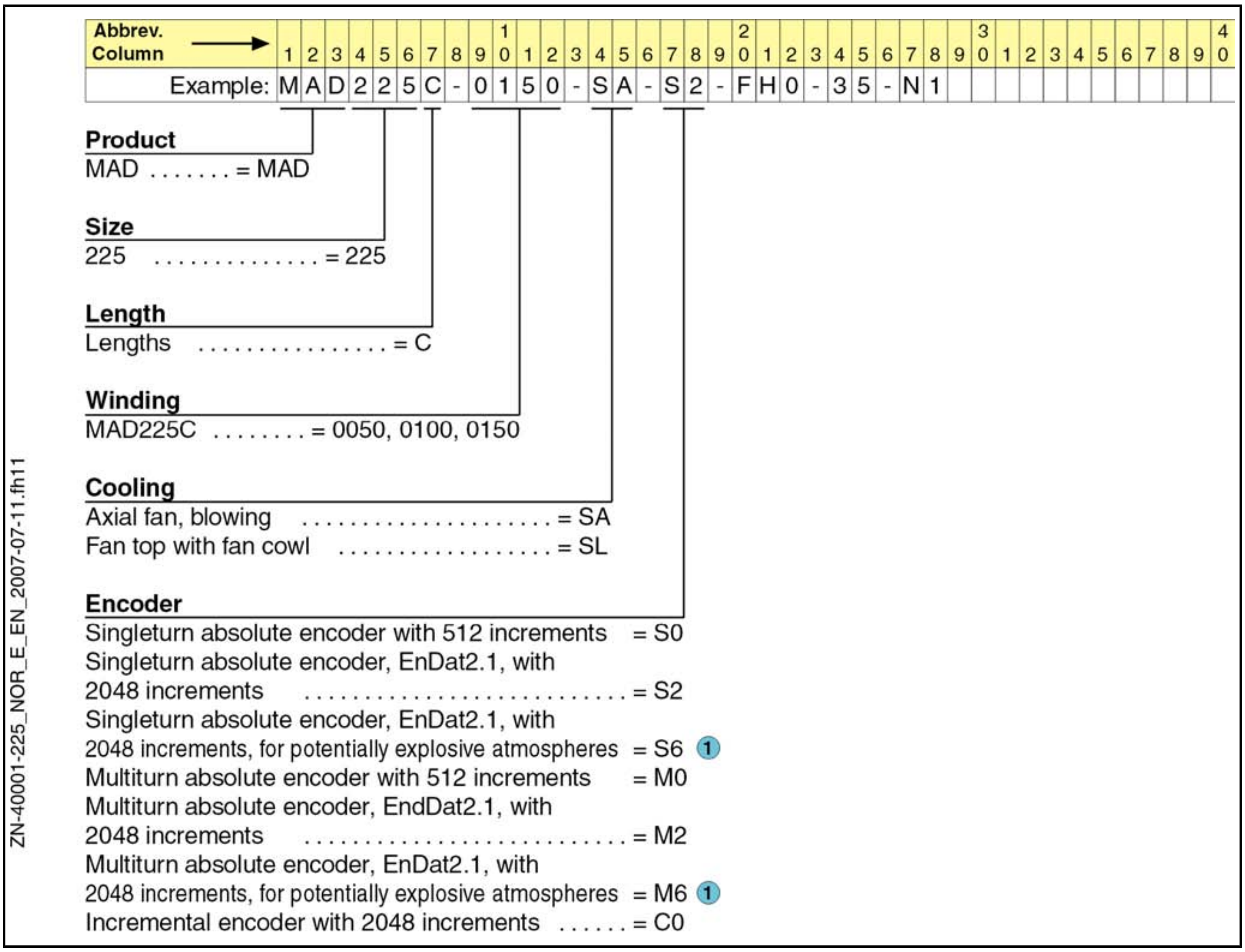


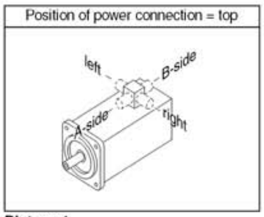

*Fig.6-12: Type code MAD225 (1/2)*

Type Codes IndraDyn A

| Abbrev. Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | D | 2 | 2 | 5 | C | - | 0 | 1 | 5 | 0 | - | S | A | - | S | 2 | - | F | H | 0 | - | 3 | 5 | - | N | 1 | | | | | | | | | | | | |

**Electrical connection see picture 1**

| | Terminal box | Terminal box, turnable ② |
|---|---|---|
| A-Side | F | E |
| B-Side | K | H |
| Right | S | D |
| Left | T | G |




**Picture 1**

**Shaft ③**

| | plain shaft | with key balanced with entire key | with key balanced with half key |
|---|---|---|---|
| Without shaft sealing ring | H | Q | L |
| With shaft sealing ring | G | P | K |
| With labyrinth sealing | F | R | - |

**Holding brake**

Without holding brake . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 0

**Mounting style**

Flange mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 05

Flange and foot mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 35

**Bearing**

Standard . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = N

Reinforced bearing . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = V

**Vibration severity**

A, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 1

**Note:**

① Ex type for cluster II 2G EEx pd IIB T3 according to DIN EN 60079 ff. Encoder "S6" und "M6" are only available with cooling mode "SL" and only with shaft "G", "P" and "K"

② According to DIN IEC 60204-1 and DIN IEC 60364-5-52

③ Shaft "F" and "R" are allways available with shaft sealing ring

**Standard reference**

| **Standard** | **Edition** | **Title** |
|---|---|---|
| DIN EN 60034-14 | 2004-09 | Rotating electrical machines - Part 14 |
| DIN EN 60079 ff | - | Electrical apparatus for explosive gas atmospheres (ATEX) |
| DIN IEC 60204-1 | 2002-09 | Safety of machinery - Electrical equipment of machines - Part 1 |
| DIN IEC 60364-5-52 | 2004-07 | Erection of low voltage installation - Part 5 |

*Fig.6-13: Type code MAD225 (2/2)*

# 6.7 Type Code MAF100

| Abbrev. Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 20 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 30 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | F | 1 | 0 | 0 | C | - | 0 | 1 | 5 | 0 | - | F | Q | - | S | 0 | - | A | P | 0 | - | 0 | 5 | - | N | 1 | | | | | | | | | | | | |

**Product**
MAF ....... = MAF

**Size**
100 .............. = 100

**Length**
Lengths ............ = B, C, D

**Winding**
MAF100B = 0050, 0100, 0150, 0200, 0250
MAF100C = 0050, 0100, 0150, 0200, 0250
MAF100D = 0050, 0100, 0150, 0200, 0250

**Cooling**
Liquid cooling with connection thread 1/4" = FQ
Liquid cooling with
Enclosed rapid action coupling 1/4" ....... = FR

**Encoder**
Singleturn absolute encoder with 512 increments = S0
Singleturn absolute encoder, EnDat2.1, with
2048 increments .......................... = S2
Singleturn absolute encoder, EnDat2.1, with
2048 increments, for potentially explosive atmospheres = S6 1
Multiturn absolute encoder with 512 increments = M0
Multiturn absolute encoder, EndDat2.1, with
2048 increments .......................... = M2
Multiturn absolute encoder, EndDat2.1, with
2048 increments, for potentially explosive atmospheres = M6 1
Incremental encoder with 2048 increments ...... = C0
Without motor encoder ...................... = N0

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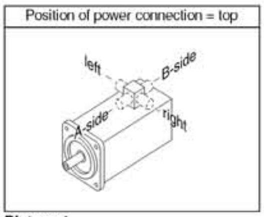
*Fig.6-14: Type code MAF100 (1/2)*

Type Codes IndraDyn A

| Abbrev. Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 20 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 30 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | F | 1 | 0 | 0 | C | - | 0 | 1 | 5 | 0 | - | F | Q | - | S | 0 | - | A | P | 0 | - | 0 | 5 | - | N | 1 | | | | | | | | | | | | |

**Electrical connection see picture 1**

| | Connector | Terminal box | Terminal box, ② turnable |
|---|---|---|---|
| A-Side | A | F | E |
| B-Side | B | K | H |
| Right | R | S | D |
| Left | L | T | G |




Picture 1

**Shaft ③**

| | plain shaft | with key balanced with entire key | with key balanced with half key |
|---|---|---|---|
| Without shaft sealing ring | H | Q | L |
| With shaft sealing ring | G | P | K |
| With labyrinth seal | F | R | - |

**Holding brake**

Without holding brake . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 0
Electrically-released, 24 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . . = 1
Electrically-clamped, 30 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . . = 5

**Mounting style**

Flange mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 05
Flange and foot mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 35

**Bearing ④**

Fixed bearing A-side . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = A
Standard . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = N
High Speed . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = H
For coupling mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = R

**Vibration severity**

A, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 1
B, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 3
C, specification according to IndraDyn A - documentation . . . . . . . . . . . . . . . = 4 ⑤

**Note:**

① Ex type for cluster II 2G EEx pd IIB T3 according to DIN EN 60079 ff. Encoder "S6" and "M6" are not available with electrical connection "A", "B", "R" and "L" and only with shaft "G", "P" and "K" and bearings "N"
② According to DIN IEC 60204-1 and DIN IEC 60364-5-52
③ Shaft "F" and "R" always available with shaft sealing ring
④ Bearing "A" is only available with holding brake "0" and vibration severity "1"
Bearing "H" is not available with encoder "S6" and "M6" and only with shaft "H" and holding brake "0"
Bearing "R" is only available with vibration severity "1"
⑤ Vibration severity "4" is only available with length "B" and "C" and bearing "N" and "H"

**Standard reference**

| **Standard** | **Edition** | **Title** |
|---|---|---|
| DIN EN 60034-14 | 2004-09 | Rotating electrical machines - Part 14 |
| DIN EN 60079 ff | - | Electrical apparatus for explosive gas atmospheres (ATEX) |
| DIN IEC 60204-1 | 2002-09 | Safety of machinery - Electrical equipment of machines - Part 1 |
| DIN IEC 60364-5-52 | 2004-07 | Erection of low voltage installation - Part 5 |

*Fig.6-15: Type code MAF100 (2/2)*

## 6.8 Type Code MAF130

Abbrev. Column → 1–40

Example: MAF130B-0150-FQ-M0-LH0-05-N1

**Product**
MAF ....... = MAF

**Size**
130 .............. = 130

**Length**
Lengths ............ = B, C, D

**Winding** 1
MAF130B = 0050, 0100, 0150, 0200, 0250
MAF130C = 0050, 0100, 0150, 0200, 0250
MAF130D = 0050, 0100, 0150, 0200, 0250

**Cooling**
Liquid cooling with connection thread 1/4" = FQ
Liquid cooling with enclosed rapid action coupling 1/4" ....... = FR

**Encoder**
Singleturn absolute encoder with 512 increments = S0
Singleturn absolute encoder, EnDat2.1, with 2048 increments .......................... = S2
Singleturn absolute encoder, EnDat2.1, with 2048 increments, for potentially explosive atmospheres = S6 2
Multiturn absolute encoder with 512 increments = M0
Multiturn absolute encoder, EndDat2.1, with 2048 increments .......................... = M2
Multiturn absolute encoder, EndDat2.1, with 2048 increments, for potentially explosive atmospheres = M6 2
Incremental encoder with 2048 increments ...... = C0
Without motor encoder ...................... = N0

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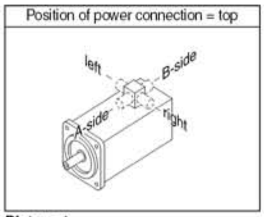
*Fig.6-16: Type code MAF130 (1/2)*

Type Codes IndraDyn A

| Abbrev. Column → | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 20 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 30 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | F | 1 | 3 | 0 | B | - | 0 | 1 | 5 | 0 | - | F | Q | - | M | 0 | - | L | H | 0 | - | 0 | 5 | - | N | 1 | | | | | | | | | | | | |

**Electrical connection see picture 1**

| | Connector | Terminal box | Terminal box, turnable ③ |
|---|---|---|---|
| A-Side | A | F | E |
| B-Side | B | K | H |
| Right | R | S | D |
| Left | L | T | G |




Picture 1

**Shaft** ④

| | plain shaft | with key: balanced with entire key | with key: balanced with half key |
|---|---|---|---|
| Without shaft sealing ring | H | Q | L |
| With shaft sealing ring | G | P | K |
| With labyrinth seal | F | R | - |

**Holding brake**

Without holding brake . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 0
Electrically-released, 80 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . . = 1
Electrically-clamped, 100 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . = 5

**Mounting style**

Flange mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 05
Flange and foot mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 35

**Bearings** ⑤

Fixed bearing A-side . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = A
Standard . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = N
High Speed . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = H
For coupling mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = R
Reinforced bearings . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = V

**Vibration severity**

A, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 1
B, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 3
C, specification according to IndraDyn A - documentation . . . . . . . . . . . . . . . . = 4 ⑥

**Note:**

① Winding "0250" with length "D" is not available with electrical connection "A", "B", "R" and "L"
② Ex type for cluster II 2G EEx pd IIB T3 according to DIN EN 60079 ff. Encoder "S6" and "M6" are not available with el. connection "A", "B", "R" and "L" and only with shaft "G", "P" and "K" and bearings "N" and "V"
③ According to DIN IEC 60204-1 and DIN IEC 60364-5-52
Electrical connection "D" and "G" is not availble with length "B"
Electrical connection "E" is only available with length "D"
④ Shaft "F" and "R" always available with shaft sealing ring
⑤ Bearing "A" is only available with holding brake "0" and vibration severity "1"
Bearing "H" is not available with encoder "S6" and "M6" and only with shaft "H" and holding brake "0"
Bearing "R" is only available with vibration severity "1"
⑥ Vibration severity "4" is only available with length "B" and "C" and bearings "N" and "H"

**Standard reference**

| Standard | Edition | Title |
|---|---|---|
| DIN EN 60034-14 | 2004-09 | Rotating electrical machines - Part 14 |
| DIN EN 60079 ff | - | Electrical apparatus for explosive gas atmospheres (ATEX) |
| DIN IEC 60204-1 | 2002-09 | Safety of machinery - Electrical equipment of machines - Part 1 |
| DIN IEC 60364-5-52 | 2004-07 | Erection of low voltage installation - Part 5 |

# 6.9 Type Code MAF160

| Abbrev. Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | F | 1 | 6 | 0 | B | - | 0 | 2 | 0 | 0 | - | F | Q | - | M | 0 | - | K | G | 0 | - | 0 | 5 | - | N | 1 | | | | | | | | | | | | |

**Product**
MAF ....... = MAF

**Size**
160 .............. = 160

**Length**
Lengths .............. = B, C

**Winding** 1
MAF160B ... = 0050, 0100, 0150, 0200
MAF160C ... = 0050, 0100, 0150, 0200

**Cooling**
Liquid cooling with connection thread 1/2" = FQ
Liquid cooling with enclosed rapid action coupling 1/2" ....... = FR

**Encoder**
Singleturn absolute encoder with 512 increments = S0
Singleturn absolute encoder, EnDat2.1, with 2048 increments .......................... = S2
Singleturn absolute encoder, EnDat2.1, with 2048 increments, for potentially explosive atmospheres = S6 2
Multiturn absolute encoder with 512 increments = M0
Multiturn absolute encoder, EndDat2.1, with 2048 increments .......................... = M2
Multiturn absolute encoder, EndDat2.1, with 2048 increments, for potentially explosive atmospheres = M6 2
Incremental encoder with 2048 increments ...... = C0
Without motor encoder ...................... = N0

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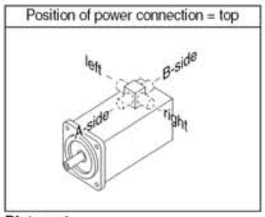
*Fig.6-18: Type code MAF160 (1/2)*

Type Codes IndraDyn A

| Abbrev. Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | F | 1 | 6 | 0 | B | - | 0 | 2 | 0 | 0 | - | F | Q | - | M | 0 | - | K | G | 0 | - | 0 | 5 | - | N | 1 | | | | | | | | | | | | |

**Electrical connection see picture 1**

| | Connector | Terminal box | Terminal box, turnable ③ |
|---|---|---|---|
| A-Side | A | F | E |
| B-Side | B | K | H |
| Right | R | S | D |
| Left | L | T | G |



Picture 1

**Shaft** ④

| | plain shaft | with key: balanced with entire key | with key: balanced with half key |
|---|---|---|---|
| Without shaft sealing ring | H | Q | L |
| With shaft sealing ring | G | P | K |
| With labyrinth seal | F | R | - |

**Holding brake**
Without holding brake . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 0
Electrically-released, 100 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . = 1
Electrically-clamped, 100 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . = 5

**Mounting style**
Flange mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 05
Flange and foot mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 35

**Bearings** ⑤
Fixed bearing A-side . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = A
Standard . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = N
For coupling mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = R
Reinforced bearings . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = V

**Vibration severity**
A, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 1
B, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 3
C, specification according to IndraDyn A - documentation . . . . . . . . . . . . . . . . = 4 ⑥

**Note:**
① Winding MAF160B-"0200", MAF160C-"0150" and MAF160C-"0200" are not available with electrical connection "A", "B", "R" and "L"
② Ex type for cluster II 2G EEx pd IIB T3 according to DIN EN 60079 ff. Encoder "S6" and "M6" are not available with el. connection "A", "B", "R" and "L" and only with shaft "G", "P" and "K" and bearings "N"
③ According to DIN IEC 60204-1 and DIN IEC 60364-5-52
④ Shaft "F" and "R" always available with shaft sealing ring
⑤ Bearing "A" is only available with holding brake "0" and vibration severity "1"
Bearing "R" is only available with vibration severity "1"
⑥ Vibration severity "4" is only available with bearings "N"

**Standard reference**

| Standard | Edition | Title |
|---|---|---|
| DIN EN 60034-14 | 2004-09 | Rotating electrical machines - Part 14 |
| DIN EN 60079 ff | - | Electrical apparatus for explosive gas atmospheres (ATEX) |
| DIN IEC 60204-1 | 2002-09 | Safety of machinery - Electrical equipment of machines - Part 1 |
| DIN IEC 60364-5-52 | 2004-07 | Erection of low voltage installation - Part 5 |

*Fig.6-19: Type code MAF160 (2/2)*

# 6.10 Type Code MAF180

Abbrev. Column → 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Example: M A F 1 8 0 C - 0 0 5 0 - F Q - C 0 - C H 0 - 3 5 - N 1

**Product**
MAF . . . . . . . = MAF

**Size**
180 . . . . . . . . . . . . . . = 180

**Length**
Lengths . . . . . . . . . . . . . . = C, D

**Winding**
MAF180B . . . = 0050, 0100, 0150, 0200
MAF180C . . . = 0050, 0100, 0150, 0200

**Cooling**
Liquid cooling with connection thread 1/2" = FQ
Liquid cooling with enclosed rapid action coupling 1/2" . . . . . . . = FR

**Encoder**
Singleturn absolute encoder with 512 increments = S0
Singleturn absolute encoder, EnDat2.1, with 2048 increments . . . . . . . . . . . . . . . . . . . . . . . . . . = S2
Singleturn absolute encoder, EnDat2.1, with 2048 increments, for potentially explosive atmospheres = S6 (1)
Multiturn absolute encoder with 512 increments = M0
Multiturn absolute encoder, EndDat2.1, with 2048 increments . . . . . . . . . . . . . . . . . . . . . . . . . . = M2
Multiturn absolute encoder, EndDat2.1, with 2048 increments, for potentially explosive atmospheres = M6 (1)
Incremental encoder with 2048 increments . . . . . . = C0
Without motor encoder . . . . . . . . . . . . . . . . . . . . . . = N0

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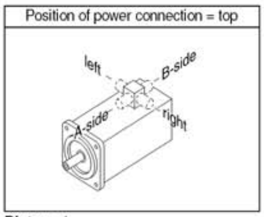
*Fig.6-20: Type code MAF180 (1/2)*

Type Codes IndraDyn A

| Abbrev. Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | F | 1 | 8 | 0 | C | - | 0 | 0 | 5 | 0 | - | F | Q | - | C | 0 | - | C | H | 0 | - | 3 | 5 | - | N | 1 | | | | | | | | | | | | |

**Electrical connection see picture 1**

| | Terminal box | Terminal box, turnable ② |
|---|---|---|
| A-Side | F | E |
| B-Side | K | H |
| Right | S | D |
| Left | T | G |




**Picture 1**

**Shaft** ③

| | plain shaft | with key: balanced with entire key | with key: balanced with half key |
|---|---|---|---|
| Without shaft sealing ring | H | Q | L |
| With shaft sealing ring | G | P | K |
| With labyrinth seal | F | R | - |

**Holding brake**

Without holding brake . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 0
Electrically-released, 240 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . . = 2
Electrically-clamped, 300 Nm . . . . . . . . . . . . . . . . . . . . . . . . . . . = 5

**Mounting style**

Flange and foot mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 35

**Bearings** ④

Fixed bearing A-side . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = A
Standard . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = N
For coupling mounting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = R
Reinforced bearings . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = V

**Vibration severity**

A, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 1
B, according to DIN EN 60034-14 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . = 3
C, specification according to IndraDyn A - documentation . . . . . . . . . . . . . . . = 4 ⑤

**Note:**

① Ex type for cluster II 2G EEx pd IIB T3 according to DIN EN 60079 ff.
Encoder "S6" and "M6" are only available with shaft "G", "P" and "K" and bearings "N"
② According to DIN IEC 60204-1 and DIN IEC 60364-5-52
③ Shaft "F" and "R" always available with shaft sealing ring
④ Bearing "A" is only available with holding brake "0" and vibration severity "1"
Bearing "R" is only available with vibration severity "1"
⑤ Vibration severity "4" is only available with length "C" and bearing "N"

**Standard reference**

| **Standard** | **Edition** | **Title** |
|---|---|---|
| DIN EN 60034-14 | 2004-09 | Rotating electrical machines - Part 14 |
| DIN EN 60079 ff | - | Electrical apparatus for explosive gas atmospheres (ATEX) |
| DIN IEC 60204-1 | 2002-09 | Safety of machinery - Electrical equipment of machines - Part 1 |
| DIN IEC 60364-5-52 | 2004-07 | Erection of low voltage installation - Part 5 |

*Fig.6-21: Type code MAF180 (2/2)*

# 6.11 Type Code MAF225

| Abbrev. Column → | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 20 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 30 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | F | 2 | 2 | 5 | C | - | 0 | 1 | 5 | 0 | - | F | Q | - | S | 2 | - | F | K | 0 | - | 3 | 5 | - | N | 1 | | | | | | | | | | | | |

**Product**
MAF ....... = MAF

**Size**
225 .............. = 225

**Length**
Lengths ................ = C

**Winding**
MAF225C ........ = 0050, 0100, 0150

**Cooling**
Liquid cooling with connection thread 1/2" = FQ
Liquid cooling with
enclosed rapid action coupling 1/2" ....... = FR

**Encoder**
Singleturn absolute encoder with 512 increments = S0
Singleturn absolute encoder, EnDat2.1, with
2048 increments ........................... = S2
Singleturn absolute encoder, EnDat2.1, with
2048 increments, for potentially explosive atmospheres = S6 1
Multiturn absolute encoder with 512 increments = M0
Multiturn absolute encoder, EndDat2.1, with
2048 increments ........................... = M2
Multiturn absolute encoder, EnDat2.1, with
2048 increments, for potentially explosive atmospheres = M6 1
Incremental encoder with 2048 increments ...... = C0

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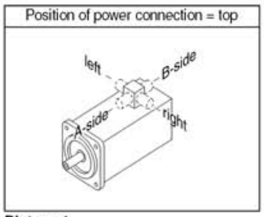
*Fig.6-22: Type code MAF225 (1/2)*

Type Codes IndraDyn A

| Abbrev. Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 20 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 30 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example: | M | A | F | 2 | 2 | 5 | C | - | 0 | 1 | 5 | 0 | - | F | Q | - | S | 2 | - | F | K | 0 | - | 3 | 5 | - | N | 1 | | | | | | | | | | | | |

**Electrical connection see picture 1**

| | Terminal box | Terminal box, turnable ② |
|---|---|---|
| A-Side | F | E |
| B-Side | K | H |
| Right | S | D |
| Left | T | G |



Picture 1

**Shaft ③**

| | plain shaft | with key: balanced with entire key | with key: balanced with half key |
|---|---|---|---|
| Without shaft sealing ring | H | Q | L |
| With shaft sealing ring | G | P | K |
| With labyrinth sealing | F | R | - |

**Holding brake**
without holding brake . . . . . . . . . . = 0

**Mounting style**
Flange mounting . . . . . . . . . . = 05
Flange and foot mounting . . . . . . . . . . = 35

**Bearings**
Standard . . . . . . . . . . = N
Reinforced bearings . . . . . . . . . . = V

**Vibration severity**
A, according to DIN EN 60034-14 . . . . . . . . . . = 1

**Note:**
① Ex type for cluster II 2G EEx pd IIB T3 according to DIN EN 60079 ff.
Encoder "S6" und "M6" are only available with shaft "G", "P" and "K"
② According to DIN IEC 60204-1 and DIN IEC 60364-5-52
③ Shaft "F" and "R" are allways available with shaft sealing ring

**Standard reference**

| Standard | Edition | Title |
|---|---|---|
| DIN EN 60034-14 | 2004-09 | Rotating electrical machines - Part 14 |
| DIN EN 60079 ff | - | Electrical apparatus for explosive gas atmospheres (ATEX) |
| DIN IEC 60204-1 | 2002-09 | Safety of machinery - Electrical equipment of machines - Part 1 |
| DIN IEC 60364-5-52 | 2004-07 | Erection of low voltage installation - Part 5 |

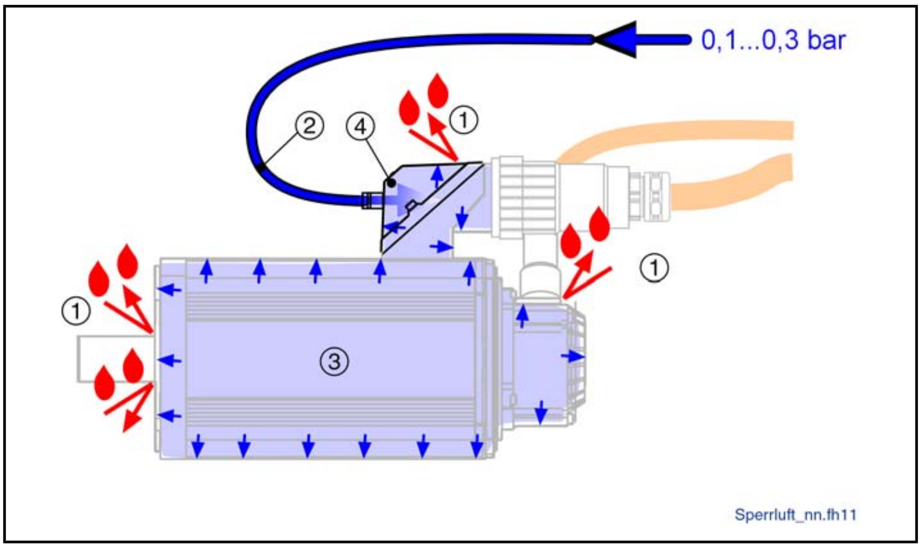
*Fig.6-23: Type code MAF225 (2/2)*

# 7 Accessories

## 7.1 Sealing Air Connection

When the motor is to be operated under adverse conditions, a higher protection class than the standard protection class with radial shaft sealing ring (IP65) may be required. High demands may be made on the tightness of motor seals when the motors are operated in areas where oily coolants are used. We recommend using sealing air in addition to the radial shaft sealing ring for these areas of application.

A defined excess pressure in the motor interior induced by the sealing air connection reliably prevents the penetration of, for example, creep oils and coolants.




① Splashing water, lubricant
② Compressed air line
③ Excess pressure inside the motor
④ Lid for sealing air (with connector for compressed air line)

*Fig.7-1: Motor with sealing air connection*

For IndraDyn A motors of frame sizes 100 to 160 with connectors for power connection, air pressure connector kits are available as accessory.

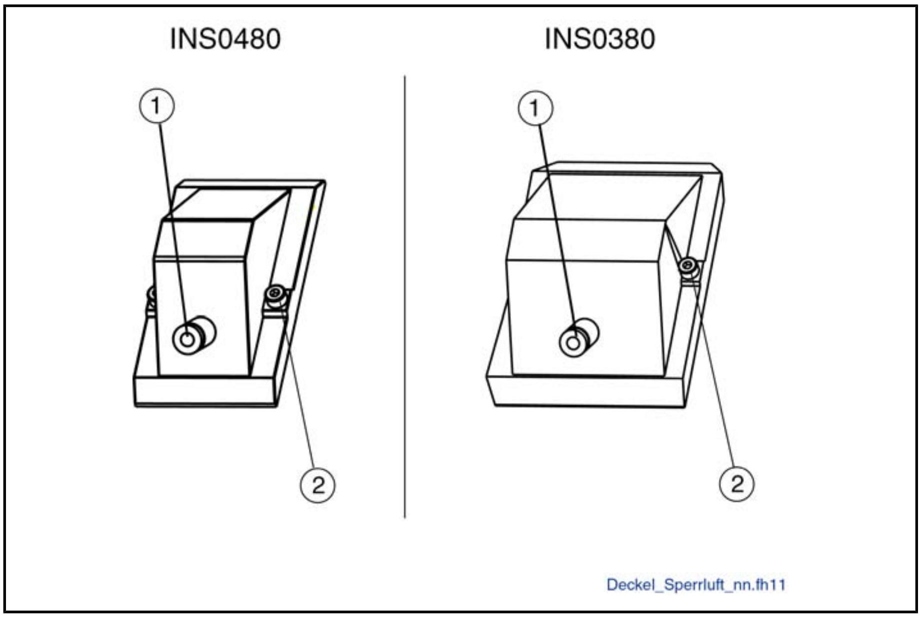
**Product Number of Accessory Sets**

| Motor frame size MAD/MAF... | Motor flange socket (type) | Description |
|---|---|---|
| 100 | INS0480 | SUP-M01-MHD (MNR R911283006) |
| 130...160 | INS0380 | SUP-M02-MHD (MNR R911283007) |

*Fig.7-2: Sealing air connection accessory*

The air-pressure connector can be retrofitted by simply replacing the existing lid with the lid in the accessory kit. This lid comprises the connector for the compressed air line.

Accessories




① Connector for compressed air line
② Fastening screws (2x)
*Fig.7-3: Lid for the air-pressure connector kit*

☞ When mounting the lid, make sure the O-ring is correctly positioned in the lid. The required motor protection class is only ensured when the O-ring is fitted correctly.

- Tightening torque of the two fastening screws: 3 Nm.
- An installation manual is included with the selected accessory kit.

**Technical Data**

Motor operation with sealing is permitted only under the following conditions:

- System pressure at the motor
  - 0.1...0.2 bar
- Properties of the compressed air
  - As far as possible free of dust and oil (select corresponding filter)
  - Relative air humidity 20…30%

**Additional Components**

To operate the motor with sealing air under the above-named conditions, other devices or components as e.g.

- compressor
- pressure regulator valve
- compressed air filter plus compressed air dryer, if applicable
- compressed air line (e.g. plastic tube PA 4 x 0.75)

are required. The user will have to procure and install these components as required.

For information on selection or dimensioning of suitable Rexroth accessories, please contact your sales partner, or directly

**Supplier of Accessory Components**

Bosch Rexroth AG
Pneumatics
Ulmer Str. 4
30880 Laatzen, Germany
Phone: +49 (511) 21 36-0
Fax +49 (511) 2 13 62-69

## 7.2 Gearbox

In certain conditions, switched and planetary gearboxes can be attached to IndraDyn A motors.

Regarding the aforementioned Bosch Rexroth recommends using gearboxes of the Rexroth GTM series that are attachment-compatible to the IndraDyn A motors.

| Type | Gearbox type | Preconditions at the motor | Supplier |
|---|---|---|---|
| GTM | Planetary gearbox | Plain motor drive shaft | Bosch Rexroth |

*Fig.7-4: Gearboxes for IndraDyn A motors*

When selecting a gearbox please note the information in the type code of the GTM gearboxes.

The compatibility and availability of gearboxes of other manufacturers or other types of gearboxes has to be discussed with the corresponding gearbox manufacturer. Please, also observe the notes in chapter 9.14.2 "Gearboxes" on page 287.

☞ For IndraDyn A motors, only low axial shaft stresses are permitted. (see chapter 9.13 "Bearings and Shaft Stress" on page 277). Therefore, IndraDyn A motors are not suitable for machine elements that generate axial loading of the motor (e.g. helical driving pinions).

## 7.3 Thread Reducing Fittings for Terminal Boxes "F, K, S, T"

Upon delivery, all IndraDyn A motors with power connection via terminal box of the options "F, K, S, T" are supplied with reducers for the connecting threads of the terminal box.

☞ The reducers are located in the terminal box and are comprised in the motor delivery. You do not need to order them separately.

To order additional reducers, please use the following order numbers:

| Reducer | Order number |
|---|---|
| from M32x1.5<br>to M25x1.5 | R911311878 |
| from M40x1.5<br>to M25x1.5 | R911310332 |
| from M40x1.5<br>to M32x1.5 | R911310197 |

| | |
|---|---|
| from M50x1.5<br>to M32x1.5 | R911311876 |
| from M50x1.5<br>to M40x1.5 | R911311880 |

*Fig.7-5: Thread reducing fittings for terminal boxes "F, K, S, T"*

## 7.4 Adapter Plates and Thread Reducing Fittings for Terminal Boxes "D, E, G, H"

The scope of delivery of the IndraDyn A motors with power connection via terminal boxes "D, E, G, H" covers the adapter plates and possibly required reducers to connect the power cable.

☞ The adapter plates have already been screwed tightly to the terminal box. The reducers are located in the terminal box and are comprised in the motor delivery.

To re-order adapter plates or reducers, please use the following order numbers:

| Reducer/Expansion | Order number |
|---|---|
| from M32x1.5<br>to M25x1.5 | R911311878 |
| from M32x1.5<br>to M40x1.5 | in preparation |
| from M40x1.5<br>to M25x1.5 | R911310332 |
| from M50x1.5<br>to M40x1.5 | R911311880 |
| | |
| Adapter plate | |
| Adapter plate RLK 1200 - M32x1.5 | R911324549 |
| Adapter plate RLK 1300/1400 - M32x1.5 | R911324551 |
| Adapter plate RLK 1300/1400 - M40x1.5 | R911324552 |
| Adapter plate RLK 1300/1400 - M50x1.5 | R911324553 |
| Adapter plate RLK 1500 - M50x1.5 | R911324554 |
| Adapter plate RLK 1500 - M63x1.5 | R911324555 |

*Fig.7-6: Thread reducing fitting for terminal boxes "D, E, G, H".*

# 8 Connection Techniques

## 8.1 Notes

CAUTION

**Destruction of the motors by direct connection to the 50/60Hz mains network (three-wire or single-phase mains)!**

The motors described here may be operated only with suitable drive control devices, with variable output voltage and frequency (converter mode) as specified by Rexroth.

☞ Supplementary descriptions and important information on connecting the motors in ATEX design to be observed additionally can be found in the operating instructions of the ATEX motors "DOK-MOTOR*-IDYN*A*ATEX-IBxx-D5-P, MNR R911323996.

Rexroth offers a wide range of ready-made cables and plug-in connectors that are optimally adapted to the products and different demands.

Rexroth ready-made cables have the following significant advantages:

- Pre-wired without additional finishing
- Laid out for continuous alternate bending use
- Resistant against mineral oils, grease and biological oils, free of silicone and halogen, low adhesion
- Use of licensed cables acc. to UL and CSA
- Burning characteristics fulfill VDE0472-804 requirements
- Compliance with EMC directives
- Protection class up to IP67

Power cables and power plugs are not in the scope of delivery of the linear motor. They must be ordered as a separate position.

You can find additional information...

- On the selection of **power and encoder cables** in the documentation "Rexroth connecting cables", MNR R911280894 (DE) and "Rexroth connecting cables IndraDrive and IndraDyn", MNR R911322948 (DE).
- For connecting the IndraDyn A in **ATEX design** in the operating instructions of ATEX motors with product number "DOK-MOTOR*-IDYN*A*ATEX-IBxx-D5-P, MNR R911323996.
- For connecting the IndraDyn A in **ATEX design** in the operating instructions of ATEX motors with product number "DOK-MOTOR*-IDYN*A*ATEX-IBxx-D5-P, MNR R911322500.
- Documentation "Electromagnetic Compatibility (EMC) …" MNR R911259740

## 8.2 Power Connection

### 8.2.1 General Information

The power connection of the IndraDyn A motors is situated at the top of the motors and may be executed via

- **connector** or
- **terminal box**

depending on the corresponding motor.

Please also refer to the data in the type code of the respective motor.

☞

- For the connection option "connector", please note:

  The power cable must be equipped on the motor side with a coupling with a bayonet connection.
- For the connection option "terminal box", please note:

  Depending on the motor, the power cable must have wire end ferrules or ring terminals at U, V, W, and the PE must be equipped with a ring cable lug.
- The design of the power cable also depends on the drive device used.

  Please observe the documentation of the drive device.

### 8.2.2 Additional Grounding Wire on Motors

**Source: Rotating Electrical Machines - DIN EN 60034-1**

In accordance with EN 60034--1:2004 (11.1 Grounding of Machines), motors of frame size MAF225C-0150 have to be grounded with an additional grounding wire with a minimum wire cross-section of 16 mm².

To this end, the motor flange is equipped with a connection screw with a thread of M12. Using this connection screw, attach the additional grounding wire via a ring terminal for M12 threads and connect the cable with the grounding strip in the control cabinet.

**Source: Machine Safety - DIN EN 60204-1**

According to the modifications to DIN EN 60204-1:1998-11, all motors are prepared to have a connection for a second grounding wire until the provisions of the DIN EN 60204-1:2006 (chapter 8.2.8) become effective.

Until the modified standard will become vain on 2009-06-01, this additional grounding connection can be provided using a connection option (terminal or screw) at the motor flange.

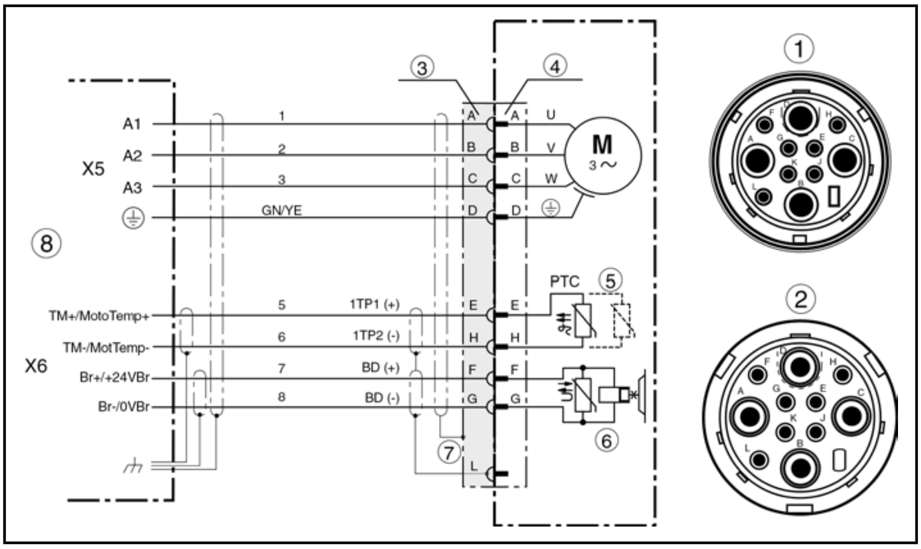
## 8.3 Power Connection with Connector

### 8.3.1 Motors with Connector

| Motor frame size MAD/MAF... | Connector |
|---|---|
| 100 | INS480 |
| 130...160 | INS380 |
| 180...225 | not available |

*Fig.8-1: Overview over motors with connector*

### 8.3.2 Connection Diagram




| | |
|---|---|
| ① | Connector INS480 (view on the plug-in side) |
| ② | Connector INS380 (view on the plug-in side) |
| ③ | Coupling |
| ④ | Connector |
| ⑤ | Only one PTC sensor is applied. The cables for the spare sensor are in the connector housing |
| ⑥ | Holding Brake (Option) |
| ⑦ | Overall shield connection via cable clamp of strain relief in the plug |
| ⑧ | Connection designations at the Rexroth drive controller |

*Fig.8-2: Power connection via connector, connection diagram*

### 8.3.3 Connector

Ready-made Rexroth power cables with coupling to connect IndraDyn A motors are provided with a bayonet connection.

| Connector | Coupling | Terminal area | Current rating |
|---|---|---|---|
| INS0480 | INS048x | 1.5 mm² - 10 mm² | max. 41 A |
| INS0380 | INS038x | 6.0 mm - 35.0 mm² | max. 100 A |

*Fig.8-3: Couplings for connectors*

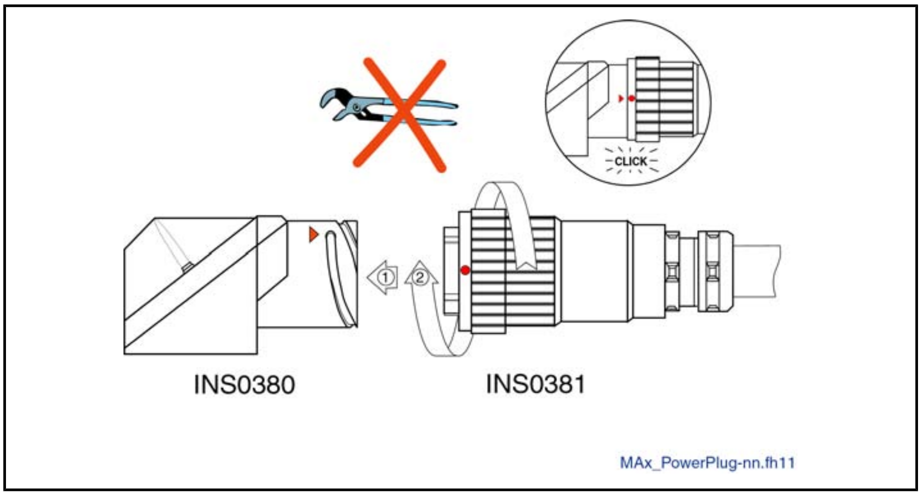



*Fig.8-4: Plugged power connection*

Follow the following steps to connect the motors via connector:

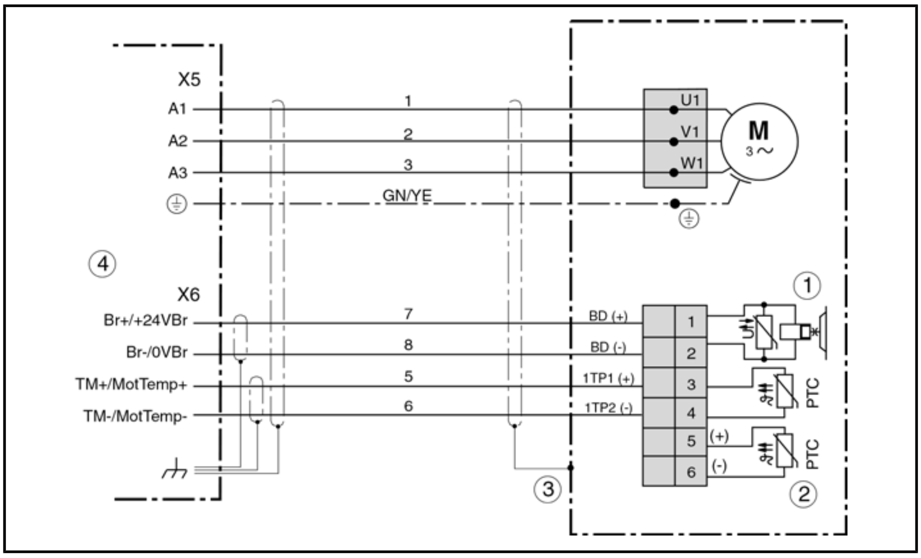
1. Insert the coupling into the connector; pay attention to the coding.
2. Manually tighten the union nut until it audibly locks in.
3. Marks on the couplinh and the connector are aligned when the bayonet connection is locked in.

## 8.4 Power Connection Terminal Box (Type Code Option "F, K, S, T")

| Motor frame size MAD/MAF... | Terminal box (type code option F, K, S, T) | | | | |
|---|---|---|---|---|---|
| | Description | U-V-W | Max. cross-section of connection | ⌀PE | Connecting thread |
| 100 | Size 1 (RLK0003) | WEF* | 10mm² | Ring terminal for M6 thread | see motor dimension sheet and details in chapter 7.3 "Thread Reducing Fittings for Terminal Boxes "F, K, S, T" " on page 225 |
| 130 | Size 2 (RLK0004) | WEF* | 25mm² | Ring terminal for M8 thread | |
| 160 | Size 3 (RLK0005) | WEF* | 35mm² | Ring terminal for M8 thread | |
| 180 | Size 4 (RLK0006) | Ring terminal for M6 thread | 50mm² | Ring terminal for M10 thread | |
| 225 | Size 5 (RLK0007) | Ring terminal for M6 thread | 50mm² | Ring terminalfor M12 thread | |
| *) WEF = wire end ferrule | | | | | |

*Fig.8-5: Overview motors with terminal boxes "F, K, S, T"*

**Connection diagram terminal box**



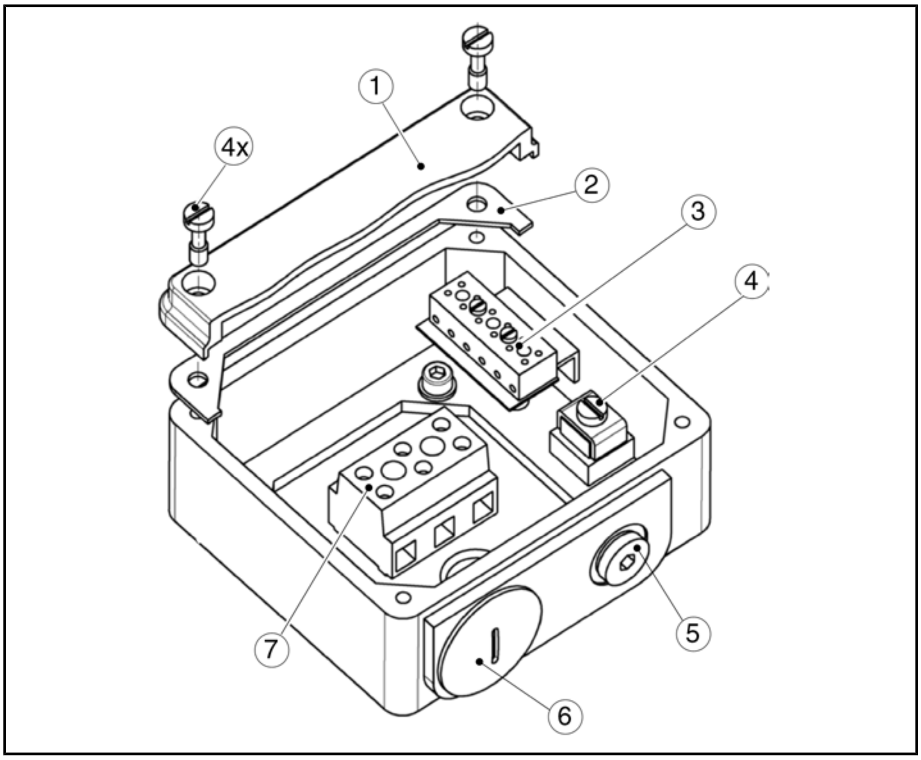

| | |
|---|---|
| ① | Holding Brake (Option) |
| ② | Backup temperature sensor. Connect the backup sensor only if necessary. |
| ③ | Shield connection via cable clamp of strain relief in the screwed connection. |
| ④ | Connection designations at the Rexroth drive controller |
| *Fig.8-6:* | *Connection diagram terminal box* |

☞

- The brake connections 1-2 are assigned only if the motor was manufactured with the brake option.
- Only one of the PTC thermistor connector pairs (3-4 or 5-6) in the motor cable should be connected to the motor; the other one pairs serves a spare.
- Do not remove or damage the seal glued into the cover.
- Observe the size of the screwed cable connection and connection thread for the cable inlet into the terminal box.
- In particular, make sure that the connection cables are installed in the terminal box orderly and free of tension to avoid abrasion or pressure marks on the cables.
- The connections of the motor-windings in the terminal box must not be removed.

Connection Techniques

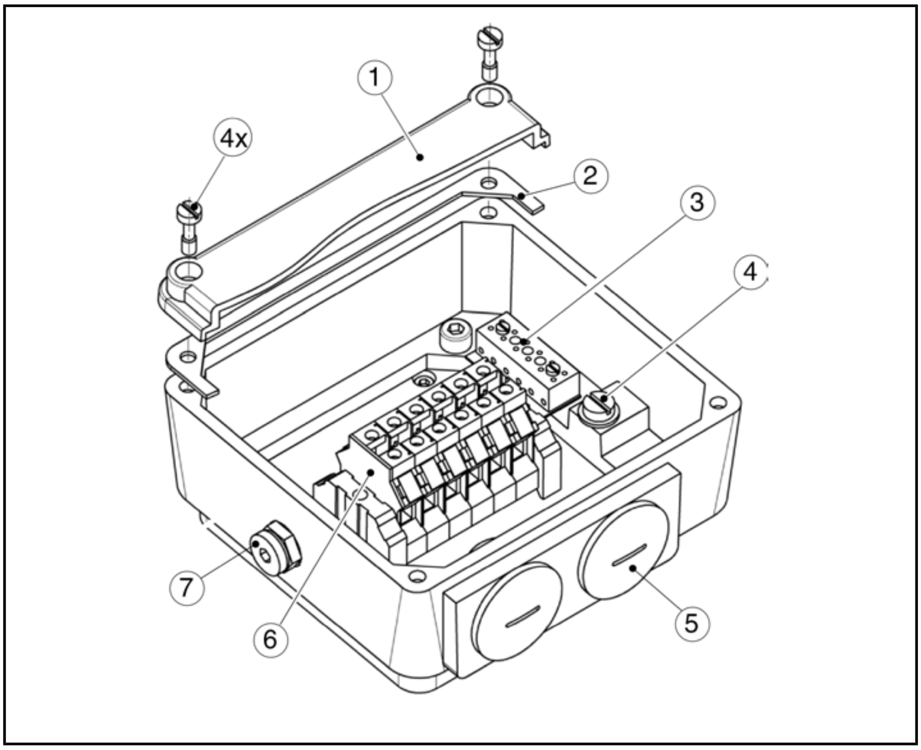
**Terminal Box (Option "F, K, S, T") at Motor Frame Size 100**




| | |
|---|---|
| ① | Lid |
| ② | Seal |
| ③ | Terminal strip (brake, temperature sensor) |
| ④ | PE connection |
| ⑤ | Purge gas connection (only for motors in ATEX design) |
| ⑥ | Protection cover of screwed cable connection |
| ⑦ | Terminal block U-V-W |

*Fig.8-7: Terminal Box (Option "F, K, S, T") at Motor Frame Size 100*

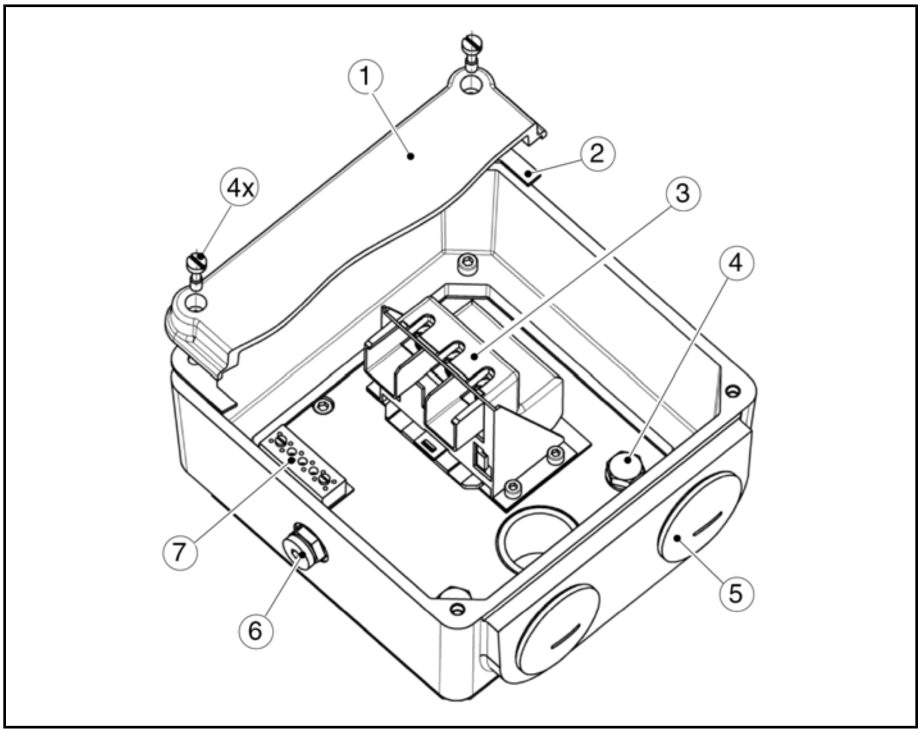
**Terminal box (Option "F, K, S, T") at Motor Frame Size 130...160**




| | |
|---|---|
| ① | Lid |
| ② | Seal |
| ③ | Terminal strip (brake, temperature sensor) |
| ④ | PE connection |
| ⑤ | Protection cover of screwed cable connection (2x) |
| ⑥ | Terminal block U-V-W (2x) |
| ⑦ | Purge gas connection (only for motors in ATEX design) |

*Fig.8-8: Terminal box (Option "F, K, S, T") at Motor Frame Size 130...160*

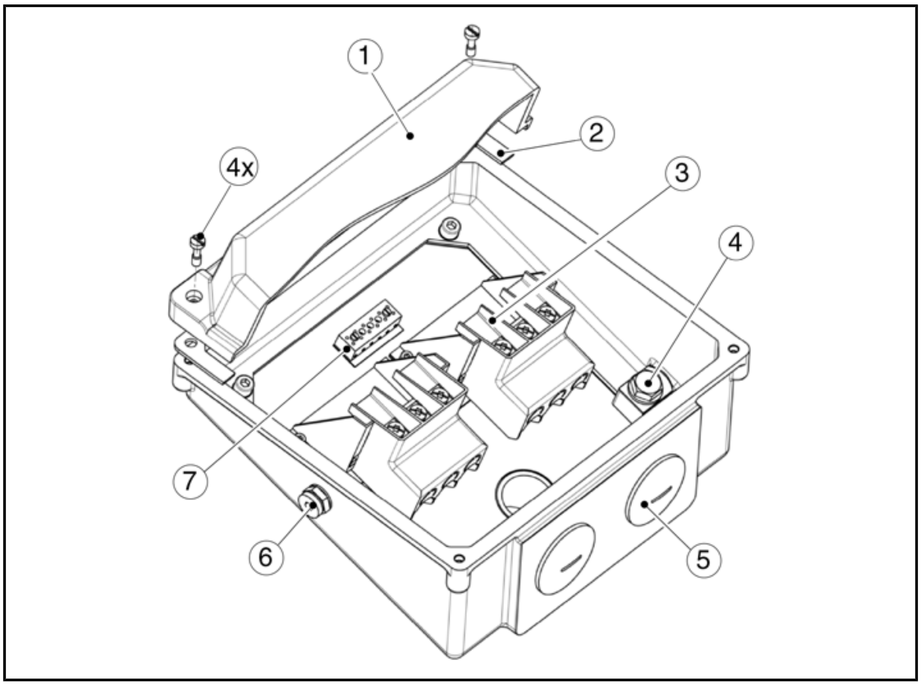
**Terminal Box (Option "F, K, S, T") at Motor Frame Size 180**




| | |
|---|---|
| ① | Lid |
| ② | Seal |
| ③ | Terminal block U-V-W |
| ④ | PE connection (2x) |
| ⑤ | Cable gland (2x) |
| ⑥ | Purge gas connection (only for motors in ATEX design) |
| ⑦ | Terminal strip (brake, temperature sensor) |

*Fig.8-9: Terminal box (option "F, K, S, T") at motor frame size 180*

**Terminal Box (Option "F, K, S, T") at Motor Frame Size 225**




| | |
|---|---|
| ① | Lid |
| ② | Seal |
| ③ | Terminal block U-V-W (2x) |
| ④ | PE connection (2x) |
| ⑤ | Cable gland (2x) |
| ⑥ | Purge gas connection (only for motors in ATEX design) |
| ⑦ | Terminal strip (brake, temperature sensor) |

*Fig.8-10: Terminal box (option "F, K, S, T") at motor frame size 225*

A schematic diagram of the respective connection (standard or double cabling) is located in the lid of the terminal box.

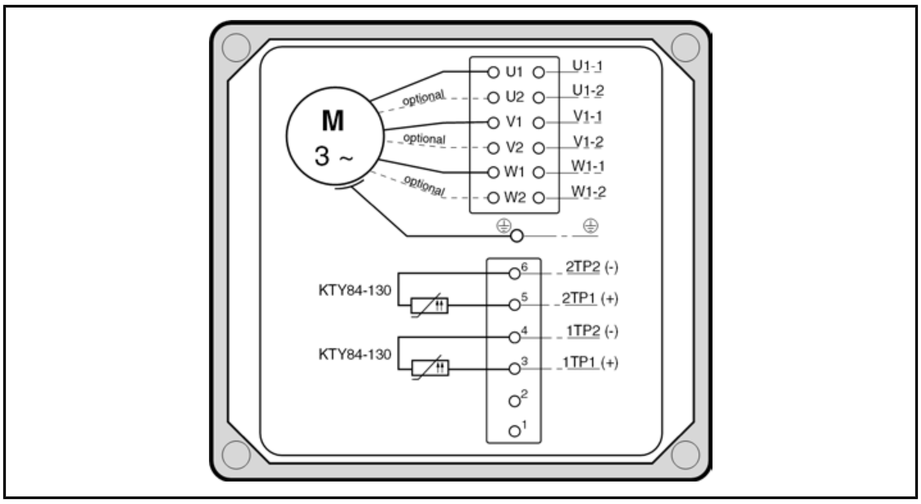



*Fig.8-11: Label in the lid of the terminal box*

☞ The brake connections (1-2) are assigned only if the motor was manufactured with the brake option.

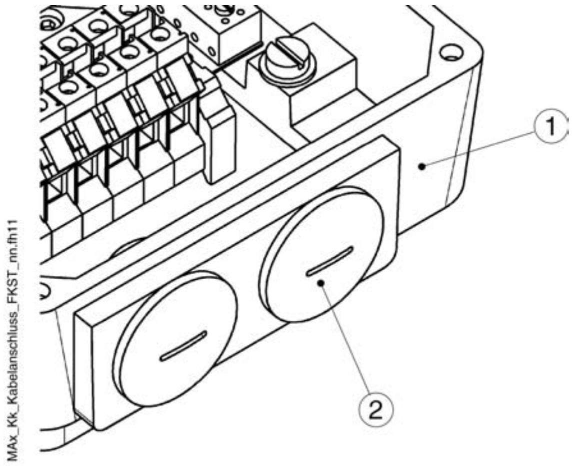
**Power Cable Connection at Terminal Box of Option "F, K, S, T"**

The required outlet direction of the power cable is selected in the type code of the motor. In accordance with the specification of the outlet direction by the user, the terminal box is mounted to the motor in the factory and must not be modified afterwards.

☞ As opposed to the connection option "terminal box rotatable", the outlet direction must not be modified upon delivery and during the installation of the motors respectively.

The connection of the power cable to terminal boxes of the type code option "F, K, S, T" requires the following steps:

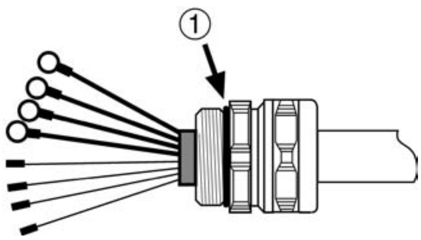
1. Open terminal box lid.




① Terminal box of Option "F, K, S, T"
② Protection cover of screwed cable connection
*Fig.8-12: Terminal box (option "F, K, S, T")*

2. Unscrew the protection cover of the screwed cable connection ②.
3. Run the power cable through the opening into the terminal box up to the screwed cable connection and attach the screwed cable connection to the terminal box.

   There is an O-ring at the screwed cable connection of the power cable. Ensure that the O-ring is actually situated in the screwed connection of the power cable during assembly.




① Positioning the O-Ring
*Fig.8-13: O-ring at the screwed cable connection*

CAUTION

**Improperly inserted or missing seals may cause loss of motor protection class and danger of explosion of ATEX motors!**

Conduct a visual inspection to check the O-ring for proper state and position at the screwed connection of the power cable before attaching the power cable to the terminal box.

If the O-ring is missing, do not use the power cable. In this case, contact your Rexroth sales or service partner.

4. Connect the wires in accordance with the connection diagram for standard or double cabling.

   Observe the following tightening torques:

**Screw tightening torques in NM (±10%) for power connection MAD/MAF to terminal boxes of the options "F, K, S, T"**

| Terminal box "F, K, S, T" | U-V-W | | PE | | | |
|---|---|---|---|---|---|---|
| | M4 | M6 | M6 | M8 | M10 | M12 |
| MAx100 | 1.5 | -/- | 2.5 | -/- | -/- | -/- |
| MAx130B-xxxx<br>MAx130C-xxxx<br>MAD130D-0050<br>MAD130D-0100<br>MAD130D-0150<br>MAD130D-0200<br>MAF130D-0050<br>MAF130D-0100<br>MAF130D-0200 | 1.5 | -/- | -/- | 3.5 | -/- | -/- |
| MAD130D-0250<br>MAF130D-0150<br>MAF130D-0200<br>MAx160 | -/- | 3.2 | -/- | 3.5 | -/- | -/- |
| MAx180 | -/- | 6.0 | -/- | -/- | 12.0 | -/- |
| MAx225 | -/- | 6.0 | -/- | -/- | -/- | 20.0 |

*Fig.8-14: Screw tightening torques in NM in the MAx terminal box "F, K, S, T"*

5. Close and fasten the lid of the terminal box.

   Moisten the thread of the fastening screws for the lid with liquid screw fastener Loctite 243 and fasten the lid using all the fastening screws.

   Tightening torque of the screws: 6.5 Nm (±10%)

   Before tightening the screws, make sure that the seal between the lid and the terminal box housing is positioned properly.

CAUTION

**Improperly inserted or missing seals may cause loss of motor protection class and danger of explosion of ATEX motors!**

Check the attached seal at the terminal box lid for proper state and position before attaching the terminal box lid to the terminal box.

# 8.5 Power Connection Terminal Box "Rotatable" (Type Code Option "D, E, G, H")

| Motor frame size MAD/MAF... | Terminal box (type code options D, E, G, H). | | | | |
|---|---|---|---|---|---|
| | Description | U-V-W | Max. cross-section of connection | ∅PE | Connecting thread |
| 100 | RLK1200 | WEF* | 16mm² | Ring terminal for M6 thread | see motor dimension sheet and details in chapter 7.4 "Adapter Plates and Thread Reducing Fittings for Terminal Boxes "D, E, G, H"" on page 226 |
| 130 | RLK1300 | WEF* | 35mm² | Ring terminal for M8 thread | |
| 160 | | WEF* | 35mm² | Ring terminal for M8 thread | |
| 180 | RLK1400 | Ring terminalfor M12 thread | 50mm² | Ring terminalfor M12 thread | |
| 225 | RLK1500 | Ring terminalfor M12 thread | 70mm² | Ring terminalfor M12 thread | |
| *) WEF = wire end ferrule | | | | | |

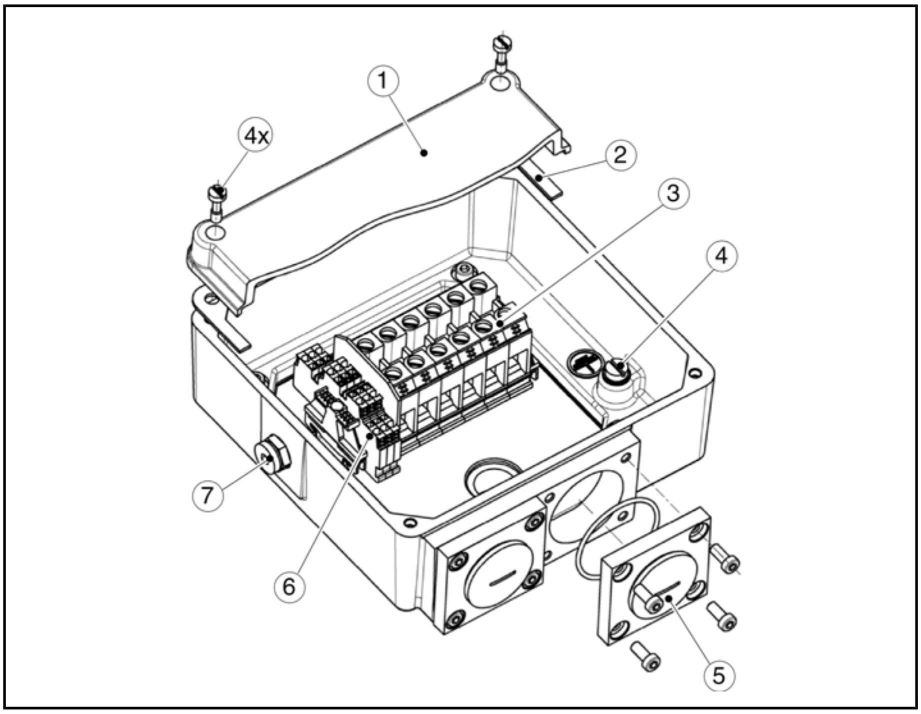
*Fig.8-15: Overview motors with terminal box "D, E, G, H"*

☞ The screwed cable connection at the pivotable terminal boxes is done via adapter plates and, if applicable, thread reducing fittings. The parts are part of the motor delivery and may be ordered separately, if required.

Product numbers see chapter 7.4 "Adapter Plates and Thread Reducing Fittings for Terminal Boxes "D, E, G, H"" on page 226.

Connection diagram and notes see chapter 8.4 "Power Connection Terminal Box (Type Code Option "F, K, S, T")" on page 230.

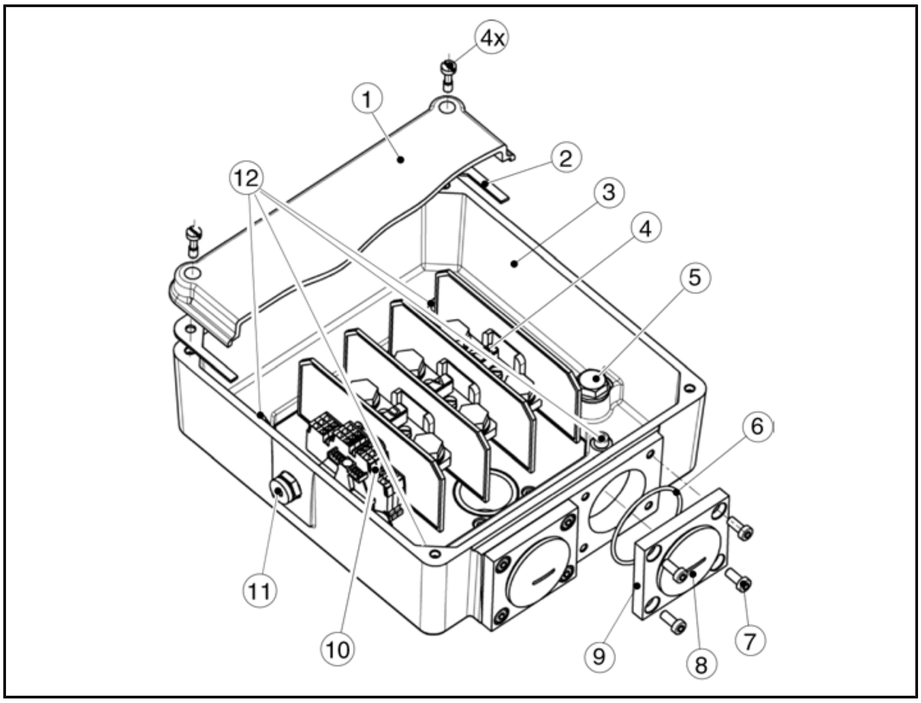
**Terminal Box (Option "D, E, G, H") at Motor Frame Size 100..160**




| | |
|---|---|
| ① | Lid |
| ② | Seal |
| ③ | Terminal block U-V-W |
| ④ | PE connection |
| ⑤ | Cable entry |
| ⑥ | Terminal strip (brake, temperature sensor) |
| ⑦ | Purge gas connection (only for motors in ATEX design) |
| *Fig.8-16:* | *Terminal box (Option "D, E, G, H") at motor frame size 100..0.160* |

Connection Techniques

**Terminal Box (Option "D, E, G, H") at Motor Frame Size 180...225**




① Lid
② Seal
③ Terminal box pivotable (options ""D, E, G, H").
④ Terminal block U-V-W
⑤ PE connection
⑥ O-ring
⑦ Adapter plate fastening screws
⑧ Protection cover of screwed cable connection
⑨ Adapter plate
⑩ Terminal strip (brake, temperature sensor)
⑪ Purge gas connection (only for motors in ATEX design)
⑫ Terminal screws for setting the cable outlet direction (4x)

*Fig.8-17: Terminal box (Option "D, E, G, H") at motor frame size 180...225*

**Power Cable Connection at "Terminal Box Rotatable" (Options "D, E, G, H")**

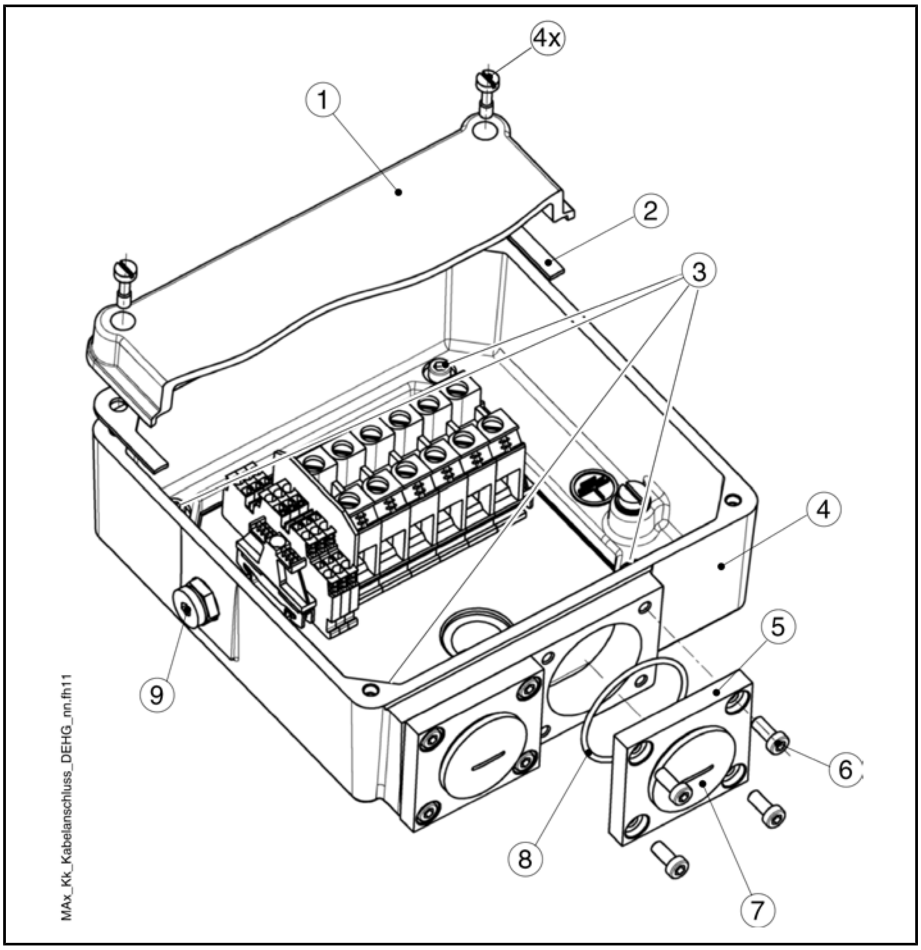
The required outlet direction of the power cable is selected in the type code of the motor. In accordance with the specification of the outlet direction by the user, the terminal box is factory-mounted at the motor.

☞ By selecting the connection option "terminal box rotatable", the user can adapt the cable outlet direction to a new or modified connection situation directly at the installation site simply by "turning" the terminal box.

The connection of the power cable to terminal boxes of the type code option "D, E, G, H" requires the following steps:

1. Open the lid of the terminal box ①.

   Open and remove the fastening screws (4 screws).




| | |
|---|---|
| ① | Terminal box lid |
| ② | Seal terminal box lid |
| ③ | Fastening screws for terminal box (4 screws) |
| ④ | Terminal box of the option ""D, E, G, H" |
| ⑤ | Adapter plate for screwed cable connection |
| ⑥ | Fastening screws for adapter plate (4 screws) |
| ⑦ | Protection cover of screwed cable connection |
| ⑧ | O-ring |
| ⑨ | Purging Connections |

*Fig.8-18: Terminal box pivotable (options "D, E, G, H").*

2. Check the direction of the outgoing cable and turn the terminal box if necessary.

- Detach the terminal box.

  Open the fastening ③ and turn the terminal box ④ to the required outlet direction in 90° increments.
- Fasten the terminal box.

Screw in and tighten the fastening screws ③.

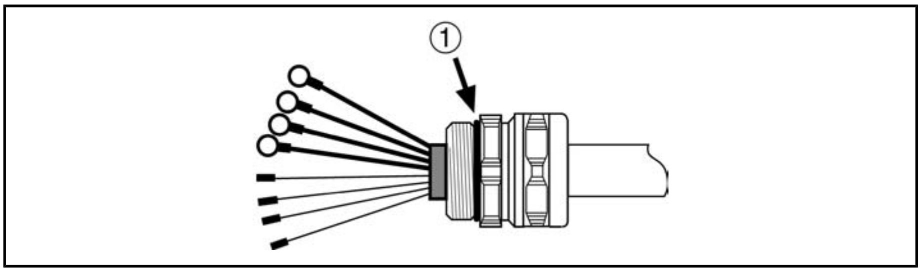
Tightening torque of the screws: 6.5 Nm (±10%)

CAUTION

**Improperly inserted or missing seals may cause loss of motor protection class and danger of explosion of ATEX motors!**

A seal is located between terminal box and motor housing. Check the terminal box after turning or re-fastening for proper condition and correct position of the seal.

3. Unscrew the protection cover of the screwed cable connection ⑦.
4. Detach the adapter plate ⑤ at the terminal box ④.
5. Tightly screw the adapter plate to the metric cable connection at the power cable.




① Positioning the O-Ring

*Fig.8-19: O-ring at the screwed cable connection*

CAUTION

**Improperly inserted or missing seals may cause loss of motor protection class and danger of explosion of ATEX motors!**

Conduct a visual inspection to check the O-ring for proper state and position at the screwed connection of the power cable before attaching the adapter plate to the power cable.

If the O-ring is missing, do not use the power cable. In this case, contact your Rexroth sales or service partner.

6. Run the power cable through the opening into the terminal box up to the adapter plate. Refasten the adapter plate to the terminal box.

   Tightening torque of the screws: 9 Nm (±10%)

CAUTION

**Improperly inserted or missing seals may cause loss of motor protection class and danger of explosion of ATEX motors!**

Check the O-ring inserted into the adapter plate for proper state and position before attaching the adapter plate to the terminal box.

7. Connect the wires in accordance with the connection diagram for standard or double cabling.

   Observe the following tightening torques:

**Screw tightening torques in NM (±10%) for power connection MAD/ MAF to terminal boxes of the options "D, E, G, H"**

| Terminal box pivotable Option "D, E, G, H" | U-V-W | | PE | |
|---|---|---|---|---|
| | M6 | M12 | M8 | M12 |
| MAx100<br>MAx130<br>MAx160 | 2.5 | - / - | 3.5 | - / - |
| MAx180<br>MAx225 | - / - | 14.0 | - / - | 20.0 |

*Fig.8-20: Screw tightening torques in Nm in the MAx terminal box "D, E, G, H"*

8. Close and fasten the lid of the terminal box.

   Moisten the thread of the fastening screws for the lid ① with liquid screw fastener Loctite 243 and fasten the lid with all the fastening screws.

   Tightening torque of the screws: 6.5 Nm (±10%)

CAUTION

**Improperly inserted or missing seals may cause loss of motor protection class and danger of explosion of ATEX motors!**

Check the attached seal at the terminal box lid for proper state and position before attaching the terminal box lid to the terminal box.

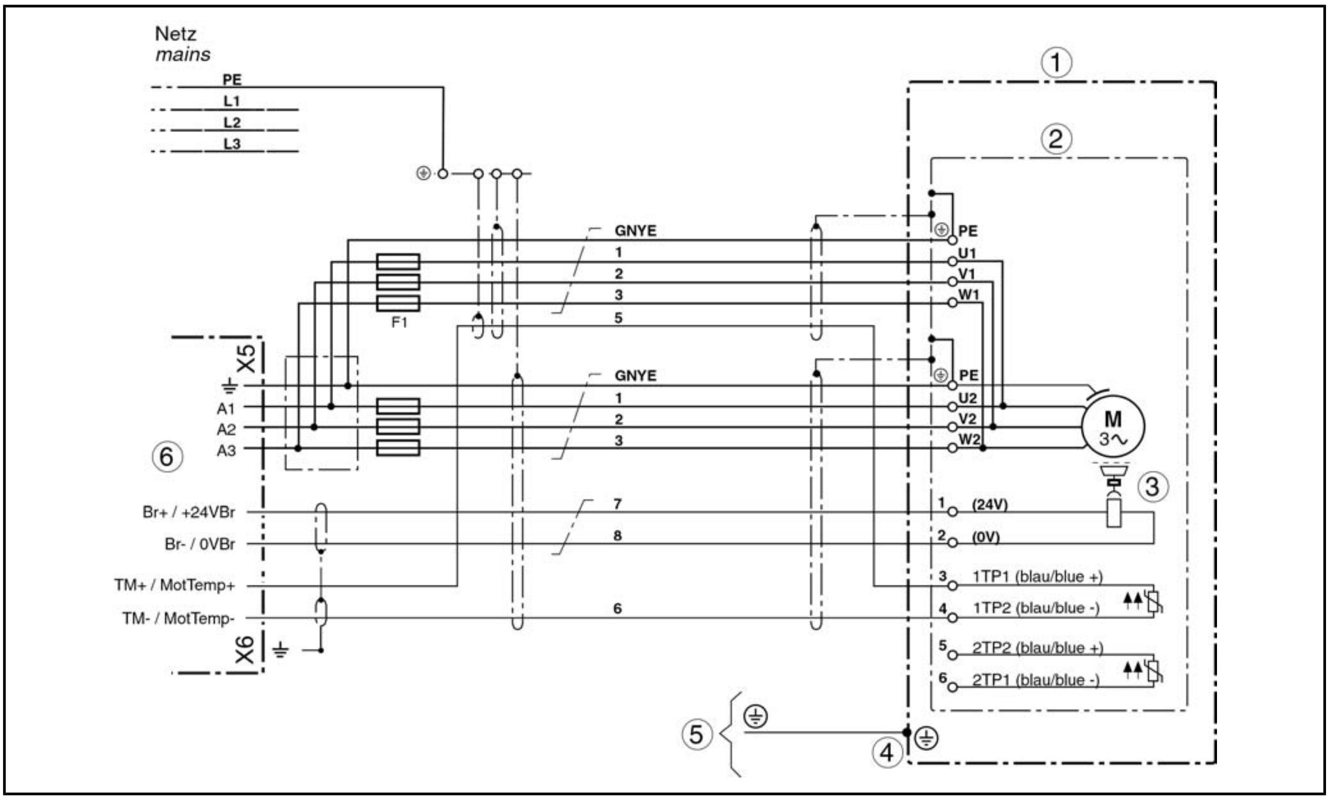
## 8.6 Double Cabling

A motor connection with two power cables is required if a corresponding single cable cannot be used due to the large bending radius or due to its dimensions.

☞ The following connection diagram shows a possible connection. When planning the double cabling, please note the applicable installation regulations at the installation site of the machine.

**Connection diagram double cabling**

Connection Techniques




| | |
|---|---|
| ① | Motor housing |
| ② | Terminal box |
| ③ | Holding Brake (Option) |
| ④ | Equipotential bonding connection at the motor (for MAF225C-0150 respectively ATEX motors only) |
| ⑤ | Equipotential bonding connection at the machine (required with MAF225C-0150 and ATEX motors) |
| ⑥ | Rexroth drive controller |
| *Fig.8-21:* | *Connection diagram double cabling* |

☞

- Double cabling may only be effected with the power connection by means of terminal box.
- Wires not shown in the switching diagram are not required and must not be connected.
- The fuses F1 (NH…) which protect the wires from overload in case of cable break are dimensioned in accordance with the current carrying capacity of the respective line cross-section.
- The fuses should be installed in the switch cabinet so that they are as close as possible to the power output of the drive device.
- The shields of the power cables should be connected to the switch cabinet with the largest possible surface area!
- Cable pairs must be properly connected to series terminal strips or to the terminal studs of the drive controllers; they must also fulfill safety requirements.

## 8.7 Connection Designations at the Drive Control Device

The following overview shows the connection and clamp designations for power connection, brake connection and the motor temperature monitoring at the respective Rexroth drive controller.

| REXROTH drive controller | Clamp designation | | |
|---|---|---|---|
| | Power | Temperature sensor | Holding brake |
| | (terminal box X5) | (terminal box X6) | |
| **IndraDrive** | A1, A2, A3 | MotTemp+<br>MotTemp- | +24VBr<br>0VBr |
| **DIAX04** | A1, A2, A3 | TM+<br>TM- | Br+<br>Br- |
| **ECODRIVE** | A1, A2, A3 | TM+<br>TM- | Br+<br>Br- |

*Fig.8-22: Clamp designations on drive control device*

## 8.8 Encoder Connection

Depending on the encoder type, the connection of the encoder to IndraDyn A motors has a 10-pole, 12-pole or 17-pole connector at the motor housing.

| Motor | Frame size | Connector (X3) for encoder connection | | |
|---|---|---|---|---|
| | | M2 / S2<br>M6 / S6 | M0 / S0 | C0 |
| **MAD** | 100 | RGS1003 | INS0524 | INS0629 |
| | 130 | RGS1004 *) | INS0638 | INS0719 |
| | 160 | | | |
| | 180 | | | |
| | 225 | | | not available |
| **MAF** | 100 | RGS1003 | INS0524 | INS0629 |
| | 130 | | | |
| | 160 | | | |
| | 180 | | | |
| | 225 | | | not available |
| *) Connector RGS1004 cannot be ordered as an individual component. It is an integral part<br>of the encoder connection cable to connect encoder option M2/S2. | | | | |

*Fig.8-23: Designations of encoder connectors*

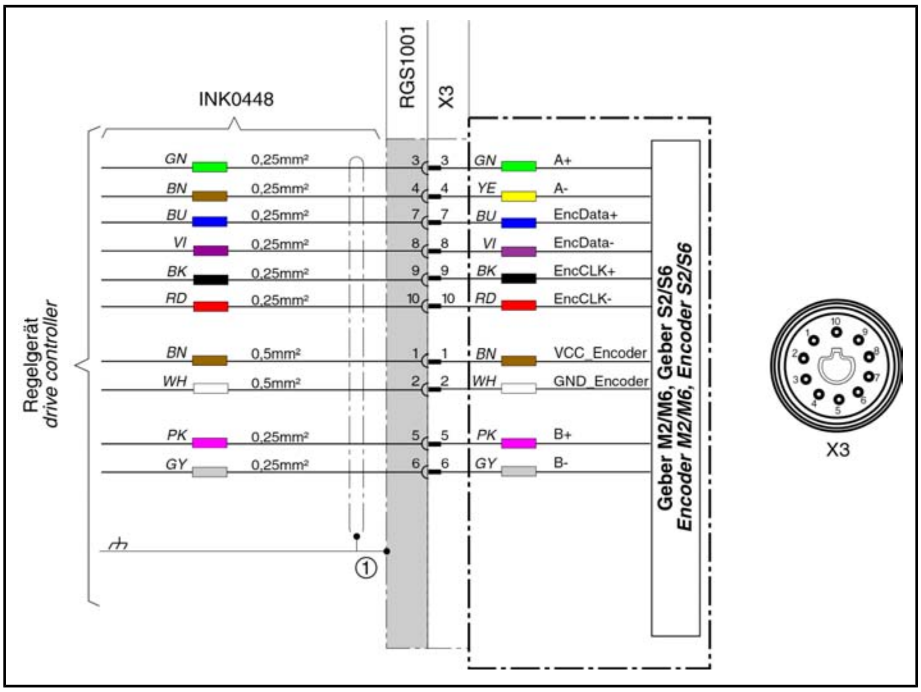
In connection with the specified connectors, the following coupling can be used at the connection cable:

| Connector (X3) | Coupling |
|---|---|
| INS0524 | INS0510, INS0511, INS0713 |
| INS0629 | INS0379 |
| INS0638 | INS0510, INS0511, INS0713 |
| INS0719 | INS0379 |
| RGS1003 | RGS1001 |
| RGS1004 *) | RGS1001 |
| *) Connector RGS1004 cannot be ordered as an individual component. It is an integral part of the encoder connection cable to connect encoder option M2/S2. | |

*Fig.8-24: Coupling for encoder connectors*

See the following chart for the connector assignment:

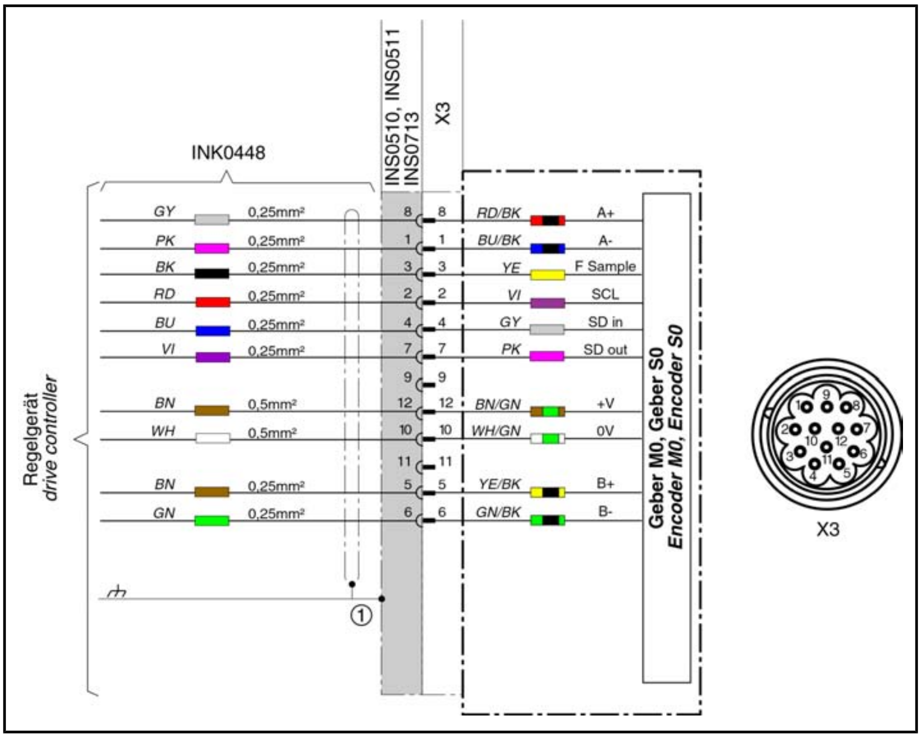
**Terminal Assignment Encoder Options M2/S2 and M6/S6**




① Shield connection via cable clamp of strain relief

*Fig.8-25: Connection encoder type M2/S2 and M6/S6*

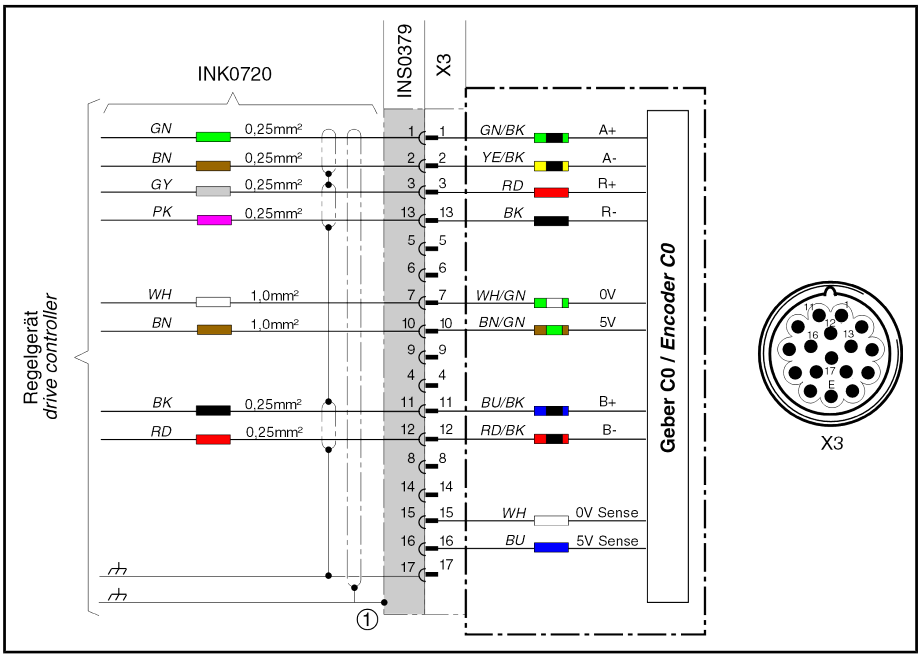
**Terminal Assignment Encoder Option M0 / S0**




① Shield connection via cable clamp of strain relief

*Fig.8-26: Connection encoder type M0 / S0*

**Terminal Assignment Encoder Option C0**




① Shield connection via cable clamp of strain relief

*Fig.8-27: Connection encoder type C0*

The cable for connecting the motor encoder and the drive device must have a compatible coupling on the motor side.

The connector on the motor side and the coupler on the cable side are connected to each other and screwed on by hand. Thus, they are structured as a mirror image, i.e. with different poles.

Please take note of the mechanical coding.

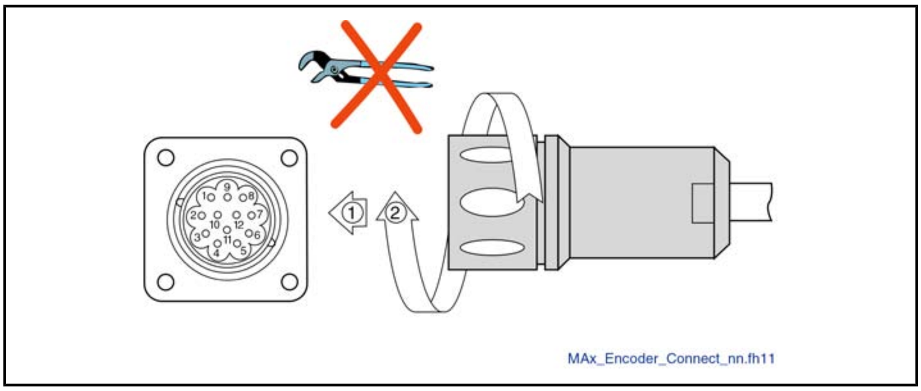



*Fig.8-28: Sample encoder plugged connection*

1. Insert the coupling into the connector; pay attention to the coding.
2. Manually tighten the union nut.

# 8.9 Temperature Sensor

IndraDyn A motors are equipped with two PTC temperature sensors **KTY84-130**, which are mounted stationary into the motor winding. Additional information on the temperature sensor, see chapter 9.9 "Motor Temperature Monitoring" on page 267.

☞

- Before reconnecting the sensor, take measures regarding ESD protection.
- Observe the correct polarity when using the sensor for external temperature measurement.
- Connection diagram see chapter 8.3.2 "Connection Diagram" on page 229 and chapter 8.4 "Power Connection Terminal Box (Type Code Option "F, K, S, T")" on page 230 at the beginning of this chapter.
- The wire colors of the replacement sensor within the power connector must be connected in the same way, the exchanged sensor within the connector was, to keep the polarity.

# 8.10 Holding Brake

The motor holding brake is triggered either directly through the controller or by an external trigger.

☞

- Connection diagram see chapter 8.3.2 "Connection Diagram" on page 229 and chapter 8.4 "Power Connection Terminal Box (Type Code Option "F, K, S, T")" on page 230 at the beginning of this chapter.
- The control voltage is +24 $V_{DC}$ (+/- 10 %)
- Take note of the different functions of an electrically clamping and an electrically releasing brake (see chapter 9.10.2 "Selecting Holding Brakes" on page 269).

# 8.11 Motor Cooling System

## 8.11.1 Fan connection

The motor fan is connected to the supply system via a cable and motor protecting switch and functions independent of the drive device.

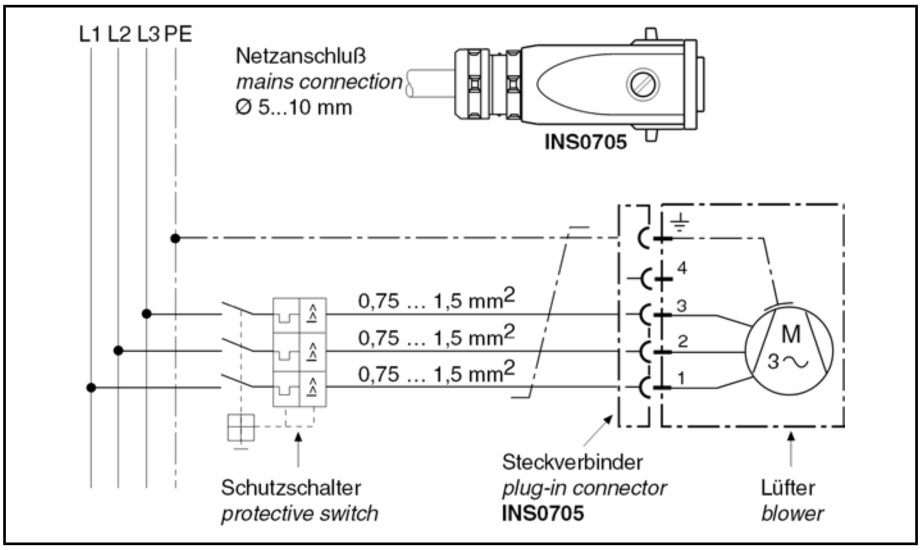



*Fig.8-29: Fan connection*

☞
- To establish the connection, the fan plug must be opened and closed.
- The electric connection may be established by skilled personnel only. Please observe the safety notes.
- The tightness of the plug housing must not be reduced.
- The machine manufacturer selects the motor protection switch and the electrical protection. Please observe the regulations in the country of installation.
- The plug for connecting the motor fan is included in the scope of delivery and is located on the fan.

## 8.11.2 Coolant Connection

For liquid-cooled motors, the following connections are available:

- Coolant connection using the connection threads at the motor
- Coolant connection using quick couplers

☞ To supply the MAF motors with cooling liquid, you will need additional installation material as e.g. hoses and fixing clamps (not included in the delivery).

| Motor MAF ... | Connection via … | | Note |
|---|---|---|---|
| | Thread | Quick coupler [Ø $d_i$ Hose] | |
| 100...130 | G1/4" | 9 mm | Selection of connection type by type code |
| 160...225 | G1/2" | 13 mm | |

*Fig.8-30: Overview coolant connections*

☞ Inflow (IN) and outflow (OUT) can be assigned at the user's discretion. The assignment does not affect the performance data of the motor.

**Coolant Connection Threads**

On delivery, the connection threads at the motor are covered with protective stoppers. These protective stoppers must only be removed shortly before screwing-in the coolant lines or the quick couplers to avoid the intrusion of dirt into the cooling system.

Depending on the type of selected connection threaded joint, the maximum admissible tightening torque of the motor-side threaded joint may not be applied to the full extent, but has to be reduced to the admissible value of the customers' connection threaded joint. For this, please note the information of the manufacturer of the connection threaded joint you selected.

The following table provides an overview of the values the motor-side connection threads may be loaded with. Exceeding the tightening torque or depth of engagement can lead to irreversible motor damage.

| Frame size MAF… | Connecting thread | Max. permissible depth of engagement [mm] | Permissible tightening range [Nm] |
|---|---|---|---|
| 100...130 | G1/4" | 14 | 18...20 |
| 160....225 | G1/2" | 18 | 27...30 |

*Fig.8-31: Coolant connection thread, admissible tightening torques and thread depths*

The motor-sided coolant connections are designed for coolant connection threads with axial sealing.

Bosch Rexroth recommends to use connection threads, which contain an O-Ring for axial sealing of the screw connection.

Not suited is a sealing using hemp bred, teflon tape or even with conical threads as this kind of sealing can stress and/or even damage the connection thread on the motor

☞ The impermeability of the coolant connection is in the responsibility of the machine manufacturer and has to be tested and acceptet by him after installing the motor.

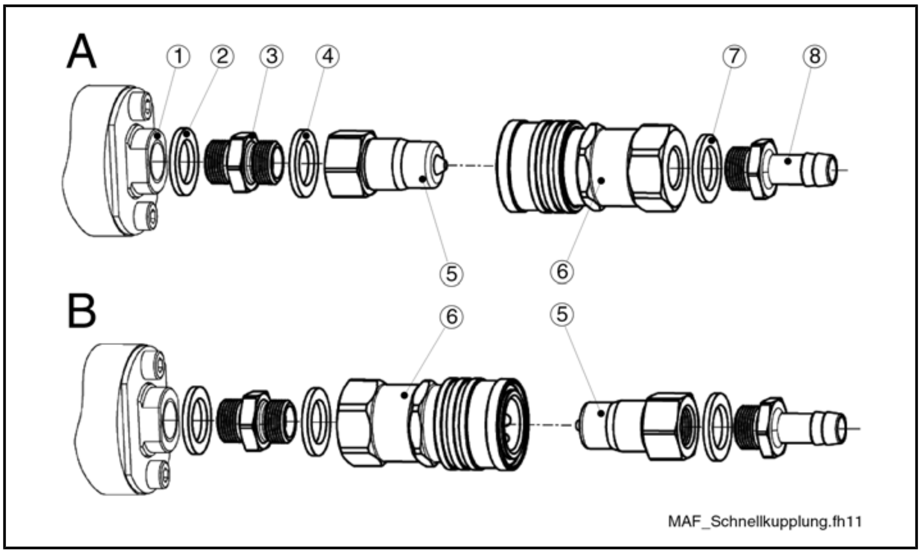
Furthermore, a regular test of correct state of the coolant connection should be stored in the maintenance plan of the machine.

**Quick Coupler**

The quick coupler is another option for the coolant connection. It has a leak protection at both sides and can be released also under full pressure of the coolant system.

If a motor having this coolant connection is ordered, all parts of the quick coupler are included in the motor delivery. In accordance with the ambient conditions of the motor, the user can select one of two mounting options for the quick coupler.

1. **Option A**: Sealing nipple mounted at motor side
2. **Option B**: Coupling mounted at motor side




| | |
|---|---|
| ① | Connection threads at the motor |
| ②④⑦ | Seal |
| ③ | Double nipple |
| ⑤ | Sealing nipple |
| ⑥ | Coupling |
| ⑧ | Threaded nozzle for hose |

*Fig.8-32: Mounting options of the quick coupler*

☞ First, connect the double nipple of the quick coupling with the coupling or the sealing nipple of the quick coupling. After that, screw the double nipple into the connection thread at the motor. This procedure prevents any multiple stress on the connection thread in the motor during mounting.

When mounting the quick coupler, observe

- the correct position of the seals and
- the tightening torques between the individual coupler components specified below.

| Thread sizes of the quick coupler | Permissible tightening range [Nm] between the components of the quick coupler |
|---|---|
| 1/4" | 23...25 |
| 1/2" | 28...30 |

*Fig.8-33: Permissible tightening torque of the quick coupler*

Once the quick coupler has been attached to the motor, the coolant hose can be slipped over the threaded nozzle and fastened.

When selecting the coolant hose , observe the required inner diameter of the hose $d_i$ pursuant to fig. 8-30 " Overview coolant connections" on page 250.

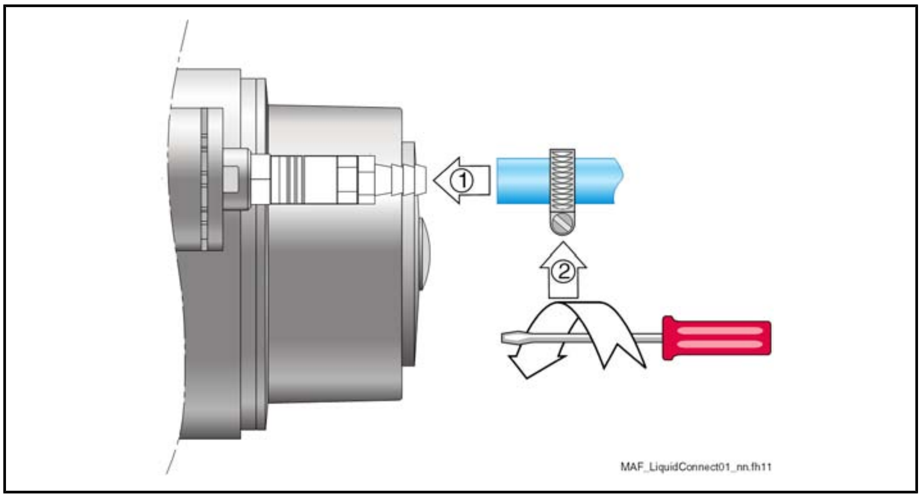



*Fig.8-34: Example for connection of a coolant hose*

**Basic procedure for assembly:**

1. Remove the protective covers of the coolant connection threads at the motor and screw in the pre-mounted quick coupler.
2. Slip the hose on the connection element (threaded nozzle). Avoid any bending or damaging of the screwed connection at the motor side.
3. Screw down the hose end over the connection element with the fixing clamp.
   - For service purposes, the quick coupling may be removed from the sealing nipple using the coupler. It is not necessary to open the hose connection.

If you use another connection technology at the hose side, other assembly steps may be required. Refer to the manufacture for information on assembly.

## 8.11.3 Operating Pressure

A maximum coolant supply pressure of **3bar** applies to all MAF motors, regarding the pressure effectively existing directly at the coolant connection of the motor.

Please note that additional screwed or branch connections in the cooling circuit can reduce the flow and supply pressure of the coolant.

# 9 Application Notes

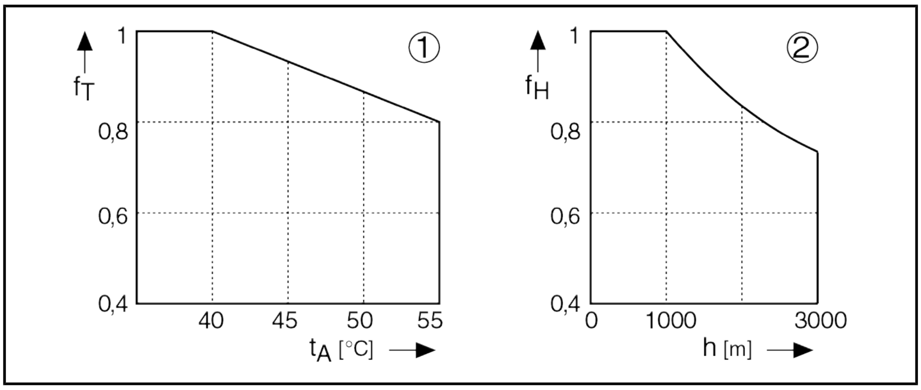
## 9.1 Operating Conditions

### 9.1.1 Setup Elevation and Ambient Temperature

The performance data specified for the motors apply under the following conditions:

- Ambient temperatures ranging from 0 ºC to +40 ºC
- Setup elevation of 0 m to 1,000 m above sea level.

If you want to use the motors in areas with values beyond these ranges, the performance data are reduced according to the following figure.




① Utilization depending on the ambient temperature
② Utilization depending on the setup elevation
$f_T$ Temperature utilization factor
$t_A$ Ambient temperature in degrees Celsius
$f_H$ Height utilization factor
h Setup height in meters
*Fig.9-1: Utilization factors*

If **either** the ambient temperature **or** the setup height exceeds the nominal data:

1. Multiply the motor data provided in the selection data with the calculated utilization factor.
2. Ensure that your application does not exceed the reduced motor data.

If **both** the ambient temperature **and** the site altitude exceed the nominal data:

1. Multiply the load factors $f_T$ and $f_H$ determined.
2. Multiply the value obtained by the motor data specified in the selection data.
3. Ensure that your application does not exceed the reduced motor data.

## 9.2 Humidity

Ambient climatic conditions are defined in different classes according to DIN EN 60721-3-3 (1995), Table 1. They are based on observations made over long periods of time throughout the world and take into account all influencing quantities that could have an effect, such as the air temperature and humidity.

Based on this table, Rexroth recommends class 3K4 for continuous use of the motors.

This class is excerpted in the following table.

| Environmental factor | Unit | Class 3K4 |
|---|---|---|
| Low air temperature | °C | +5 [1]) |
| High air temperature | °C | +40 |
| Low relative air humidity | % | 5 |
| High relative air humidity | % | 95 |
| Low absolute air humidity | g/m³ | 1 |
| High absolute air humidity | g/m³ | 29 |
| Speed of temperature change | °C/min | 0.5 |
| [1]) Rexroth permits 0°C as the lowest air temperature. | | |

*Fig.9-2: Classification of climatic ambient conditions according to DIN EN 60721-3-3, Table 1*

# 9.3 Vibration and Shock

## 9.3.1 Vibration

Sine-shaped vibrations occur in stationary use; depending on their intensity, they have different effects on the robustness of the motors.

The robustness of the overall system is determined by the weakest component.

According to DIN EN 60721-3-3 and DIN EN 60068-2-6, the following values are approved for Rexroth IndraDyn A motors:

| Direction | Amplitude 0 – 55 Hz | Acceleration 55 – 2000Hz |
|---|---|---|
| axial | 0.3 mm | 1 m/s² |
| radial | 0.75 mm | 30 m/s² (10 m/s² in connection with M2/M6 and S2/S6 encoders) |

*Fig.9-3: Maximum values for sine-shaped vibrations*

The construction and effectiveness of vibration-absorbing or vibration-decoupling attachments depends on the application and must be tested using measurements. This does not lie within the area of responsibility of the motor manufacturer. Modifications of the motor construction result in nullification of the warranty.

## 9.3.2 Shock

The shock stress of the motors is indicated by specifying the maximum permitted acceleration in non-stationary use, such as during transport.

Damage to functions is prevented by maintaining the limit values specified.

According to DIN EN 60721-3-3 (1995), the values for IndraDyn A motors are as follows:

| Motor frame size | Maximum admissible shock stress (Duration 11ms) | |
|---|---|---|
| | axial | radial |
| 100...225 | 10 m/s² | 150 m/s² |

*Fig.9-4: Shock stress*

Please, also observe the information in chapter 10 "Handling and Transport" on page 301.

## 9.4 Compatibility Test

All Rexroth controls and drives are developed and tested according to the latest state-of-the-art of technology.

As it is impossible to follow the continuing development of all materials (e. g. lubricants in machine tools) which may interact with our controls and drives, it cannot be completely ruled out that any reactions with the materials used by Bosch Rexroth might occur.

For this reason, before using the respective material a compatibility test has to be carried out for new lubricants, cleaning agents etc. and our housings / our housing materials.

## 9.5 Protection Class

The protection classes according to IEC 60529 are applicable to IndraDyn A motors. All installation situations of the motor have to provide for the motors not being exposed to the ambient conditions outside of the applicable protection class.

The protection class is defined by the abbreviation IP (International Protection) and two reference numbers specifying the degree of protection. The first code number describes the degree of protection against contact and penetration of foreign substances; the second code number describes the degree of protection against water penetration.

| 1st code number | Degree of protection |
|---|---|
| 6 | Protection against intrusion of dust (dust-proof);<br>complete contact protection |
| 5 | Protection against intrusion of dust (dust-secure);<br>complete contact protection |
| 4 | Protection against intrusion of solid foreign bodies, more than 1mm in diameter |
| 2 | Protection against intrusion of solid foreign bodies, more than 12.5 mm in diameter |
| **2nd code number** | **Degree of protection** |
| 5 | Protection against a water jet from a nozzle directed against the housing from all directions (jet water) |
| 4 | Protection against water splashing against the housing from all directions (splash water) |
| 0 | Not protected! |

*Fig.9-5: IP protection classes*

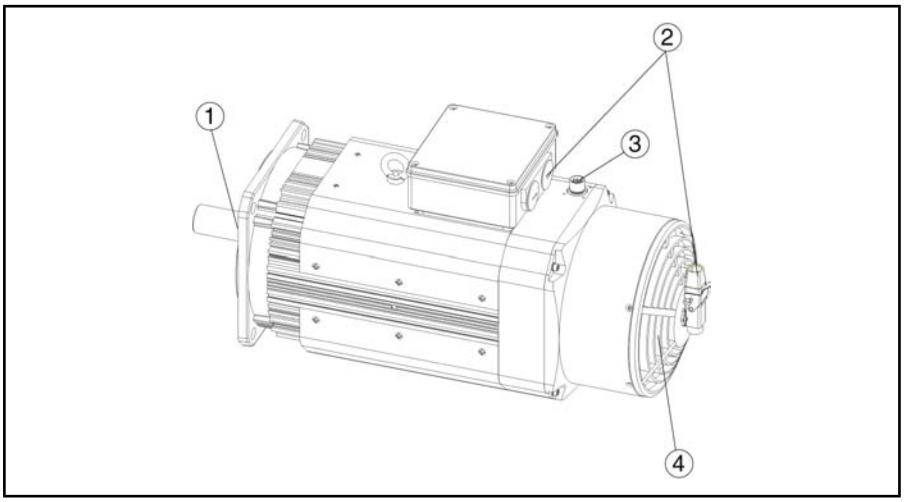



*Fig.9-6:*

| Protection class range | | Protection class | Note |
|---|---|---|---|
| ① | Drift shaft without shaft seal | IP 54 | IP40 with vertical installation situation (see chapter 9.6.3 "Vertical Installation Position" on page 259) |
| ① | Output shaft with shaft sealing ring | IP 65 | Option (see chapter 9.12.3 "Output Shaft with Shaft Sealing Ring " on page 274 |
| ① | Output Shaft with Labyrinth Seal | IP 65 | Option (see chapter 9.12.4 "Output Shaft with Labyrinth Seal" on page 276 |
| ② | Power Connection<br>Fan connection | IP 65 | Terminal box or plug |
| ③ | Connection of motor encoder | IP 65 | |
| ④ | Motor Fan | IP 65 | Fan motor IP 65<br>Fan grid IP 24 |

*Fig.9-7: Definition of the protection class ranges at the motor*

It must be ensured that, in each and every installation position, the motors are not subjected to ambient conditions outside of the particularly applicable protection class according to IEC 60529.

Products and ranges with a low protection class are not suited for cleaning procedures with high pressure, vapor or water jet.

WARNING

**Motor damage by intrusion of liquid!**

Pending liquids (e.g. cooling lubricants, gearbox oil, etc.) at the drive shaft are inadmissible.

When installing gearboxes please use gearboxes with closed (oil-proof) lubrication system only.

# 9.6 Shape and Installation Position

## 9.6.1 General Information

IndraDyn A motors are available in frame shapes B05 and B35. Please refer to the table below for the conditions of installation permissible according to EN 60034-7.

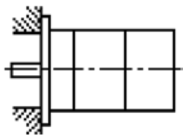
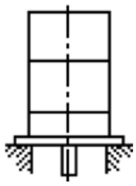
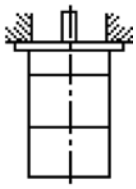
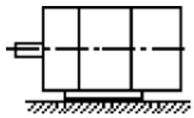
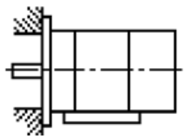
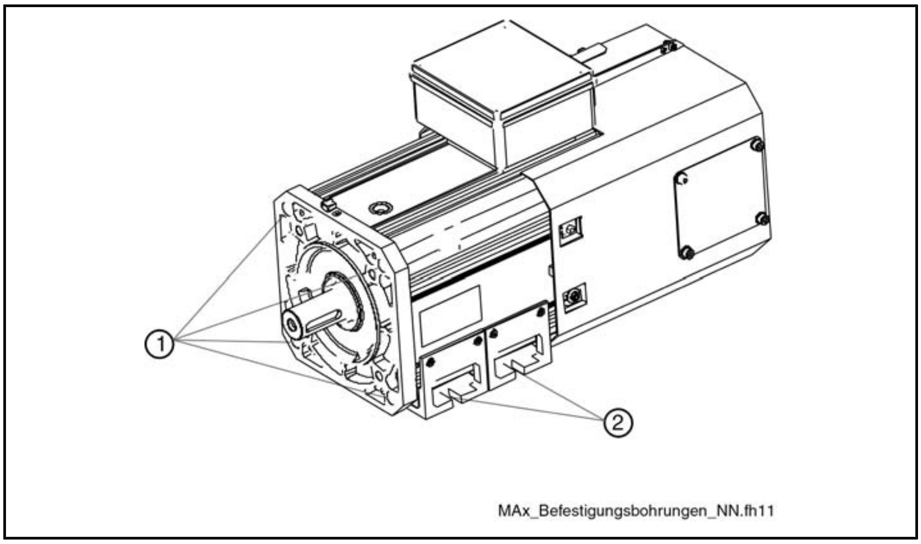
| Motor Frame shape | Permissible conditions of installation Description | Sketch | Setup |
|---|---|---|---|
| B05 | IM B5 |  | Flange mounting on the drive end of the flange |
| | IM V1 |  | Flange attached on the drive side of the flange; drive side pointing down |
| | IM V3 |  | Flange attached on the drive side of the flange; drive side pointing down |
| B35 | IM B3 |  | Foot installation , feet pointing down |
| | IM B5 |  | Flange mounting on the drive end of the flange |

*Fig.9-8: Installation positions*

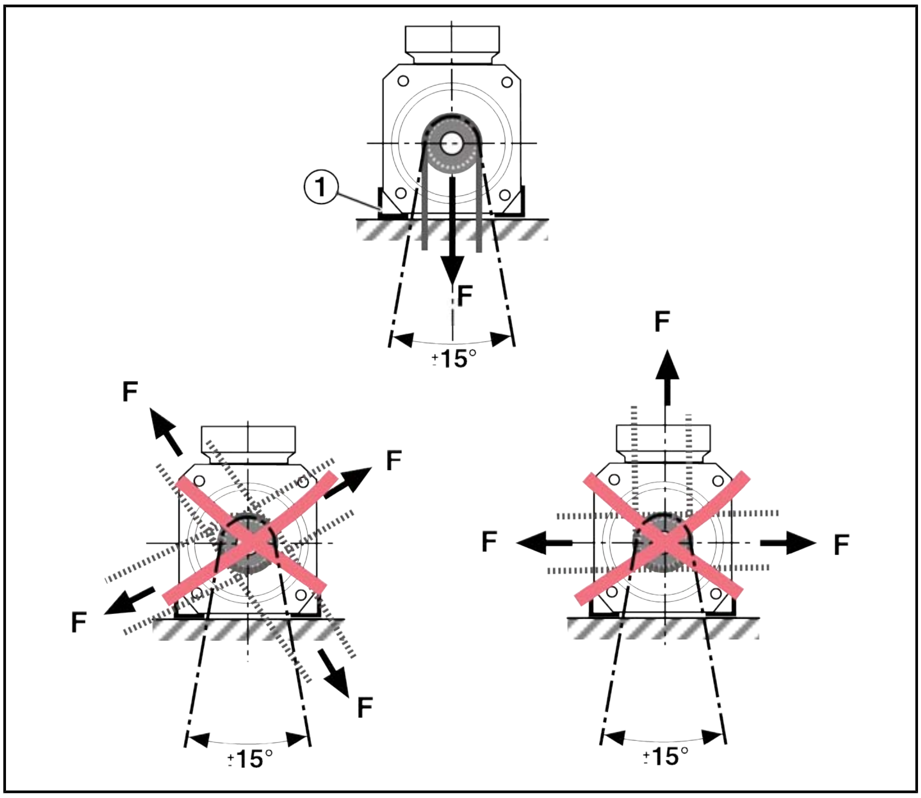
IndraDyn A motors in motor frame shape B35 can either be fixed by means of foot assembly or flange assembly.




① Flange for flange assembly
② Assembly feet (both sides)
*Fig.9-9: Mounting types of the IndraDyn A motors*

## 9.6.2 Foot Assembly

As opposed to flange assembly, the radial forces in the case of foot assembly may act on the assembly surface ( 15°) only in the vertical direction. The transfer of forces with other effective force directions is not permitted.




① Assembly feet
*Fig.9-10: Sample MAF foot assembly*

**When using foot assembly, please pay attention to the following:**

- Forces affecting the motor feet that are transferred from a gearbox are not permitted.
- Forces that are effective via a gearbox shaft must be supported on the gearbox.
- An improper installation situation results in forces that can quickly lead to motor damage.
- The notes in chapter 11 "Installation " on page 305 for foot assembly as well. Check the alternative "flange assembly".

## 9.6.3 Vertical Installation Position

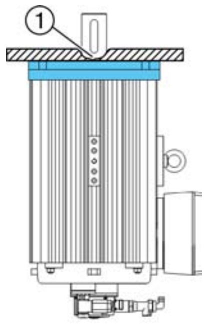
**Overhead Output Shaft**

For vertical installation positions with overhead output shaft (chapter 9.6.3 "Vertical Installation Position" on page 259) , dirt and fluids can enter the motor interior more easily, causing malfunctions or failures.

The protection class on the flange side of motors with a shaft sealing ring is IP 65. Hence, tightness is ensured only in case of splashing fluids. Fluid levels present on the A-side require a higher protection class.

For motors of frame size 225, please also note that by reason of the high rotor weight and the bearing pre-tension, the axial bearing stress (on the B-side) occurring with this installation position is so high that the useful life of the bearing must be expected to be significantly reduced to approx. 30% of the originally calculated bearing life.

For vertical installation position with overhead output shaft, a **bearing life reduced by approx. 30%** has to be taken into account for motors of the frame size 225.




① Shaft grommet IP 40 (standard)
Shaft grommet with radial shaft sealing ring IP65 (option)

*Fig.9-11: Example for MAF in vertical installation position, overhead output shaft*

☞

- **Shaft end:** The protection class on the flange side of motors with a shaft sealing ring is IP 65. However, sealing is ensured only in case of splashing fluids. Liquid levels present on the shaft end require a higher protection class.
- **B side:** The protection class for the fan screens in axial fans is IP 24. Chips or larger dirt particles can penetrate the fan screen as well.
- **Protection class:** The factory-attached protection class of IndraDyn A motors must not be reduced by modifications or by retrofitting accessories.

**Output Shaft at Bottom**

When motors of frame size 225 are operated in vertical installation position with output shaft pointing down and in connection with a coupling, pay attention to the following facts when selecting a suitable coupling:

- the axial pre-tensioning force of the coupling in pre-tensioned state must not exceed **400Nm**.

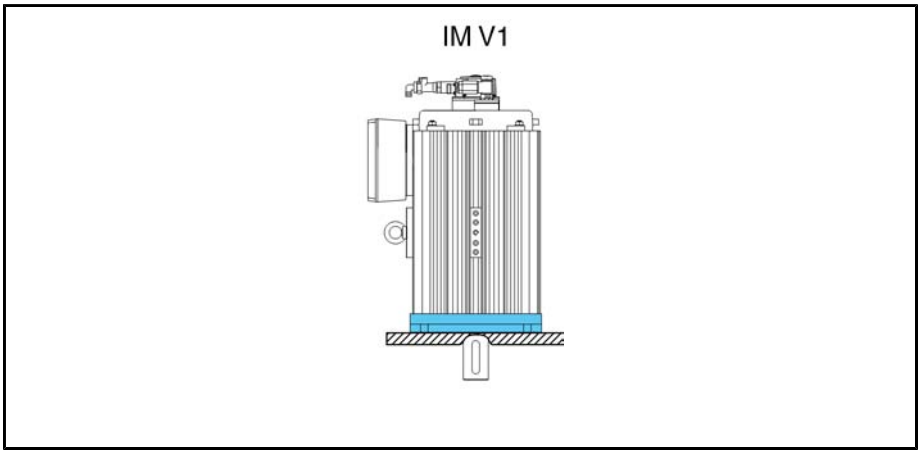



*Fig.9-12: Example for MAF in vertical installation position, output shaft at bottom*

# 9.7 Housing Paint

The housing paint of the motors consists of a black (RAL9005) 2K epoxy resin coating based on

- epoxy polyamide resin in water.

| Chemically resistant against | Limited resistance against | No resistance against |
|---|---|---|
| diluted acids and alkaline solutions | organic solvents | concentrated acids and alkaline solutions |
| water, sea-water, sewage | hydraulic oil | |
| commercial machine oils | | |

*Fig.9-13: Resistance of paint*

The motor housing of standard motors (no ATEX motors) in principle may be recoated with additional varnish having a layer thickness of max 40µm.

Check the adhesion and resistance of the new paint coat before applying it.

Motors in ATEX design are excluded from the aforementioned in order to not to effect the surface properties (e.g. insulation resistance, electrostatic charge) adversely.

☞ Recoating motors in ATEX design is not admissible!

# 9.8 Motor Cooling

## 9.8.1 Fan

**MAD motors** may be operated with fans only. Cooling occurs using air flows that are guided through air plates over the surface of the motor.

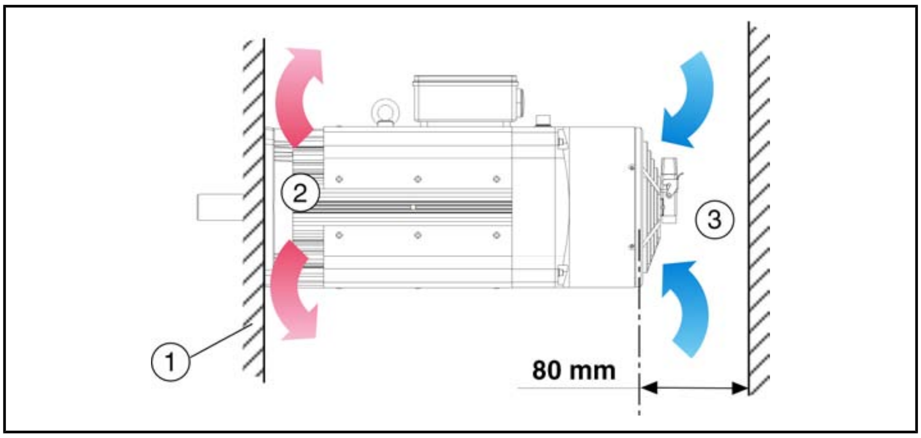
**Axial Fan**

An axial fan is used for cooling purposes. The fan is only available with the ”blowing” option. Please note the information included in the type code.

**Fan Adapter**

For applications where an external fan needs to be attached to the motor, e.g. in heavily soiled or explosive atmospheres, the motors are equipped with a fan adapter for connecting the air hose. For this, observe the product number in the type code, as well as the information in chapter 9.8.2 "Radial Ventilation in Strongly Contaminated or Explosive Atmospheres" on page 262.

In order to ensure that the required amount of air (see chapter 4, ”Technical Data”) can be routed by the axial fan, a minimum distance between the fan screen and the machine must be kept so that the air can be sucked in and flow off. The distance is determined by the motor construction.




① Machine
② Air flow-off space
③ Air suck-in space

*Fig.9-14: MAD ventilation*

- Observe routing the air flow during machine construction. The minimum distance ③ to the other machine parts is 80 mm for all MAD motors.
- The design for all fan variants is "blowing".

Pollution can reduce the performance of the fans and lead to thermal overload of the motors.

When the machine is operated in a polluted environment, increase the system availability by regularly cleaning the fan and motor radiator fins.

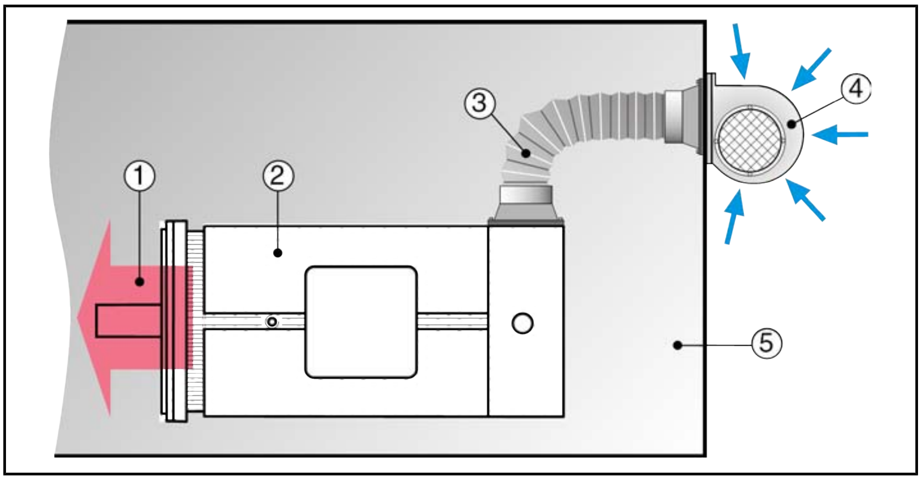
The machine construction must allow easy access to the motor and the fans for maintenance work.

## 9.8.2 Radial Ventilation in Strongly Contaminated or Explosive Atmospheres

When IndraDyn A motors in ATEX design are operated in a potentially explosive or strongly contaminated atmosphere, clean air for the motor cooling has to be supplied externally via a hose or an air duct.

- For this application, select motors with fan cover and fan adapter (type code option "SL") to connect an air hose.

**Sample Application**




① Air exit
② Motor
③ Air duct (not included in scope of delivery)
④ Air entry (not included in scope of delivery)
⑤ Working area

*Fig.9-15: Example for radial ventilation via fan adapter*

The machine manufacturer must select a suitable radial fan for potentially explosive atmospheres under consideration of the machine specification.

Radial fans for IndraDyn A motors are generally not comprised in the Rexroth scope of delivery.

| Fan adapter at the MAD... | Connection diameter for the air hose connection (further details see motor dimension drawing) |
|---|---|
| 100 | Ø 80 mm |
| 130 | Ø 100 mm |
| 160...225 | Ø 150 mm |

*Fig.9-16: Connection diameter at the fan adapter*

☞ After installation of the ventilation system, a specified air volume flow has to be available at the motor (see the information on average air volume in the motor data sheet in chapter 4, "Technical Data").

Accordingly, when selecting radial fans, or in case of central ventilation, the installed length of hose or of air channel and the type of air supply (straight or angled) must be taken into consideration.

- The machine manufacturer carries out the calculation of the required air supply capacity using the system specifications.
- Air channel and fan hoses do not belong to the Rexroth scope of delivery.

Bosch Rexroth recommends the following manufacturer of powerful radial fans and connection material such as air hoses, hose clamps, etc.:

| Source for radial fan | |
|---|---|
| **Elektror**<br>airsystems GmbH | Richard-Hirschmann-Straße 12<br>73728 Esslingen am Neckar, Germany<br>Phone +49(0)711 319 73- 0<br>Fax +49(0)711 319 73- 5000<br>e-mail: info@elektror.de<br>Internet: www.elektror.de |
| **Source for air hoses and connection accessories** | |
| **NORRES**<br>Schlauchtechnik GmbH & Co. KG | Freiligrathstraße 38<br>45881 Gelsenkirchen, Germany<br>Phone +49(0)209 800 00-0<br>Fax +49(0)209 800 00-71/-72<br>e-mail: info@norres.de<br>Internet: www.norres.de |

*Fig.9-17: Sources for radial fans and connection accessories*

**Radial Fan Denominations of the Company Elektror (Preferred Types) for Hose Ventilation**

| Motor frame size MAD... | Fan* | |
|---|---|---|
| | Air hose length 10m | Air hose length 15m |
| 100 | D064M | RD16 |
| 130 | RD64 | RD72 |
| 160 | RD5 | RD6 |
| 180 | RD62 | RD64 |
| 225 | RD7 | RD7 |
| *) for 400V/50Hz | | |

*Fig.9-18: Radial fan preferred types*

If you need more detailed information on radial fans such as technical data, dimension sheets or if you need other radial fans for different supply voltgaes, please contact Elektror.

## 9.8.3 Coolants

**MAF motors** must only be operated using an externally connected cooling system.

The motor power loss $P_V$ transformed to heat is dissipated using the cooling system. Accordingly, MAF motors may only be operated if coolant supply is ensured. The cooling system must be rated by the machine manufacturer in such a way that all requirements regarding flow, pressure, cleanliness, temperature gradient etc. are maintained in every operating state.

Application Notes

CAUTION

**Impairment or failure of motor, machine or cooling system!**

- It is essential that you take into account the motor data and the explanations and conceptions of the cooling systems in the documentation "Liquid Cooling, Dimensioning, Selection", MNR R911265836.
- Heed the manufacturer's instructions when constructing and operating cooling systems.
- Do not use any lubricants or cutting materials from operating processes.

All information and technical data are based on water as the coolant. If other coolants are used , these data no longer apply and must be recalculated.

A cooling with floating water from the supply network is not admissible. Calcareous water can cause deposits or corrosion and damage the motor and the cooling system. Water used as cooling water has to meet certain criteria and, if applicable, has to be treated accordingly. You will find detailed information with your manufacturer for coolant additives (see "Recommended Manufacturers of Coolant Additives" on page 265).

For corrosion protection and for chemical stabilization, the cooling water has to have an additive suitable for mixed-installations with the materials acc. to chapter 9.8.5 "Materials Used" on page 266.

Use of too aggressive coolants, additives, or cooling lubricants can cause irreparable motor damages.

- Use systems with a closed circulation and a fine filter ≤ 100 µm.
- Observe the environmental protection and waste disposal instructions at the place of installation when selecting the coolant.

**Aqueous Solution**

Aqueous solutions ensure reliable corrosion protection without significant changes to the physical properties of the water. The recommended additives contain no materials hazardous to water.

**Emulsion with Corrosion Protection**

Corrosion protection oils for coolant systems contain emulsifiers which ensure a fine distribution of the oil in the water. The oily components of the emulsion protect the metal surfaces of the coolant duct against corrosion and cavitation. An oil content of 0.5 – 2 volume percent has proved to be of value.

If, in addition to its function of corrosion protection, the corrosion protection oil also assumes the function of lubricating the coolant pump, the oil content must approx. be 5 vol.%.

- Observe the instructions of the pump manufacturer!

**Cleaning the Coolant Circuit**

Inspect and clean (purge) the cooling system in regular intervals as specified in the maintenance plan of the machine and cooling system manufacturer respectively.

Note that the utilization of unsuitable cleaning agents may irreparably damage the motor cooling system. This type of damages does not lie within the responsibility of Bosch Rexroth.

CAUTION

**Risk of damage to the motor cooling system by unsuitable cleaning agents! Invalidation of warranty!**

⇒ For cleaning and motor cooling, only liquids or agents must be used that do not corrode the motor cooling system and do not react aggressively to the materials used in our motors.

⇒ Observe the information by the manufacturers of the cleaning agent and the cooling system.

### 9.8.4 Coolant Additives

**Recommended Manufacturers of Coolant Additives**

The proper chemical treatment of the closed water systems is precondition to prevent corrosion, to maintain thermal transmission, and to minimize the growth of bacteria in all parts of the system.

In this context, Bosch Rexroth recommends using coolant additives of the company NALCO Deutschland GmbH.

Depending on the size of the cooling system, the user may use different additives in form of "ready-to-use cooling water" and "water treatment kits".

> The packaging size and the ingredients of the water treatment kit are completely adapted to the corresponding system volume and the user may fill them into the coolant reservoir without observing further mixing ratios.

**Ready-to-use cooling water (company NALCO)**

| System volume in liters | Ordering designation | Additives NALCO... |
|---|---|---|
| 0.5-50 | Nalco PCCL100.11R | PCCL100 |

*Fig.9-19: Ready-to-use cooling water (company NALCO)*

**NALCO PCCL100**

... is a ready-to-use, preserved cooling water for the use in closed cooling water systems. It is supplied directly to the closed systems and contains all reagents in the propter treatment concentration.

Nalco PCCL100 is a corrosion inhibitor protecting iron, copper, copper alloys and aluminum against corrosion. Nalco PCCL100 is free of nitrite and minimizes the micro-biological growth.

**Water treatment kits (company NALCO)**

<table>
<tr><th>System volume in liters</th><th>Ordering designation</th><th>Additives NALCO...</th></tr>
<tr><td>50...99</td><td>480-BR100-100.88</td><td rowspan="4">TRAC100<br>7330<br>73199</td></tr>
<tr><td>100...199</td><td>480-BR100-200.88</td></tr>
<tr><td>200...349</td><td>480-BR100-350.88</td></tr>
<tr><td>349...500</td><td>480-BR100-500.88</td></tr>
</table>

*Fig.9-20: Water treatment kits (company NALCO)*

**NALCO TRAC100**

... is a liquid corrosion and film inhibitor for the use in closed cooling systems. Optionally with TRASAR technology: it monitors, shows and dosages the product automatically to its target concentration and continuously protects the system. NALCO TRAC100 is a complete inhibitor protection iron metal, copper alloys and alumnum against corrosion. NALCO TRAC100 is free of nitrite and minimizes the requirements for micro-biological control.

**NALCO 7330**

... is a non-oxidizing broad band biocide and approved for application in closed cooling circuit systems.

**NALCO 73199**

... is an organic corrosion inhibitor supporting a fast own protection layer and covering protection layer for non-ferrous metals.

The above additives are part of the preventive water treatment program by Nalco. It comprises not only the chemicals but also test methods, service and equipment. All these are made available to the user of the products.

The water treatment program is a specification for the user and describes the minimum requirements. Consult Nalco on any additional equipment, tests and services to ensure optimum performance and system protection of the cooling systems.

For additional information and order placement, please contact:

- **NALCO Deutschland GmbH**
  Plankstr. 26
  71691 Freiberg/Neckar, Germany
  Fax +49(0)7141-703-239
  slund@nalco.com
  www.nalco.com

Bosch Rexroth is not in a position to give general statements or carry out investigations regarding applicability of process-related coolants, additives, or operating conditions.

The performance test for the used coolants and the design of the liquid coolant system are generally the responsibility of the machine manufacturer. See also chapter 9.4 "Compatibility Test" on page 255.

## 9.8.5 Materials Used

When used with MAF motors, the coolant comes into contact with the following materials:

| Motor, housing | Screwed connections | Quick coupler |
|---|---|---|
| CU, CuZn39Pb2 | Brass, chromium-plated | Brass, chromium-plated |

*Fig.9-21: Materials in the cooling loop*

In dimensioning and operating the cooling system, the machine manufacturer has to exclude all chemical or electro-chemical interactions with subsequent corrosion or decomposition of motor parts.

## 9.8.6 Coolant Inlet Temperature

IndraDyn A motors are designed according to DIN EN 60034-1 for operating with +10...+40°C coolant inlet temperature. This temperature range must be strictly observed. At higher coolant temperatures, the reduction of the available torque is increased. Because of high coolant temperature gradients, lower temperatures may lead to destruction of the motor.

Install systems in the cooling circuit for monitoring flow, pressure and temperature.

**Setting the Inlet Temperature**

The coolant inlet temperature has to be set considering the specified temperature range and the existing ambient temperature.

The lower limit of the recommended coolant inlet temperature can be limited in dependence on the existing ambient temperature. To avoid condensation , a value of max. 5 °C below the existing ambient temperature is permitted as the lowest temperature to be set.

**Example 1:**

Permitted coolant inlet temperature range: +10...+40°C

Ambient temperature: +20°C

Coolant inlet temperature to be set: +15...+40°C

**Example 2:**

Permitted coolant inlet temperature range: +10...+40°C

Ambient temperature: +30°C

Coolant inlet temperature to be set: +25...+40°C

☞ The coolant inlet temperature must be set in a temperature range of +10°C - +40°C and may be only max. 5°C under the existing ambient temperature to avoid condensation.

## 9.9 Motor Temperature Monitoring

In their standard configuration, stators of IndraDyn A motors are equipped with built-in motor protection temperature sensors.

**Temperature Measurement Sensor**

| Description | KTY84-130 |
|---|---|
| Resistor at 25°C | 577 Ohm |
| Resistor at 100°C | 1,000 Ohm |
| Continuous current at 100°C | 2 mA |

*Fig.9-22: Sensor temperature measurement*

The activation temperatures set on the controller side for protection of the motor are specified at:

⇒ **110°C** pre-warning temperature

⇒ **120°C** shut-down temperature

**Exception:**

- frame size MAD225 ⇒ **120°C** pre-warning temperature
- frame size MAD225 ⇒ **130°C** shut-down temperature

☞ Ensure correct polarity when using the sensor for an external temperature measurement.

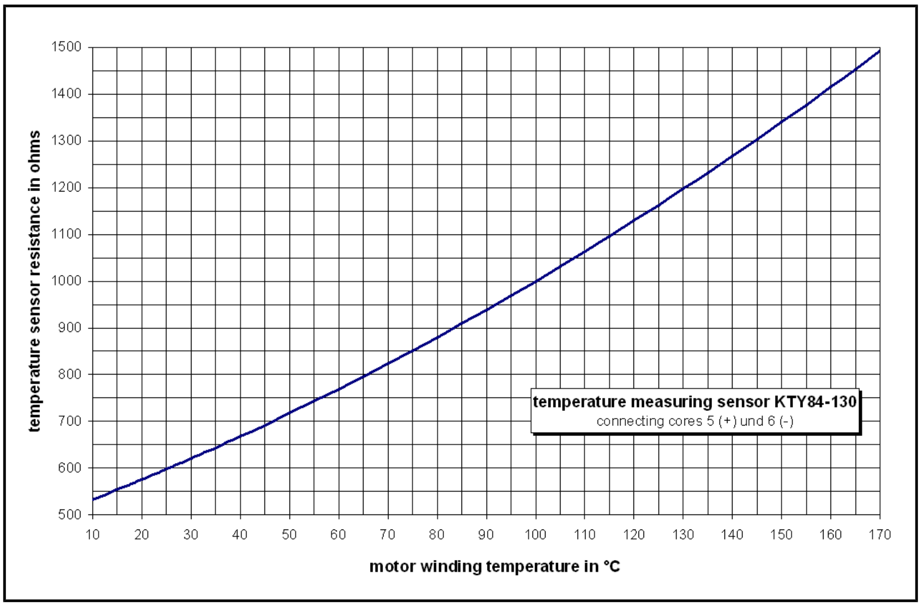



*Fig.9-23: Characteristic of temperature measurement sensor KTY84-130 (PTC)*

A polynomial of degree 3 is sufficient for describing the resistance characteristic of the sensor used for temperature measurement (KTY84-130). In the following, this is specified for determining a temperature from a given resistance and vice-versa.

Application Notes

**Temperature Depending on Resistance**

$$T_w = A \cdot R_{KTY}^{\,3} + B \cdot R_{KTY}^{\,2} + C \cdot R_{KTY} + D$$

$T_w$ Winding temperature of the motor in °C
$R_{KTY}$ Resistance of the temperature sensor in Ohms
$A = 3.039 \cdot 10^{-8}$
$B = -1.44 \cdot 10^{-4}$
$C = 0.358$
$D = -143.78$

*Fig.9-24: Polynomial used for determining the temperature with a known sensor resistance (KTY84)*

**Resistance Depending on Temperature**

$$R_{KTY} = A \cdot T_w^{\,3} + B \cdot T_w^{\,2} + C \cdot T_w + D$$

$T_w$ Winding temperature of the motor in °C
$R_{KTY}$ Resistance of the temperature sensor in Ohms
$A = 1.065 \cdot 10^{-6}$
$B = 0.011$
$C = 3.93$
$D = 492.78$

*Fig.9-25: Polynomial used for determining the sensor resistance (KTY84) with a known temperature*

☞ Note the correct polarity when using the sensor for temperature measurement.

You can find further details on connecting the temperature sensors in chapter 8 ”Connection Techniques”.

# 9.10 Holding Brake (Option)

## 9.10.1 General Information

In **normal operation**, use the brake only when at a standstill and when performing the drive-internal brake check. The motor holding brake is required for holding the axle when the machine is in a de-energized state.

DANGER

Dangerous movements! Persons endangered by falling or descending axles!

⇒ Observe supplementary standards and directives. For European countries:

**- DIN EN 954 / 03.97 on security-related parts of controllers.**

**- Instruction sheet for vertical axes**

Editor:

Süddeutsche Metall-Berufsgenossenschaft

Fachausschuss Eisen und Metall II

Wilhelm-Theodor-Römheld-Str. 15

D-55130 Mainz, Germany

USA: See National Electric Code (NEC), National Electrical Manufacturers Association (NEMA) as well as regional building regulations.

The following is generally valid: Comply with all applicable national regulations!

⇒ The serially delivered motor holding brake does not suffice to ensure protection of persons!

⇒ Ensure protection of persons by superordinate fail-safe measures.

- Cordon off the hazardous area by means of a safety fence or a safety screen.
- Additionally secure vertical axes to prevent them from sinking or descending after having shutdown the motor, for instance as follows:
  - lock the vertical axes mechanically,
  - provide an external braking / collecting / clamping device, or
  - ensure sufficient weight compensation of the axes.
  - miscellaneous suitable measures..

**Brake Control**

The brake's control mechanism must ensure this function in normal operation. **Under the worst stress condition of power supply a voltage of 24 VDC +/- 10% has to be provided to the motor.** To identify a failure on time during operation, the power supply for the brakes must be monitored by an undervoltage detection system.

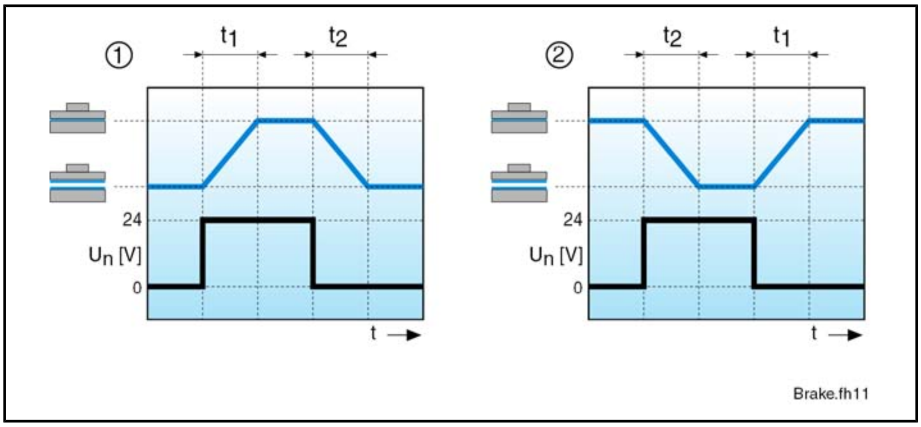
**Functional Test**

Before startup and during operation specifications the brake function must be tested with the "brake command" function. By applying a small amount of motor torque, the brake is checked for slippage. Additional information and specifications on this function may be found in the firmware functional descriptions of the Rexroth controllers.

## 9.10.2 Selecting Holding Brakes

### General Information

Brakes are either electrically clamping or electrically releasing. Due to functional differences, different brakes should be used for main spindle and servo-axles. Observe the safety requirements during the system design.




| | |
|---|---|
| ① | Electrically clamping brake |
| ② | Electrically releasing brake |
| $t_1$ | Connection time holding brake clamping delay |
| $t_2$ | Separation time holding brake release delay |

*Fig.9-26: Wiring diagram of the holding brake*

## Main Spindle Applications

**Electrically Clamping Holding Brake**

The **electrically clamping** holding brake can be used to lock a main spindle during standstill and when the control ”controller enable” signal is off, e.g. when a tool change is performed without a closed position loop.

- Clamp the motor at standstill only, after the controller has signaled the motor is at standstill.

The **electrically releasing** holding brake should not be used for main spindles. Such use can lead to pre-mature deterioration or even destruction of the brake when the holding brake is unintentionally clamped at high motor speed (e.g. under power loss or wire breakage situations).

## Servo Applications

**Electrically Releasing Holding Brake**

The **electrically releasing** holding brake is used to hold the axes at a standstill and when the ”controller enable” signal is off. When the supply voltage fails and the controller is enabled, the **electrically releasing** holding brake will close automatically.

- Do not use the holding brake as an operational brake for moving axes.

If the holding brake is engaged repeatedly on a drive in motion or the rated brake energy is exceeded, premature brake wear can occur.

The **electrically clamping** holding brake is inappropriate for servo applications because clamping in a de-energized clamping state is not possible.

# 9.10.3 Layout of Holding Brakes

## General Information

The physical conditions of holding brakes require consideration of two states. In addition to normal operation, failures must also be considered. The effective braking torques are physically different.

## Normal Operation

In **normal operation**, using the holding brake for clamping of an axis standstill, the brake's static torque (M4) rating in the data sheets applies directly as static friction (M4) – stiction (friction coefficient $\mu_H$).

## Fault Condition (EMERGENCY STOP)

In **fault conditions (i.e., EMERGENCY STOP)**, where the holding brake is used to stop a moving axis, the ”dynamic braking torque”, or sliding friction (friction factor $\mu_G$) applies.

The dynamic braking torque is reduced in comparison to the indicated static holding torque M4. Therefore, note the following description of dynamic sizing.

**Dynamic Sizing**

The load torque must be lower than the minimum dynamic torque which the brake can provide. Otherwise the deceleration effect of the brake is not sufficient to stop the axis.

If a mass is to be decelerated in a defined time or in a defined way, the additional moment of inertia of the whole system must be taken into account.

## Further Important Aspects for Sizing:

The holding brake is not a safety brake (cf. **DIN EN 954 / 03.97, vertical axis data sheet SMBG)**. Due to uncontrollable influencing factors such as a rust film on the brake surface, the brake holding torque can be reduced. Additionally, excessive voltages and temperatures can weaken the permanent magnets and the brake.

**Recommendation for Brake Sizing**

Bringing these factors together, the following recommendations can be given for sizing the holding brakes to the axles.

**The necessary holding torque required for the application must not exceed a maximum of 60% of the static holding torque (M4) of the used holding brake.**

☞ Do not use the holding brake to stop a moving axle! This is permitted for EMERGENCY STOP situations only. In this situation, the specified rated torque of the holding brake (M4) is reduced to the value of the available dynamic braking torque. Complete deterioration of brake holding capability can be expected after approximately 20,000 revolutions of the brake when clamped.

Observe the instructions on commissioning holding brakes as described in chapter 12 ”Startup, Operation, and Maintenance”.

# 9.11 Motor Encoder

## 9.11.1 Options

"**S2**": Singleturn absolute encoder with EnDat2.1 interface. $1V_{ss}$ sine/cosine signals with 2048 lines per rotation and absolute period assignment within one shaft rotation. The encoder has a data memory which already contains all relevant motor parameters required for commissioning the motor.

”**M2**”: Multiturn absolute encoder with EnDat2.1 interface. $1V_{ss}$ sine/cosine signals with 2048 lines per rotation and absolute period assignment within 4096 rotations. The axle position is recorded if the power fails. The encoder has a data memory which already contains all relevant motor parameters required for commissioning the motor.

"**S6**": Encoder option for explosive areas in pressure-resistant casing with connection cable length 15 m. Technical characteristics same as option "**S2**".

"**M6**": Encoder option for explosive areas in pressure-resistant casing with connection cable length 15 m. Technical characteristics same as option "**M2**".

"**S0**": Singleturn absolute encoder with $I^2C$ interface. $1V_{ss}$ sine/cosine signals with 512 lines per rotation and absolute period assignment within one shaft rotation.

"**M0**": Multiturn absolute encoder with I²C interface. $1V_{ss}$ sine/cosine signals with 512 lines per rotation and absolute period assignment within one shaft rotation. The axle position is recorded if the power fails.

"**C0**": Incremental encoder sine-/cosine signals 1Vss with 2048 lines per rotation.

"**N0**": The motor is supplied without a factory-attached encoder unit. The rear of the motor is blocked by a cover.

☞ You will find information on the required supply voltage of the motor encoders in fig. 6-2 " IndraDyn A motor encoder" on page 201.

## 9.11.2 Compatibility

Due to different encoder technologies, the motor encoders can be connected to certain drive controllers and interfaces only. The encoder data must be parameterized in the controller. The compatibility can be seen in the following table:

| | ECO 03 | DI-AX04 | IndraDrive | | | | | |
|---|---|---|---|---|---|---|---|---|
| Encoder option | DKC 40... 200 | HDD, HDS | AD-VANCED | BASIC OPEN-LOOP | BASIC SER-COS | BASIC PROFI-BUS | BASIC ANA-LOG | BASIC UNIVER-SAL |
| C0, M0, S0 | + | + | + | - | - | - | - | + |
| M2, S2 M6, S6 | - | - | + | + | + | + | + | + |
| **+** compatible **-** incompatible | | | | | | | | |

*Fig.9-27: Encoder compatibility*

## 9.11.3 Accuracy

There are two types of precision for rotary encoders: "absolute precision" and "relative precision".

**Absolute**

The absolute precision of rotary encoders is determined primarily by the quality and precision of the encoder construction as well as by the mechanical attachment to the motor.

The following values apply to IndraDyn A motors:

| Encoder option | Technical data | Absolute accuracy |
|---|---|---|
| **S2, S6** | Singleturn absolute encoder with EnDat2.1 interface. Sinus/cosine signal 1Vss with 2,048 lines | ± 0.0056° (± 20" ) |
| **M2, M6** | Multiturn absolute encoder with EnDat2.1 interface. Sinus/cosine signal 1Vss with 2,048 lines | ± 0.0056° (± 20" ) |
| **S0** | Singleturn absolute encoder with I²C interface. Sinus/cosine signal 1Vss with 512 lines | ± 0.0167° (± 60" ) |

| Encoder option | Technical data | Absolute accuracy |
|---|---|---|
| M0 | Multiturn absolute encoder with I²C interface. Sinus/cosine signal 1Vss with 512 lines | ± 0.0167° (± 60" ) |
| C0 | Incremental encoder, sinus/cosine signal 1Vss with 2048 lines | ± 0.0056° (± 20" ) |

*Fig.9-28: Absolute encoder accuracy*

**Relative**

The relative precision of encoder systems is also referred to as "repetitive accuracy". It is determined primarily by the interpolation variances during further processing of the measured signals in the installed and in the external interpolation and digitization electronics.

For 2AD motors, the following guidelines apply for operation with Rexroth drive controllers (as of the publishing date of this documentation):

| Encoder option | Technical data | Relative accuracy |
|---|---|---|
| S2, S6 | Singleturn absolute encoder with EnDat2.1 interface. Sinus/cosine signal 1Vss with 2048 lines | ± 0.001' |
| M2, M6 | Multiturn absolute encoder with EnDat2.1 interface. Sinus/cosine signal 1Vss with 2048 lines | ± 0.005' |
| S0 | Singleturn absolute encoder with I²C interface. Sinus/cosine signal 1Vss with 512 lines | ± 0.001' |
| M0 | Multiturn absolute encoder with I²C interface, sinus/cosine signals 1Vss with 512 lines | ± 0.005' |
| C0 | Incremental encoder<br>Sinus/cosine signal 1Vss with 2048 lines | ± 0.01' |

*Fig.9-29: Relative encoder precision*

Continuous further development of the hardware and firmware for drive controllers may result in variances from the above values. Therefore, always observe the information in the current drive controller documentation.

The precision of encoder systems is only a secondary factor for the precision of processing and positioning processes in a system. Determining factors for the precision that can be attained include the functions of the system and the quality of the mechanical construction, among other things.

### 9.11.4 Encoder Connection

The position of the encoder connection cannot be altered. For more details, refer to the motor dimension sheet and to chapter 8 ”Connection Techniques”.

Detailed information on the encoder connection on the controller side and on setting its parameters can be found in the documentation of the drive controllers.

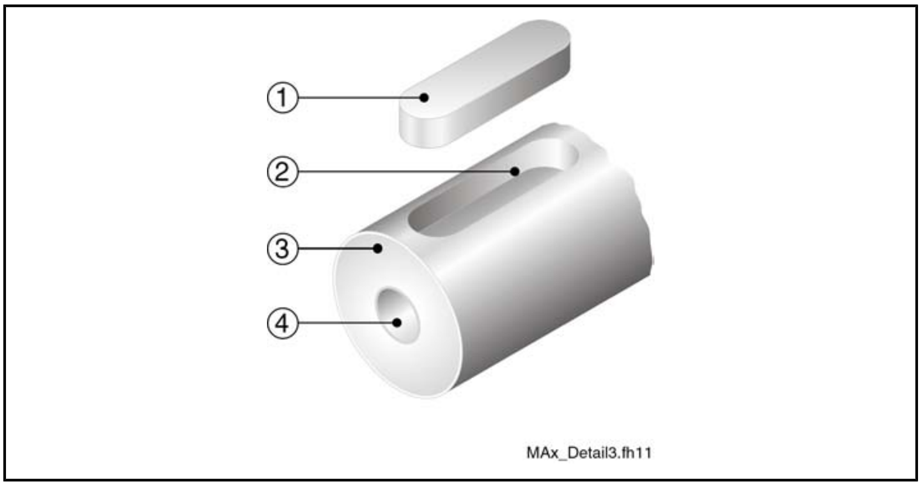
## 9.12 Output shaft

### 9.12.1 Smooth Shaft

The recommended standard model for all IndraDyn A motors provides a non-positive, zero backlash shaft-hub connection with a high degree of quiet running. Use clamping sets, clamping sleeves or clamping elements to couple the machine elements to be driven.

## 9.12.2 Output Shaft with Key

The optional key according to DIN 6885, sheet 1, edition 08-1968, permits keyed transmission of torques with constant direction, with low requirements for the shaft-hub connection.




| | |
|---|---|
| ① | Key |
| ② | Keyway |
| ③ | Motor shaft |
| ④ | Centering hole |
| *Fig.9-30:* | *Output shaft with key* |

The machine elements to be driven must additionally be secured in the axial direction via the centering hole on the end face.

☞ Avoid strong reversing operation. Deformations in the area of the keyway can lead to breakage of the shaft.

**Balance with Half Key**

The motor is balanced by a half key. The mass relationships are similar to those for a plain shaft. Inserting a complete key results in an unbalance that must be compensated on the machine element that is to be driven.

The hub of a machine element that is to be driven (pinion, pulley, etc.) should correspond to the key length.

☞ If the hub is shorter, use a graduated key.

**Balancing with a Complete Key**

The motor is balanced using the included key. Hence, the machine element to be driven must be balanced without a key. The groove length in the hub is independent of the length of the key.

Modifications to keys may be made only by the user himself and on his own responsibility. Bosch Rexroth does not provide any warranty for modified keys or motor drive shafts.

## 9.12.3 Output Shaft with Shaft Sealing Ring

With the optional radial shaft sealing ring according to DIN 3760 – Design A, gearboxes with oil bath or circulating oil lubrication can be attached to IndraDyn A motors. IndraDyn A motors can also be operated in a dusty or humid environment.

☞ For open oil-lubricated gearboxes, strong atomized spray or speeds of over 4000min$^{-1}$ we recommend ordering the motor with labyrinth seal (see chapter 9.12.4 "Output Shaft with Labyrinth Seal" on page 276).

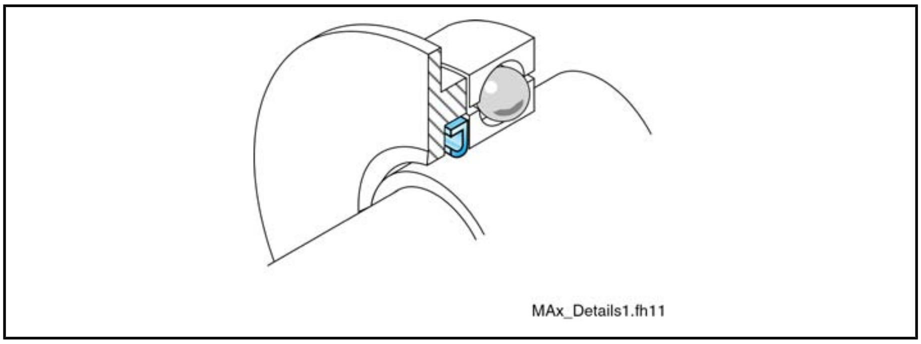



*Fig.9-31: Shaft sealing ring*

**Wear**

Radial shaft sealing rings are rubbing seals. Hence, they are subject to wear and generate frictional heat.

Wear of the rubbing seal can be reduced only if lubrication is adequate and the sealing point is clean. Here, the lubricant also acts as a coolant, supporting the discharge of frictional heat from the sealing point. The useful life of the sealing lip at the radial shaft sealing ring depends in cleanliness, lubrication and motor speed.

☞ Prevent the sealing point from becoming dry and dirty. Always ensure sufficient cleanliness and lubrication.

**Resistance**

The materials used for the radial shaft sealing rings are highly resistant to oils and chemicals. The performance test for the particular operating conditions lies, however, within the machine manufacturer's responsibility.

As of the publication date of this document, the following material assignment is applicable:

| MAD/MAF motor ... | Sealing material | Abbreviation |
|---|---|---|
| 100...160 | Polytetrafluorethylene | PTFE |
| 180 | Viton | FKM |
| 225 | Polytetrafluorethylene | PTFE |

*Fig.9-32: IndraDyn A shaft sealing ring*

The complex interactions between the sealing ring, the shaft and the fluid to be sealed, as well as the particular operating conditions (frictional heat, soiling, etc.), do not allow accurate calculation of the lifetime of the shaft sealing ring.

However, with a circumferential speed of 5 m/s and under favorable conditions (e.g. sufficient cleanliness and lubrication), a useful life of 5,000…10,000 h can be realized.

**Vertical Mounting Positions IM V3/ IM V6**

The protection class on the flange side of motors with a shaft sealing ring is IP 65. Thus, tightness is ensured in case of splashing fluids only. Fluid levels present on the A-side require a higher protection class. In the case of the vertical installation position of the motor, also observe the notes in the section "Vertical Installation" of this chapter.

## 9.12.4 Output Shaft with Labyrinth Seal

To protect the motor output shaft against spraying fluids, IndraDyn A motors of frame size 225 can be directly ordered with labyrinth seal. Please note the correct product number of the motors according to chapter 6, "Type Codes".

The labyrinth seal is provided to prevent the penetration of oil and splashing water (lubricating coolants etc). into the motor.

However, correct functioning of the labyrinth seal is only ensured when

- the motor installation position is horizontal,
- the position of the drain hole is always below the output shaft,
- the fluid level present at the motor is at least 5 mm below the drain hole,
- the motor speed is at least 200min$^{-1}$.

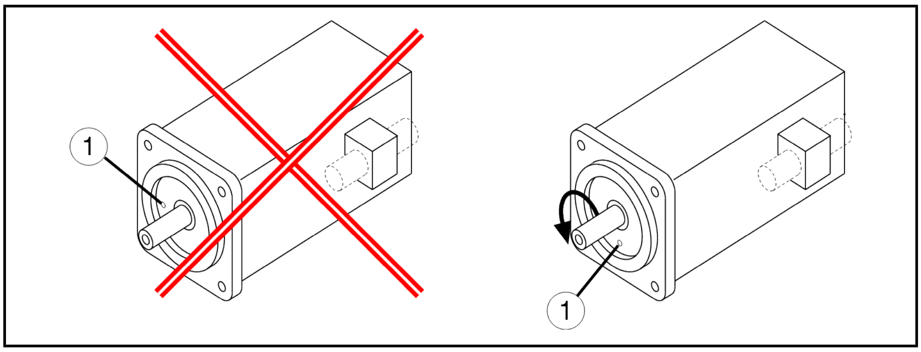
In the delivery state of the motor the labyrinth seal is installed in a way that, when looking on the A-side of the motors, the terminal box and the power connector respectively are on top and the drain hole of the labyrinth seal is at the bottom (below the output shaft) (see fig. 9-34 "Labyrinth seal on the MAD130 (example)" on page 277).

---

☞ In certain installation situations, it may be necessary to install the motor with the power connection positioned at the side or pointing down.

In these cases, turn the flange of the labyrinth seal before installing the motor until the drain hole is once more below the output shaft.

---



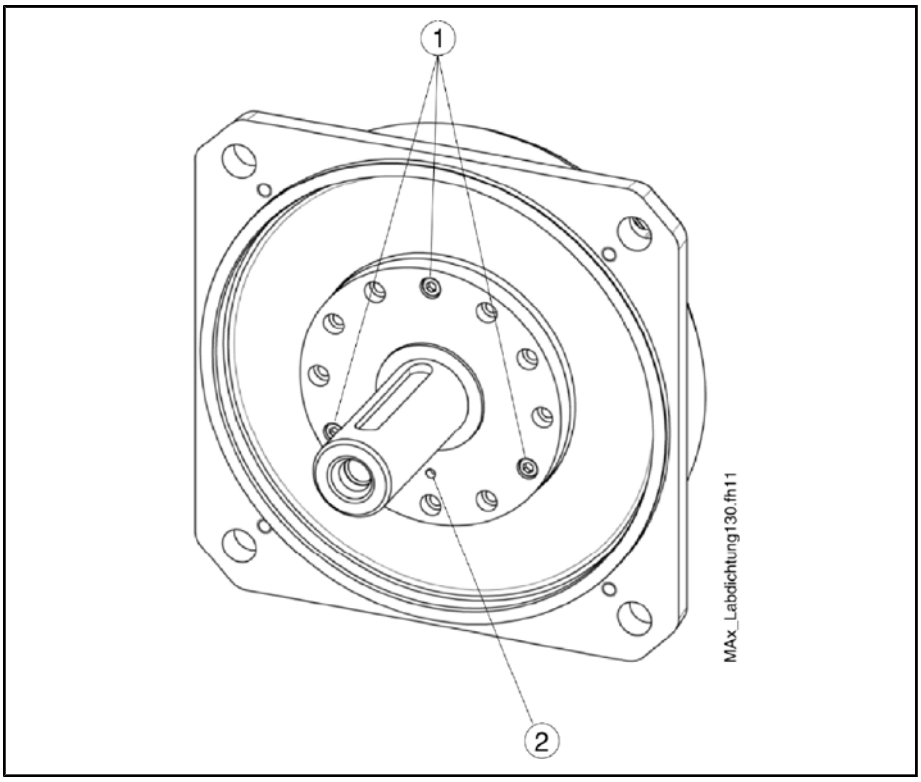

① Drain hole

*Fig.9-33: Example for a permissible position of the drain hole of the labyrinth seal*

**Notes on Modifying the Position of the Drain Hole in the Labyrinth Seal**

If the motor is not installed as in delivery state (power connection on top), the position of the drain hole of the labyrinth seal has to be adapted.

For this, the flange of the labyrinth seal may be rotated in 30° increments. Thus, it is possible to adapt the drain hole in the flange quickly to the properties of the machine, i.e. adjust the drain hole upwards or downwards.




① Fastening screws (4 screws for MAx225)
② Drain hole (always adjust pointing downwards depending on the motor mounting position)

*Fig.9-34: Labyrinth seal on the MAD130 (example)*

In order to bring the position of the drain hole to the required position, the following steps have to be conducted before mounting the motor.

1. Unscrew the fastening screws ① (M6 DIN912).

   ⇒ If necessary, heat the screws to approx. 70°C to loosen them as they are glued in with Loctite 243.

2. Please observe the required mounting position of the motor and rotate the flange into the position, in which the drain hole ② is below the output shaft (see fig. 9-33 " Example for a permissible position of the drain hole of the labyrinth seal" on page 276).
3. Moisten the fastening screws with Loctite 243 and screw them into the holes in the flange into the corresponding threaded holes (observe 30° increments!).

   ⇒ Tightening torque of the fastening screws: 9 Nm

# 9.13 Bearings and Shaft Stress

## 9.13.1 Bearing Variants

Depending on the frame size of the IndraDyn A motors, the following bearing variants are available:

- Standard bearing "**N**" = deep-groove ball bearing
- Fixed bearing A-side "**A**" = deep-groove ball bearing
- High speed bearing "**H**" = deep-groove ball bearing, light construction

- Bearing for increased radial forces "**R**" = deep-groove ball bearing + special bearing seat
- reinforces bearing "**V**" = deep-groove ball bearing + cylinder roller bearing

**Standard Bearing**

Universal bearing type **(type code option "N")** suitable for absorbing low to medium radial and axial forces.

**Advantages:**

- High availability and lifetime.
- Suitable for high speeds.
- Low-noise running.

**Limitation:**

- Suitable for low to medium radial and axial load only.

**Fixed Bearing A-Side**

Universal bearing type **(type code option "A")** suitable for absorbing higher rotating forces.

**Advantages:**

- Higher availability and lifetime during effects of rotating radial forces.
- Allows for absorbing higher rotating radial forces as they may be caused in motor operation in connection with a coupling.
- Higher speeds than R bearing.
- Low-noise running.
- No influence on machine accuracy by thermally related shaft expansion.

**Limitation:**

- Motors with A bearings are not available with brakes.

**High Speed Bearing**

The high speed bearing **(type code option "H")** permits very high speeds due to a deep-groove ball bearing with an accordingly low-weight construction.

**Advantage:**

- Very high speeds are possible.

**Limitation:**

- Can only be used with low radial stress.
- Use in motor frame sizes 100…130 only
  - with horizontal motor installation position, and
  - without shaft sealing ring at the output shaft

**Bearing for Coupler Connection**

This bearing for coupler connection **(type code option "R")** allows for absorbing higher rotating radial forces, which can occur when the motor is operated in connection with a coupler.

**Advantages:**

- Couplers with a somewhat higher radial stiffness can be used.
- High resistance to rotating radial forces which may occur when the motor is operated with a coupler.

**Limitation:**

- The available maximum motor speed is reduced.

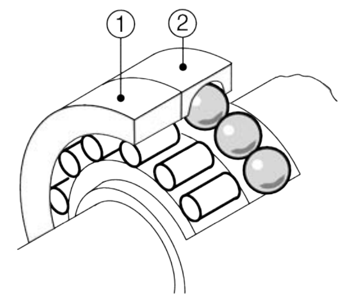
---

☞ This bearing variant is replaced by the bearing variant "fixed bearing A-side" and is not applicable!

---

**Reinforced Bearing**

The reinforced bearing **(type code option "V")** is equipped with an additional cylindrical roller bearing on the output side.




| | |
|---|---|
| ① | Cylindrical roller bearing |
| ② | Deep-groove ball bearing |

*Fig.9-35: Reinforced bearing*

**Advantage:**

- Can absorb higher radial forces .

**Limitation:**

- The grease lifetime of the reinforced bearing is reduced to half of the standard value.
- In certain motors, a reduction of the maximum permitted speed results.
- Motors with a reinforced bearing may be operated with a permanent radial load only. The bearings could be damaged by resulting sliding friction.

Motors with a reinforced bearing must be operated at a minimum with the following radial loads:

| Frame size | 130 | 160 | 180 | 225 |
|---|---|---|---|---|
| Minimum radial load [kN] | 1 | 1.5 | 2 | |

*Fig.9-36: Minimum radial load with reinforced bearing*

Application Notes

## 9.13.2 Tips for Selection

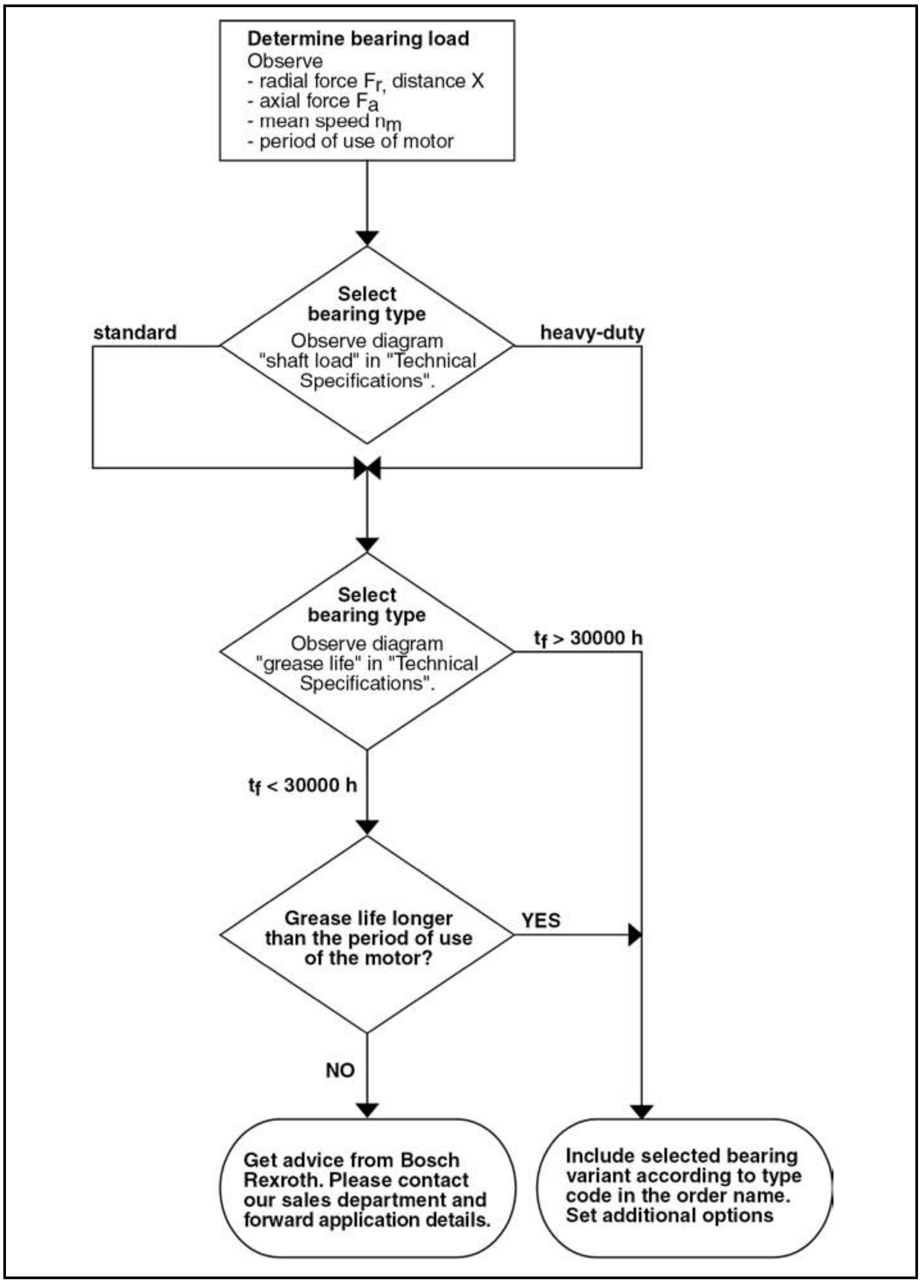



*Fig.9-37: Bearing selection process*

## 9.13.3 Radial Load, Axial Load

During operation, both radial and axial forces act upon the motor drive shaft and thus upon the bearings. Machine design and motor type must be carefully adapted to make sure that the specified stress limits are not exceeded.

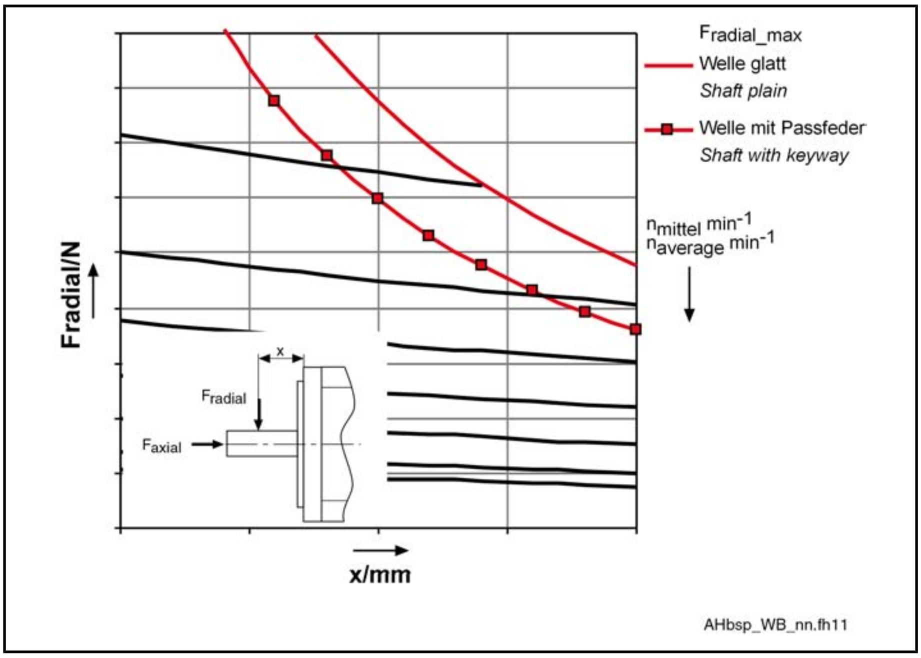



*Fig.9-38: Example of a shaft stress diagram*

**Maximum Permitted Radial Force**

The maximum permissible radial force $F_{radial\_max}$ depends on the following factors:

- Shaft break stress
- Force's point of application x
- Shaft designs (plain; with keyway)

**Permittable Radial Force**

The permitted radial force $F_{radial}$ depends on the following factors:

- Arithmetic mean speed ($n_{mittel}$)
- Force's point of application x
- Bearing Lifetime

**Permittable Axial Force**

For IndraDyn A motors, only low axial shaft stresses are permitted.

| MAD/MAF | 100 | 130...180 | 225 |
|---|---|---|---|
| admissible axial load $F_{axial}$ [N] | 30 | 50 | 100 |

*Fig.9-39: Axial load*

The permitted axial load applies for all installation positions. Therefore, the motors are **not** suitable for machine elements that generate axial load of the motors (e.g. helical driving pinions).

When installing the motor vertically additionally observe the notes in chapter 9.6.3 "Vertical Installation Position" on page 259.

☞ Avoid impermissible axial stresses or jolting of the motor drive shaft.

**Average Speed**

The initialization and deceleration times can be ignored in the calculation if the time in which the drive is operated at a constant speed is significantly higher than the acceleration and deceleration time. In the exact calculation of the mean speed according to the following example, the run-up and braking times are taken into account.

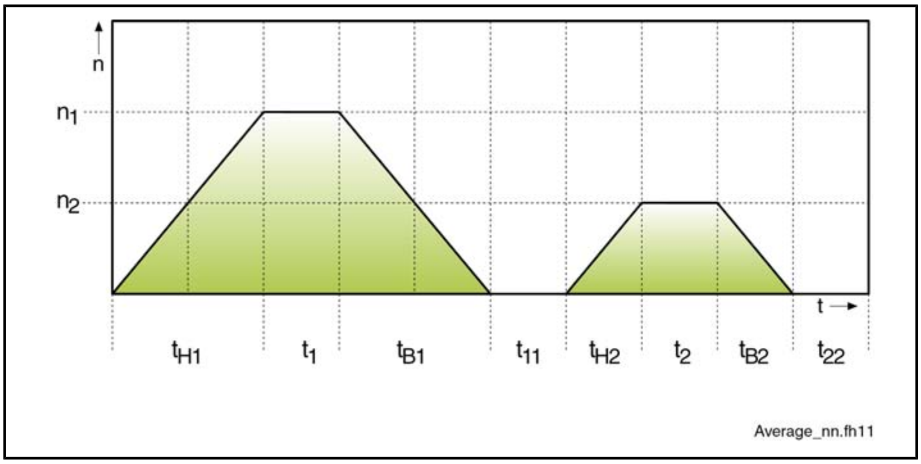



*Fig.9-40: Average speed (graphic representation)*

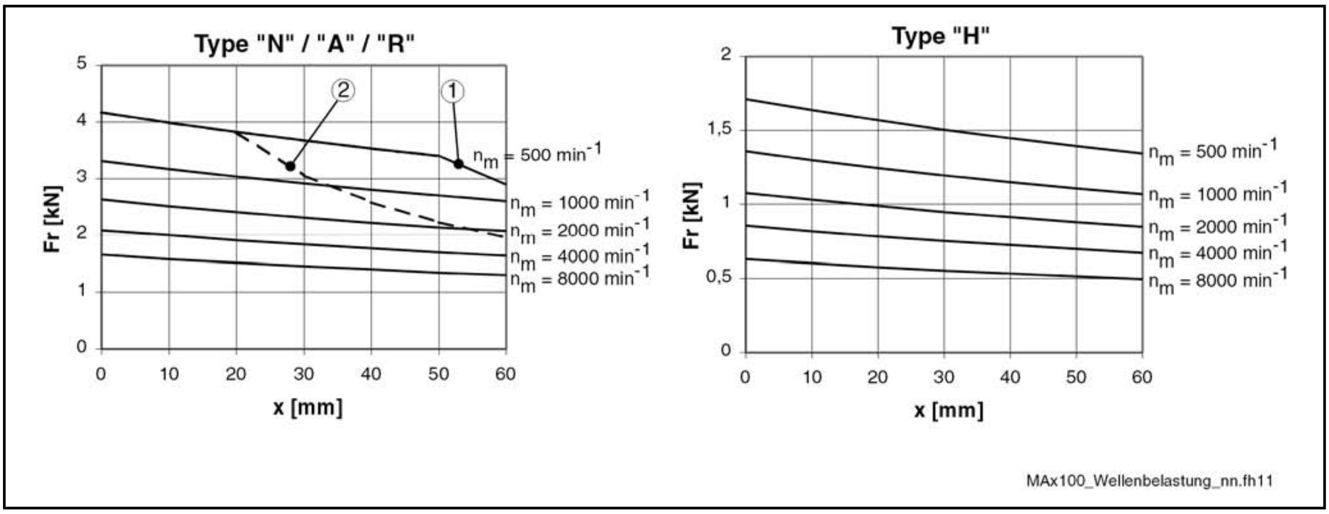
$$n_{1m} = \frac{\frac{n_1}{2} \cdot t_{H1} + n_1 \cdot t_1 + \frac{n_1}{2} \cdot t_{B1}}{t_{H1} + t_1 + t_{B1} + t_{11}}$$

| | |
|---|---|
| $n_{1m}$ | Average speed in section 1 |
| $n_1$ | Processing speed |
| $t_{H1}$ | Run-up time |
| $t_1$ | Processing time |
| $t_{B1}$ | Braking time |
| $t_{11}$ | Standstill time |
| $n_{2m}$ | Average speed in section 2 |
| $n_2$ | Processing speed |
| $t_{H2}$ | Run-up time |
| $t_2$ | Processing time |
| $t_{B2}$ | Braking time |
| $t_{22}$ | Standstill time |

*Fig.9-41: Average speed (calculation formula)*

A complete processing cycle can consist of several sections with different speeds. In this case, the average is to be generated from all the sections.

**Shaft Stress Frame Size 100**

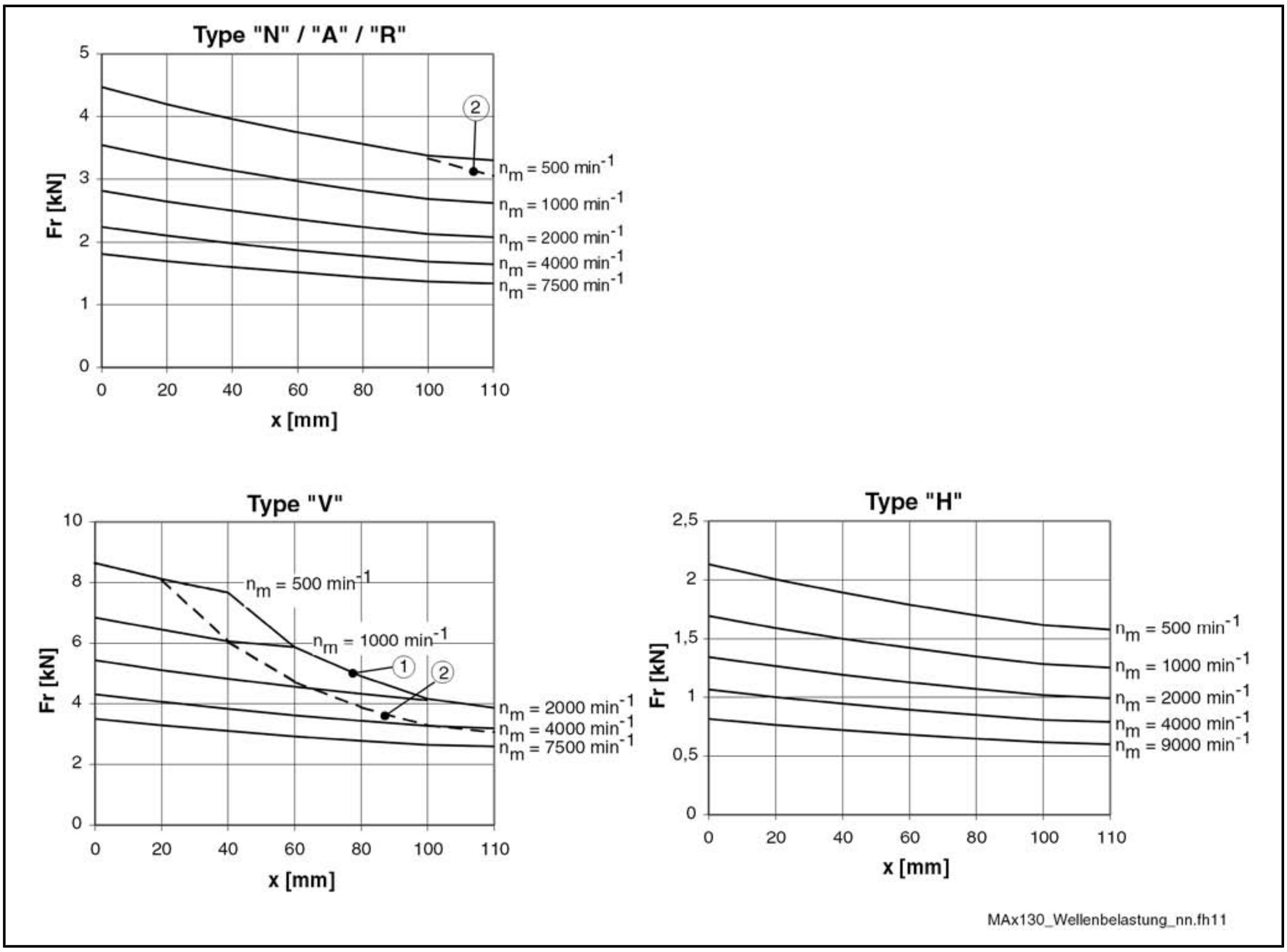



| | |
|---|---|
| "N" | Standard bearings |
| "A" | Fixed bearing A-side |
| "H" | High-speed bearing |
| "R" | Bearing for coupler connection |
| ① | Stress limit for drive shaft without key |
| ② | Stress limit for drive shaft with key |
| $n_m$ | Average speed |

*Fig.9-42:* *Shaft stress frame size 100 (Lh=30,000 operating hours)*

**Shaft Stress Frame Size 130**

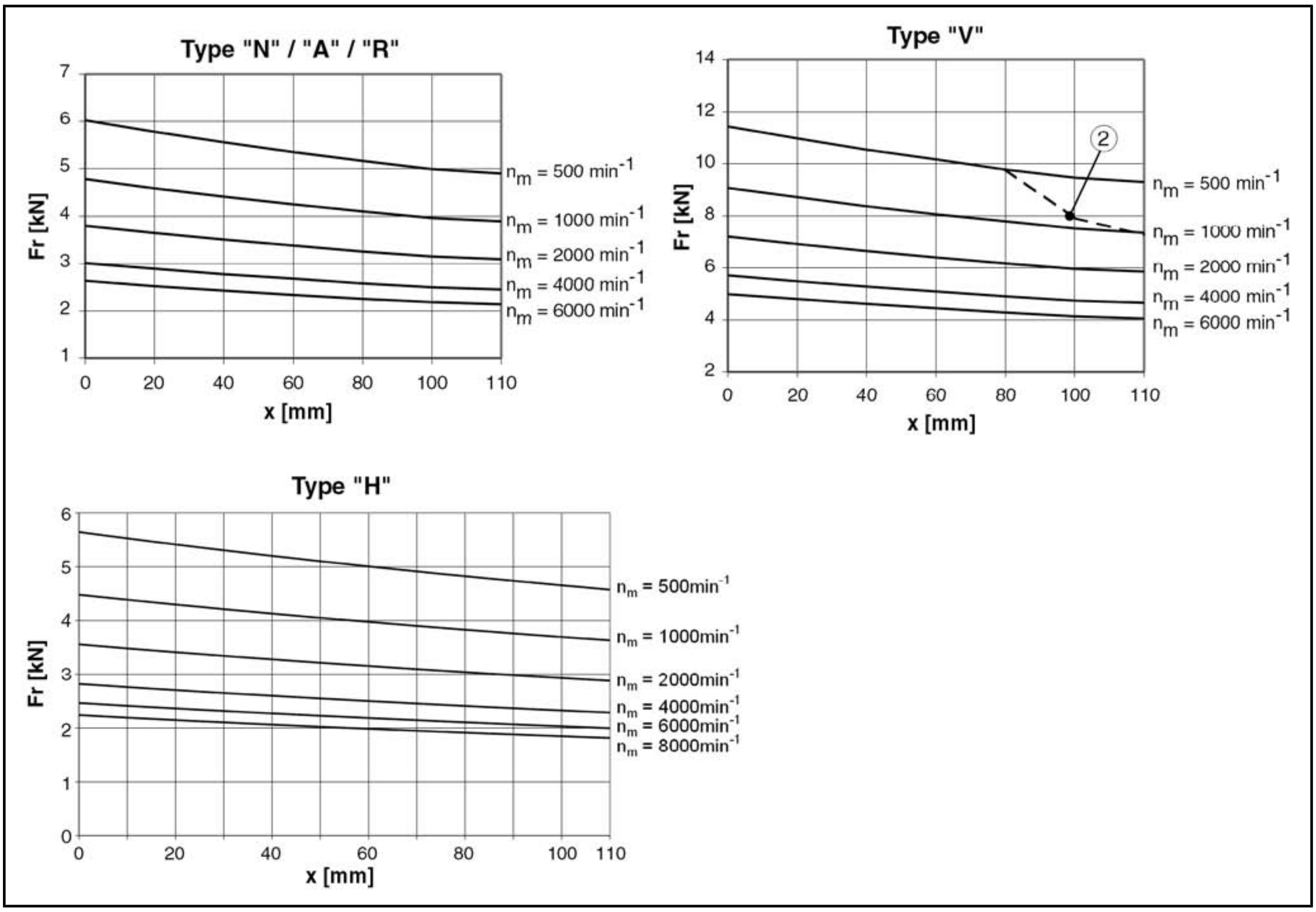
Application Notes




| | |
|---|---|
| "N" | Standard bearings |
| "A" | Fixed bearing A-side |
| "V" | Reinforced bearing |
| "R" | Bearing coupler connection |
| "H" | High-speed bearing |
| ① | Stress limit for drive shaft without key |
| ② | Stress limit for drive shaft with key |
| $n_m$ | Average speed |

*Fig.9-43: Shaft stress frame size 130 (Lh=30,000 operating hours)*

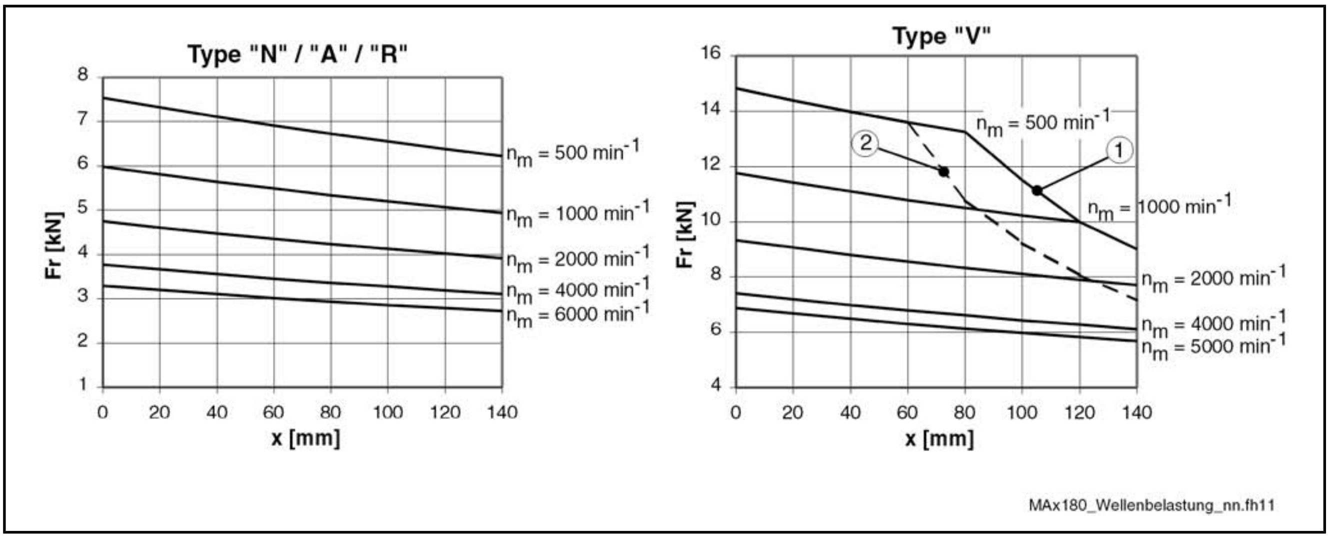
**Shaft Stress Frame Size 160**




| | |
|---|---|
| "N" | Standard bearings |
| "A" | Fixed bearing A-side |
| "R" | Bearing for coupler connection |
| "V" | Reinforced bearing |
| ① | Stress limit for drive shaft without key |
| ② | Stress limit for drive shaft with key |
| $n_m$ | Average speed |
| *Fig.9-44:* | *Shaft stress frame size 160 (Lh=30,000 operating hours)* |

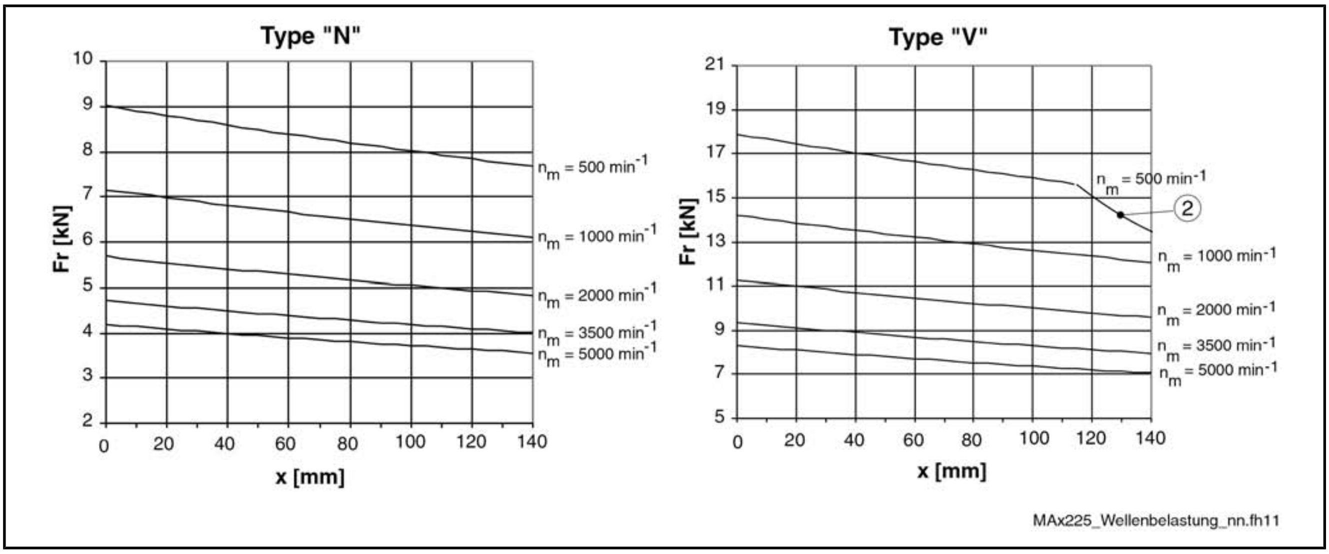
**Shaft Stress Frame Size 180**

Application Notes




| | |
|---|---|
| "N" | Standard bearings |
| "A" | Fixed bearing A-side |
| "R" | Bearing for coupler connection |
| "V" | Reinforced bearing |
| ① | Stress limit for drive shaft without key |
| ② | Stress limit for drive shaft with key |
| $n_m$ | Average speed |
| *Fig.9-45:* | *Shaft stress frame size 180 (Lh=30,000 operating hours)* |

**Shaft Stress Frame Size 225**




| | |
|---|---|
| "N" | Standard bearings |
| "V" | Reinforced bearing |
| ② | Stress limit for drive shaft with key |
| $n_m$ | Average speed |
| *Fig.9-46:* | *Shaft stress frame size 225 (Lh=30,000 operating hours)* |

# 9.14 Attachment of Drive Elements

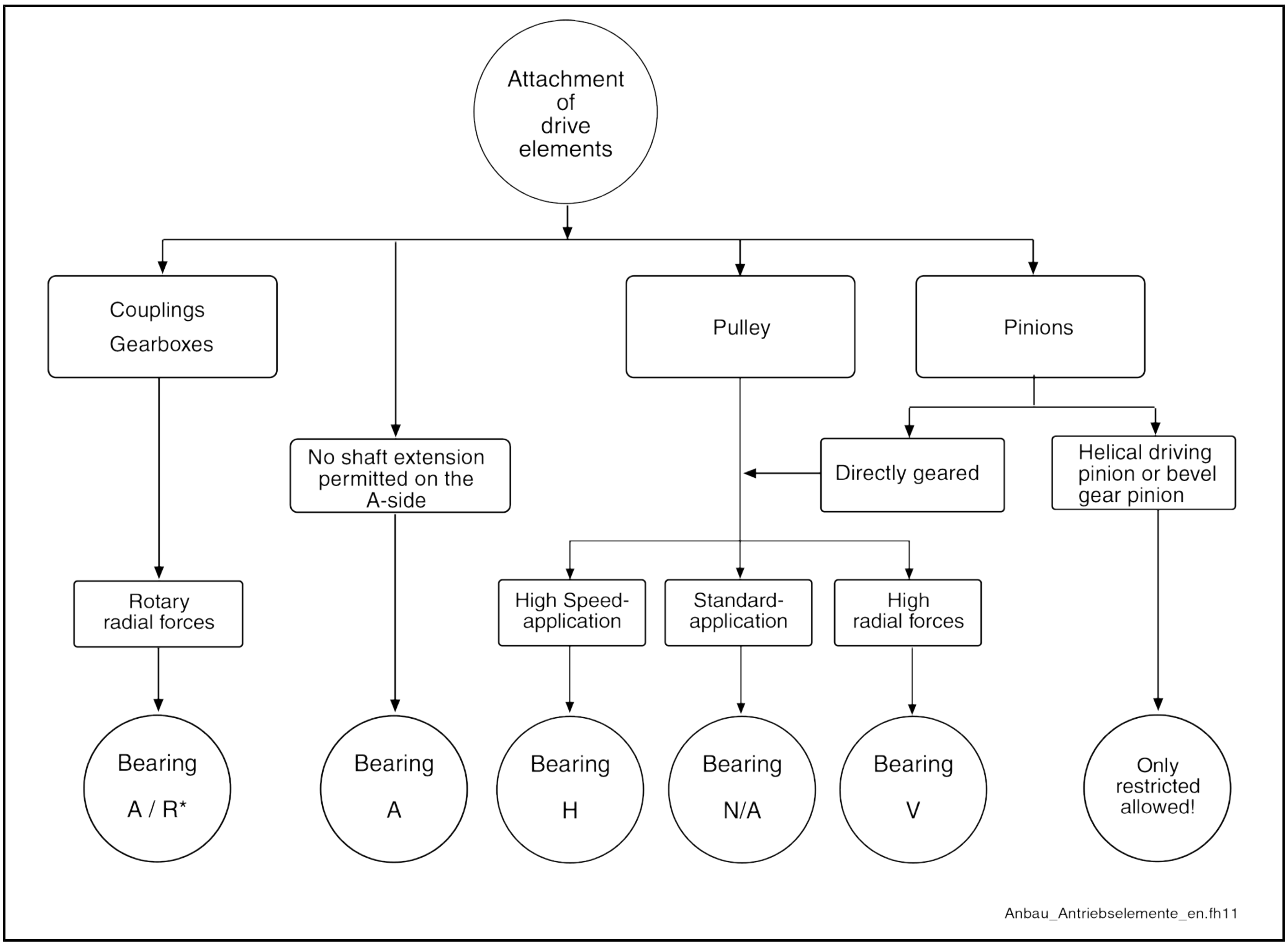
## 9.14.1 General Information

Whenever attaching drive elements to the output shaft, such as

- Gearboxes

- Couplers
- Belt pulley
- Bevel wheels

please be sure to observe the following notes.




*) Bearing "R" will be replaced by bearing "A" and does no longer apply

*Fig.9-47: Attachment of drive elements*

**Overdetermined Bearings**

Generally, overdetermined bearings are to be avoided by all means when connecting drive elements. The tolerances inevitably present in such cases will lead to additional forces acting on the bearing of the motor shaft and, should the occasion arise, to a distinctly reduced service life of the bearing and/or to fatigue transverse rupture/vibration rupture of the motor shaft.

☞ If redundant attachment cannot be avoided, it is absolutely necessary to consult with Bosch Rexroth.

## 9.14.2 Gearboxes

**WARNING**

**Motor damage by intrusion of liquid!**

Pending liquids (e.g. cooling lubricants, gearbox oil, etc.) at the drive shaft are inadmissible.

When installing gearboxes please use gearboxes with closed (oil-proof) lubrication system only.

## 9.14.3 Couplers

Couplers are attached to transmit torques of two separate shaft ends. Usually, shaft offset, angle errors or axial distances must be offset. When an excessively stiff coupler is attached, a rotating radial force (= constantly causing change of angle position) may occur on the shaft end. This rotating radial force can cause an impermissibly high load on the bearing seat and thus a significant reduction of bearing lifetime.

☞ For coupler attachments to IndraDyn A motors, Rexroth offers bearing variant ”A”.

By selection Bearing "A", higher rotating radial forces can be absorbed without limiting the speed of the motor. Furthermore, there is no relevant thermally related change of length in the connection area of the motor output shaft.

| Motor frame size MAD/MAF... | Permitted rotating radial forces | | |
|---|---|---|---|
| | Bearing A | bearing N / H / V | Bearing R* |
| 100B | 1,000 | 25 N | 800 N |
| 100C | 1,000 | 25 N | 800 N |
| 100D | 1,000 | 30 N | 800 N |
| 130B | 1,200 | 40 N | 1,000 N |
| 130C | 1,200 | 50 N | 1,000 N |
| 130D | 1,200 | 55 N | 1,000 N |
| 160B | 1,500 | 65 N | 1,300 N |
| 160C | 1,500 | 65 N | 1,300 N |
| 180C | 1,800 | 95 N | 1,600 N |
| 180D | 1,800 | 100 N | 1,600 N |
| 225C | not available | 120 N | not available |
| *) Bearing "R" will be replaced by bearing "A" and does no longer apply | | | |

*Fig.9-48: Permitted rotating radial forces*

☞ When bearing ”R” is used, a limited maximum speed is available.

For information on the maximum speed of the respective motor, please refer to chapter 4 "Technical Data".

**Coupler Recommendations**

Rexroth recommends using axially offsetting couplers in connection with bearing ”A”, for example

- Spring flange couplers with two sets of springs (double cardanic)
- Metal bellow couplers

These coupler variants are backlash-free and have a high torsion stiffness along with low radial spring stiffness.

☞ Should you be unable to use the recommended coupler variants, it is imperative that you contact Bosch Rexroth.

We recommend e.g. the following manufacturers of the above-named coupling:

- **A. Friedrich Flender GmbH**

  Alfred Flender Straße 77

  46395 Bocholt, Germany

  Phone +49 (0)2871 920

  Fax +49 (0)2871 922 596

Internet:www.flender.com

- **JAKOB GmbH&CoKG**
  Daimler Ring 42
  63839 Kleinwallstadt, Germany
  Phone +49 (0)6022 2208 0
  Fax +49 (0)6022 2208 22
  Internet: www.jakobantriebstechnik.de

- **R+W Antriebselemente GmbH**
  Alexander-Wiegand-Straße 8
  63911 Klingenberg, Germany
  Phone +49 (0)9372 9864 0
  Fax +49 (0)9372 9864 20
  Internet: www.rw-kupplungen.de

## 9.14.4 Skew Bevel Driving Pinions

By attaching skew bevel driving pinions directly to the drive shaft, the motor bearings are exposed to inadmissible operating conditions in the area of the force dead center (dead center between accelerating and braking and vice versa). Additionally, the flange-side end of the output shaft may displace in relation to the motor housing due to thermal effects. In doing so, the admissible axial forces of the motor bearings may be exceeded.

---

☞ The **direct attachment** of skew bevel driving pinions to the output shaft of the motor is not admissible.

With skew bevel driving pinions, only drive elements with their own bearings may be used which are connected to the motor shaft via axially compensating couplers.

---

## 9.14.5 Bevel Gear Pinions

Additionally, the flange-side end of the output shaft may displace in relation to the motor housing due to thermal effects depending on the motor bearings selected. In doing so, the admissible axial forces of the motor bearings may be exceeded.

When using bevel gear pinions directly attached to the output shaft, this change in length results in a thermally dependent axial force, if the drive pinions are specified axially on the machine side. This causes the risk of exceeding the maximum permissible axial force or of the play within the gears increasing to an impermissible degree.

---

☞ The direct attachment of bevel gear pinions to the motor shaft thus is admissible for motors with A bearings only.

If bevel gear pinions have to be used in connection with another bearing variant, only drive elements with their own bearings may be used which can be connected to the motor shaft via axially compensating couplers.

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Application Notes

# 9.15 Bearing Lifetime

The bearing lifetime is an important criterion for the availability of IndraDyn motors. When the lifetime is considered, the "mechanical lifetime" of bearing components and materials is differentiated from the "grease lifetime" of the bearing lubricant.

If IndraDyn motors are operated within the limits specified for radial and axial loads, the mechanical service life of the bearings is as follows:

**Mechanical Bearing Lifetime**

**$L_{10h}$ = 30,000 operating hours**

(calculated according to ISO 281, ed. 1993.01)

This applies to all IndraDyn motors based on the following:

- The permitted load of the motor from chapter chapter 9.13 "Bearings and Shaft Stress" on page 277 is never exceeded.
- The motor is operated under the permitted conditions for use and in the permitted ambient temperature range of 0° C to +40° C.
- The ”average speed” driven over the entire processing cycle conforms with the characteristic curves for the grease lifetime, whereby

$$n_m < n_{m\,(t_f = 30000\,h)}$$

| | |
|---|---|
| $n_m$ | Average speed |
| $n_{m(tf)}$ | Average speed for which a grease lifetime of 30,000 h can be expected. |

*Fig.9-49: Average speed (grease lifetime)*

**Differing loads can have the following effects:**

- Premature failure of the bearings due to increased wear or mechanical damage.
- Reduction of the grease lifetime leads to premature failure of the bearing.
- Avoid exceeding the stress limits.

**Mechanical Bearing Lifetime with Increased Radial Force**

In other cases, the bearing lifetime is reduced as follows:

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

| | |
|---|---|
| $L_{10h}$ | Bearing lifetime (according to ISO 281, ed. 12/1990) |
| $F_{radial}$ | Determined permissible radial force in N (Newtons) |
| $F_{radial\_ist}$ | Actually acting radial force in N (Newtons) |

*Fig.9-50: Calculation of the bearing service life L10h if the permissible radial force Fradial is exceeded*

☞ Under no circumstances may the actually acting radial force $F_{radial\_ist}$ be higher than the maximum permissible radial force $F_{radial\_max}$.

## 9.16 Grease Lifetime

The grease lifetime ($t_f$) is defined as the time from start-up until breakdown of a bearing as a consequence of lubrication failure.

Note that unfavorable operating and ambient conditions reduce the grease service life. When calculating the grease service life to be expected ($t_{fq)}$ ), consider certain reduction factors for unfavorable operating and ambient conditions for each individual application. The following table indicates the reduction factors in accordance with the publication no. WL 81 115/4 DA by FAG Kugelfischer AG.

**Reduction Factors**

| Description | Description | Influence | Factor | Comment |
|---|---|---|---|---|
| Influence of dust and moisture at the function surfaces of the bearing | $f_1$ | moderate | 0.9...0.7 | For this environment, Rexroth offers the option ”radial shaft sealing ring”. By using this option ⇨ $f_1$ = 1 |
| | | strong | 0.7...0.4 | |
| | | very strong | 0.4...0.1 | |
| Influence of impact load, vibrations and oscillations | $f_2$ | moderate | 0.9...0.7 | e.g. for machine tools and printing presses |
| | | strong | 0.7...0.4 | e.g. for materials-handling technology (portals) |
| | | very strong | 0.4...0.1 | e.g. for punches, presses |
| Influence of higher bearing temperatures | $f_3$ | moderate (up to 75°C) | 0.9...0.6 | The bearing temperature depends on the motor load. Using a special high temperature grease results in: usage 0...70% ⇨ $f_3$ = 1 usage 71...100% ⇨ $f_3$ = 0.99...0.7 |
| | | strong (75...85°C) | 0.6...0.3 | |
| | | strong (85..120°C) | 0.3...0.1 | |
| Influence of high load | $f_4$ | P/C=0.1...0.15 | 1.0...0.7 | Loading the shaft/bearing correspondingly in accordance with the respective shaft load diagram results in the following for IndraDyn A motors: Load 0...70% ⇨ $f_4$ = 1 Load 71...100% ⇨ $f_4$ = 0.99...0.7 |
| | | P/C=0.15...0.25 | 0.7...0.4 | |
| | | P/C=0.25...0.35 | 0.4...0.1 | |

| Description | De-scrip-tion | Influence | Factor | Comment |
|---|---|---|---|---|
| Influence of air flows through the bearing | $f_5$ | insignificant flows | 0.7...0.5 | In case of proper operation, there is no influential air flow in the motor ⇨ $f_5 = 1$ |
| | | significant flows | 0.5...0.1 | |
| With centrifugal effect or vertical shaft depending on the sealing | $f_6$ | vertical | 0.7...0.5 | IN case of horizontal motor installation ⇨ $f_6 = 1$ |

*Fig.9-51: Reduction factors for grease service life*

**Calculation**

$$t_{fq} = t_f \times f_1 \times f_2 \times f_3 \times f_4 \times f_5 \times f_6$$

*Fig.9-52: Reduction factors for calculating the expected grease lifetime*

☞ Ensure that the permitted loads from chapter 9.13 "Bearings and Shaft Stress" on page 277 are not exceeded.

If the deployment duration of the motor is limited by the expected grease service life, the deployment duration of the motor can be increased in marginal cases by using the standard bearing in place of the reinforced bearing in exceptional cases. In this case, the expected grease service life increases. However, the increased load of the standard bearing reduces the available mechanical lifetime to below 30,000 operating hours.

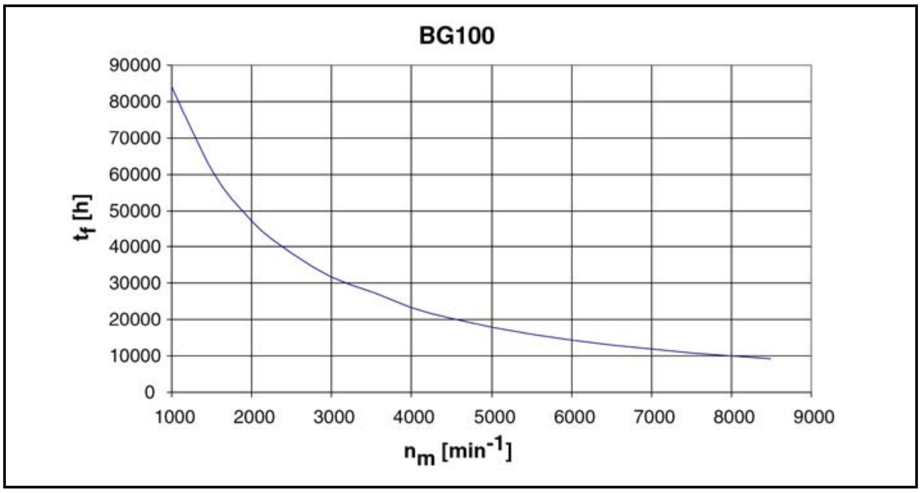
- This requires subsequent calculation of the bearing lifetime by Rexroth. In this case, contact one of our branch offices and explain your application with all relevant application data (stress cycle, axial and radial stresses, speeds).

The calculation and dimensioning of the bearing is based on standard DIN ISO 281.

See the diagrams below for the available grease service life of the deep-groove ball bearings and cylindrical roller bearings in IndraDyn A motors.

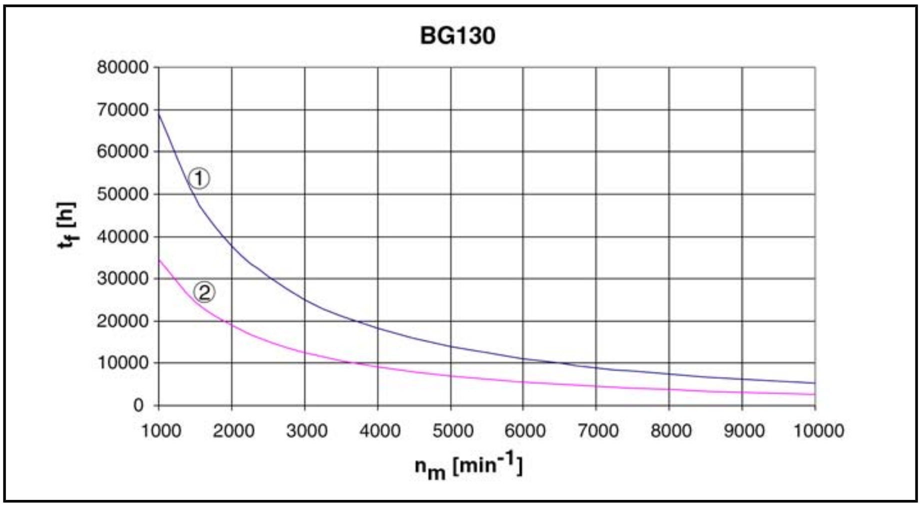
Depending on the motor frame size and bearing type the diagram contains different characteristic curves.

**Grease Lifetime Frame Size 100**




| | |
|---|---|
| $t_f$ | Grease lifetime (without reduction factors) |
| $n_m$ | Average speed |
| *Fig.9-53:* | *Grease lifetime frame size 100* |

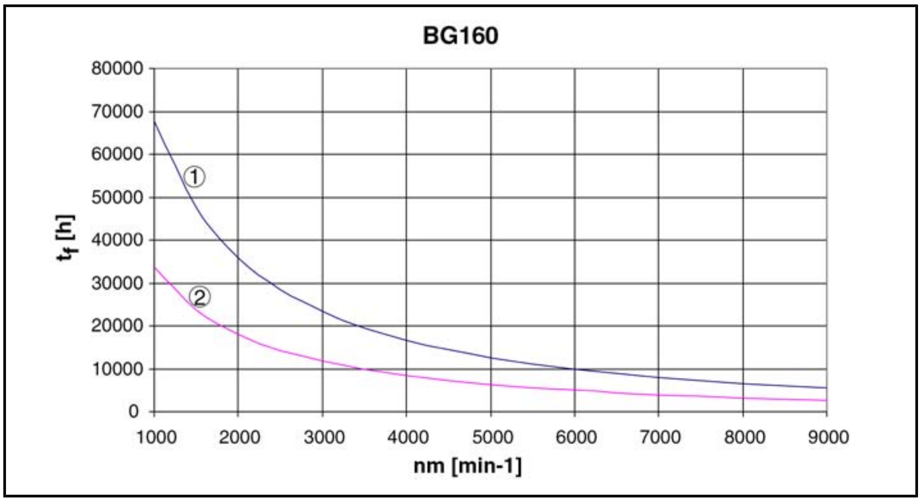
**Grease Lifetime Frame Size 130**




| | |
|---|---|
| $t_f$ | Grease lifetime (without reduction factors) |
| $n_m$ | Average speed |
| ① | Characteristic curve bearing "N, A, H, R" |
| ② | Characteristic curve bearing "V" |
| *Fig.9-54:* | *Grease lifetime frame size 130* |

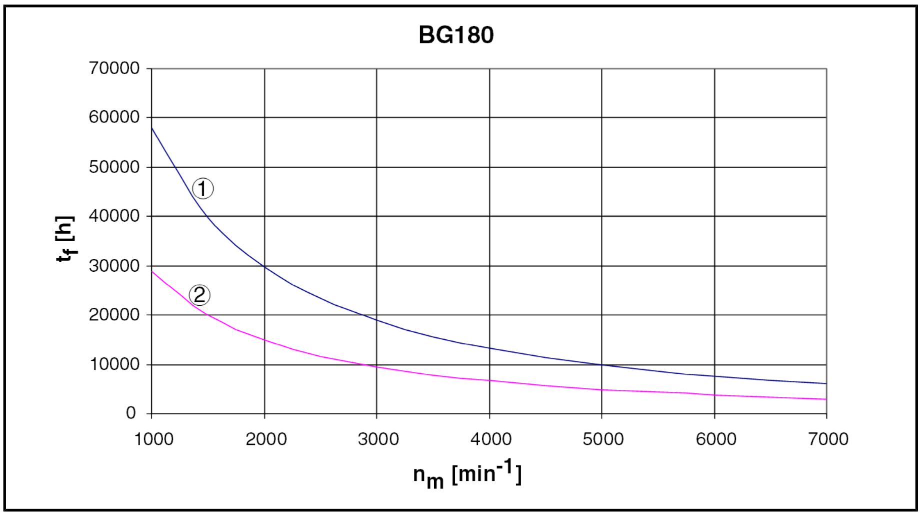
Application Notes

**Grease Lifetime Frame Size 160**



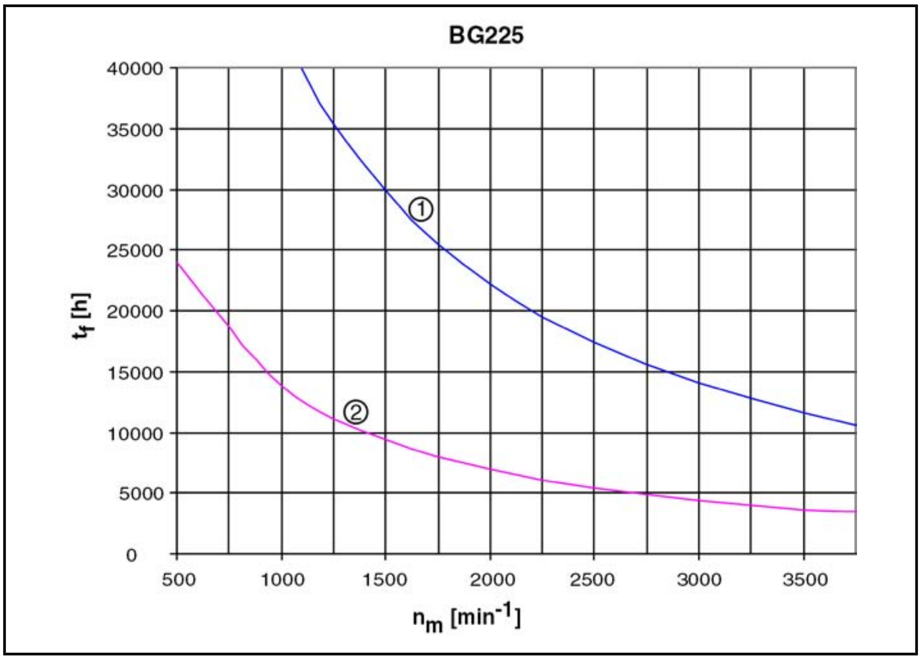

$t_f$ Grease lifetime (without reduction factors)
$n_m$ Average speed
① Characteristic curve bearing "N, A, H, R"
② Characteristic curve bearing "V"
*Fig.9-55: Grease lifetime frame size 160*

**Grease Lifetime Frame Size 180**




$t_f$ Grease lifetime (without reduction factors)
$n_m$ Average speed
① Characteristic curve bearing "N, A, R"
② Characteristic curve bearing "V"
*Fig.9-56: Grease lifetime frame size 180*

**Grease Lifetime Frame Size 225**




| | |
|---|---|
| $t_f$ | Grease lifetime (without reduction factors) |
| $n_m$ | Average speed |
| ① | Characteristic curve bearing "N" |
| ② | Characteristic curve bearing "V" |

*Fig.9-57: Grease lifetime frame size 225*

# 9.17 Oscillating Quantity Level

IndraDyn A motors are balanced dynamically and meet the limits of the bearing housing vibrations according to EN 60034-14:2004.

The motors are measured in specified velocity levels and in free suspension (see EN 60034-14:2004, chapter 6.2 Free suspension)

The following details provide an overview over the position of the different oscillating quantity levels in connection with further oscillating quantity levels improved and specified by Bosch Rexroth.

Rexroth IndraDyn A motors basically achieve better values in level A than required by the EN 60034-14:2004. That is why a second characteristic curve is established that can be considered as standard for all IndraDyn A motors of this level.

The oscillating quantity level A (according to EN 60034-14:2004) is only shown to represent the maximum admissible values of this level according to EN 60034-14.

Additionally, level B (according to EN 60034-14:2004) and level C (factory standard) are available for special requirements for the mechanical smoothness.

☞ Please also refer to the data on the oscillating quantity level in the type code of the respective motor.

Application Notes

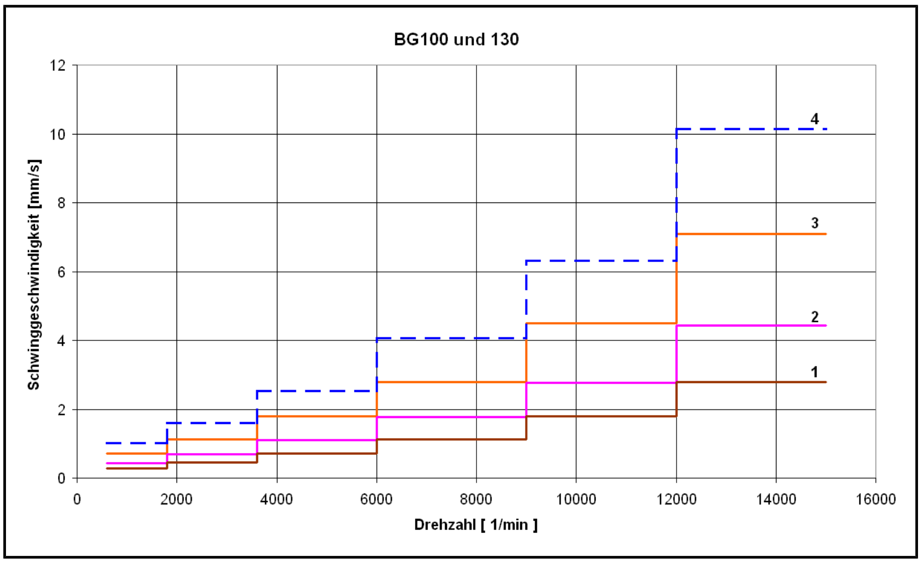
**Oscillating Quantity Level MAx100...130 / Technical Data**

**Table containing admissible oscillating velocities for frame size 100...130**

| Speed | Oscillating velocity in mm/s | | | |
|---|---|---|---|---|
| | Level A | Level B | Level C | Level A (admissible values according to EN 60034-14:2004) |
| 600...1,800 | 0.71 | 0.44 | 0.28 | 1.01 |
| 1,800...3,600 | 1.12 | 0.7 | 0.45 | 1.6 |
| 3,600...6,000 | 1.8 | 1.1 | 0.71 | 2.52 |
| 6,000...9,000 | 2.8 | 1.77 | 1.12 | 4.06 |
| 9,000...12,000 | 4.5 | 2.76 | 1.8 | 6.31 |
| 12,000...15,000 | 7.1 | 4.44 | 2.8 | 10.14 |

*Fig.9-58: Admissible oscillating velocities for frame size 100...130*

Oscillating Force Step Diagram Frame Size 100...130




① Oscillating quantity level C (according to Bosch Rexroth factory standard)
② Oscillating quantity level B (according to EN 60034-14:2004)
③ Oscillating quantity level A (according to Bosch Rexroth factory standard)
④ Oscillating quantity level A (according to EN 60034-14:2004)

*Fig.9-59: Graphic representation of the oscillating quantity levels of the frame sizes 100...130*

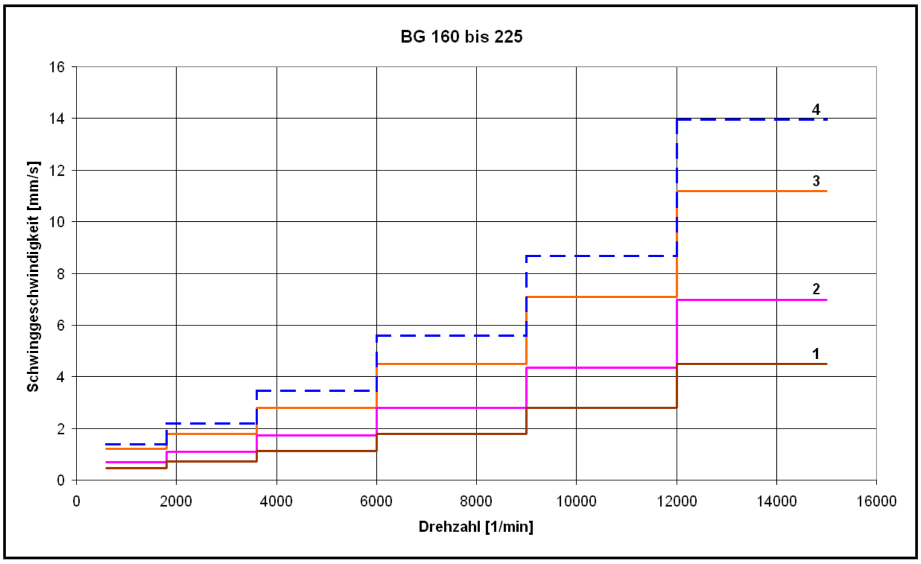
**Oscillating Quantity Level MAx160...225 / Technical Data**

**Table containing admissible oscillating velocities for frame size 160..0.225**

| Speed | Oscillating velocity in mm/s | | | |
|---|---|---|---|---|
| | Level A | Level B | Level C | Level A (admissible values according to EN 60034-14:2004) |
| 600...1800 | 1.2 | 0.7 | 0.45 | 1.39 |
| 1800...3600 | 1.8 | 1.1 | 0.71 | 2.2 |
| 3600...6000 | 2.8 | 1.74 | 1.12 | 3.47 |
| 6000...9000 | 4.5 | 2.79 | 1.8 | 5.58 |

| | | | | |
|---|---|---|---|---|
| 9000...12000 | 7.1 | 4.34 | 2.8 | 8.68 |
| 12000...15000 | 11.2 | 6.97 | 4.5 | 13.94 |

*Fig.9-60: Admissible oscillating velocities for frame size 160..0.225*




① Oscillating quantity level C (according to Bosch Rexroth factory standard)

② Oscillating quantity level B (according to EN 60034-14:2004)

③ Oscillating quantity level A (according to Bosch Rexroth factory standard)

④ Oscillating quantity level A (according to EN 60034-14:2004)

*Fig.9-61: Overview of the oscillating quantity levels of frame sizes 160...225*

You will find further and more detailed information (for the measurement variables, machine arrangement or measurement conditions in EN 60034-14

☞ Please note, that the oscillating behavior of attached or driven machine elements may effect the motor as well and resulting in premature wear or failure in the most unfavorable cases.

Due to the system-specific influences on the oscillating behavior of the system as a whole, the machine manufacturer must determine the specific circumstances.

In certain cases, the machine elements may need to be balanced in such a manner that no resonance or repercussions occur.

☞ Already take the vibration behavior of the motor and the machine elements into account when designing the system.

# 9.18 Explosion Protection

## 9.18.1 Motors in Ex-pd Design (Type Code Option "M6" or "S6")

☞ Motors in this ATEX design (Ex-pd) are certified as explosion-proof devices.

The motors having this protection class are components for device group II, category 2G, directive 94/9/EC, appendix II, section 2.2.1 and may only be used in an environment in which

- **an explosive atmosphere results seldom or on a short-term basis** due to gases, vapors or fog
- **an explosive atmosphere may result occasionally** due to gases, vapors or fog.

The system and the components must thus be designed and manufactured by the user in such a manner that sources of ignition are avoided assuming that device malfunctions occur frequently and that operating states occur that are usually unexpected.

CAUTION

**Explosion hazard! Invalidation of warranty!**

⇒ The motor admitted for operation in ATEX atmospheres and labeled accordingly is merely a part of a drive concept. Commissioning of the motors in such areas may be carried out only with a control device that is classified and permitted according to the conditions of the explosive atmospheres.

⇒ It is imperative that you pay attention to the information and notes in respect of project planning for the selected control device for motor purging already during project planning and before commissioning the system.

Please observe the required selection criteria in the type code of the corresponding motor, as well as the supplementary details, e.g. on selection, protection principle and labeling of the motors in chapter 13 "Motors in Ex-pd Design for Explosive Areas" on page 319.

### 9.18.2 Motors in Ex-nA Design (Type Code Option S003)

Motors of this ATEX design (Ex-nA) are certified as non-sparking equipment.

The motors having this protection class are components for device group II, category 3G respectively 3D, directive 94/9/EC, appendix II, section 2.3 and may only be used in an environment in which

- **an explosive atmosphere results never or only seldom or on a short-term basis** due to gases, vapors or fog.

Please observe the supplementary details, e.g. on protection principle and labeling of these motors in chapter 14 "Motors in Ex-nA Design for Explosive Areas" on page 333.

## 9.19 Acceptances and Authorizations

### 9.19.1 CE Symbol

Declarations of conformity confirming the design and compliance with the valid EN standards and directives are available for the IndraDyn A motors. If necessary, these certificates of conformity can be requested from the responsible sales office.

The CE symbol is applied to the motor name plate of IndraDyn A motors.

CE_Zeichen.fh11

*Fig.9-62: CE Symbol*

## 9.19.2 UR, cUR Listing

IndraDyn A motors have been presented to and approved by the UL authorities "Underwriters Laboratories Inc.®".

The appropriate identification of the motors is specified on the motor name plate.

CUR_Zeichen.fh11

*Fig.9-63: cUR sign*

# 10 Handling and Transport

## 10.1 Delivery Status

### 10.1.1 General Information

IndraDyn A motors are delivered in wooden crates or in cartons. Packing units on pallets are secured by retaining straps.

CAUTION

**Injuries due to uncontrolled movement of the retaining straps when cutting!**

⇒ Maintain a sufficient distance and carefully cut the retaining straps.

On delivery from the factory, the motor drive shaft and the connectors have protective sleeves. Remove the protective sleeves just before assembly.

### 10.1.2 Factory Test

All IndraDyn A motors undergo the following inspections, among others, at the factory:

**Electrical Test**

- High-voltage test according to EN 60034-1 (= VDE 0530-1).
- Insulation resistance according to EN 60204-1/1.92, section 20.3.
- Ground wire connection according to EN 60204-1/1.92, section 20.3.

**Mechanical Test**

- Concentricity and position tolerances of shaft end and fastening flange according to DIN 42955.
- Vibration measurement according to DIN 2373.

### 10.1.3 Test on the Customer Side

Since all IndraDyn A motors undergo a standardized inspection procedure, high-voltage tests on the customer side are not required. Motors and components could be damaged if they undergo several high-voltage tests.

CAUTION

**Destruction of motor components by improperly executed high-voltage test! Invalidation of warranty!**

⇒ Avoid repeated tests.

⇒ Observe the regulations of EN 60034-1 (see VDE 0530-1).

## 10.2 Identification

The total scope of a delivery can be seen in the delivery note or waybill. However, the contents of a delivery may be distributed over several packages.

Each individual package can be identified using the shipment label attached to the outside.

Each device has an individual name plate containing the device designation and technical information.

- After having received the goods, compare the ordered and the supplied type. Submit claims concerning deviations immediately.

## 10.3 Labeling

The type designation of the complete product results from the options selected. These designations, along with additional product data, are impressed on the name plate.

Using the designation and the serial number, every Bosch Rexroth product can be uniquely identified.

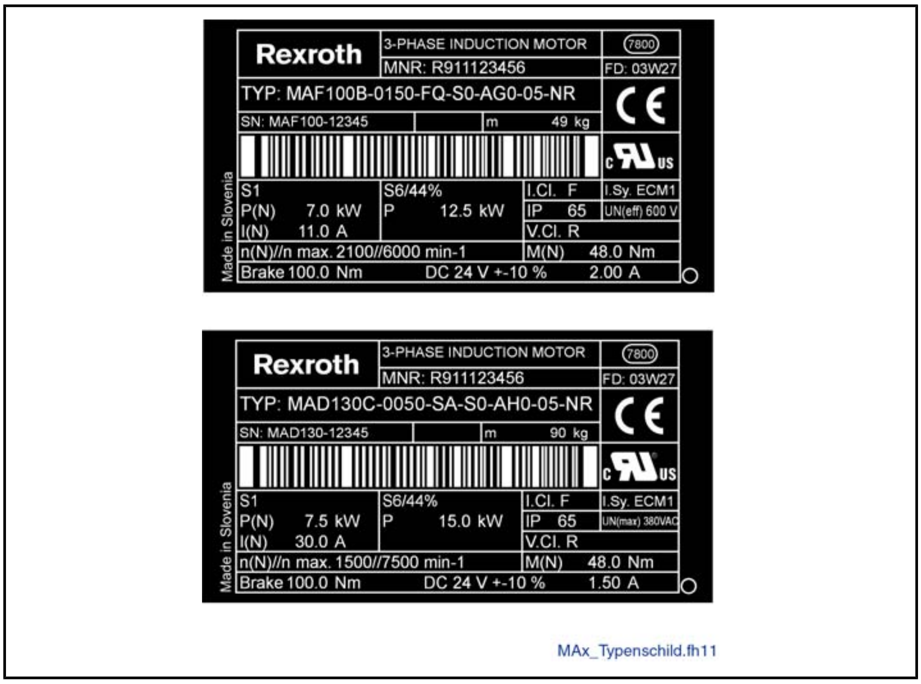



*Fig.10-1: IndraDyn A type labels*

IndraDynA motors are supplied with 2 name plates each.

Attach the second name plate to an easily visible portion of the machine. Thus, you will be able to read the motor data at any time without having to get into inaccessible places where the built-in motor may be situated.

Before sending questions to Bosch Rexroth, always specify the full type identification data and serial number of the products involved.

# 10.4 Transport and Storage

## 10.4.1 General Information

CAUTION

**Damage or injuries and invalidation of the warranty due to improper handling!**

- Protect the products from moisture and corrosion .
- Avoid mechanical stressing, throwing, tipping or dropping of the products.
- Only use lifting equipment suitable for the weight of the motor.
- Never lift the motor out of the fan housing.
- Use suitable protective equipment and wear protective clothing during transport.

☞
- Permitted **transport temperature range**: -20°C to +80°C.
- Permitted **storage temperature range**: 0°C to +45°C.
- For a **storage time** of one to five years, the motor must warm up for one hour at 1000 rpm before starting normally.
- The max. permitted **storage time** of the motors is 5 years.. After the max storage duration is exceeded, the bearing grease must be replaced.
- Also observe the notes regarding storage and transport on the packaging.

## 10.4.2 Notes for Transport

To protect the motor from dirt, dust etc., Bosch Rexroth recommends to transport the motor

- to the intended installation site and
- to keep it until the actual time of installation into the machine

in the packaging in which it has been delivered from Rexroth.

To lift the motor out of the transport crate or to install it into the machine, use the transport or lifting eye bolts at the motor.

As a minimum, the lifting eye bolts are in accordance with the requirements of DIN 580. Before each transport, ensure that the lifting eye bolts are screwed down fully to the stop face and that your selected lifting equipment and lifting method will not overload the lifting eye bolts.

☞ Please note the DIN 580 standard on transport of motors by means of the attached lifting eye bolts. Non-observance of the information in this standard may cause overload of the lifting eye bolts and result in injury to persons or damage to products.

## 10.4.3 Information on Storage

**Ambient Mechanical Conditions**

When delivered, IndraDyn A motors are equipped with protective sleeves and covers. During transport and storage, the protective sleeves must remain on the motor.

- Remove the protective sleeves just before assembly.
- Also use the protective sleeves if you return the goods.

During transport and while being stored, the motors must not exceed the stress limits according to EN 60721-3-2 (1997) class 2M2

# 11 Installation

## 11.1 Safety

**WARNING**

**Risk of injuries due to live parts! Lifting of heavy loads!**

- Install the motors only when they are de-energized and not connected electrically.
- Use suitable lifting equipment and protective equipment and wear protective clothing during transport.
- Do not lift or move the motor by the fan unit.
- Please note the safety information from the preceding chapters, and in particular the notes on transport of motors in chapter 10, "Handling and Transport".

Carry out all working steps especially carefully. In this way, you minimize the risk of accidents and damage.

IndraDyn A motors from frame size 130 have additional threaded holes on their long sides for inserting eyelets (for details, see the dimension sheet). Additional eyelets can simplify handling and transport.

## 11.2 Mechanical Attachment

### 11.2.1 General Information

**Fastening Screws**

To attach the motors correctly and safely to the machine, Bosch Rexroth recommends the following screws and washers for motor mounting.

- **Motor frame size 100**
  - pan-head machine screw DIN EN ISO 4762 - M12 x … - 8.8

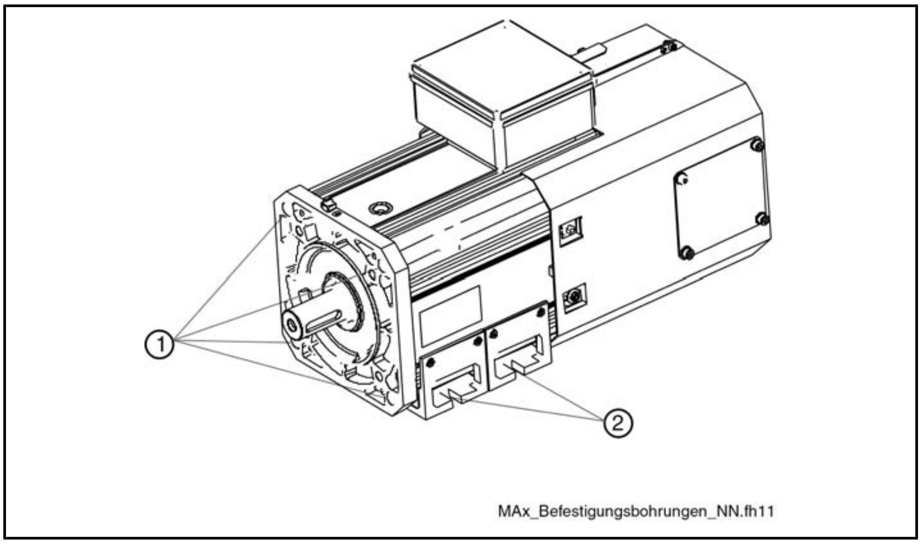
    and
  - washer DIN EN ISO 28738
- **Motor frame size 130...225**
  - hexagonal screws DIN EN ISO 4014 - M... x ... - 8.8

    or
  - cylinder screws DIN EN ISO 4762 - M... x ... - 8.8

    and
  - washer DIN EN ISO 7090 - ... - 200 HV

If the screws and washers used do not comply with this recommdation, the stability class of the screws and the hardness class must be equivalent in order to transmit the required tightening torques (see fig. 11-2 " Attachment holes and tightening torques of the screws" on page 306).

## 11.2.2 Mounting mode




① Holes for flange assembly
② Mounting feet for foot assembly
*Fig.11-1: Motor attachment types*

IndraDyn A motors are manufactured either for flange assembly (B05) or for foot assembly (B35). Details on the attachment holes can be found in the corresponding dimension sheet. For fastening, the following general assignment applies:

<table>
<tr><th rowspan="3">MAD/MAF</th><th colspan="3">B05 (flange assembly)</th><th colspan="3">B35 (Foot assembly)</th></tr>
<tr><th>Hole</th><th colspan="2">Thread (8.8)</th><th>Hole</th><th colspan="2">Thread (8.8)</th></tr>
<tr><th>Ø [mm]</th><th>Type</th><th>$M_{GA}$ [Nm] at $\mu_G$0.12</th><th>Ø [mm]</th><th>Type</th><th>$M_{GA}$ [Nm] at $\mu_G$0.12</th></tr>
<tr><td>100</td><td>14</td><td>M12</td><td>84</td><td>11</td><td>M10</td><td>48</td></tr>
<tr><td>130</td><td rowspan="4">18</td><td rowspan="4">M16</td><td rowspan="4">206</td><td>12</td><td>M10</td><td>48</td></tr>
<tr><td>160</td><td>14</td><td rowspan="2">M12</td><td rowspan="2">84</td></tr>
<tr><td>180</td><td>14,5</td></tr>
<tr><td>225</td><td>21</td><td>M20</td><td>415</td></tr>
<tr><td colspan="7">$M_{GA}$ = Torque given in Newton meters.<br>$\mu_G$ = cooefficient of friction</td></tr>
</table>

*Fig.11-2: Attachment holes and tightening torques of the screws*

**Foot Assembly**

Before fastening IndraDyn A motors by means of foot assembly, please pay attention to the distance from motor shaft center to lower foot edge specified in the respective motor dimension sheet. Compare this value with the connection dimension present on the machine side.

☞ Before fastening the motor to the machine, it must be aligned so that the center line of the motor shaft is in true alignment with the center line of the connection shaft.

Heed the details in chapter 9.6.2 "Foot Assembly" on page 258 about this assembly mode.

For foot assembly of the motors, we recommend to proceed as follows:

1. With MAD130...225: Dismount the lower air plates on the side to get free access to the mounting holes.
2. Align the motor so that the center line of the motor shaft is in true alignment with the center line of the connection shaft of the machine. To align the motor, use lengths of steel plate as a base.
3. Connect the motor firmly to the machine (for tightening torques refer to fig. 11-2 " Attachment holes and tightening torques of the screws" on page 306).
4. With MAD130...225: Re-install the fan shrouds dismounted at the beginning to the motor.

| Frame size | Type of motor fastening | Number of mounting holes | Peak-to-valley height of the screwing surface to the machine |
|---|---|---|---|
| 100 | Assembly feet () | 4 | Rz32 |
| 130 | Feet plates (2) | | |
| 160 | Assembly feet () | | |
| 180 | via stator profile | | |
| 225 | Assembly feet () | | |

*Fig. 11-3: Overview foot assembly*

## 11.2.3 Assembly Preparation

- Log all measures taken in the commissioning log.

Prepare motor assembly as follows:

1. Check the components for visible damage. Defective components may not be mounted.
2. Ensure that dimensions and tolerances on the system side are suitable for motor attachment (for details, see the dimension sheet).
3. Ensure that mounting can be done in a dry, clean and dust-free environment.
4. Keep tools and auxiliary material, as well as measuring and testing equipment, ready at hand.
5. Check whether all components, assembly surfaces and threads are clean.
6. Ensure that the holder for the motor flange on the machine side has no burrs.
7. Remove the protective sleeve of the motor drive shaft. Retain the sleeve for later use.

## 11.2.4 Motor Assembly

- Mount the motor.

**Note:**

- With flange assembly: Avoid clamping or jamming the centering bundle on the motor side.
- With flange assembly: Avoid damage to the insertion fitting on the system side.

- With foot assembly: Align the center line of the motor shaft in true alignment to the connection shaft. Please note the information in section 'Foot Assembly' in this chapter.
- Connect the motor firmly to the machine (observe tightening torques!).
- Check the fit and accuracy of the connection before you proceed.

After having mounted the motor mechanically as prescribed, establish the electrical connections.

# 11.3 Electrical Connection

## 11.3.1 General Information

Use ready-made connection cables by Bosch Rexroth. These cables provide a number of advantages, such as extreme load capability and resistance as well as a design suitable for EMC.

- Complete the electrical connection of the IndraDyn A motors according to the information in chapter 8 "Connection Techniques", or for ATEX motors according to chapter 13 "Motors for Hazardous Areas".

---

☞ The terminal diagrams of the product documentation are used to generate the system circuit diagrams. Solely the system circuit diagrams of the machine manufacturer are decisive for connecting the drive components to the machine.

---

## 11.3.2 Additional Grounding Wire on Motors

Notice that certain motors have to be fitted with an additional ground wire when connecting them. For information on this additionally required ground wire refer to chapter 8.2.2 "Additional Grounding Wire on Motors" on page 228.

# 12 Operating IndraDyn A Motors

## 12.1 Start-Up

### 12.1.1 General Information

CAUTION

**Material damage due to errors in the controls of motors and moving elements! Unclear operating states and product data!**

- Do not carry out commissioning if connections, operating states or product data are unclear or faulty!
- Do not carry out commissioning if the safety and monitoring equipment of the system is damaged or not in operation.
- Damaged products may not be operated!
- ⇒ Contact Bosch Rexroth for missing information or support during commissioning!

The following notes on commissioning refer to IndraDyn A motors as part of a drive system with drive and control devices.

### 12.1.2 Preparation

1. Keep the documentation of all products you are using ready.
2. Log all measures taken in the commissioning log.
3. Check the products for damage.
4. Check all mechanical and electrical connections.
5. Activate the safety and monitoring equipment of the system.

### 12.1.3 Execution

**When all prerequisites have been fulfilled, proceed as follows:**

1. Activate the fan at the MAD or the external cooling system for supply of the MAF motors, and check for regular condition. Observe the notes of the manufacturer.
2. Carry out the commissioning of the drive system according to the instructions of the corresponding product documentation. You can find the respective information in the functional description of the drive control device.
3. Log all measures taken in the commissioning report.

Commissioning of drive controllers and the control unit may require additional steps. The inspection of the functioning and performance of the systems is not part of the commissioning of the motor; instead, it is carried out within the framework of the commissioning of the entire machine. Observe the instructions and regulations given by the machine manufacturer.

## 12.2 Deactivation

**In the case of malfunctions or maintenance, or to deactivate the motors, proceed as follows:**

1. Observe the instructions of the machine documentation.
2. Use the machine-side control commands to bring the drive to a controlled standstill.
3. Switch off the power and control voltage of the drive device.
4. **Only for MAD**: Switch off the motor protection switch for the motor fan.

   **Only for MAF**: Switch off the external coolant supply.
5. Switch off the main switch of the machine.
6. Secure the machine against accidental movements and against unauthorized operation.
7. Wait for the discharge time of the electrical systems to elapse; then disconnect all electrical connections.
8. Before dismounting the motor and - if applicable - the fan unit, secure them against dropping or movement before detaching the mechanical connections.
9. Log all measures taken in the commissioning report.

## 12.3 Disassembly

DANGER

**Fatal injury due to errors in activating motors and working on moving elements!**

- Do not work on unsecured and operating machines.
- Switch off the control device and the machine and wait for the discharging time of the electric systems to elapse.
- Secure the machine against accidental movements and against unauthorized operation.
- Before dismantling, secure the motor and power supply against falling or movement before disconnecting the mechanical connections.
- Do only loosen the coolant supply when it is not pressurized (not necessary when using the option "quick coupling".)

1. Observe the instructions of the machine documentation.
2. Please observe the safety notes and carry out all steps as described in the above instructions in the "Deactivation" section.
3. Before dismantling, secure the motor and power supply against falling or movement before disconnecting the mechanical connections.

   At the MAF motor, also empty the coolant channels.
4. Dismantle the motor from the machine. Store the motor properly!
5. Document all executed measures in the commissioning report and the machine maintenance plan.

# 12.4 Maintenance

## 12.4.1 General Information

Asynchronous motors of the IndraDyn A series operate without wear within the given operating conditions and service life. However, operation under unfavorable conditions can lead to limitations in availability.

- Increase availability with regular preventive maintenance measures. Observe the information in the maintenance schedule of the machine manufacturer and the service measures described below.
- Log all maintenance measures in the machine maintenance plan.

## 12.4.2 Measures

DANGER

**Danger of injury due to moving elements! Danger of injury due to hot surfaces!**

- Do not carry out any maintenance measures when the machine is running.
- Switch off the control device and the machine and wait for the discharging time of the electric systems to elapse.
- During maintenance work, secure the system against restarting and unauthorized use.
- Do not work on hot surfaces.

Bosch Rexroth recommends the following maintenance measures, based on the maintenance plan of the machine manufacturer:

| Measure | Interval |
|---|---|
| **Only for MAF**:<br>Check the functioning of the coolant system | According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours. |
| **Only for MAD**:<br>Check the functioning of the motor fan and the air circulation. | According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours. |
| Check the mechanical and electrical connections. | According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours. |
| Check the machine for smooth running, vibrations and bearing noises. | According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours. |
| Remove dust, chips and other dirt from the motor housing, cooling fins and the connections. | Depending on the degree of soiling, but after one operating year at the latest. |

*Fig. 12-1: Maintenance measures*

## 12.4.3 Motor Fan

### General Information

It may become necessary to dismantle the fan unit for maintenance measures or troubleshooting.

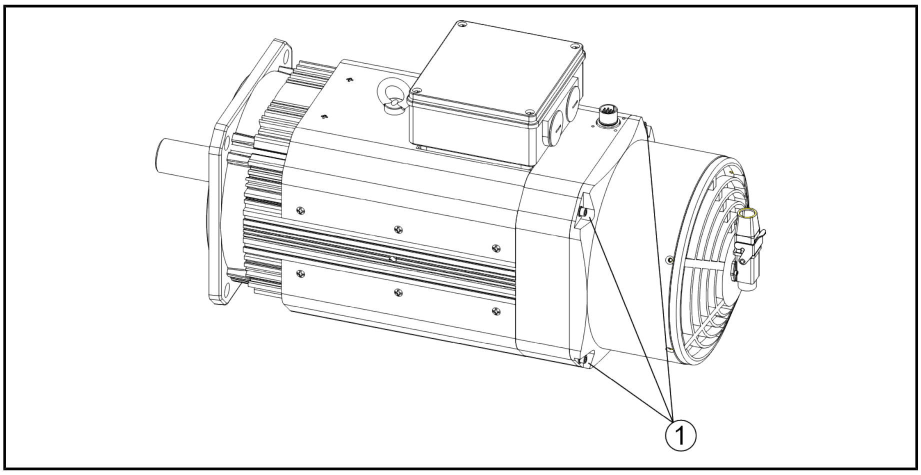
- This work must be carried out only by skilled personnel.
- Do not carry out any maintenance measures when the machine is running. Please observe the safety notes.
- During dismantling, keep the strips, screws and nuts with which the fan units are fastened.

Parts of the fan unit housings consist of several elements that are screwed together. Remove only the indicated screws.

The fastening and basic housing of the fan unit are essentially identical for axial and radial fans.

### General Procedure for Maintaining the Fan:

1. Switch off the system and disconnect the electrical fan connection.
2. Before loosening the fastening screws, make sure the fan unit does not drop; carefully remove the fan unit from the motor.
3. After completing cleaning or troubleshooting, reattach the fan unit. Secure the fastening screws with "LOCTITE 243 screw fastener" and reestablish the connections.
4. Check the functioning of the motor fan and the air circulation.
5. Log all maintenance measures in the machine maintenance plan.




① Motor fastening screw (4 pc.)

*Fig.12-2: MAD fan (example MAD130)*

## 12.4.4 Coolant Supply

It may become necessary to dismantle the coolant supply for maintenance measure or troubleshooting.

- This work must be carried out only by skilled personnel.

- Do not carry out any maintenance measures when the machine is running. Please observe the safety notes.
- Protect open supply cables and connections against penetration of pollution.

### 12.4.5 Maintenance and Setup of Holding Brakes

In order to ensure proper functioning of the holding brake, it must be checked before the motor is installed.

**Before Initial Startup**

Measure the holding torque of the brake; grind in the holding brake, if necessary.

**Proceed as follows:**

1. De-energize the motor and secure it against re-energization.
2. Measure the transferable holding torque of the holding brake with a torque wrench. The holding torque of the brakes is stated in the data sheets.
3. If the holding torque specified in the data sheets is attained, the holding brake is ready for operation.

> ☞ If the holding torque specified in the data sheets is **not attained**, the holding brake must be ground in as described in step 4.

4. Grinding in:

| Grinding-in recommendation | |
|---|---|
| Interval | 1x |
| Grinding-in speed | 100 $min^{-1}$ / 30s duration |
| Program | 500ms, clocked |
| Ambient temperature | -20°C to +50°C |

*Fig. 12-3: Recommended procedure for grinding in motor holding brakes*

- If the holding torque specified in the data sheets is attained, the holding brake is ready for operation.

  If the holding torque specified in the data sheets is **not attained**, repeat step 4 (grinding-in process).

If the specified holding torque is not attained after the second grinding-in process, the holding brake is not operable. Notify Bosch Rexroth Service.

**During Operation**

If holding brakes are required only sporadically (braking cycle >48 h) during operation, film rust may develop on the brake friction surface.

To prevent the holding torque from dropping below the specified holding torque, we recommend the grinding procedure described below:

| Grinding-in recommendation | |
|---|---|
| Interval | Once in 48 h |
| Grinding-in speed | 100 $min^{-1}$ |
| Number of grinding-in revolutions | 1 |
| Ambient temperature | -20°C to +50°C |

*Fig. 12-4: Recommended procedure for grinding in motor holding brakes*

☞

- During normal operation, it is not necessary to grind in the brake. It is sufficient if the brake is activated twice a day by removing the controller enable signal.
- The option of automatically implementing the grinding-in routine in the program run is described in the documentation of the particular drive controllers.

# 12.5 Troubleshooting

## 12.5.1 General Information

DANGER

**Danger of injury due to moving elements! Danger of injury due to hot surfaces!**

- Do not carry out any maintenance measures when the machine is running.
- Switch off the control device and the machine and wait for the discharging time of the electric systems to elapse.
- During maintenance work, secure the system against restarting and unauthorized use.
- Do not work on hot surfaces.

Possible causes for the malfunctioning of IndraDyn A motors can be limited to the following areas:

- Motor-cooling circuit, fan function and temperature curve
- Internal temperature sensor
- Motor encoder or encoder connection
- Mechanical damage of the motor
- Mechanical connection to machine

The encoder connection and the temperature sensor are controlled by the drive controller or control unit; corresponding diagnoses are indicated. Observe the notes in the corresponding documentation.

Some sample faults are in the following, along with potential causes. This list does not lay claim to completeness.

## 12.5.2 Excess Temperature of Motor Housing

**Status** The housing temperature of the motor rises to unusually high values.

CAUTION

**Damage to motor or machine by restarting after excessive motor temperature!**

- Liquid-cooled motors should not be restarted or supplied with cold coolant immediately after failure of the coolant system and an increased motor temperature. Risk of damage!
- Wait until the motor temperature has dropped to approx. 40° C before restarting.

**Possible Causes**

1. Failure or malfunction in the fan or cooling system.
2. The original operating cycle has been changed.
3. The original motor parameters have been changed.
4. Motor bearings worn or defective.

**Measures**

1. With **MAD**, check fan function. Clean if necessary. In the case of a malfunction, contact Bosch Rexroth Service.

With **MAF**, check the cooling system. Clean or rinse the cooling circuit if required. Contact the machine manufacturer if the coolant system malfunctions.

2. Check the layout of the drive for changed requirements. If overloading occurs, stop operation. Risk of damage!
3. Reset to the original parameters. Check the layout of the drive in the case of changed requirements.
4. Contact the machine manufacturer.

### 12.5.3 High Motor Temperature Values, but Housing Temperature is Normal

**Status** The diagnostics system of the drive controller indicates unusually high values for the winding temperature via the display or control software. However, the temperature of the motor housing is normal.

**Possible Causes**

1. Wiring error or cable break in sensor cable.
2. Diagnostics system defective.
3. Check the wiring and connection of the temperature sensor according to the terminal diagram.
4. Winding temperature sensor malfunction (PTC).

**Measures**

1. Check the diagnostics system on the drive device or the control unit.
2. Check the resistance value of the temperature sensor using a multimeter.
   - Set the measuring instrument to resistance measurement.
   - Shut down the system and wait for the discharging time to elapse. Separate the temperature sensor connection from the drive device and connect the wire pair with the measuring instrument (this includes the sensor cable in the test). Check values in accordance with fig. 9-23 "Characteristic of temperature measurement sensor KTY84-130 (PTC)" on page 267.

### 12.5.4 Motor or Machine Table Generate Vibrations

**Status** Audible or tactile vibrations occur on the motor.

**Possible Causes**

1. Driven machine elements are insufficiently coupled or damaged.
2. Motor bearings worn or defective.

   Available bearing lifetime or grease lifetime elapsed.
3. Motor mount has come loose
4. Drive system is instable from a control point of view.

**Countermeasures**

1. Contact the machine manufacturer.
2. Contact the machine manufacturer.
3. Check the mechanical connection. Do not continue to use damaged parts. Contact the machine manufacturer.
4. Check parameters of the drive system (motor and encoder data). Observe the notes in the documentation for the drive controller.

### 12.5.5 Specified Position is not Attained

**Status** The positioning command of the control unit is not precisely executed, or not at all. No malfunction display on the device controller or the control.

**Possible Causes**

1. Wiring of encoder cable is incorrect or defective. Pin assignment (encoder signals) in cable or plug may be switched.
2. Insufficient shielding of encoder cable against interference.
3. Incorrect encoder parameters set in drive controller.

4. Motor-machine connection has come loose.
5. Encoder defective.

**Countermeasures**

1. Check wiring according to terminal diagram and check cables for damage.
2. Check shielding; if necessary, increase effective contact surfaces of shielding.
3. Correct the parameters. Observe the commissioning log.
4. Check the mechanical connection. Do not continue to use damaged parts. Contact the machine manufacturer.
5. The encoder must be replaced. Contact the machine manufacturer.

# 12.6 Disposal and Environmental Protection

## 12.6.1 Disposal

### Products

Our products can be returned to us free of charge for disposal. However, it is a precondition that the products are free of oil, grease or other dirt.

Furthermore, the products returned for disposal must not contain any undue foreign matter or foreign component.

Please send the products free domicile to the following address:

Bosch Rexroth AG

Electric Drives and Controls

Bürgermeister-Dr.-Nebel-Strasse 2

D-97816 Lohr am Main

### Packaging Materials

The packaging materials consist of cardboard, wood and polystyrene. These materials can be easily recycled in any municipal recycling system. For ecological reasons, please refrain from returning the empty packages to us.

## 12.6.2 Environmental Protection

### No Release of Hazardous Substances

Our products do not contain any hazardous substances which may be released in the case of appropriate use. Accordingly, our products will normally not have any negative effect on the environment.

### Materials Contained in the Products

#### Electronic Devices

Electronic devices mainly contain:

- steel
- aluminum
- copper
- synthetic materials
- electronic components and modules

#### Motors

Motors mainly contain:

- steel
- aluminum

- copper
- brass
- magnetic materials
- electronic components and modules

## Recycling

Due to their high content of metal, most of the product components can be recycled. In order to recycle the metal in the best possible way, the products must be disassembled into individual modules.

Metals contained in electric and electronic modules can also be recycled by means of special separation processes. The synthetic materials remaining after these processes can be thermally recycled.

If the products contain batteries or rechargeable batteries, these batteries are to be removed before recycling and disposed of.

# 13 Motors in Ex-pd Design for Explosive Areas

## 13.1 General Information on Motors in Ex-pd Design (Type Code Option "M6" / "S6")

### 13.1.1 Introduction

IndraDyn A motors in this ATEX design are not certified as explosion-proof parts, but are only prepared for acceptance as a part of an overall system. Any additionally required safety equipment as described in this chapter and the operating manual of the motors is to be provided by the user.

When delivered from the factory, operating instructions are included with the ATEX motors. These operating instructions form a part of the product and must be kept by the user of the motors over the entire operation and lifetime of the product. If the product is passed on or sold, these instructions must also be passed on to each new owner or user.

☞ The operating instructions of the ATEX motors......

- contains detailed notes on
  - Mechanical attachment
  - Connection (electrical connection, cooling connection, purge gas connection)
  - Commissioning
  - Purging time of the overall system
  - Maintenance and disassembly
- contains the translations in the following languages along with the language of compilation:

  French, Italian, Spanish and English
- has the product number
  - **DOK-MOTOR*-IDYN*A*ATEX-IBxx-D5-P, MNR R911312072**

Should you not have the operating instructions in your language, contact your Bosch Rexroth sales partner before installing the motor.

DANGER

**Danger of explosion!**

IndraDyn A motors in ATEX design must not be installed or commissioned without having read and understood the enclosed operating manual, and without having implemented the measures described in the operating manual.

## 13.1.2 Device Group / Device Category

According to directive 94/9/EC, Rexroth IndraDyn A ATEX motors are equipment of

- device group II
  - device category 2G
  - device category 3G

and suitable for application in the following explosive atmospheres:

- Zone 1
- Zone 2

**Device Group II, Device Category 2G**

Equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a high level of protection. Equipment of this category is intended for use in areas, in which it can be expected that an explosive atmosphere of dust / air mixture can occur **occasionally**. The means of protection relating to equipment in this category ensure the required level of protection, even in case of frequently occurring disturbances which normally have to be taken into account.

**Device Group II, Device Group3G**

Equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a high level of protection. Equipment of this category is intended for use in areas in which explosive atmospheres caused by dust whirled up are **unlikely** to occur or, if they do occur, are likely to do so only **rarely and for a short period of time**. Equipment of this category ensures the required level of protection during normal operation.

## 13.1.3 Zones of Explosive Atmospheres

The following information is based on EN 60079-14:2003 the BGBI. 1996 part 1 page 1914. If you would like to receive detailed information, please consult these documents.

Explosive areas  are classified into the following zones in accordance with the probability that an explosive atmosphere is present:

**Zone 0**

... includes areas in which an explosive atmosphere which contains a mixture of air and gas, vapors and mists exists permanently, over a long period, or frequently.

Electrical equipment is only allowed for zone 0 if it complies with the specifications according to EN 50020: 2003 (self-security ”i”).

**Zone 1**

... comprises areas in which an explosive atmosphere of gas, vapors or mists is to be expected occasionally.

Electrical equipment is allowed to be used in zone 1, if it is designed for zone 0 or for one of the ignition protection classes described in fig. 13-2 " Ignition protection classes" on page 321.

**Zone 2**

... comprises areas in which the presence of an explosive atmosphere caused by gas, vapors or mists is not to be expected, or - should it still occur - in all likelihood rarely or for a short period of time.

Electrical equipment is permissible for use in zone 2 if it:

- is designed according to the requirements for zone 0 or 1;
- is specifically designed for zone 2.

- corresponds to the requirements of a recognized standard for industrial electrical equipment and has no ignitable hot surfaces when in undisturbed operation.

## 13.1.4 Device Groups, Ignition Protection Classes, and Temperature Classes

The electrical equipments for explosive areas are subdivided into:

**Device Groups**

- **Group I:** Electrical equipment for mines susceptible to fire damp.
- **Group II:** Electrical equipment for all explosive atmospheres, other than mines susceptible to fire damp.

The electrical equipment of Group II can be further classified according to the character of the explosive atmosphere for which they are intended.

For the ignition protection classes pressure-resistant casing ”d” and intrinsic safety ”i”, all electrical equipment of Group II is classified in IIA, IIB and IIC (see appendix A according to EN 50014:1992).

**Classification of the Gases and Vapors**

| Explosion sub-group | Gases and vapors | | | |
|---|---|---|---|---|
| IIA | Ammoniac<br>Methane<br>Ethane<br>Propane | Ethylene alcohol<br>Cyclohexane<br>n-Butane | Benzines in general<br>Kerosine<br>n-Hexane | Acetaldehyde |
| IIB | City gas<br>Acrylic nitrile | Ethylene<br>Ethylene oxide | Ethylene glycol<br>Hydrogen sulfide | Ethylene ether |
| IIC | Hydrogen | Ethyne<br>(Acetylene) | Carbo-bisulphide | |

*Fig. 13-1: Explosion sub-group gases and vapors*

For all ignition protection classes, the equipment of Group II has to be labeled with subject to their maximum surface temperature as described in fig. 13-3 " Classification of the maximum surface temperature in classes for electrical equipment of Group II" on page 322.

**Ignition Protection Classes**

The electrical equipment is designed according to the ignition protection class. The requirements are stipulated in special standards.

| Ignition protection class | Labeling | Standard (predecessor) |
|---|---|---|
| Pressure-resistant casing | Ex d | EN 60079-1 (EN 50018) |
| Increased safety | Ex e | EN 60079-7 (EN 50019) |
| Intrinsic safety | Ex i | EN 60079-11 (EN 50020) |
| Pressurizing | Ex p | EN 60079-2 (EN 50016) |
| Encapsulation | Ex m | EN 60079-18 (EN 50028) |
| Oil immersion | Ex o | EN 60079-6 (EN 50015) |
| Powder filling | Ex q | EN 60079-5 (EN 50017) |
| Ignition protection class ‘n‘ | Ex n | EN 60079-15 (EN 50021) |

*Fig. 13-2: Ignition protection classes*

Electrical equipment of these ignition protection classes are certified by way of a prototype test by a neutral body.

**Temperature Classes**

Electrical equipment of group II must be labeled according to EN 60079-0:2004, chapter 5.3.2.2, and either

- classified (preferably) in a temperature class in compliance with the following table
- labeled with the respective maximum surface temperature, or
- if applicable, restricted to the action of a specific gas for which the equipment is intended.

| Temperature class | Maximum surface temperature [°C] |
|---|---|
| T1 | 450 |
| T2 | 300 |
| T3 | 200 |
| T4 | 135 |
| T5 | 100 |
| T6 | 85 |

*Fig. 13-3: Classification of the maximum surface temperature in classes for electrical equipment of Group II*

# 13.2 Intended Use

WARNING

**Danger of explosion!**

- The IndraDyn A motors in this ATEX design are not certified as explosion-protected devices, but are only prepared for acceptance as a part of an overall system. Additional safety equipment is required that has to be established by the user. Please, observe the notes in chapter 13.6 "Additional Components " on page 327.
- To ensure protection from explosion, only use purging devices with an ATEX protection class suitable for the motor, or higher.
- The values indicated on the identification label (fig. 13-5 "Type label of ATEX motors" on page 326) for example for the purging volume, the purge gas, the initial pressure and the over pressure must be ensured and monitored by the purging device.

**Range of Application**

The motors described here (components for group II, category 2G, directive 94/9/EC, appendix II, section 2.2.1) may only be used in an environment in which

- **an explosive atmosphere will probable not occur** caused by gases, vapors and fog,
- **an explosive atmosphere may result occasionally** due to gases, vapors or fog.

The system and the components must thus be designed and manufactured by the user in such a manner that sources of ignition are avoided assuming that device malfunctions occur frequently and that operating states occur that are usually unexpected.

# 13.3 Application Conditions

## 13.3.1 General Information

**Connection Specifications**

The motors may only be operated with Bosch Rexroth drive control devices and connection cables of the IndraDrive series. Control devices or cables from other manufacturers are not permitted. The connector terminals in the terminal box must be screwed on tightly. Do not disconnect or connect connectors when they are energized due to the danger of sparking within the explosive atmospheres!

**Grounding**

Speed-controlled drive systems contain unavoidable discharge currents flowing through the earth. For this reason the motors have to be grounded according to EN 60079-0:2004, chapter 15.4 over the motor cable and over a separate ground wire with **min. 4 mm²** (MAF225C-0150 with min. 25 mm²) cross section. Check that the grounded conductor is checked for proper connection and firm seat before commissioning.

☞ Adapt checking the grounding wire connections regularly into the machine maintenance plan.

If the protective conductor in the motor cable and the second separate protective conductor on the motor housing are not connected or are interrupted by corrosion or other defects during their lifetime, the discharge current flows (as leakage current) over conducting housing parts. This must be prevented using the measures mentioned above (directive 94/9/EC, appendix II, chapters 1.2.3, 1.3.3, and 1.4).

**Danger of Corrosion**

Corrosion of the motor housing due to aggressive substances (such as certain coolants, lubricants, cutting oils or salt mists) is to be prevented.

**Emergency Stop**

Stored energy in the drive devices circuit has to be degraded or isolated as soon as possible via pressing the **emergency stop**, so that in the case of failure the risk of an effect into the danger zone is reduced. (directive 94/9/EC, appendix II, section 1.6.2)

There are for example the following options:

- discharge of the energies via an intermediate circuit short-circuit
- Insulation of energies before the transition to the potentially explosive area through disconnection of cables and motors situated in the potentially explosive areas.

**Other Environmental Influences**

Heed the following regarding dangers caused by other disturbances:

- Operation only inside the specified ambient conditions
- Maximum vibration and impact loads
- Protection of the grounding conductor connection from dirt, corrosion, humidity and/or aggressive substances etc.

**Surface of the Motor Housing**

The housing paint of the motors consists of a black (RAL9005) 2K epoxy resin coating based on epoxy-polyamide resin in water.

Overcoating the motors in ATEX design is not admissible in order to not to effect the surface properties (such as insulation resistance, electrostatic charge) adversely.

## 13.3.2 Internal Motor Brake (Option)

In **normal operation**, use the brake located within the motor only when at a standstill and when performing the drive-internal brake check. In these cases, only low temperatures (<100° C) occur and no sparks are generated because critical grinding of the brake linings does not occur.

**Brake Control**

The brake's control mechanism must ensure this function in normal operation. **Particularly under the least favorable installation conditions for the power supply cables to the brake and under the least favorable load condition for the power supply, a supply voltage of 24 V +/- 10 % must be applied to the motor**. If a voltage divergence occurs due to a failure during operation, this failure must be identified and corrected immediately. The failure can be identified, for example, using a monitoring device for under voltage.

**Malfunctions**

Only during a **malfunction**, i.e. in the case of a fault in the system, may the brake be activated when the motor is turning to, for example, prevent dangerous dropping of vertical axes. In this case, sparks may be generated in the brake and increased temperatures may occur within the motor. When a fault occurs, the operator must eliminate it immediately.

**Functional Test**

Before commissioning and, during operation, in periodic intervals (e.g. every 8 hours), the function of the brake is to be checked in the framework of an appropriate brake test. Through the application of a defined motor torque, the brake is tested for slippage. In case of certain drive control devices, it is possible to carry out an integrated brake test using the command Holding system check. Further information can be found in the respective firmware operation manual for the drive control device.

## 13.4 Residual Risks

**Failure of the Protective Equipment**

If the purging device and the monitor for maintaining the protective measures fail simultaneously, explosion protection in an explosive atmosphere is no longer ensured and a danger of explosion exists.

**Overloading**

When the motor is overloaded, including cases where errors in the mechanical or electrical equipment of the machine cause such overloading, high temperatures may occur that result in explosion hazards.

**Grounding and Stray Currents**

Variable-speed drive systems cause unavoidable discharge currents. If the grounded connector in the motor cable and the second separate grounded connector on the motor housing are not connected as specified or are interrupted by corrosion or other defects during their lifetime, the discharge current flows (as leakage current) over conducting housing parts, resulting in the dangers of sparking at joints and, if explosive materials are present, explosions. Therefore, check the proper conditions of both grounded conductors in regular intervals.

**Material Ageing**

The periods of action and penetration of explosive materials depend on the application. They depend on the aging of the seals, the mechanical design of the motor, the characteristics of the explosive materials and the average temperature that occurs during the operating time as a consequence of the load cycles.

## 13.5 Selecting and Labeling ATEX Motors

**Motor Selection**

If an ATEX version of a motor is required, the motor must be selected and ordered on the basis of a predefined encoder type in the respective motor type code.

ATEX motors are defined by way of selecting the encoder option

- **M6**
- **S6**

in the motor type code.

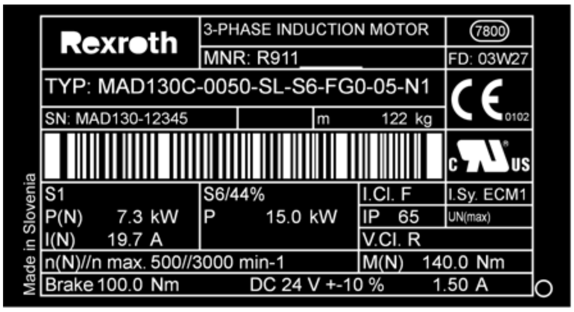
Accordingly, the figure 6 on the 18th position of the type code signifies an ATEX motor. This applies to the following motors:

- **MAD**□□□□-□□□□-□□-□**6**-□□□-□□-□□
- **MAF**□□□□-□□□□-□□-□**6**-□□□-□□-□□

**Labeling**

IndraDyn A motors in ATEX design have an additional label that is located on the side of the motor housing, next to the motor type label. The identification plate is located laterally at the motor housing next to the name plate and shows:

- the classification of the motor according to ATEX
- important details for adjusting the motor purging device.

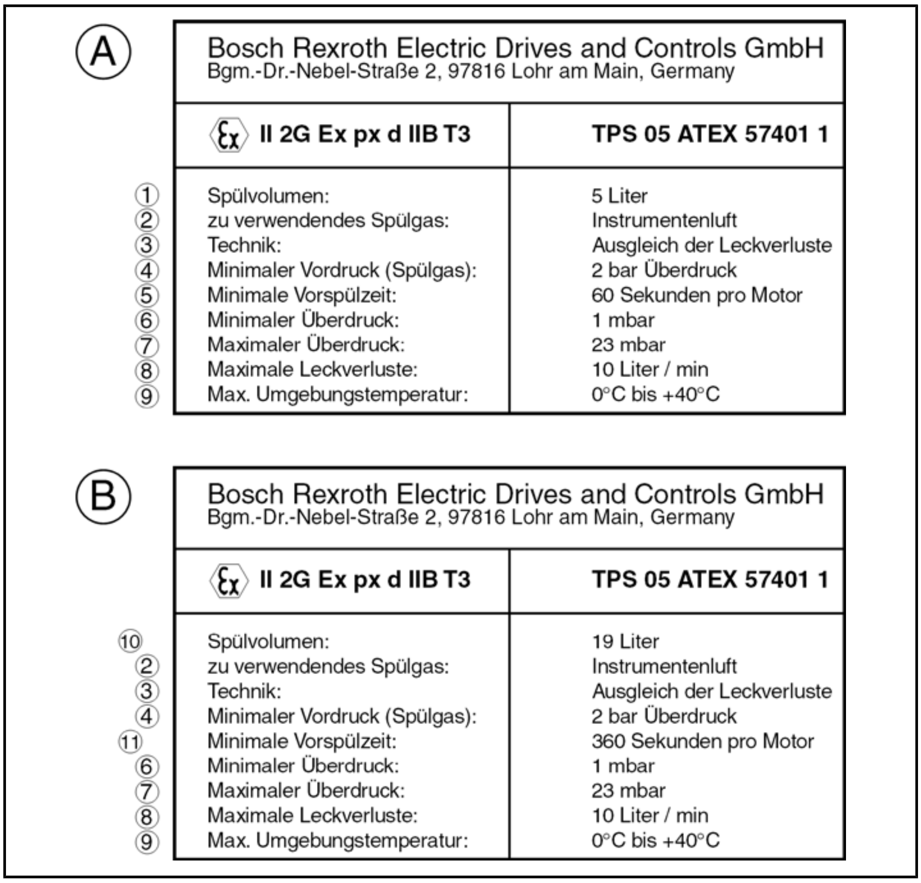



MAD_Typenschild.fh11

CE: CE Symbol
0102 Code number of the ATEX test authority
*Fig.13-4: Motor name plate (example: MAD-motor)*

Motors in Ex-pd Design for Explosive Areas

**Additional Designation Label on the ATEX Motor**




| | |
|---|---|
| Ⓐ | Designation label on motors of frame size 100...180 |
| Ⓑ | Designation label on motors of frame size 225 |
| Ex | ATEX symbol |
| II | Device Group II, which is suitable for all ATEX atmospheres except mines susceptible to firedamp |
| 2G | Device Category 2: the device is suitable only for ATEX atmospheres that are caused by gas that can occur occasionally |
| Ex | The European Standard for ATEX protection has been applied |
| px | Ignition protection class px means that an ATEX atmosphere is kept away from the ignition source (EN 60079-2), considering the special requirements in the construction sample test certificate |
| d | Ignition protection class D means that the transmission of an explosion to external areas is ruled out (EN 60079-1) |
| IIB | Explosion subgroup for certain gases and vapors |
| T3 | The max. permitted surface temperature (inside and outside of the housing) is 155° C |
| TPS*** | Motor registration number |
| ① | Purging volume: 5 liter |
| ② | Use scavening gas: Instrument air |
| ③ | Technique: Equalization of leak losses |
| ④ | Min. initial pressure (scavening gas): 2 bar excess pressure |
| ⑤ | Minimum purging time: 60 sec. per motor |
| ⑥ | Minimum excess pressure: 1 mbar |
| ⑦ | Maximum excess pressure: 23 mbar |
| ⑧ | Maximum leak losses: 10 liter / min |
| ⑨ | Maximum ambient temperature: 0 °C to +40 °C |
| ⑩ | Purging volume: 19 liter |
| ⑪ | Minimum purging time: 360 sec. per motor |

*Fig. 13-5: Type label of ATEX motors*

**UR, cUR Identification**

The motors have been presented to and approved by the UL authorities ”Underwriters Laboratories Inc.®” according to UL1004 and CSA22.2., No. 100. The corresponding identification is done on the motor name plate.

**Declaration of Conformity**

A declaration of conformity confirming the design and compliance with the valid EN standards and directives is available for the motors. A copy of the declaration of conformity can be found at the end of this chapter.

# 13.6 Additional Components

## 13.6.1 General Information

To operate a motor as part of an overall system within an ATEX atmosphere, further components are necessary. Not all required components are in the scope of delivery of Bosch Rexroth. Components that are not available from Bosch Rexroth are signified as additional components and have to be ordered by the manufacturer of the system.

An overall system mainly consists of:

**Bosch Rexroth components**

- MAD or MAF motors in ATEX design (type code option encoder S6 or M6)
- IndraDrive motor drive
- Connecting Cables

**Additional components of other manufacturers to be provided**

- Purging equipment and monitoring unit with connection hoses, accepted as an overall system and certified for the required protection class.
- For MAF motors: External cooling system (liquid cooling). For specification refer to the motor project planning manual
- For MAD motors: External cooling system (fan) For specification refer to motor project planning manual and the following notes.

## 13.6.2 Motor Fan

Cool the MAD motors for ATEX atmospheres during operation with a forced ventilation. We recommend using a radial fan, which must be mounted outside of the hazardous area. Mounting a fan directly on the motor is not permitted within explosive atmospheres. Observe the information in the project planning manual regarding motor cooling when calculating and selecting a suitable motor fan.

☞ Fans, an air hose and the small parts required for connection (hose clamps, etc.) do not belong to the Bosch Rexroth scope of delivery.

## 13.6.3 Ex p Control Device for Motor Purging

The IndraDyn A motor in ATEX design is merely a part of a drive system which provides explosion protection only in combination with an Ex p control device for motor purging.

WARNING

**Explosion hazard! Danger to life and high material damage by improper handling!**

The motor within ATEX atmospheres may only be commissioned as an overall system with a control device for motor purging. The control device must be classified and certified according to a protection class that is the same as or higher than that of the motor.

☞ The control device, which is required to safely operate the motor in an ATEX atmosphere, does not belong to the Bosch Rexroth scope of delivery and must be provided by the user.

Certification of the motors according to the ignition protection class

- **Ex-d** (encoder housing)
- **Ex-px** (motor housing)

according to EN 60079-1:2004 bzw. EN 60079-2:2004 was made using a control device of type **07-3711-2213/1002** manufactured by

- **BARTEC GmbH**
  Max-Eyth-Str. 16
  D-97980 Bad Mergentheim, Germany
  Phone +49 (0)7931 597-0
  Fax +49 (0)7931 597 -119
  e-mail info@bartec.de
  P.O.Box 1166, D-97961 Bad Mergentheim, Germany

Observe the notes of the manufacturer when selecting and commissioning the control device when designing the drive system.

### 13.6.4 Connecting Cables

☞ Only Bosch Rexroth connection cables are to be used to operate the motors in explosive atmospheres.

Bosch Rexroth provides suitable ready-made connection cables for the motors. They are checked for conformity with the directives and relevant DIN and EN standards. When selecting cables, use the following documentation

- **Rexroth Connection Cables**
  DOK-CONNEC-CABLE-*INDRV-AUxx-xx-P
  Material number R911322948 (German)
  Material number R911322949 (English)

## 13.7 Installation, Commissioning, Maintenance and Disassembly of ATEX Motors

**Preparation**

Before installing the motor, check whether the required information is present on the type label of the motor, such as the

- Equipment group and category,
- Explosion subgroup,
- Maximum permitted surface temperature,

correspond to the locally permitted conditions for use in potentially explosive areas.

Check the components for visible damage. Defective components must not be mounted.

Before installation, ensure that the environmental conditions at the location of use, such as the ambient temperature, the humidity, the vibration, and shock stresses do not exceed the admissible values.

Further detailed notes on

- Mechanical attachment
- Connection (electrical connection, cooling connection, purge gas connection)
- Commissioning
- Purging time of the overall system
- Maintenance and disassembly

of the ATEX motors may be found in the operating manual

- **DOK-MOTOR*-IDYN*A*ATEX-PRxx-D5-P**
  Material number R911312072

WARNING

**Danger of explosion!**

The motors may be commissioned in an explosive environment only if:

- The application notes of this project planning and those of the operating manual for ATEX motors have been understood and implemented.
- The overall system, consisting of motor, purging equipment, protective devices, and motor cooling equipment is inspected, accepted and logged according to the requirements of the relevant standards.

# 13.8 Declaration of Conformity

Electric Drives and Controls · Hydraulics · Linear Motion and Assembly Technologies · Pneumatics · Service

Rexroth
Bosch Group

**Konformitätserklärung**
**im Sinne der EG-Richtlinie 94/9/EG**
Produkt/Product/Produit: MAD/MAF (ATEX)

**TC 30501-1**
2007-06-28

**Declaration of Conformity as per EC directive 94/4/EC**
**Déclaration du fabricant conformément à la directive "CE" 94/4/CE**

Hiermit erklären wir in alleiniger Verantwortung, dass das Produkt

Assuming sole responsibility, we herewith declare that the product

Par la présente, nous déclarons sous notre propre et unique responsabilité que le produit

1 **Produkt:** / **Product:** / **Produit:** AC-Motor / AC motor / Moteur AC

2 **Hersteller:** / **Manufacturer:** / **Constructeur:** Bosch Rexroth Electric Drives and Controls GmbH, Bürgermeister-Dr.-Nebel-Straße 2, 97816 Lohr a. Main / Germany

3 **Typ / Type:** MAD...-...-...-.6-... ; MAF...-...-...-.6-...

4 **ab Herstelldatum:** / **from date of manufacture:** / **à partir de la date de fabrication:** 2006-04-01

5 **Angewendete Normen / Applicable standard / Normes utilisées**

| Norm / Standard / Norme | Titel / Title / Titre | Ausgabe / Edition |
|---|---|---|
| EN 60079-0 | Electrical apparatus for explosive gas atmospheres - Part 0: General requirements | 2004 |
| EN 60079-2 | Electrical apparatus for explosive gas atmospheres - Part 2: Pressurized enclosures „p" | 2004 |
| EN 60079-1 | Electrical apparatus for explosive gas atmospheres - Part 1: Flameproof enclosures “d” | 2004 |

6 **Baumusterprüfbescheinigungen / Type Examination Certificate / Attestation d'examen de type**
TPS 05 ATEX 57401 1 — EG-Baumusterprüfbescheinigung des TUEV Product Service TUEV Sued, Germany mit Prüfbericht 71320291, betreffend MAD/ MAF

den Bestimmungen der EG-Richtlinie 94/9/EG vom 23. März 1994 entspricht.
Die Produkte sind ausschließlich zum Einbau in eine Maschine mit funktionierenden und zugelassenen Schutz- und Überwachungseinrichtungen für den Explosionsschutz bestimmt.
Die Verwendung der in der Baumusterprüfbescheinigung angegebenen Sicherheitseinrichtungen und Komponenten unter den dort genannten Betriebsbedingungen und Normen wird vorausgesetzt.

complies with the provisions of EC Directive 94/9/EC dated 23rd March 1994.
The product is intended solely for installation in a machine with working and approved safety and monitoring equipment for the explosion protection.

As a prerequisite, the safety devices and components specified in the Type Examination Certificate must be used under the operating conditions and standards mentioned in this certificate.

satisfait aux dispositions de la Directive CE 94/9/CE du 23 mars 1994.
Les produits sont tous, sans exception, destinés et être intégrés à une machine avec l'équipement immatriculé de securité et protection explosive.

Il est présupposé que les dispositifs de sécurité et composants indiqués dans l'Attestation d'examen de type sont utilisés sous les conditions de foncionnement et normes mentionnées dans l'Attestation d'examen.

**Bosch Rexroth Electric Drives and Controls GmbH**
Bürgermeister-Dr.-Nebel-Straße 2 • 97816 Lohr a. Main
Germany



TC-30501-001-KOE_N_D3_2007-03-27.doc

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*Fig.13-6: Declaration of conformity (1/2)*

Konformitätserklärung / Declaration of Conformity / Déclaration du fabricant conformément
**MAD/MAF (ATEX)**

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**TC 30501-1** : 2007-06-28

| | | |
|---|---|---|
| Für das Gesamtsystem ist eine Zulassung einschließlich der Schutz- und Überwachungs-einrichtungen für den Explosions-schutz erforderlich, in der die Anforderungen der Normen auf Einhaltung im Gesamtsystem geprüft wurden. | The approval of the overall system with the safety and monitoring equipment for the explosion protection included is required. The requirements of the standards must be approved for compliance in the overall system. | La certification du système entier avec l'équipement de securité et protection explosive compris est nécessaire. L'observation des exigences normatives dans le système entier doit avoir été vérifiée. |
| Die Inbetriebnahme des Produktes ist solange untersagt, bis festgestellt wurde, dass die Maschine, in die das Produkt eingebaut werden soll, den Bestimmungen der EG-Richtlinie entspricht. | It is prohibited to put the product into operation until it has been established that the machine in which the product is to be installed complies with the provisions of the EC Directive. | La mise en service du produit est proscrite tant qu´il n´a pas été constaté que la machine dans laquelle ce produit doit être monté, répond aux dispositions de la directive CE. |
| **Erläuterungen:** Der bestimmungsgemässe Gebrauch des Produktes setzt die Einhaltung der Benutzungs-bestimmungen und Anwendungs-bedingungen, die in der Dokumentation zu diesem Produkt angegeben werden, durch den Anwender voraus. | **Explanations:** For the product to be used as intended the user must comply with the provisions of use and conditions of application laid down in the documentation of the product. | **Explications:** L'utilisation correcte du produit, c´est-à-dire en conformité avec sa destination, présuppose le respect par son utilisateur des prescriptions d´utilisation et conditions d´application stipulées dans la documentation du produit. |
| **Dokumentation:** | **Documentation:** | **Documentation:** |

DOK-MOTOR*-IDYN*A*ATEX-IB02-D5-P

| | | |
|---|---|---|
| Der Motor hat die folgende Kennzeichnung: | The motor has the following markings: | Le moteur a la caractérisation suivante: |

**CE Ex II 2 G Ex px d IIB T3**

Lohr a. Main , den 2007-07-09 i.V. i.V.

Ort/place/lieu Datum/date

Michael Steinbrecher
Leiter Qualitäts-Management/
Head of Quality Management/
Directeur Gestion Qualité

Norbert Nellen
Produktsicherheitsbeauftragter/
Product Safety Supervisor/
Responsable Sécurité des Produits

Änderungen im Inhalt der Konformitätserklärung sind vorbehalten. Derzeit gültige Ausgabe auf Anfrage.
We reserve the right to make changes in the conformity declaration. Presently applicable edition can be obtained upon request.
Le fabricant se réserve le droit de modifier le contenu de la dèclaration. Edition actuellement en vigueur demande.

*Fig.13-7: Declaration of conformity (2/2)*

# 14 Motors in Ex-nA Design for Explosive Areas

## 14.1 General Information on Motors in Ex-nA Design

MAD motors in Ex-nA design according to directive 94/9/EC supplement the series of IndraDyn A motors of Rexroth.

Motors of the Ex-nA design are certified as non-sparking equipment.

The available types are

- **MAD**100□-□□□□-□□-□□-□□□-□□-□□/**S003**
- **MAD**130B-□□□□-□□-□□-□□□-□□-□□/**S003**
- **MAD**130C-□□□□-□□-□□-□□□-□□-□□/**S003**

Regarding the order process of this motor design, please contact the responsible sales representative.

When delivered from the factory, operating instructions are included with the ATEX motors. These operating instructions form a part of the product and must be kept by the user of the motors over the entire operation and lifetime of the product. If the product is passed on or sold, these instructions must also be passed on to each new owner or user.

☞ The operating instructions of the motors in Ex-nA design have the product number **DOK-MOTOR*-IDYN*A*EXnA-IBxx-D5-P, MNR R911322500** and contains detailed notes on...

- Mechanical attachment
- Connection (electrical connection, cooling connection, etc.)
- Commissioning
- Maintenance and disassembly

It contains the translations in the following languages along with the language of compilation (German):

- French, Italian, Spanish and English

Should you not have the operating instructions in your language, contact your Bosch Rexroth sales partner before installing the motor.

## 14.2 Safety Instructions for Electric Drives and Controls

**Personnel**

The persons responsible for the safety of persons involved in the work or affected by it must act in accordance with the national legislation.

All persons working on, with or in the vicinity of an electrical system must be informed of the relevant safety requirements, safety guidelines and internal instructions (source: EN 50110-1:2004).

Taking the relevant national regulations into account, ATEX motors may be commissioned only by a skilled and competent electrician for ATEX protection.

**Warning Symbols**

In order to indicate dangers that can occur especially during the operation of ATEX motors, the following warning symbols and key words are used in these operating instructions. Signal words describe the degrees of hazard seriousness. The degree of hazard seriousness identifies the risk that exists if the safety information is not observed. In addition to the notes regarding safety listed here, please also observe the general safety notes in the project planning instructions for these motors.

| Warning symbols with signal word | Hazard classification (according to ANSI Z 535) |
|---|---|
| CAUTION | Bodily injury or damage may occur. |
| WARNING | Death or severe bodily harm may occur. |
| DANGER | Death or severe bodily harm will occur. |

*Fig.14-1: Hazard classification (according to ANSI Z 535)*

# 14.3 Appropriate Use

The ATEX motors are certified as non-sparking equipment. However, please observe the notes in chapter 14.8 "Additional Components" on page 341. Additionally required safety precautions have to be established by the user, if applicable.

The motors described herein (components for device group II, category 3G respectively 3D, directive 94/9/EC, appendix II, section 2.3) may only be used in an environment in which

- **an explosive atmosphere results never or only seldom or on a short-term basis** due to gases, vapors or fog.

The system and the components must thus be designed and manufactured by the user in such a manner that sources of ignition are avoided assuming that device malfunctions occur frequently and that operating states occur that are usually unexpected.

| Device category | Applicable in zone | Also applicable in zone | Basic requirements |
|---|---|---|---|
| 1 | 0 | 1<br>2 | Equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a very high level of protection. Equipment of this category is intended for use in areas in which explosive atmospheres caused by mixtures of air and gases, vapors or mists or by air/dust mixtures are present **continuously, for long periods or frequently**. Equipment of this category must ensure the required level of protection, even if there are only rare incidents, and is characterized by means of protection, meaning that<br>● in the event of failure of one means of protection, at least an independent second means of protection provides the required level of protection; or<br>● in the event of two faults occurring independently of each other, the required protection is guaranteed. |
| | 20 | 21<br>22 | |
| 2 | 1 | 2 | Equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a high level of protection. Equipment of this category is intended for use in areas, in which it can be expected that an explosive atmosphere of dust / air mixture can occur **occasionally**. The means of protection relating to equipment in this category ensure the required level of protection, even in case of frequently occurring disturbances which normally have to be taken into account. |
| | 21 | 22 | |
| 3 | 2 | - | Equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a high level of protection. Equipment of this category is intended for use in areas in which explosive atmospheres caused by dust whirled up are **unlikely** to occur or, if they do occur, are likely to do so only **rarely and for a short period of time**. Equipment of this category ensures the required level of protection during normal operation. |
| | 22 | - | |

*Fig. 14-2: ATEX category and zones according to ATEX*

# 14.4 Application Conditions for Motors According to ATEX Classification Device Group II, Device Category 3

## 14.4.1 Safety

DANGER

**Danger of life or material damage, danger of explosion due to inappropriate use! Heed the following to prevent danger due to ignitable gases or explosive dust-air mixtures in the vicinity of the motors:**

⇒ Only the **components and accessories** described in this documentation are allowed to be used for these motors.

⇒ The **application conditions** described in this documentation have to be observed in any case when project planning and operating the motors within the machine or equipment.

## 14.4.2 Device Category II

**Gases, Vapors – G (Gas) and Dusts – D (Dust)**

The motors described herein (components for device group II, category 3 according to directive 94/9/EC) may only be used in an environment

- where no explosive atmosphere can occur during **normal operation**, as this is avoided by ventilation and monitoring.
- where explosive atmosphere can occasionally occur in an **event of fault** and this atmosphere can be eliminated and intercepted by the user im-

mediately after occurrence. Thus the explosive atmosphere appears rarely and for a short period of time.

Therefore, the machine and the components have to be designed by the user in this way that no inflammable gas or dust in the area of the motor during normal operation can occur.

An event of fault by ignitable gas or dust must be identified immediately and the error has to be fixed. Further operation after occurrence is not allowed.

The failure of occurrence of ignitable gas or air/dust mixtures should not accumulate. If this is the case more often, measures to reduce the probability of the occurrence have to be taken immediately (directive 94/9/EC, annex II, chapter 1.2.3)

**Dusts – D (Dust)**

When using the motors described herein (components for device group II, category 3) in an area with **dust and air/dust mixtures** the erection appointments in the EN60079-15:2003 for

- normal operation and
- Fault condition

have to be observed.

The installation or extension of this motors has to be projected in this way that dust deposit on the motors can not inflame and the ATEX protection is not affected.

Dust deposit has to be avoided because of the motor cooling on the motor housing. If dust accumulations cannot be avoided, the procedures for determining the ignition temperature of dust (EN 50281-2-1;1998) have to be observed. The admissible layer thickness of the dust deposit is to be limited due to the danger of heat accumulation

The smoldering temperature of the dust must exceed the max. motor temperature clearly. (directive 94/9/EC, annex II, chapter 1.2.4 and chapter 2.1.2.3)

**Ambient Temperature**

If the environmental temperature is outside of the usual, the area of the machine or equipment has to be marked by the user (EN 60079-0:2004, chapter 5.1.1).

**Temperatures**

The ignition temperature of the ignitable gas, the smoldering temperature of the explosive dust or the ignition temperature of the ignitable air/dust mixture has to be far above of the maximum motor temperature (155°C). (Further information see directive 94/9/EC, appendix II, chapter 2.3.1.2, 2.3.2.2)

The maximum operating temperature at 40°C ambient temperature is

- 120°C within the motor
- outside of the motor housing: 110 °C.

**Connection Conditions**

The motors may be operated only with Rexroth IndraDrive drive control devices. Controllers of other manufacturers are not permitted.

DANGER

**Danger of explosion due to inadmissible temperature increase!**

⇒ The temperature sensors have to be analyzed by Rexroth IndraDrive controllers.

**Grounding**

Speed-controlled drive systems contain unavoidable discharge currents flowing through the earth. For this reason, the motors have to be grounded over the motor cable and over a separate ground wire (see chapter 14.10.4 "Equipotential Bonding Conductor" on page 347. Check that the position of the grounding conductor is fixed before commissioning.

☞ Adapt checking the grounding wire connections regularly into the machine maintenance plan.

If the protective conductor in the motor cable and the second separate protective conductor on the motor housing are not connected or are interrupted by corrosion or other defects during their lifetime, the discharge current flows (as leakage current) over conducting housing parts. This has to be prevented using the measures mentioned above (directive 94/9/EC, appendix II, chapters 1.2.3, 1.3.3, and 1.4).

**Risks of Corrosion**

Corrosion of the motor housing due to aggressive substances (such as certain coolants, lubricants, cutting oils or salt mists) is to be prevented.

**Emergency Stop**

Stored energy in the intermediate circuit has to be degraded or isolated as soon as possible via pressing the emergency stop, that in the case of failure the risk of an effect into the danger zone is reduced (directive 94/9/EC, annex II, chapter 1.6.2 ).

The following options exist for the activation of the emergency stop device:

- Reduction of energies via an intermediate short circuit.
- Insulation of energies before the transition to the potentially explosive area through disconnection of cables and motors situated in the potentially explosive areas.

**Fan**

The fan for cooling the motor during operation has to be outside of the explosive atmosphere.

The cooling air connection is made at the fan adapter of the motor.

**Other Environmental Influences**

Heed the following regarding dangers caused by other disturbances:

- Operation only inside the specified ambient conditions,
- Do not exceed the maximum vibration and shock stresses.
- Prevent corrosion due to humidity, aggressive substances and soiling of the protective conductor connections.

**Surface of the Motor Housing**

The housing paint of the motors consists of a black (RAL9005) 2K epoxy resin coating based on epoxy-polyamide resin in water.

Overcoating the motors in ATEX design is not admissible in order to not to effect the surface properties (such as insulation resistance, electrostatic charge) adversely.

## 14.5 Index of Applied Standards

| Standard | Title | Version |
|---|---|---|
| EN 60079-0 | Electrical apparatus for explosive gas atmospheres<br>Part 0: General requirements | 2004 |
| EN 60079-15 | Electrical apparatus for explosive gas atmospheres<br>Part 15: Construction, test and marking of type of protection "n" electrical apparatus | 2005 |
| EN 61241-0 | Electrical apparatus for use in the presence of combustible dust<br>Part 0: General requirements | 2006 |
| EN 61241-1 | Electrical apparatus for use in the presence of combustible dust<br>Part 1: Protection by enclosures "tD" | 2004 |

*Fig. 14-3: Standards used*

## 14.6 Residual Risks

The residual risks have to be taken into account by the user when designing the installation.

WARNING

**Explosion hazard!**

Due to the risks mentioned herein, the motors are **not** approved for use in areas, in which an explosive atmosphere or explosive materials

- do occur permanently or over a longer period or
- due to frequent device failures or error states to be expected typically

(directive 94/9/EC (annex I), EN 60079-0; 2004).

**Overloading**

When the motor is operated with too much load, including the case where errors in the mechanical or electrical equipment of the machine occur, high temperatures that result in the danger of explosions can occur under the following conditions:

- an explosive atmosphere develops in the area,
- explosive materials penetrate the motor during their period of action – for example, due to old seals,
- the shaft of the motor is overloaded or is insufficiently cooled according to the information in the design instructions,
- the single-channel temperature monitor via the software functions fails as a result of an error in the drive control device, so that higher temperatures occur on and in the motor housing.

**Dust Atmosphere**

When operating in explosive dust atmosphere:

- During the residence time a thick dust film accumulates on the motor. Hereby a sufficient cooling of the motor could no more guaranteed.
- The dust film has an insufficient heat conductivity,
- Due to the insulating dust film, the motor is loaded in such a way, that he becomes heated over the allowed temperature.
- The one-channel temperature control by software function brakes down due to a failure within the electric drive, so that higher temperature occur on and in the motor housing.

**Grounding and Stray Currents**

Variable-speed drive systems cause unavoidable discharge currents. If the grounding connector in the motor cable and the second separate grounding connector on the motor housing are not connected as specified or are interrupted due to corrosion or other defects during their lifetime, the discharge current flows as leakage current over conducting housing parts, resulting in the risks of sparking at transfer points and, if explosive materials are present, explosions.

**Material aging**

The periods of action and penetration of explosive materials depend on the application. They depend on the aging of the seals, the mechanical design of the motor, the characteristics of the explosive materials and the average temperature that occurs during the operating time as a consequence of the load cycles.

**Temperature monitoring**

As the result of an error, the single-channel temperature monitor in the drive system can fail during its lifetime and not be detected, even if the motor is operated within the normal temperature range and load cycle.

## 14.7 Labeling the Motors

Rexroth MAD motors in Ex-nA design are suitable for the use in explosive atmospheres of the zones 2 and 22. The motors comply with device group II, category 3 according to directive 94/9/EC.

The motors are labeled “**S003**” in the motor type code at position 23...27.

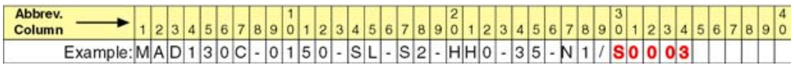



*Fig. 14-4: Type code identification Ex_nA*

Motors in ATEX design have an additional label that is located on the side of the motor housing, next to the motor type label. The identification plate is located laterally at the motor housing next to the name plate and shows:

- the classification of the motor according to ATEX

  **II 3 G Ex nA II T4**

- Additional information

**Motor Name Plate**

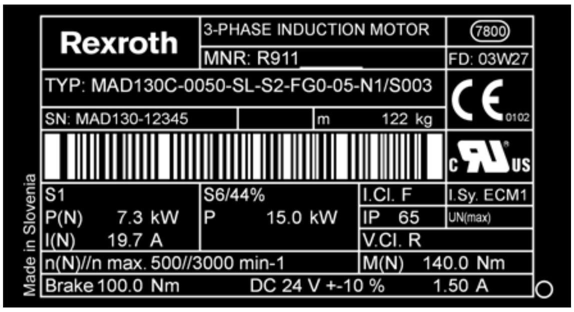
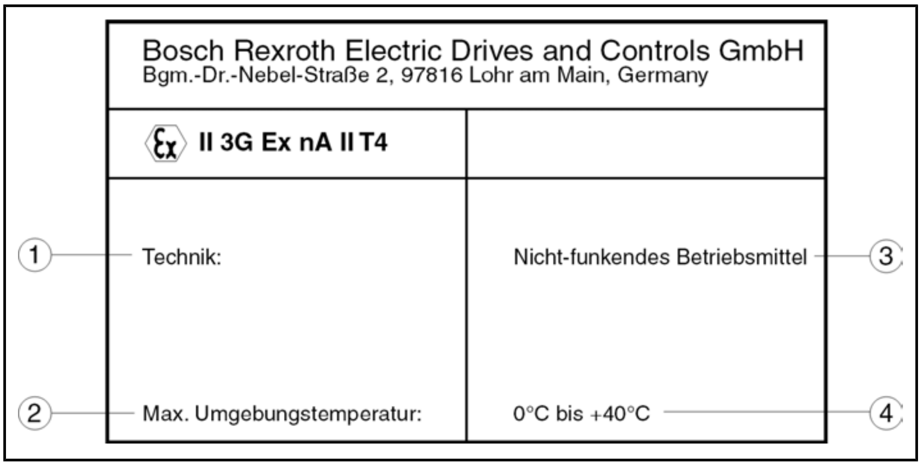



*Fig. 14-5: Motor name plate (example: MAD-motor)*

Motors in Ex-nA Design for Explosive Areas

**Additional Identification Plate on the Ex-nA motor**




| | |
|---|---|
| Ex | ATEX symbol |
| II | Device Group II, which is suitable for all ATEX atmospheres except mines susceptible to firedamp |
| 3G | Category 3, i.e. units suitable for ATEX atmosphere by gas or dust, which occurs rarely and temporary |
| Ex | The European Standard for ATEX protection has been applied |
| n | Ignition protection class n means that the requirements of EN 60079-15 for rarely and temporary occurrence of an explosive atmosphere are complied with. |
| A | Non-sparking apparatus |
| II | Explosion subgroup for the field of gases and vapors |
| T4 | Temperature class of the maximum admissible surface temperature (max 135°C) within and outside of the housing. The maximum surface temperature must not exceed the lowest ignition temperature of the corresponding explosive atmosphere! |
| ① | Technique |
| ② | Permissible ambient temperature |
| ③ | Non-sparking apparatus |
| ④ | 0°C to +40°C |

*Fig. 14-6: Identification plate on Ex-nA motors*

☞ In addition to the ATEX identification for gas explosive areas on the motor name plate, these motors have a second ATEX approval for dust explosive areas.

Thus, please observe the following identification before using the motors in dust explosive atmospheres.

| II 3 D Ex tD A22 IP65 120°C | |
|---|---|
| **Code** | **Meaning:** |
| II | Equipment group II which is suitable for all potentially explosive areas other than firedamp-endangered excavations |
| 3 | Device group 3<br>Device suitable for ATEX atmosphere by gas or dust only, which occurs rarely and temporary only |
| D | D = Dust |
| Ex | The European standard for explosion protection has been applied. |
| tD | Dust ignition protection class according to EN 61241-15:2004<br>"Protection through housing" |

| II 3 D Ex tD A22 IP65 120°C | |
|---|---|
| **Code** | **Meaning:** |
| A22 | Dust-proof equipment according to procedure A for zone 22 |
| IP65 | Protection class according to IEC 60529 |
| 120°C | Maximum surface temperature of the motor |

*Fig. 14-7: Ex_nA identification (dust)*

# 14.8 Additional Components

## 14.8.1 General Information

To operate a motor as part of an overall system within an ATEX atmosphere, further components are necessary. Not all required components are in the scope of delivery of Bosch Rexroth. Components that are not available from Bosch Rexroth are identified as additional components and have to be ordered by the manufacturer of the system.

An overall system mainly consists of:

**Bosch Rexroth devices and components**

- MAD motors in Ex-nA design
- IndraDrive controller
- Connecting Cables

**Additional components to be provided**

- External cooling system (fan) For specification refer to motor project planning manual and the following notes.

## 14.8.2 Motor Fan

Cool the MAD motors for ATEX atmospheres during operation with a forced ventilation. We recommend using a radial fan, which has to be mounted outside of the explosive atmosphere (see fig. 9-15 " Example for radial ventilation via fan adapter" on page 262). Mounting a fan directly on the motor is not permitted within explosive atmospheres. Observe the information in chapter 9.8.2 "Radial Ventilation in Strongly Contaminated or Explosive Atmospheres" on page 262 when calculating and selecting a suitable motor fan.

> Fans, an air hose and the small parts required for connection (hose clamps, etc.) do not belong to the Bosch Rexroth scope of delivery.

## 14.8.3 Connecting Cables

> Only Bosch Rexroth connection cables are to be used to operate the motors in explosive atmospheres.

Bosch Rexroth provides suitable ready-made connection cables for the motors. They are checked for conformity with the directives and relevant DIN and EN standards. When selecting cables, use the following documentation

- **Rexroth Connection Cables**
  DOK-CONNEC-CABLE-*INDRV-AUxx-xx-P
  Material number R911322948 (German)
  Material number R911322949 (English)

# 14.9 Mechanical Attachment

**Preparation**

Before installing the motor, check whether the required information is present on the designation label of the motor, such as the

- Equipment group and category,
- Explosion subgroup,
- Maximum permitted surface temperature,

correspond to the locally permitted conditions for use in potentially explosive areas.

Check the components for visible damage. Defective components must not be mounted.

Before the installation, make sure that the environmental conditions on site, such as the ambient temperature, the humidity, the vibration and shock environment do not exceed the details specified in the project planning manual of the motor.

**Mounting**

At the factory the motors are produced either for flange mounting (frame shape 05) or for foot mounting (frame shape 35).

For further information, see

# 14.10 Connection Technique

## 14.10.1 General Information

**DANGER**

**Explosion hazard due to improper handling during the connection of the motor!**

- Ensure that the power is off and that the motor is connected only in an atmosphere that is not capable of explosions.
- Before working on the system, always use a suitable measuring instrument (e.g. multimeter) to assure that the parts no longer have a residual voltage (e.g. due to the residual energies of capacitors in filters, drive devices, etc.). Wait for their discharging time.
- The connection between the ground-reference lug and the grounding conductor must be made before any other connections.
- In particular, make sure that the connection cables are installed in the terminal box orderly and free of tension to avoid abrasion or pressure marks on the cables.
- The connection points to or on the control device must be located outside of the explosive atmosphere.
- The ATEX motors may be operated only with Rexroth IndraDrive drive control devices. Control devices from other manufacturers are not permitted.

The motors have to be grounded via the motor cable and the separate grounding wire (equipotential bonding according to EN 60079-0:2004, chapter 15) with

**min. 4 mm²** cross section (see fig. 14-12 "Equipotential bonding exemplary for MAD130" on page 347).

The power connection is located on top and is provided only as a terminal box in the case of ATEX motors.

The following connections must be made to ensure safe operation of the motors:

- Power connection (incl. temperature sensor and holding brake, if applicable)
- Encoder connection
- Equipotential bonding connection
- Cooling connection

## 14.10.2 Power Connection

We recommend keeping the following standard tools at hand to connect the motors:

- 1 torque screwdriver 1/4" (adjustable)
- 1 torque wrench 1/2" (with adjustment scale)
- 1 socket wrench set 1/4" + 1/2"
- 1 set of Allen keys
- 1 set of combination wrenches

**Power Cable Connection at "Terminal Box Rotatable" (Options "D, E, G, H")**

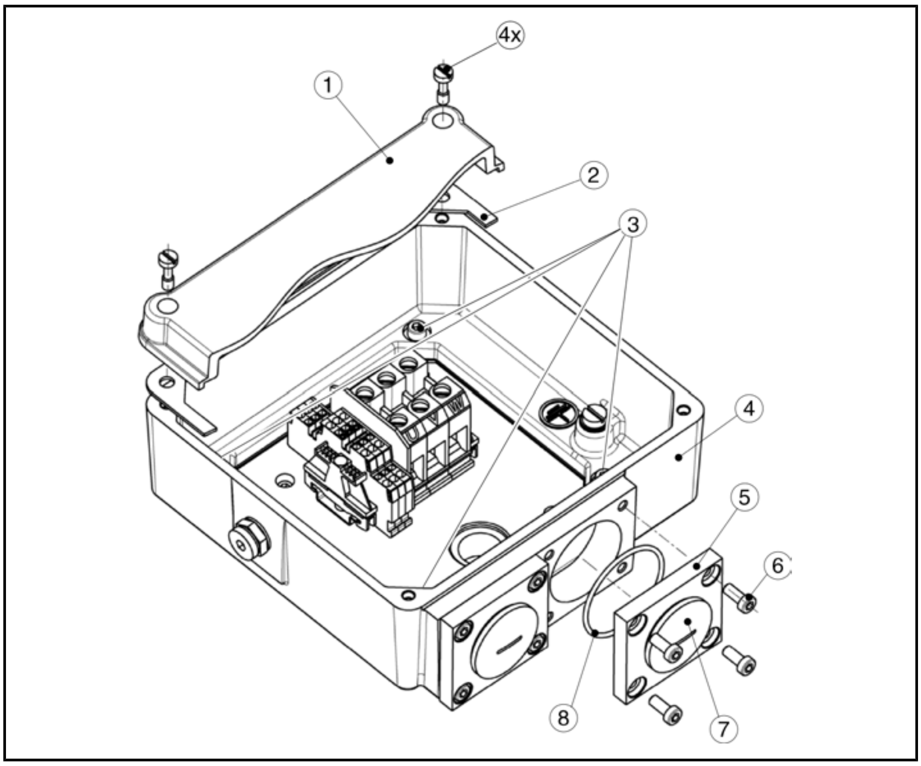
The required outlet direction of the power cable is selected in the type code of the motor. In accordance with the specification of the outlet direction by the user, the terminal box is factory-mounted at the motor.

☞ By selecting the connection option "terminal box rotatable", the user can adapt the cable outlet direction to a new or modified connection situation directly at the installation site simply by "turning" the terminal box.

The connection of the power cable to terminal boxes of the type code option "D, E, G, H" requires the following steps:

1. Open the lid of the terminal box ①.

   Open and remove the fastening screws (4 screws).




| | |
|---|---|
| ① | Terminal box lid |
| ② | Seal terminal box lid |
| ③ | Fastening screws for terminal box (4 screws) |
| ④ | Terminal box of the option ""D, E, G, H" |
| ⑤ | Adapter plate for screwed cable connection |
| ⑥ | Fastening screws for adapter plate (4 screws) |
| ⑦ | Protection cover of screwed cable connection |
| ⑧ | O-ring |

*Fig. 14-8: Terminal box pivotable (options "D, E, G, H").*

2. Check the direction of the outgoing cable and turn the terminal box if necessary.
   - Detach the terminal box.

     Open the fastening ③ and turn the terminal box ④ to the required outlet direction in 90° increments.
   - Fasten the terminal box.

   Screw in and tighten the fastening screws ③.

   Tightening torque of the screws: min 12 to max 14 Nm

CAUTION

**Improperly inserted or missing seals may cause loss of motor protection class and danger of explosion of ATEX motors!**

A seal is located between terminal box and motor housing. Check the terminal box after turning or re-fastening for proper condition and correct position of the seal.

3. Unscrew the protection cover of the screwed cable connection ⑦.
4. Detach the adapter plate ⑤ at the terminal box ④.
5. Tightly screw the adapter plate to the metric cable connection at the power cable.

There is an O-ring at the screwed cable connection of the power cable. Before tightening the adapter plate, ensure that the O-ring is actually situated in the screwed connection of the power cable.

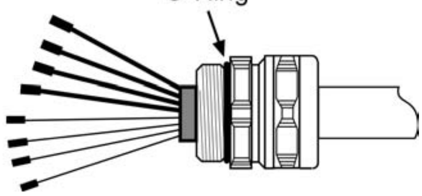



*Fig. 14-9: O-ring at the screwed cable connection*

CAUTION

**Improperly inserted or missing seals may cause loss of motor protection class and danger of explosion of ATEX motors!**

Conduct a visual inspection to check the O-ring for proper state and position at the screwed connection of the power cable before attaching the adapter plate to the power cable.

If the O-ring is missing, do not use the power cable. In this case, contact your Rexroth sales or service partner.

6. Run the power cable through the opening into the terminal box up to the adapter plate. Refasten the adapter plate to the terminal box.

   Tightening torque of the screws: 9 Nm

   Pay attention to the O-ring between adapter plate ⑨ and terminal box ③!

CAUTION

**Improperly inserted or missing seals may cause loss of motor protection class and danger of explosion of ATEX motors!**

Check the O-ring inserted into the adapter plate for proper state and position before attaching the adapter plate to the terminal box.

7. Connect the wires according to the connection diagram:

   Observe the following tightening torques:

**Screw tightening torques in NM for power connection to terminal boxes of the options "D, E, G, H"**

| Terminal box rotatable Option "D, E, G, H" | U-V-W | PE |
|---|---|---|
| | M6 | M8 |
| MAD100...130 | 2.5 Nm | 3.5 Nm |

*Fig. 14-10: Screw tightening torques*

8. Close and fasten the lid of the terminal box.

   Moisten the thread of the fastening screws for the lid ① with liquid screw fastener Loctite 243 and fasten the lid with all the fastening screws.

   Tightening torque of the screws: min 6 to max 7 Nm

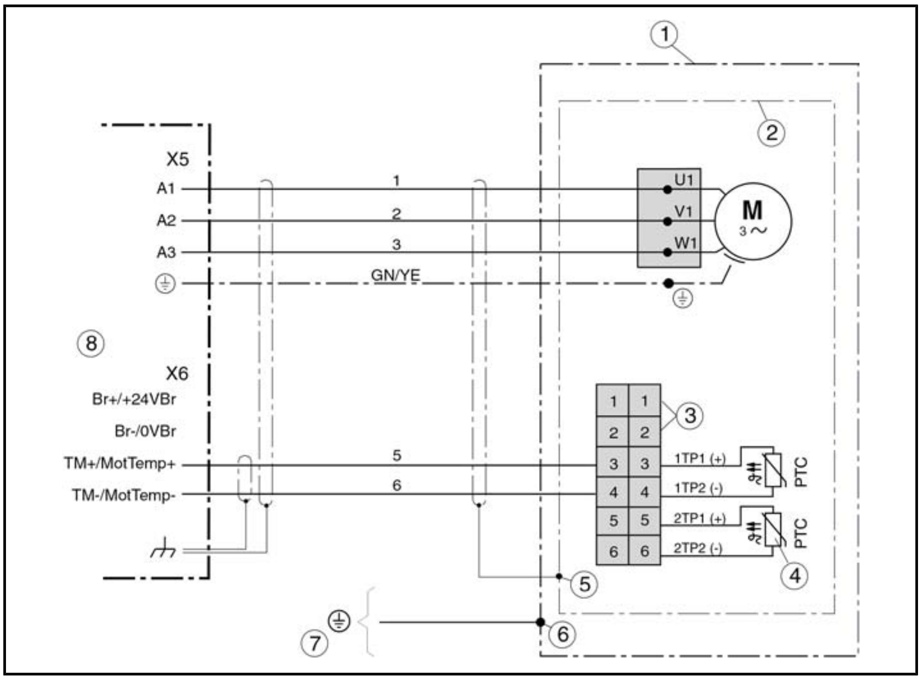
   Before tightening the screws, make sure that the seal ② between the lid ① and the terminal box housing ③ is positioned properly.

CAUTION

**Improperly inserted or missing seals may cause loss of motor protection class and danger of explosion of ATEX motors!**

Check the attached seal at the terminal box lid for proper state and position before attaching the terminal box lid to the terminal box.

**Connection Diagram**




| | |
|---|---|
| ① | Motor |
| ② | Terminal box |
| ③ | Holding brake (not used) |
| ④ | Backup temperature sensor. Connect the backup sensor only if necessary. |
| ⑤ | Shield connection via cable clamp of strain relief in the screwed cable connection |
| ⑥ | Equipotential bonding motor |
| ⑦ | Equipotential bonding machine |
| ⑧ | Connection designations at the Rexroth drive controller |

*Fig. 14-11: Electrical connection diagram (ex-nA design)*

- Only one contact pair of the PTC thermistor connections position 3-4 or 5-6 is connected to the motor cable.
- The seal between the terminal box lid and the terminal box must neither be damaged nor removed.
- Observe the size of the threaded cable connection and connection thread for the cable inlet into the terminal box.
- The connections of the motor-windings in the terminal box must not be removed.

## 14.10.3 Encoder Connection

A 15 meter-long connection cable is connected with the explosion-protected motors. This connection cable has been connected with the encoder at the factory. The connection cable has been connected to the encoder in the factory and has to be connected to the controller after the motor has been mounted.

DANGER

**Explosion hazard due to improper handling during the connection of the motor!**

The junction to/on the motor drive device must be located outside of the explosive atmosphere.

Observe the following when connecting the encoder:

- The encoder housing on the motor may no longer be opened in principle! Do not remove any of the screws on the encoder housing.
- Work may be carried out only if the electrical system is not under power.
- Please observe the information of project planning for the controller, as well as the details in chapter 8.8 "Encoder Connection " on page 245 of this documentation.

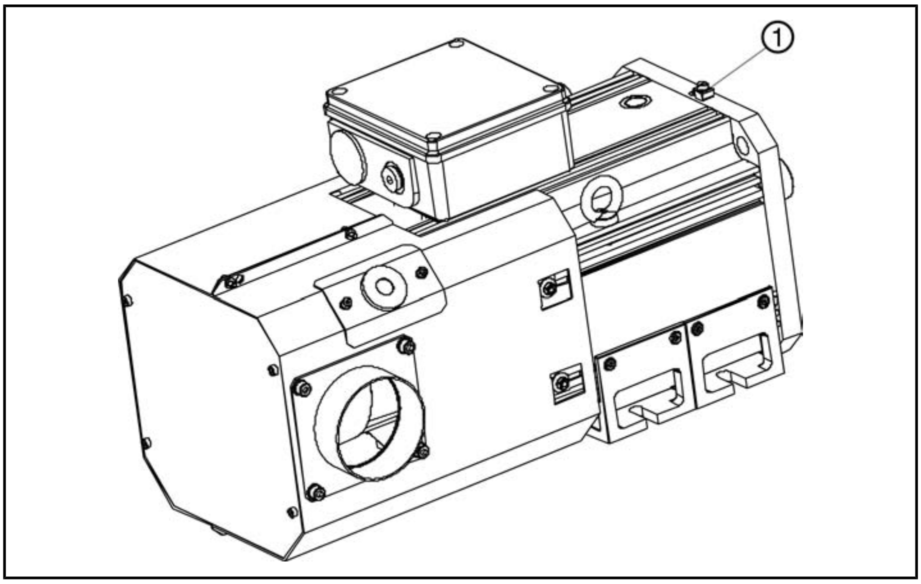
## 14.10.4 Equipotential Bonding Conductor

WARNING

**Explosion hazard due to improper handling during the connection of the motor!**

The equipotential bonding on the motor has to be connected according to EN 60079-0:2004, chapter. 15.4 in addition to the grounding wire with a separate cable with **min 4 mm²** cross section.

The motors for ATEX atmospheres have an additional connection terminal on the motor flange to connect the equipotential bonding. Connect the equipotential bonding on the motor via the cable having the equipotential bonding of the machine or installation and tighten the screwed connection.




① Terminal for grounding conductor

*Fig. 14-12: Equipotential bonding exemplary for MAD130*

| Protective conductor terminal on motor frame size MAD... | Terminal area |
|---|---|
| 100...130 | 0..0.10mm² |

*Fig.14-13: Terminal for grounding conductor*

### 14.10.5 Cooler of MAD Motors

MAD motors in ATEX design are equipped with a fan adapter for operation with an external fan.

☞ The required fan and corresponding connection materials (air hose, connection clamps, etc.) do not belong to the scope of delivery of the motor; these must be provided by the machine manufacturer.

CAUTION

**Danger of explosion due to electrostatic charge"**

Please observe the following when selecting and mounting the air hose between motor and fan,

- the hose has to be approved for the use in ATEX atmospheres on the basis of its properties.
- there must be no electrostatic charge.

MAD motors may be operated only if the fan provides the specified minimum amount of air flow on the motor side. Therefore, when selecting radial fans or central ventilation systems, take into account the length of the air duct to be installed, as well as the air baffles. You will find further notes on the aforementioned in chapter 9.8.2 "Radial Ventilation in Strongly Contaminated or Explosive Atmospheres" on page 262.

## 14.11 Acceptance Test

Before the system is commissioned the first time or after having replaced the motor, you have to carry out an acceptance test, including an acceptance log, in which the notes and conditions for application specified herein are confirmed.

## 14.12 Commissioning

### 14.12.1 General Information

CAUTION

**Damage to property due to errors in the control of motors and moving elements!**

- Commissioning in ATEX atmospheres is prohibited until it has been ascertained that the overall system corresponds to the demands and certification conditions for ATEX protection.
- Do not carry out commissioning if connections, operating states or product data are unclear or faulty!
- Do not carry out commissioning if the safety and monitoring equipment of the system is damaged or not in operation.
- Contact Bosch Rexroth for missing information or support during commissioning!

### 14.12.2 Preparation

1. Keep the documentation of all products you are using ready.
2. Check the products for damage.
3. Check all mechanical and electrical connections (incl. the potential equalization line!).
4. Activate the safety and monitoring equipment of the system.

### 14.12.3 Execution

When all prerequisites have been fulfilled, proceed as follows:

1. Activate the fan for cooling the MAD motor.
2. Carry out the commissioning of the drive system according to the instructions of the corresponding product documentation. You can find the respective information in the functional description of the drive control devices.
3. Log all measures taken in the commissioning report.

The commissioning of drive control devices and the control unit may require additional steps. The inspection of the functioning and performance of the systems is not object of these operating instructions; instead, it is carried out within the framework of the commissioning of the machine as a whole. Observe the instructions and regulations given by the machine manufacturer.

## 14.13 Dismantling

DANGER

**Explosion hazard! Fatal injury due to errors during the control of motors or works on moving elements!**

- Do not work on unsecured and operating machines.
- Before accessing motors after having switched them off, let them cool down for a sufficiently long time. Cool-down times **of up to 140 minutes** may be required!
- Make sure that the motor is only dismantled in the de-energized state and a non-explosive atmosphere.
- Before working on the system, always use a suitable measuring instrument (e.g. multimeter) to assure that the parts no longer have a residual voltage (e.g. due to the residual energies of capacitors in filters, drive devices, etc.). Wait for their discharging time.
- Secure the machine against accidental movements and against unauthorized operation.
- Before dismantling, secure the motor and power supply against falling or movement before disconnecting the mechanical connections.
- Observe the notes regarding dismantling in the documentation of the motor purging control device.

**In the case of malfunctions, maintenance or deactivation of the motors, proceed as follows:**

1. Use the control commands to bring the drive to a controlled standstill.
2. Switch off the power and control voltage of the drive device.
3. Switch off the motor protection switch for the motor fan.

4. Switch off the main switch of the machine.
5. Secure the machine against accidental movements and against unauthorized operation.
6. Wait for the cooldown times of the motor and the discharge time of the electrical systems to elapse.
7. Disconnect all electrical connections.
8. Before dismantling, secure the motor and power supply against falling or movement before disconnecting the mechanical connections.
9. Dismantle the motor from the machine.
10. Log all measures taken in the commissioning report.

## 14.14 Maintenance / Repair

Increase availability with regular preventive maintenance measures. Notice the information in the maintenance schedule of the machine manufacturer and the following details regarding maintenance measures and intervals for the motor.

**WARNING**

**Explosion hazard!**

**Death by electrocution possible due to live parts with more than 50 V!**

- Working on parts that are under power while the danger of explosions exists is strictly prohibited.
- Before starting work that has to be carried out, observe the important safety regulations according to DIN VDE 530, such as releasing the power; securing against restarting; ensuring that the system is not under power; grounding and short-circuiting; and covering or fencing off neighboring parts that are under power.
- Ensure that the measures mentioned above cannot be repealed before the work is completed.

**Servicing**

| Measure | Interval |
|---|---|
| Check the functioning of the fan and the air circulation. | According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours. |
| Check the air hoses for motor cooling for proper seat and tightness. | According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours. |
| Check the mechanical and electrical connections. | According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours. |
| Check the machine for smooth running, vibrations and bearing noises. | According to the guidelines in the machine maintenance plan, but at least every 1,000 operating hours. |
| Remove dust, chips and other dirt from the motor housing, cooling fins and the connections. | Depending on the degree of soiling, but after one operating year at the latest. |

*Fig. 14-14: Maintenance measures*

WARNING

**Danger of explosion due to inappropriate repair or servicing works!**

- Repairs on ATEX motors may only be carried out by Bosch Rexroth Electric Drives and Controls GmbH or workshop that has been authorized by Bosch Rexroth.

Defective ATEX motors must be sent back to the place of manufacture or to a Bosch Rexroth authorized workshop for ATEX motors for repairs such as

- Replacing the motor encoder
- Replacing the radial shaft sealing ring
- ...

In no case may they be dismantled or repaired by a workshop not authorized by Bosch Rexroth.

# 15 Service and Support

## 15.1 Helpdesk

Our service helpdesk at our headquarters in Lohr, Germany, will assist you with all kinds of inquiries.

Contact us:

- By phone through the Service Call Entry Center,
  Monday to Friday 7:00 am - 6:00 pm CET
  **+49 (0) 9352 40 50 60**
- By fax
  **+49 (0) 9352 40 49 41**
- By e-mail: service.svc@boschrexroth.de

## 15.2 Service Hotline

Out of helpdesk hours please contact our German service department directly:

**+49 (0) 171 333 88 26**

or

**+49 (0) 172 660 04 06**

Hotline numbers for other countries can be found in the addresses of each region (see below).

## 15.3 Internet

Additional notes regarding service, maintenance and training, as well as the current addresses of our sales and service offices can be found on

http://www.boschrexroth.com

Outwith Germany please contact our sales/service office in your area first.

## 15.4 Helpful Information

For quick and efficient help please have the following information ready:

- Detailed description of the fault and the circumstances
- Information on the type plate of the affected products, especially type codes and serial numbers
- Your phone and fax numbers as well as your e-mail address so we can contact you in case of questions

# Index

# Notes

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R911295781

Printed in Germany
DOK-MOTOR*-MAD/MAF****-PR06-EN-P