rexroth
A Bosch Company

Operating Instructions

MAD / MAF

Asynchronous Housing Motors

R911336186, Edition 05

Disclaimer

The data specified above only serve to describe the product. As our products are constantly being further developed, no statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.

Table of contents

1 About this documentation

1.1 Validity of the documentation

This instruction has to be complied with by assemblers, operator, service engineers and facility operators. It contains notes about handling the motor or motor components of a kit motor.

Before operating motors or its components, read this operating instruction to ensure a safe and smooth functionality and a long motor lifetime.

1.2 Editions of this documentation

Table 1: Record of revisions

Edition	Release date	Remark
05	02/2025	Storage instructions updated.
04	11/2024	Intended application section added; Removed supplemental directives. The reader is referred to the ➦ Rexroth Motors Safety Notes (R911340694).
03	05/2023	UKCA label added
02	03/2022	Encoder option M6 / S6 removed
01	11/2011	First edition

1.3 Additional documentation

This operating instruction is only valid with the following Rexroth documentation:

Table 2: Additional documentation

	Title	Document type	Document number
🕮	MAD/MAF Asynchronous Housing Motors	Project Planning Manual	DOK-MOTOR*-MAD/MAF****-PR□□-□□-P
🕮	Rexroth Connection Cable	Selection Data	DOK-CONNEC-CABLE*INDRV-AU□□-□□-P

1.4 Presentation of information

Explanation of signal words and the safety alert symbol

The Safety Instructions in the available application documentation contain specific signal words (DANGER, WARNING, CAUTION or NOTICE) and, where required, a safety alert symbol (in accordance with ANSI Z535.6-2011).

The signal word is intended to draw your attention to the safety instructions and describes the seriousness of the danger.

The safety alert symbol (a triangle with an exclamation point), which precedes the signal words DANGER, WARNING and CAUTION, is used to alert the reader to personal injury hazards.

⚠ DANGER	Non-compliance with this safety instructions **will** result in death or severe personal injury.

⚠ WARNING	Non-compliance with this safety instructions **can** result in death or severe personal injury.
⚠ CAUTION	Non-compliance with this safety instructions can result in moderate or minor personal injury.
NOTICE	Non-compliance with this safety instructions can result in material damage.

Table 3: Symbols

Symbol	Meaning
🕮	Reference to supplementary documentation
	This note gives important information, which must be observed.
⇒	Single, independent handling step
1. 2. 3.	Numbered instruction: The numbers show that the action steps must be taken one after the other.
	Warning against dangerous electric voltage.
	Warning against hot surfaces.
	Warning against rotating machine parts.
	Warning against overhead load.
	Warning against crushing hazard.
	Electrostatic sensitive devices.
	Access for persons with cardiac pacemaker forbidden.
	Do not carry along metal parts or clocks.
	Hammer scales are forbidden.

Markup

The following markups are used for a user-friendly text information representation:

🕮 Reference to supplementary documentation

This note gives important information, which must be observed.

- Listings on the first level contain a bullet point
  - Listings on the second level contain a dash

→ Handling instructions are specified in numbered lists. Please comply with the order of the handling instructions.

2 Safety instructions

2.1 About this product

Observe the general safety notes in this chapter and the safety instructions in this documentation. Therewith, you avoid personal danger, damage and errors.

This operating instruction must be stored and transferred in case of sale during the complete product lifetime.

2.2 Important directions on use

2.2.1 Intended use

Introduction

Bosch Rexroth products are designed and manufactured using the latest state-of-the-art-technology. The products are tested prior to delivery to ensure operational safety and reliability.

⚠ WARNING	**Personal injury and property damage by using products incorrectly!** Failure to use our products in an unintended way may cause situations resulting in property damage and personal injury.
NOTICE	**Inappropriate use** Bosch Rexroth, as the manufacturer, does not provide any warranty, assume any liability, or pay any damages for damage caused by products not being used as intended. Any risks resulting from the products not being used as intended are the sole responsibility of the user.

Before using the products by Bosch Rexroth, the following condition precedent must be fulfilled so as to ensure that they are used as intended:

- Personnel that in any way uses our products must first read and understand the relevant safety instructions and be familiar with their appropriate use.
- Hardware products must be left in their original condition, i.e. no structural changes may be made. Software products must not be decompiled and their source code must not be changed.
- Damaged or defective products must not be installed or put into operation.
- It must be ensured that products are installed in compliance with all regulations specified in the documentation.

Prerequisites for proper and safe use of the motors are proper transport, appropriate storage, proper assembly and connection, careful maintenance, operation and overhaul.

Areas of use and application

Typical applications include, for example:

- Handling and mounting systems
- Packaging and food machines
- Printing and paper converting machines
- Machine tools

The motors have been exclusively designed for installation in industrial machinery. The motors have been designed and manufactured in compliance with the EU directives and harmonized standards specified in the following.

Standards	
EN 60034-1 EN 60034-1:2010 + Cor.:2010	Rating and performance behavior
EN 60034-5 EN IEC 60034-5:2020	Type of protection
Directives	
2014/35/EU	Low voltage directive

The machine manufacturer must evaluate the electric and mechanic safety as well as environmental influences in the assembled state of the machine according to the Machine Directive 2014/35/EC EN 60204-1:2018 (Safety of machinery - Electrical equipment of machines -Part 1: General requirements).

The electrical installation must comply with the protection requirements of EMC Directive 2014/30/EU. The plant manufacturer is responsible for appropriate installation (for example: physical separation of signal and power cables, using shielded cables, ...). The EMC instructions of the converter manufacturer must be observed.

The machine may not be commissioned before conformity with these directives has been confirmed.

For application-specific use of motors, drive controllers with various levels of power, DC bus voltage and different interfaces are available. For regulation and controlling of motors, additional sensors like length measuring systems must be connected.

Before commissioning, every connected drive controller must be programmed according to the specified motor function for the specified application.

- The motors may only be operated under the assembly, mounting and installation conditions, in the normal position, and under the environmental conditions (temperature, degree of protection, humidity, EMC etc.) specified in this documentation.
- The motors may only be used with the accessories and attachments specified in this documentation. Components that are not explicitly specified must not be installed nor connected. The same applies for cables and lines.
- The device may only be operated in the explicitly specified configurations and combination of components and in compliance with the respective functional description of the software and firmware.

2.2.2 Unintended use

Any use of 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 as "non-intended use".

Do not use these motors, if

- the intended application range is not explicitly approved for Bosch Rexroth motors.
- the operating conditions do not comply with the specified ambient conditions. For example, they may not be operated under water, under extreme temperature fluctuations, under extreme maximum temperatures or in potentially explosive atmospheres.

These motors are not suited to be operated directly on the power supply.

Trademark right third parties

Comply with the trademark rights of third parties during assembly and use of single components delivered by Bosch Rexroth. For any infringement of the right, the customer is liable for the accruing damage.

2.3 Qualification of personnel

Any work with or on the described product may only done by qualified or skilled personnel. For the purpose of this manual, qualified personnel means persons who are familiar with transporting, installing, mounting, commissioning and operating the components of the electrical drive and control system and the associated hazards and have an appropriate qualification for their job.

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 instructionsEN 50110-1:2013.

2.4 General safety instructions

Important! Please read all instructions before motor installation.

Do not install or operate motors or components of the electric drive and control system before you have not carefully read all delivered documents.

Keep this instructions!
The operating instruction must be stored and transferred in case of sale during the complete product lifetime.

Please observe the particular applicable national, local and system-specific regulations, the safety instructions in the documentation and the warning and informative labels on the motors.

Observe the general safety notes in this chapter and the safety instructions in this documentation. Therewith, you avoid personal danger, damage and errors.

Improper use of the motors and failure to follow the safety instructions in this document may result in material damage, personal injury, electric shock or, in extreme cases, to death!

In the case of damage due to non-observance of the safety notes, Bosch Rexroth assumes no liability.

Applications for functional safety are only allowed if the motors have the **SI**-sign on the rating plate.

2.5 Product- and technology-dependent safety instructions

2.5.1 Protection from electric voltage

Work required on the electric system may only be carried out by skilled electricians. Tools for electricians (VDE tools) are absolutely necessary.

Before working:

- Enable.
- Secure against reactivation.
- Ensure de-energization.
- Ground and short-circuit.
- Cover or shield any adjacent live parts.

After completing the job, cancel the measures in reverse order.

Dangerous voltage occurs during operation! Danger to life, risk of injury by electric shock!

- Before start-up, connect the protective conductors on all electric components according to the connection plan.
- Operation, even for short measuring purposes is only allowed with fixed connected protective conductor on the specified points of the components.

2.5.2 Protection from mechanical danger

Dangerous movements! Danger to life, risk of injury, heavy injury or material damage.

- Do not stay within the motion zone of the machine. Avoid unauthorized access into the danger zone.
- Additionally secure vertical axes to prevent them from sinking or descending after having shutdown the motor, for instance as follows:
  - Mechanically lock the vertical axis,
  - providing an external braking / catching / clamping device, or
  - ensure sufficient weight compensation of the axes.

  Only using the serially delivered **motor holding brake** or an external holding brake activated by the drive controller **is not suitable for personal protection!**

Rotating parts! Danger to life, risk of injury, heavy injury or material damage.

- Secure key and/or transmission elements against ejection.
- Install covers on dangerous rotating machine parts before start-up.

2.5.3 Protection against magnetic and electromagnetic fields

Magnetic and electromagnetic fields are created in the direct environment of live conductors or permanent magnets of electro motors and are a serious danger for persons.

Strong magnetic and electromagnetic fields pose a health hazard for persons with heart pacemakers, metallic implants and hearing aids in the direct environment of motor components!

- Persons with heart pacemakers and metallic implants are not allowed to approach or handle these motor components.

Crushing hazard of fingers and hands due to strong attractive forces of the magnets!

- Handle only with protective gloves.

Risk of destruction of sensitive parts!

- Keep watches, credit cards, check cards and identity cards and all ferromagnetic metal parts, such as iron, nickel and cobalt away from permanent magnets.

2.5.4 Protection against burns

Risk of burns due to hot motor surfaces!

- Avoid contact with hot motor surfaces. **Temperatures may rise over 60 °C**.
- Allow the motors to cool down long enough before touching them.
- Temperature-sensitive components may not come into contact with the motor surface. Ensure appropriate mounting distance of connection cables and other components.

2.5.5 Electrostatic sensitive devices (ESD)

Rexroth motors contain parts which underlie an electrostatic danger. These components, especially temperature sensors of the motor winding can be destroyed by improper use.

Avoid, e.g. direct contact of open stranded wires of the connection cable of temperature sensors without being electrostatically discharged or grounded.

Do suitable ESD protective measures before you handle imperiled components (e.g. ESD protective clothes, wristlets, conductive floor, grounded cabinets and working surfaces).

3 Scope of delivery

The scope of delivery of a MAD/MAF motor contains:

- Motor in original package
- Additional type plate
- General safety instructions
- Optional connecting accessories for motors with terminal box
- Protective covers for output shaft, plug connections and coolant connections of water-cooled motors.

On delivery, immediately verify whether the delivered goods are those specified on the delivery note. Damage to packaging and goods detected upon delivery must be reported to the transport company immediately. The commissioning of damaged products is prohibited.

4 About this product

4.1 Product description

4.1.1 Intended application

MAD/MAF motors are equipped with a high-resolution encoder and are therefore in conjunction with a converter for servo-applications designed for demanding control operations.

4.1.2 Technical features

The MAD/MAF motor series are asynchronous housing motors for operating converters or inverters of Bosch Rexroth.

Product	AC motor
Manufacturer	Bosch Rexroth AG Buergermeister-Dr.-Nebel-Straße 2 97816 Lohr a. Main / Germany
Type	**MAD**100, -130, -160, -180, -225 **MAF**100, -130, -160, -180, -225
Listed acc. to UL standard (UL)	UL 1004, Fifth Edition
Listed acc. to CSA standard (UL)	Canadian National Standard(s) C22.2 No. 100-04
UL-Files (UL)	E 335445
Ambient temperature during operation	0 ... 40 °C
Motor design	B05 (B35) (DIN EN 60034-7)
Type of protection	IP65 (DIN EN 60034-5)
Oscillating quantity level	See motor type code
Concentricity, run-out, alignment	for encoder S2, M2 tolerance R (DIN IEC 60072-1)
Flange	acc. to DIN 42955
Shaft end	Cylindric (DIN 748 part 3), keyway optional, centering hole (DIN 332 part 2)
Installation altitude	0 ... 1000 m
Sound pressure level	< 75 dB(A)
Insulation class	155 (DIN EN 60034-1)
Balancing	Complete or half key balancing
Electrical connection	Power connection: Terminal boxes or device connectors Encoder connection Device connector
Encoder system	S2 (optically, Singleturn EnDat 2.1, 2,048 signal periods) M2 (optically, Multiturn EnDat 2.1, 2,048 signal periods) C0 (optically, incremental encoder, 2,048 signal periods)

Product	AC motor
Holding brake (option)	dependend from the holding brake (see type code) electrically clamped or electrically released U_N 24V DC (±10%)

4.1.3 Frame size

Table 4: Allowed installation types B05 acc. to DIN EN 60034-7

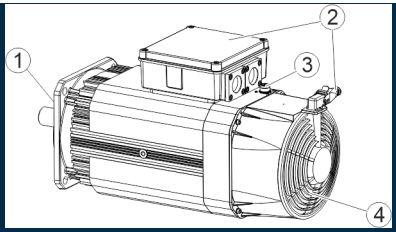
Motor frame size B05		
IM B5	IM V1	IM V3
		
Flange attachment on the drive side of the flange	Flange attachment on the drive side of the flange, drive side facing down	Flange attachment on the drive side of the flange, drive side facing up

Table 5: Allowed installation types B35 acc. to DIN EN 60034-7

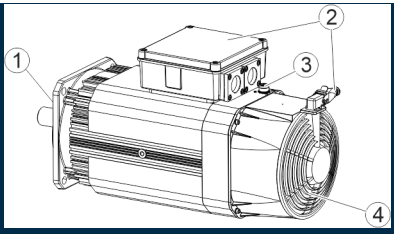
Motor frame size B35	
IM B3	IM B5
	
Foot assembly, feet at the bottom	Flange attachment on the drive side of the flange

4.1.4 Type of protection

Table 6: Defining the motor components subject to protection



Component subject to protection		Degree of protection	Remark
①	Output shaft without shaft sealing ring	IP54	Observe the detailed motor project planning manual for vertical installation
	Output shaft with shaft sealing ring	IP65	Option
	Output shaft with labyrinth seal	IP65	Option
②	Power connection Fan connection	IP65	Terminal box or plug
③	Motor encoder connection	IP65	



Component subject to protection		Degree of protection	Remark
④	Motor fan	IP65	Fan grille IP65 Fan grille IP24

4.1.5 Output shaft

Centering hole

Table 7: Centering hole

Centering hole, acc. to DIN 332-2	MAD / MAF				
	100	130	160	180	225
DS M16	■	■			
DS M20			■	■	■

Key (option)

Table 8: Keyway

Keyway [1], according to DIN 6885-AS	MAD / MAF				
	100	130	160	180	225
10×8×45	■				
12×8×80		■			
16×10×80			■ (only MAD)		
18×10×80			■ (only MAF)		
18×11×110				■	
20x12x110					■

1) included in the scope of delivery

4.1.6 Bearing

MAD and MAF motors have permanently greased bearings. For details about available bearing variants and their bearing lifetime depending on the shaft and bearing load refer to 🕮 ➦ project planning manual MAD/MAF Asynchronous Housing Motors.

4.1.7 Cooling

Surface ventilation

MAD motors may only be operated with a fan. Cooling takes place via air streams which are guided over the surface of the motor by air baffles.

To ensure that the axial fan can move the required air volume, a minimum distance for letting the air in and out must be kept between the fan grille and the machine. This distance is based on the motor construction.

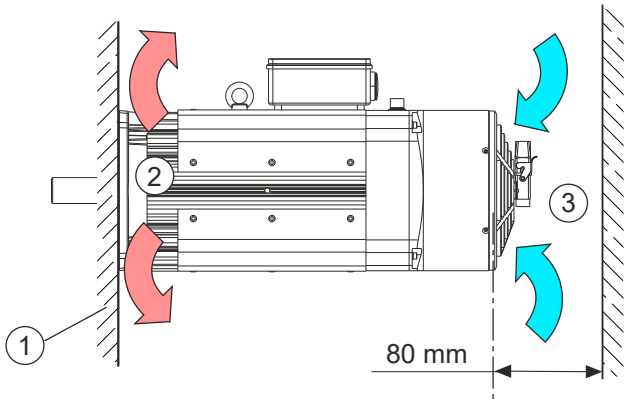


Fig. 1: MAD ventilation
① Machine
② Air outlet space
③ Air inlet space

The use of the fan under the following conditions is expressly not suitable:

- Delivery of air which contains abrasive particles
- Delivery of air which has a strongly corroding effect, e.g., salt mist
- Delivery of air which contains a high dust load, e.g., extraction of saw dust
- Delivery of combustible gases/particles
- Use of the ventilator as a technical safety component or as a component assuming safety-relevant functions

Liquid cooling

Liquid-cooled motors may only operated on a closed coolant circuit with heat exchanger. The coolant flow direction can be arbitrarily selected.

Expand the cooling circuit with anticorrosive. Observe the information in the 🕮 ➦ project planning manual MAD/MAF Asynchronous Housing Motors.

4.2 Identification

4.2.1 Product identification

Type code

Product

M A _ _ _ _ _ _ - _ _ _ _ _ - _ _ _ - _ _ _ - _ _ _ _ - _ _ - _ _

M A D = see project planning manual
M A F = see project planning manual

Frame size

M A _ _ _ _ _ _ - _ _ _ _ _ - _ _ _ - _ _ _ - _ _ _ _ - _ _ - _ _

= see project planning manual

Frame lengths

M A _ _ _ _ _ _ - _ _ _ _ _ - _ _ _ - _ _ _ - _ _ _ _ - _ _ - _ _

= see project planning manual

Winding

M A _ _ _ _ _ _ - _ _ _ _ _ - _ _ _ - _ _ _ - _ _ _ _ - _ _ - _ _

= see project planning manual

Cooling

M A _ _ _ _ _ _ - _ _ _ _ _ - _ _ - _ _ _ - _ _ _ _ - _ _ - _ _

S A = Axial fan, blowing
S L = Fan cover with fan shroud
F Q = Liquid cooling (connection thread)
F R = Liquid cooling (fast coupling)

Encoder

M A _ _ _ _ _ _ - _ _ _ _ _ - _ _ _ - _ _ - _ _ _ _ - _ _ - _ _

S 2 = Singleturn absolute encoder, EnDat2.1, 2,048 increments
M 2 = Multiturn absolute encoder, EnDat2.1, 2,048 increments
C 0 = Incremental encoder, 2.048 increments
N 0 = without motor encoder

Electrical connection

M A _ _ _ _ _ _ - _ _ _ _ _ - _ _ _ - _ _ _ - _ _ _ _ - _ _

A = Connector, A-side
B = Connector, B-side
R = Connector, right
L = Connector, left
E = Terminal box, A-side
H = Terminal box, B-side
D = Terminal box, right
G = Terminal box, left

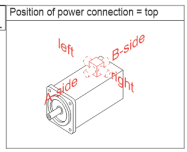


Fig. 2: Type code (1/2)

Shaft

M A _ _ _ _ _ _ - _ _ _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ - _ _ - _ _

	smooth shaft	With keyway: balanced with complete key	With keyway: balanced with half key
Without shaft sealing ring	H	Q	L
With shaft sealing ring	G	P	K
With labyrinth seal	F	R	M

Holding brake

M A _ _ _ _ _ _ - _ _ _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ - _ _ - _ _

0 = without holding brake
1 = Holding brake, electrically-released (for holding torque see project planning manual)
2 = Holding brake, electrically-released (for holding torque see project planning manual)
3 = Holding brake, electrically-released (for holding torque see project planning manual)
5 = Holding brake, electrically-clamped (for holding torque see project planning manual)

Frame size

M A _ _ _ _ _ _ - _ _ _ _ _ - _ _ _ - _ _ _ - _ _ _ _ - _ _ - _ _ - _ _

0 5 = Flange assembly
3 5 = Flange and foot assembly

Bearing

M A _ _ _ _ _ _ - _ _ _ _ _ - _ _ _ - _ _ _ - _ _ _ _ - _ _ - _ _ - _ _

A = Fixed bearing A-side
H = High Speed
N = Standard
V = Reinforced bearing

Vibration severity level

M A _ _ _ _ _ _ - _ _ _ _ _ - _ _ _ - _ _ _ - _ _ _ _ - _ _ - _ _ - _ _

1 = A, according to DIN EN 60034-14
3 = B, according to DIN EN 60034-14
4 = C, for specification refer to project planning manual

Fig. 3: Type code (2/2)

Type plate (example MAF100)

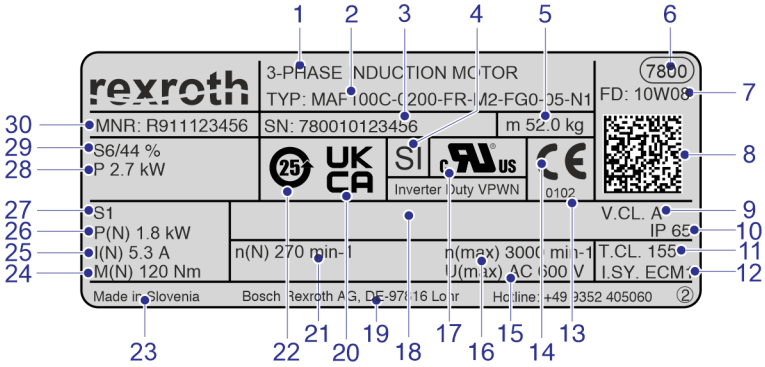


Fig. 4: MAF type plate example

1 Type of machine
2 Type designation
3 Serial number
4 Safety technology
5 Motor mass in kg
6 Manufacturing plant
7 Date of manufacture
8 Data matrix code
9 Vibration severity
10 Degree of protection by housing
11 Thermal class
12 Insulation system
13 Code number of the notified authority
14 CE mark of conformity
15 Maximum input voltage
16 Highest allowed velocity
17 UL sign
18 Fields for holding brake (option) with holding torque, rated voltage, rated current
19 Company address
20 UK Conformity Assessed (UKCA)
21 Rated speed
22 China-RoHs 2 label
23 Designation of origin
24 Rated torque in operation mode S1
25 Rated current in operation mode S1
26 Rated power in operation mode S1
27 Operation mode S1
28 Motor power in operation mode S6
29 Operation mode S6/44%
30 Material number

MAD/MAF motors are delivered with 2 type plates each. Attach the second type plate to an easily visible position at the machine. This way, you can read the motor data at any time without having to work in areas that are difficult to access and where the motor may be attached.

4.2.2 Certifications

CE

CE

Declarations of conformity certifying the design and the compliance with the valid EN standards and EC guidelines are available for all motors. If required, the declarations of conformity can be requested from the responsible sales office. The CE mark is attached to the motor type label of the motors.

UR/cUR

MAD/MAF motors were presented to “Underwriters Laboratories Inc.®” and have been approved by this UL authority. The E-file number issued is **E335445**. The appropriate identification of the motors is specified on the motor type plate.

„UKCA“

MAD/MAF motors fulfill the UKCA requirements. The appropriate identification is specified on the motor type plate.

The UK Declaration of Conformity can be found in the Bosch Rexroth Media Directory: ➦ www.boschrexroth.com/mediadirectory, keyword: ➦ „DCTC-30319-031“.

RoHS

We confirm in our manufacturer´s declaration TC 30806-1 that our products conform with the RoHS directive 2011/65/EG "Restriction of the use of certain hazardous substances in electrical and electronic equipment".

China RoHS 2

The China RoHS 2 conformity can be found on the type plate of the motors.
Information about listing: ➦ https://www.boschrexroth.com.cn/zh/cn/certificates/china-rohs2/

5 Transport and storage

5.1 Transport instructions

5.1.1 General

To protect the motor against dirt, dust, etc., Bosch Rexroth recommends transporting it

- up to the prepared installation place
- until it is actually installed in the machine

within the original packaging, the motor is delivered from Rexroth.

To lift the motor out of the transport crate or to install it in the machine, use the transport or lifting eyebolts at the motor.

The lifting eyebolts at least meet the requirements of DIN 580. Before each transport, ensure that the lifting eyebolts have been screwed down fully to the contact surface and that your selected lifting equipment and lifting method does not overstress the lifting eyebolts.

NOTICE	Please comply with DIN 580 on the transport of motors using the attached lifting eyebolts. Non-observance of the information in this standard can cause overstress to the lifting eye bolts and result in personal injury and/or product damage.

Based on DIN EN 60721-3-2, the tables below specify classifications and limit values which are allowed for our products while they are transported by land, sea or air. Refer to the detailed description of the classifications to take all of the factors which are specified in the particular class into account.

Table 9: Allowed classes of environmental conditions during transport acc. to DIN EN 60721-3-2

Classification type	Allowed class
Classification of climatic environmental conditions	2K11
Classification of biological environmental conditions	2B1
Classification of chemically active materials	2C1
Classification of mechanically active materials	2S5
Classification of mechanical environmental conditions	2M4

For a better overview, some essential environmental influencing variables of the previously mentioned classifications are listed. Unless otherwise specified, the values given are the values of the particular class. However, Bosch Rexroth reserves the right to adjust these values at any time based on future experiences or changed environmental factors.

Table 10: Allowed transport conditions

Environmental factor	Symbol	Unit	Value
Temperature	T_T	°C	-20 ... +80[1)]
Air humidity (relative air humidity, cannot be combined with a quick temperature change)	φ	%	75 (at +30 °C)
Occurrence of salt mist			Not permitted [1)]
1) Differs from DIN EN 60721-3-2			

NOTICE	Before transport, empty the liquid coolant from the liquid-cooled motors to avoid frost damage.

5.1.2 Notes about transport to the machine

NOTICE	**Never touch the connection points of electrostatic sensitive devices!** – Mounted components (e.g. KTY84, encoder) can contain parts susceptible to electrical discharge (ESD). ⇒ Observe ESD safety measures.

⚠ WARNING	**Risk of injury and material damage due to improper handling during transport!** – Only use hoisting gear suited for the weight of the motors. Use the eyebolts provided on the housing to lift the motor. All lifting eye bolts must be used and tightened before use. – Never walk under hanging loads. – Do not lift the motor at the shaft or - when using MAD motors - on the fan housing. – Use suitable protective equipment and protective clothing during transport, and wear safety shoes.
NOTICE	Please comply with DIN 580 on the transport of motors using lifting eyebolts. Non-observance of the information in this standard can cause overstress to the lifting eye bolts and result in personal injury and/or product damage.

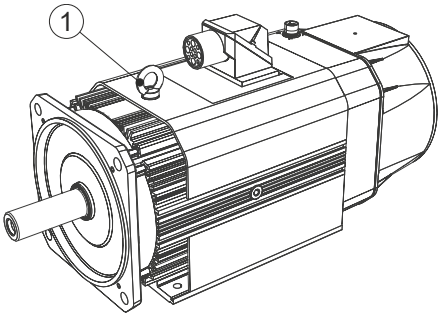


Fig. 5: Lifting and transporting motors
① Ring screws (check firm seating before use)

Before transporting the motor, determine the weight of the motor. For details about motor weight refer to the type plate.

⇒ Adjust the carrying capacity of the lifting device to the motor weight.

⇒ Avoid increased transport vibrations.

⇒ Remove any existing transport locks prior to commissioning and keep them.

5.2 Storage instructions

Environmental conditions during storage

NOTICE	**Damage or destruction of motor components due to improperly handling during storage and transport!** – Observe the permitted environmental conditions for storage. – Covers fitted to the motor at the factory must remain on the motor during transport and storage.

Generally, Bosch Rexroth recommends storing all components until they are actually installed in the machine as follows:

- at a dry and dustfree location
- at room temperature
- free from vibrations and oscillations
- protected against light or direct sunlight

Based on EN IEC 60721-3-1:2018, the tables below specify classifications and limit values which are allowed for our products while they are stored. Refer to the detailed description of the classifications to take all of the factors which are specified in the particular classification into account.

Table 11: Allowed classes of environmental conditions during storage according to EN IEC 60721-3-1:2018

Classification type	Class
Classification of climatic environmental conditions	1K21
Classification of biological environmental conditions	1B1
Classification of chemically active materials	1C1
Classification of mechanically active materials	1S10
Classification of mechanical environmental conditions	1M11

For a better overview, some essential environmental influencing variables of the previously mentioned classifications are listed. Unless otherwise specified, the values given are the values of the particular class. However, Bosch Rexroth reserves the right to adjust these values at any time based on future experiences or changed environmental factors.

Table 12: Permissible ambient conditions deviating from EN IEC 60721-3-1:2018

Environmental factor	Unit	Value
Air temperature	°C	-25 ... +55[1)]
Relative air humidity	%	5 ... 75[1)]
Absolute air humidity	g/m³	1 ... 29[1)]
Direct solar radiation	-	Not permitted

1) Deviating from EN IEC 60721-3-1:2018

NOTICE

Damage due to moisture and humidity!

- Protect the products from dampness and corrosion.
- Store them only in rainproof and dry rooms.
- Before storage, discharge the liquid coolant from liquid-cooled motors to avoid damage.

Storage times

The maximum storage duration is 2 years.

Storage durations of more than 6 months require conservation measures by the customer. Untreated metallic surfaces (e.g. shaft or flange) must be treated with a preserving agent to protect against corrosion.

Additional measures have to taken upon commissioning to ensure smooth functioning – irrespective of the storage time which may be longer than the warranty period of our products. However, this does not entail any additional warranty claims.

Table 13: Measures to be taken before commissioning motors or motor components in long-term storage

Storage time / months				Measures prior to commissioning
> 1	> 6	> 12	> 24	
●	●	●	●	Visual inspection of all parts to be damage-free
●	●	●	●	Resurface the holding brake [1]
	●	●	●	Check conservation measures. Renew corrision protection if necessary. Remove the preserving agent before commissioning
		●	●	Check the electric contacts to verify that they are free from corrosion
		●	●	Let the motor run in without load for one hour at ~20% of the specified nominal speed [2)]
		●	●	Measure insulation resistance. Dry the winding at a value of < 1kOhm per volt rated voltage.
			●	Function test and product revision if necessary by Bosch Rexroth Service

1) Only motors with holding brake are affected

2) Only motors with roller bearings are affected

Cables und plug connectors

Table 14: Measures before commissioning of cables and connectors that have been stored over longer periods of time

Storage time	Measures prior to commissioning
< 1 year	None
1 ... 5 years	Check the electric contacts to verify that they are free from corrosion
> 5 years	If the cable or the cable jacket has porous parts, replace it; otherwise check the electric contacts to verify that they are free from corrosion.

6 Assembly

6.1 Mechanical assembly

6.1.1 Flange assembly

NOTICE	**Motor damage due to ingress of liquids!** Fluid that is present on the shaft seal of the output shaft for a long time can penetrate the motors and cause damage ⇒ Make sure that no liquid can be present on the output shaft. ⇒ Do not mount any open gearboxes (gearboxes that are not hermetically sealed).

For details on mounting holes, refer 🕮 ➦ to the project planning manual Asynchronous Housing Motors MAD/MAF.

Use all motor mounting holes to mount the motor safely to the machine.

- If coupling is direct, ensure that the support is plane and the orientation is precise.
- Avoid pinching or jamming the centering collar on the motor side.
- Avoid damaging the receptacle fit on the plant side.
- Use the following screws and washers for flange assembly.

Table 15: Fastening screws for flange mounting of MAD/MAF motors

Motor frame size	Hole ⌀ [mm]	Screw 8.8 DIN EN ISO 4762 DIN EN ISO 4014	Tightening torque M_A[Nm] bei μ_K= 0.12	Washer DIN EN ISO ...
100	14	M12 × ...	84	28738
130 ... 225	18	M16 × ...	206	7090

6.1.2 Foot mounting

Before attaching the motor according to the foot mounting method, observe the clearance from the center of the motor shaft to the bottom edge of the foot specified in the particular motor dimension drawing. Compare this dimension with the connection dimension on the machine side.

The mounting holes and clearances correspond to the general tolerance according to DIN ISO 2768-1 (tolerance class m).

Before attaching the motor to the machine, it must be aligned so that the center line of the motor shaft is aligned with the center line of the connecting shaft.

The following procedure is recommended for foot mounting of the motors:

1. MAD130 ... 225: Dismount the lower lateral air baffles to have free access to the mounting holes.
2. Align the motor such that the center line of the motor shaft is flush with the center line of the connection shaft of the machine. To align the motor, use sheet steel strips as a base.

3. Connect the motor firmly to the machine.

Table 16: Fastening screws for foot assembly

Motor frame size	Hole ⌀ [mm]	Screw 8.8 DIN EN ISO 4762 DIN EN ISO 4014	Tightening torque M_A[Nm] at μ_K= 0.12	Washer DIN EN ISO ...
100	11	M10 x ...	48	28738
130	12			
160	14	M12 x ...	84	
180	14.5			
225	22	M20 × ...	206	7090

4. MAD130 ... 225: Reattach the air baffles demounted in the beginning to the motor.

In contrast to flange assembly, radial forces may only be effective in a direction perpendicular to the mounting surface (± 15°) if foot assembly is selected. The transmission of forces in other effective directions is not allowed.

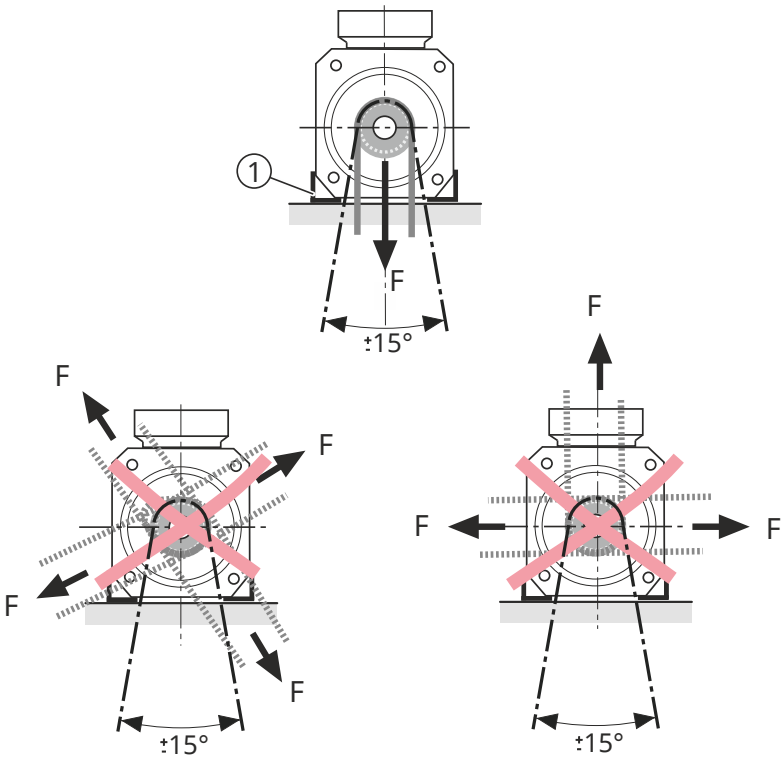


Fig. 6: Example: MAF foot assembly

① Mounting feet

Please note the following in case of foot assembly ...

- Forces which are transmitted by a gear and have an effect on the motor feet are not allowed.

  Forces taking effect via the gear shaft must be supported against the gear.
- Incorrect installation situations give rise to forces which may cause short-term damage to the motors. If necessary, consider "flange assembly" as an alternative.

6.1.3 Mount transmission elements

Fit and pull off the transmission elements such as pulleys and couplings only with suitable equipment; heat them, if necessary.

⇒ Avoid inadmissible belt tensions. Please consider the allowed radial and axial forces in the project planning manuals.

⇒ The balancing state of transmission element must comply with the balancing mode of the motor.

NOTICE	**Motor damage due to strikes onto the motor shaft!** Do not strike the shaft end and do not exceed the allowed axial and radial forces of the motor.

Fitting

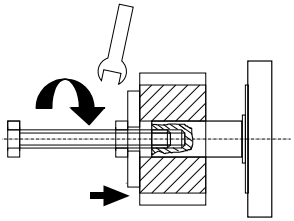


Fig. 7: Fitting the transmission element

▶ Use the centering hole for fitting transmission elements. For details about centering holes refer to the project planning manual Asynchronous Housing Motors MAD/MAF.

6.2 Electrical connection

6.2.1 General safety instructions about electrical connection

⚠ WARNING	**Danger! Electric voltage! Operations in the vicinity of live parts are extremely dangerous.** Work required on the electric system may only be carried out by skilled electricians. Tools for electricians (VDE tools) are absolutely necessary. **Prior to commencing work:** – Disconnect voltage (even auxiliary circuits). – Secure against reactivation. – Ensure de-energization. – Ground and short-circuit. – Cover or shield any adjacent live parts.

⚠ WARNING	**High electric voltage! Danger to life, risk of injury by electric shock!** ⇒ Proceed all work only when motor is in standstill. ⇒ Never connect or disconnect plug connectors under load!

NOTICE	**Never touch the connection points of electrostatic sensitive devices!** Mounted components (e.g. temperature sensors, encoder) can contain parts susceptible to electrical discharge (ESD). ⇒ Observe ESD safety measures.

6.2.2 Power connection with flange socket

During connection:

- Use ready-made connection cables of Rexroth. See documentation 🕮➥ Rexroth Connection Cables.
- Observe the circuit diagrams in 🕮➥ Project Planning Manual MAD/MAF Asynchronous Housing Motors.
- The connections must be established such that a permanent safe electrical connection is ensured.
- Establish a safe protective conductor connection.
- Do only use plug connectors free from dirt, foreign bodies and humidity.
- Completely tighten the screw-type device connector. The vibrating O-ring must no longer be visible.
- Connect or disconnect plug connections only in de-energized, dry and clean state.
- Protect the device connectors from external force effect.

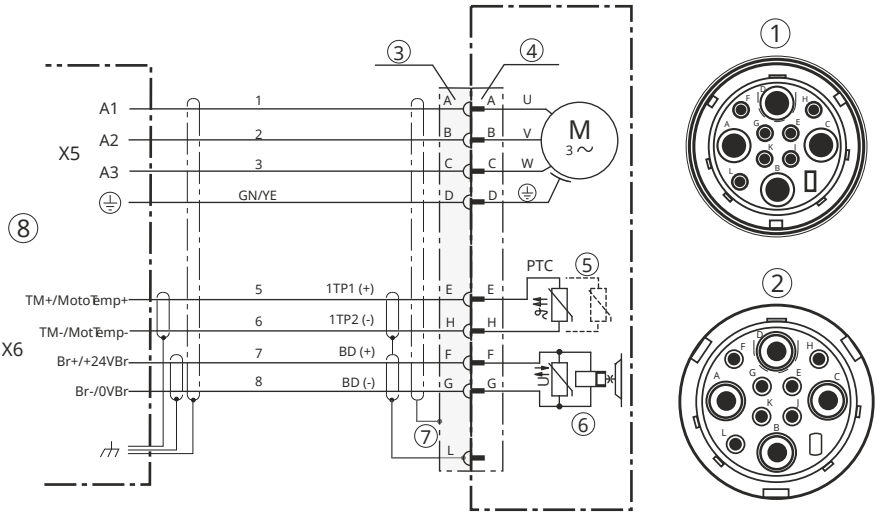


Fig. 8: Power connection via connector socket, connection diagram

① Device connector INS480 (view of plug-in side)
② Connector socket INS380 (view of plug-in side)
③ Coupling
④ Device connector
⑤ Only one PTC sensor is applied (spare sensor lines are in the socket housing)
⑥ Holding brake (option)
⑦ Overall shield connection by clamping the cables of the strain relief in the connector
⑧ Connection designations on the Rexroth drive controller

Observe the necessary power wire cross section within the 📖➦ Project Planning Manual Asynchronous Housing Motors MAD/MAF.

Use ready-made connection cables of Rexroth. See documentation 📖➦ Rexroth Connection Cables.

6.2.3 Power connection via terminal box

Table 17: Overview of motors with terminal box

Motor frame size MAD/MAF...	Designation	Terminal box U-V-W	Terminal box Terminal range [mm²]	Terminal box ∅ PE	Connection thread Cable gland
100	RLK1200	WEF[1)]	1.5 ... 16	RTE[2)] for M8 thread	Refer to 📖➦ project planning manual "MAD/MAF Asynchronous Housing Motors MAD/MAF".
130	RLK1300	WEF	1.5 ... 35	RTE for M8 thread	
160	RLK1300	WEF	1.5 ... 35	RTE for M8 thread	
180	RLK1400	RTE for M12 thread	1.5 ... 50	RTE for M12 thread	
225	RLK1500	RTE for M12 thread	1.5 ... 70	RTE for M12 thread	

1) WEF = wire end ferrule

2) RTE = ring terminal end

- Observe the necessary power wire cross section within the 📖➦ project planning manual "MAD/MAF Asynchronous Housing Motors MAD/MAF to connect the motors.
- Use ready-made connection cables of Rexroth. See documentation 📖➦ Rexroth Connection Cables.
- Cables are screwed to the terminal box via adapter plates and, if necessary, thread reducing fittings. These components are included in the motor delivery. If necessary, however, they can also be reordered separately.

Terminal box connection diagram

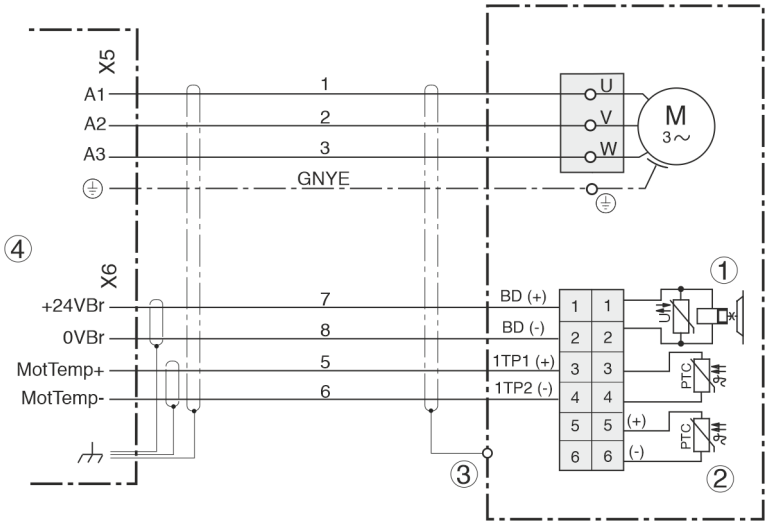
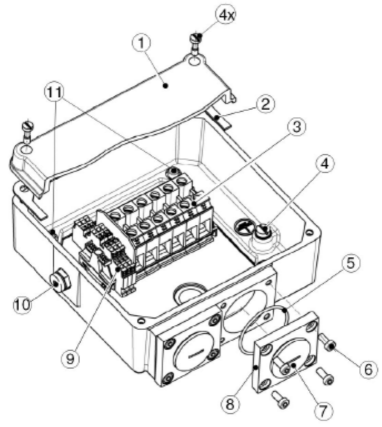


Fig. 9: Terminal box connection diagram

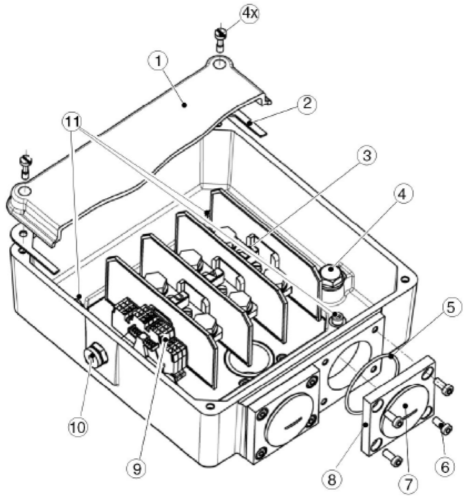
① Holding brake (option)
② Spare temperature sensor (connect spare sensor lines only if necessary)
③ Shield connection by clamping the cables of the strain relief in the cable gland
④ Connection designations on the Rexroth drive controller

- Brake connections 1-2 are only assigned if the motor is manufactured with the optional brake.
- Only one contact pair of PTC thermistor connections 3-4 and 5-6 is connected to the motor cable.
- The seal which is glued into the lid at the factory may not detached or damaged.
- Note the size of the cable gland and connection thread for the cable inlet into the terminal box.
- Pay particular attention to the orderly and tension-free routing of the connection cables in the terminal box in order to avoid chafing or pressure points on the cables.
- The connections of the internal motor windings in the terminal box must not be loosened.

Terminal box details



MAD/MAF100 ... 160



MAD/MAF180 ... 225

Fig. 10: Terminal box details

① Cover
② Seal
③ Terminal block U-V-W
④ PE connection
⑤ O-ring
⑥ Adapter plate mounting screws
⑦ Safety cover of the cable gland connection thread
⑧ Adapter plate for cable gland
⑨ Terminal strip (brake, temperature sensor)
⑩ Purge gas connection (Option)
⑪ Clamping screws for setting the outgoing cable direction (4 pcs.)

Power cable connection at the terminal box

The required output direction of the power cable is selected in the type code of the motor. According to the definition by the user about outgoing direction, the terminal box is mounted on the motor at the factory. The cable output direction on the terminal box can be adjusted by the user when required.

Connecting the power cable to the terminal box requires the following steps:

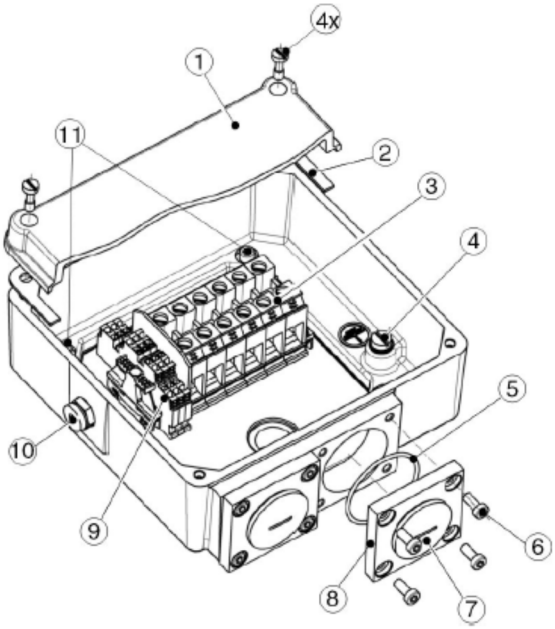


Fig. 11: Terminal boxes (Option "D, E, H, G")

① Cover
② Seal
③ Terminal block U-V-W
④ PE connection
⑤ O-ring
⑥ Adapter plate mounting screws
⑦ Safety cover of the cable gland connection thread
⑧ Adapter plate for cable gland
⑨ Terminal strip (brake, temperature sensor)
⑩ Purge gas connection (Option)
⑪ Clamping screws for setting the outgoing cable direction (4 pcs.)

1. Open terminal box lid ①.

   Loosen and remove the mounting screws (4 pieces).

2. Check cable output direction and if necessary turn the terminal box.
   - Loosen terminal boxes
     Loosen the mounting screws ⑪ and rotate the terminal box by 90 or 180 degrees to the desired output direction.
   - Fasten the terminal box.

   Screw in and thighten ⑪ the fastening screws.

   Tightening torque of the screws ⑪: 6.5 Nm (±10%)

   ⇒ A sealing is between terminal box and motor housing. After turning or before retightening the terminal box, check the proper condition and position of the sealing.
3. Unscrew the safety cover of the cable gland ⑦.
4. Detach the adapter plate ⑧ from the terminal box.

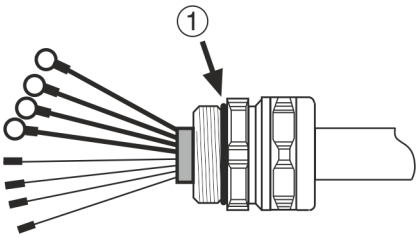


Fig. 12: O-ring at cable gland
① O-ring position

5. Screw the adapter plate firmly to the metric cable gland on the power cable.

   ⇒ Before attaching the adapter plate to the power cable, visually inspect the O-ring to verify that it is in a proper state and correctly positioned at the power cable gland. If the O-ring is missing, do not use the power cable. In this case, contact your Rexroth sales or service partner.
6. Feed the power cable up to the adapter plate through the opening in the terminal box and re-fasten the adapter plate to the terminal box.

   Tightening torque of the screws ⑥: 9 Nm (±10%)

   ⇒ Before attaching the adapter plate ⑥ to the terminal box, check the O-ring ⑤ inserted into the adapter plate for proper condition and correct position.
7. Connect the cores according to the connection diagram for standard or double cabling.

   Comply with the following tightening torques:

   Table 18: Screw tightening torques in Nm (±10%) for power connection

Terminal boxes on	U-V-W		PE	
	M6	M12	M8	M12
MAx100 ... 160	2.5	-/-	3.5	-/-
MAx180 ... 225	-/-	14	-/-	20

8. Close and fasten the terminal box lid.

Wet the thread of the fastening screws for the lid ① with liquid threadlocker and then fasten the lid with all fastening screws.

Tightening torque of the screws: 6.5 Nm (±10%)

⇒ Before fastening the terminal box lid at the terminal box, check for proper condition and the correct position of the glued-in seal ② at the terminal box lid.

Double cabling

Motor connection requires two power cables if an appropriate single cable cannot be used because of the large bending radius or because of 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.

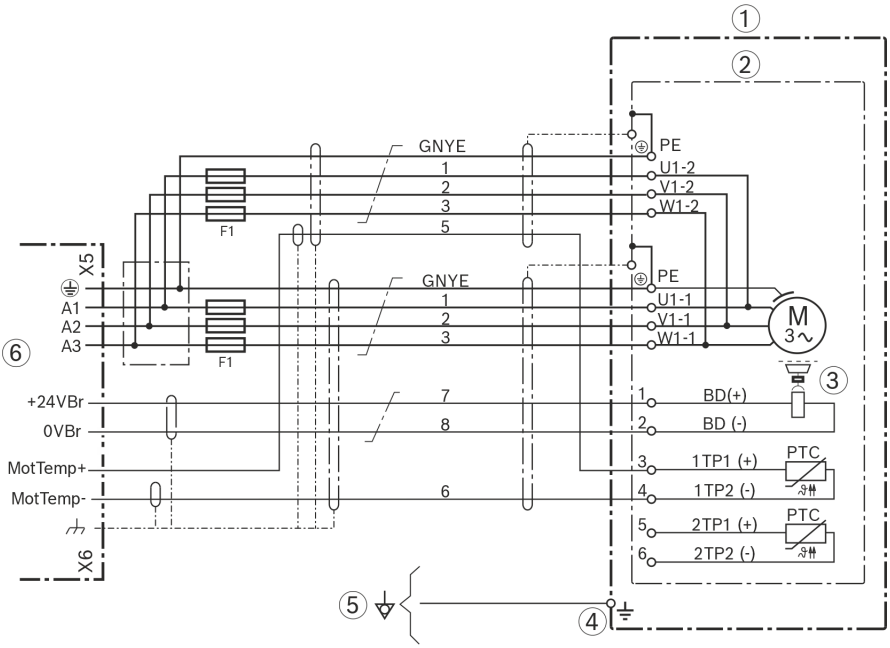


Fig. 13: Double cabling connection diagram

① Motor housing
② Terminal box
③ Holding brake (option)
④ Potential equalization connection at the motor (only available on MAF225C-0150)
⑤ Potential equalization connection at the machine (required for MAF225C-0150)
⑥ Rexroth drive controller

- The terminal box can only be used for double cabling for power connection.
- Fuses F1 (NH...) protecting the wires against overload in case of a cable break must be dimensioned according to the current carrying capacity of the particular line cross-section.
- The fuses should be installed in the control cabinet such that they are as close as possible to the power output of the controller.
- The shield of the motor power cable must be connected to the control cabinet on the motor side of the fuses such that it is conducting over a large area.
- No special power cables are available to establish the double cabling. To install the fuses, standard Rexroth power cables have to be opened and cut to the appropriate length on site.

6.2.4 Connect motor fan (only for MAD motors)

The motor fan is connected to the supply network via a cable and a motor protective switch and is operated independently of the controller.

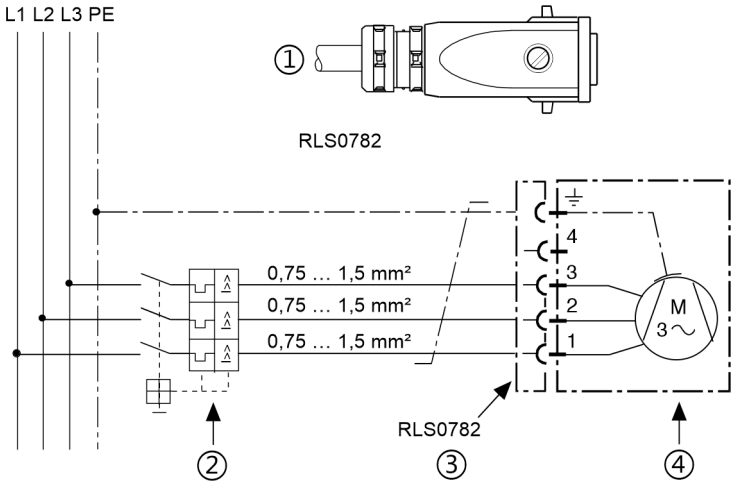


Fig. 14: Fan connection
① Power connection cable diameter Ø 7 ... 10 mm
② Protective switch
③ Plug connector
④ Fan

- To connect the motor fan, the fan connector must be opened and closed.
- The connector for connecting the motor fan is included in the scope of delivery and is located on the motor fan.
- Electric connection may only be established by specialized staff. Observe the safety instructions.
- The tightness of the connector housing may not be reduced.
- Motor protective switch and electric fusing are selected by the machine manufacturer. Follow the regulations applicable in the country where the machine is set up.

6.2.5 Connect coolant supply (only for MAF motors)

The allocation of intake (IN) and outtake (OUT) can be arbitrarily done. It does not influence the power data of the motor in any way.

Table 19: Overview of coolant ports

MAF ...	Connection via ...		Remark
	Thread	Quick coupling [Ø d_i tube]	
100 ... 130	G1/4"	9 mm	Select connection according to type code
160 ... 225	G1/2"	13 mm	

The connecting threads on the motor are covered with factory-attached protective caps. These protective plugs may only be removed immediately before screwing in the coolant ducts or the quick coupling to prevent dirt from entering the cooling system.

Notes for assembly for coolant ducts

Table 20: Coolant connection thread, allowed tightening torques and screw-in depths

MAF...	Thread	max. screw-in depth [mm]	Allowed tightening range [Nm]
100 ... 130	G1/4"	14	18 ... 20
160 ... 225	G1/2"	18	27 ... 30

NOTICE

The coolant port threads on the motor may be destroyed by incorrect tightening torques!

The allowed motor connection tightening torque may not be exceeded! If the tightening torque or screw-in depth is exceeded, the motor may be damaged irreversibly.

The coolant connections on the motor side are provided for coolant connection threads with axial sealing.

Bosch Rexroth recommends to use threaded connections which contain an O-ring for axial sealing of the screw connections.

For example, seals consisting of hemp, teflon tape or cone-shaped screw connections are not considered to be suitable, since this type of seal may stress the connection thread at the motor to an unreasonably high extent and/or damage it permanently.

The machine manufacturer is responsible for ensuring that the coolant connection is tight and for verifying and accepting the tightness after the motor has been installed.

Additional, regular inspections to ensure proper condition of the coolant connection should be logged in the maintenance schedule of the machine.

Quick coupling

It is also possible to use a quick coupling for the coolant port. The quick coupling features leak protection on either side and can be released even under full pressure.

If a motor with this type of coolant port is ordered, all quick coupling parts are included in the motor delivery. Based on the ambient conditions of the motor, the user can select from two quick coupling mounting methods.

- **Method A**: Lock nipple mounted on the motor side
- **Method B**: Coupling mounted on the motor side

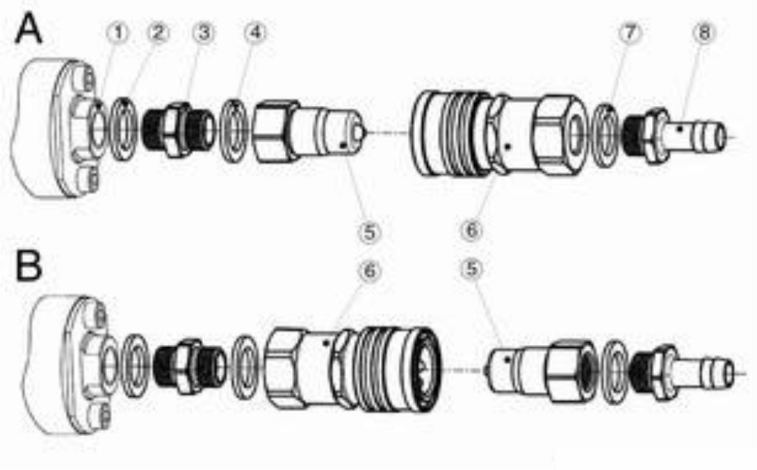


Fig. 15: Quick coupling mounting methods

① Connection thread on the motor
② Seal
③ Double nipple
④ Lock nipple
⑤ Coupling
⑥ Threaded nozzle for hose

NOTICE	Connect the double nipple to the coupling or the lock nipple. Then screw the double nipple into the connection thread on the motor. This procedure prevents the connection thread in the motor from being stressed repeatedly.

When mounting the quick coupling, ensure

- that the seals are correctly positioned,
- that the allowed screw-in depths and tightening torques at the motor are kept.
- that the following tightening torques between the individual coupling components are kept,

Table 21: Allowed tightening torque of the quick coupling

Quick coupling thread size	Allowed tightening range [Nm] between the components
1/8" ... 1/4"	23 ... 25
1/2"	28 ... 30

Table 22: Coolant connection thread, allowed tightening torques and screw-in depths

MAF...	Thread	max. allowed screw-in depth [mm]	Allowed tightening range [Nm]
100	G1/8"	14	14 ... 15
130	G1/4"	14	18 ... 20
160 ... 225	G1/2"	18	27 ... 30

When selecting the coolant hose diameter, ensure using the required inside hose diameter d_i according to ➥ Table 19 “ Overview of coolant ports” on page 36.

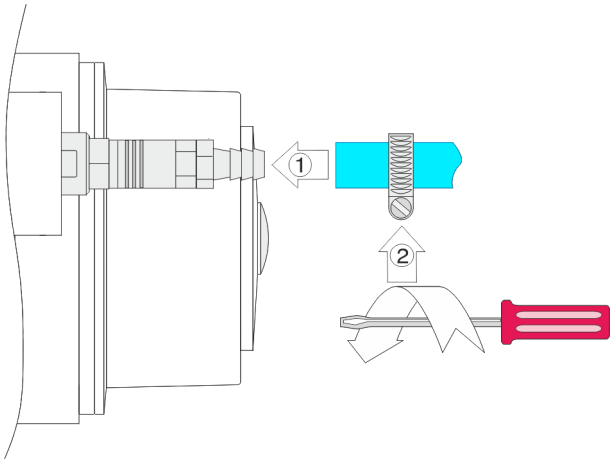


Fig. 16: Connecting the coolant hose (example)

When mounting the coolant hose, proceed as follows:

1. Remove the protective caps from the coolant port threads on the motor and screw in the pre-assembled quick coupling.
2. Push the tube onto the connection piece (threaded nozzle). Do not bend or damage the motor-sided screw connection.

3. Screw the tube end with the mounting clamp tightly above the connection piece.

   In service cases, the quick coupling can be disconnected from the lock nipple by means of the coupling. It is not necessary to disconnect the tube connection.

If a different connection method is used on the tube side, other mounting steps may be required. Mounting instructions can be obtained from the manufacturer.

- To supply MAF motors with coolant, other installation materials are also required, for example, tubes and mounting clamps (these are not included in the scope of delivery).
- Ensure that the cooling water complies with the requirements of project planning manual “MAD/MAF Asynchronous Housing Motors”.

⚠ WARNING	**Risk of injury by improper handling of pressurized lines!**
	⇒ Observe the operating instructions and the manufacturer's information on the cooling system.
	⇒ Use suitable protective equipment (safety goggles, safety shoes, safety gloves, for example).
	⇒ Immediately remove spill on the ground, otherwise risk of falling!
	⇒ Before dismounting lines, relieve pressure and empty medium.
	⇒ Do not attempt to disconnect, open or cut pressurized lines (risk of explosion).

Coolant inlet pressure at the motor

The maximum inlet pressure of the motors is 6 bar.

6.2.6 Encoder connection

The motor-sided connector socket and the cable-sided coupling must be fitted onto each other and screwed to each other manually. Observe the mechanical coding.

Table 23: Device connector encoder

Motor frame size	Device connector (X3) for encoder connection	
	M2 / S2	C0
MAD100	RGS1003	INS0629
MAD130 ... 225	RGS1004 *)	INS0719
MAF100 ... 225	RGS1003	INS0629

*) Connector socket RGS1004 cannot be ordered as a single component. It is an integral part of the encoder connecting cable for connecting encoder option M2/S2.

Pin assignment

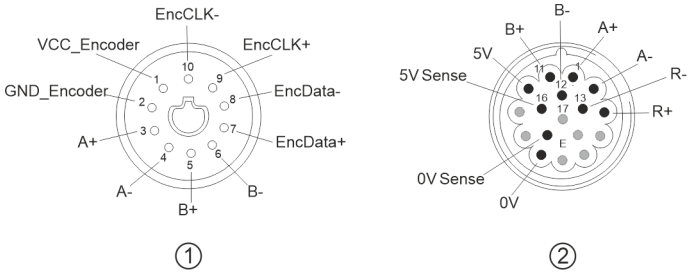


Fig. 17: Pin assignment encoder
① Encoder type M2 / S2
② Encoder type C0

7 Commissioning and operation

7.1 Safety instructions for commissioning

⚠ WARNING	**High electric voltage! Danger to life, risk of injury by electric shock!** Life parts are dangerous. ⇒ Do not connect or disconnect plug-connectors and connection clamps.
⚠ WARNING	**Risk of injury due to rotating parts!** ⇒ Do not remove any covers, machine parts or protection devices during operation. ⇒ Do not enter the range of movement of the machine. Prevent personnel from accidentally entering the machine's range of motion by using, for example: – Safety fences, safety screens or protective covers. – Optical sensors
⚠ CAUTION	**Thermal danger due to hot surfaces with temperatures over 60 °C during operation.** ⇒ Do not touch hot motor surfaces. ⇒Install protection against contact, if necessary. ⇒ Make sure that no temperature-sensitive components (cables, electronic components, ...) touch hot surfaces.

7.2 Environmental conditions during operation

Allowed class

Environmental conditions during operation are defined according to EN IEC 60721-3-3:2019 in different classes. They are based on worldwide long-term experiences and take all influencing variables into account, e.g., air temperature and air humidity.

Table 24: Allowed classes of environmental conditions during operation according to EN IEC 60721-3-3:2019

Classification type	Allowed class
Classification of climatic environmental conditions	3K22
Classification of biological environmental conditions	3B1
Classification of mechanically active materials	3S6
Classification of mechanical environmental conditions	3M12

Based on EN IEC 60721-3-3:2019 , some limit values are partially defined in the following, which our products are allowed to be exposed to during operation. Unless otherwise specified, the values given are the values of the particular class. Observe the detailed description of the classifications to take all of the factors which are specified in the particular class into account.

However, Bosch Rexroth reserves the right to adjust these values at any time based on future experiences or changed environmental factors.

Table 25: Allowed climatic operation conditions

Environmental factor	Unit	Value
Temperature	°C	0 ... +40[1)]
Relative air humidity	%	5 ... 95[1)]
Absolute air humidity	g/m³	1 ... 29[1)]
Installation altitude	m	up to 1,000 m above sea level

[1)] Deviating from EN IEC 60721-3-3:2019

Vibration

Vibrations are sinusoidal oscillations in stationary use, which vary in their effect on the resistance of the motors depending on their intensity. The resistance of the overall system is determined by the weakest component.

Based on EN IEC 60721-3-3:2019 and EN 60068-2-6:2008 the following values for MAD/MAF motors are allowed:

Table 26: Maximum values for sinusoidal vibrations

Direction	Maximum allowed vibration load 10 – 2000 Hz
Axial	10 m/s²
Radial	30 m/s² (10 m/s² in connection with M2/M6 and S2/S6 encoders)

The construction and effectiveness of vibration-absorbing or vibration-absorbed attachments depends on the application and must be determined by using measurements. This is not lie in the responsibility of the motor manufacturer. Modifications of the motor design result in loss of the warranty.

7.3 Commissioning

Before commissioning

Motors can only be commissioned with other components (drive controller, control unit).

Prior to commissioning, ensure that the following requirements are met.

- Storage time of the motor. Depending on the storage time, take measures like run in bearings, resurface the holding brake, to ensure safe operation. See also .
- Ensure that motor and motor cooling are connected properly.
- Ensure that a holding brake voltage of 24 V ±10% is applied to the motor. If necessary, adjust the voltage.
- Check the proper function of the holding brake.
- Ensure that the motor and all participating components of the drive are undamaged.
- Ensure that keys are protected against ejection.
- Please observe the general safety instructions on the protection against hazardous movements in➥ Kap. 2.5.2

Commissioning

For start up procedure refer to the project planning manual and the respective documentation about drive controller or firmware description.

7.4 Operation

During operation, keep the ambient and operation conditions as well as the technical data specified in ➥ the project planning manual Asynchronous Housing Motors MAD/MAF.

Checks during operation:

- ⇒ Pay attention to exceptional noise.
- ⇒ Pay attention to increased vibrations.
- ⇒ Check the motors and fan units for cleanliness.
- ⇒ Check the tightness of the coolant connections.
- ⇒ Check the monitoring devices and diagnostic / error messages of the controllers.

NOTICE	**Decommission the drive when deviations from normal operation exist. For further procedure refer to ➥ Chapter 9 “Disassembly and exchange” on page 45.**

7.5 Operation with third-party controllers

Rate of rise of voltage

The electrical insulationInsulation system of the motor is subject to a higher dielectric load in converter mode than when it is operated with a merely sinusoidal source voltage. The voltage load of the winding insulation in converter mode is mainly defined by the following factors:

- Crest value of voltage
- Rise time of pulses at the motor terminals
- Switching frequency of final converter stage
- Length of power cable to the motor

Main components are the switching times of the final converter stage and the length of the power cable to the motor. The rates of rise of the voltage occurring at the motor may not exceed the pulse voltage limits specified in **DIN VDE 0530-25 (VDE 0530-25): 2009-08 (picture 14, limit curve A)**, measured at the motor terminals of two strands in relation to the rise time.

These limits are complied with by the final stages of Rexroth converters.

8 Maintenance

8.1 Cleaning and servicing

⚠ WARNING

Operations in the vicinity of live parts are extremely dangerous.

- Work required on the electric system may only be carried out by skilled electricians. Tools for electricians (VDE tools) are absolutely necessary.
  - Isolate (even auxiliary circuits).
  - Secure against reactivation.
  - Ensure de-energization.
  - Ground and short-circuit.
  - Cover or shield any adjacent live parts.

⚠ WARNING

Personal and material damage during maintenance work in operation!

- Never carry out maintenance work on running machines.
  While carrying out maintenance work, secure the machine such that it cannot restart or be used by unauthorized persons.

⚠ CAUTION

Hot surfaces with temperatures over 60 °C may cause burns!

- Allow the motors to cool down prior to commencing work.
  Wear safety gloves.
  Do not work on hot surfaces.

Motors

Dirt, dust or chips may adversely affect the functionality of the motors and, in extreme cases, even cause a failure of the motors. Therefore, in regular intervals (after one year at the latest), you should clean the surface of the motors in order to achieve a sufficiently large heat radiation surface. If the cooling fins are partially covered with dirt, sufficient heat dissipation via the ambient air is no longer possible.

Insufficient heat dissipation can have undesirable consequences. The bearing life is reduced by operation at inadmissibly high temperatures (bearing grease decomposes). Overtemperature switch-off despite operation on the basis of selected data, because the appropriate cooling is missing.

Connection cables

⚠ WARNING

Electric shock due to contact with live parts!

– Change damaged connection cables and decommission the plant immediately.
  Do not repair any connection lines provisionally.

- Check the connection cable for damage at regular intervals and replace it if necessary.
- Check optionally existing drag chains on defects.
- Check the protective conductor connection at regular intervals for proper condition and tight fit and replace if necessary.

8.2 Service repair, maintenance and spare parts

Wearing parts are reliably and professionally repaired and replaced by the Rexroth Service in shopfloor-oriented quality.

NOTICE

Product damage possible, loss of warranty claims!

Please note that any repairs or modifications may only be carried out by Bosch Rexroth Service or an authorized specialist workshop.

Improper modifications can lead to damage to the engine and are therefore prohibited. In addition, improper modifications will result in the loss of warranty claims. For modification requests, conversions or repairs, please always contact our service department.

For example, the following repairs can be done:

- Replace motor encoder or battery
- Replace shaft sealing ring
- ...

The service lives of motor components, such as seals and bearings, may vary depending on the operating conditions, such as operation mode, speed, vibration and shock load, and frequent reverse mode. We recommend to change the bearing after 30,000 operating hours. Shorter replacement intervals may be necessary; cf. checks during operation . We recommend regular visual inspections on shaft sealing rings. Depending on operating conditions, signs of wear may appear after 5,000 operating hours. If necessary, replace the shaft sealing rings.

The Bosch Rexroth service helpdesk at our headquarters in Lohr, Germany and our worldwide service provide You can contact us **24/7**.

Telephone:	**+49 (0) 9352 40 50 60**
Fax:	**+49 (0) 9352 18 49 41**
Email:	service.svc@boschrexroth.de
Internet:	➦ https://www.boschrexroth.com

Preparing information

For quick and efficient help, please have the following information ready:

- Detailed description of the fault and the circumstances
- Information on the rating plate of the products in question, particularly type codes and serial numbers
- Your contact data (phone number, fax number, email address)

9 Disassembly and exchange

9.1 Notes about disassembly

⚠ WARNING

Fatal injury due to errors during the activation of motors or work on moving elements!

- Work on machines is only allowed if they are secured and while they are not running.
- Switch off the controller and the machine and wait until the discharging time of the electrical systems has elapsed before starting trouble-shooting.
- Before starting disassembly, secure the machine against unforeseeable movements and against unauthorized operation.
- Before disassembling the motor and the supply lines, secure them against dropping or moving and disconnect the mechanical connections only thereafter.
- Do not disconnect coolant lines as long as they are still under pressure (not applicable if the optional "quick coupling" is used).

1. Comply with the instructions in the machine documentation.
2. Use the machine-side control commands to decelerate the drive to a controlled standstill.
3. Switch off the power and control voltage of the controller.

4. **Only applicable to MAD motors**: Switch off the motor protection switch for the motor fan.
   Only applicable to MAF motors: Switch off the external coolant supply.
5. Switch off the main switch of the machine.
6. Secure the machine against unpredictable movements and against operation by unauthorized persons.
7. Wait until the discharging time of the electrical systems has elapsed and then disconnect all electrical connections.
8. Secure the motor and, if applicable, the fan unit and supply lines against falling or movement before disassembling the mechanical connections. Discharge the coolant ducts at MAF motors.
9. Dismount the motor from the machine. Store the motor properly!
10. Document all executed measures in the commissioning report and the machine maintenance plan.

9.2 Notes on replacing transmission elements

NOTICE	**Motor damage due to strikes onto the motor shaft**
	▶ Do not strike the shaft end and do not exceed the allowed axial and radial forces of the motor.
	▶ Use pulling-on and pulling-off tools.

Use suitable tools when disassembling transmission elements.

Pulling off

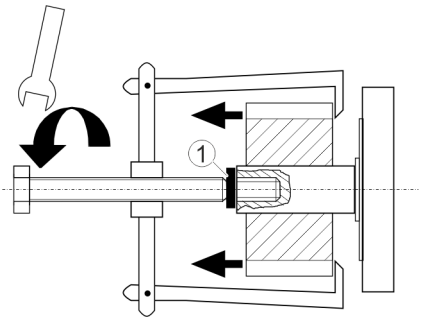


Fig. 18: Remove transmission element
① Shim

Use tools suitable for pulling off. Use a shim to protect the shaft end when using pulling-off tools. Heat the output element, if necessary.

9.3 Preparing storage

Before motors are stored, the protection covers on device connector, shaft and input openings for cooling water in case of liquid-cooled motors which were attached on delivery must be re-attached.

When motors are liquid-cooled, completely discharge the coolant from the cooling tubes (e.g., via purging the coolant holes with pressure air). This will prevent frost damage at storage temperatures ≤ 0° C.

10 Environmental protection and disposal

10.1 Environmental protection

Production processes

The products are manufactured in energy- and resource-optimized production processes which allow the resulting waste to be re-used and recycled. We regularly try to replace pollutant-loaded raw materials and supplies by more environment-friendly alternatives.

No release of hazardous substances

Our products do not contain any hazardous substances which may be released in case of appropriate use. Normally, our products will not have any negative influences on the environment.

Basic components

Basically, our products contain the following components:

Electronic devices	Motors
· Steel	· Steel / Stainless steel
· Aluminum	· Aluminum
· Copper	· Copper
· Plastics	· Brass
· Electronic components	· Magnetic materials
	· Electronic components

10.2 Disposal

Return of products

Our products can be returned to us for disposal free of charge. However, this requires that the products be free from oil, grease or other dirt.

Furthermore, the products returned for disposal may not contain any undue foreign material or third-party components.

Deliver the products "free domicile" to the following address:

Bosch Rexroth AG
Buergermeister-Dr.-Nebel-Straße 2
97816 Lohr am Main, Germany

Packaging

Packaging materials consist of cardboard, wood and polystyrene They can be recycled anywhere without any problem.

For ecological reasons, please refrain from returning the empty packages to us.

Batteries and accumulators

Batteries and accumulators can be labeled with this symbol.

The symbol indicating "separate collection" for all batteries and accumulators is the crossed-out wheeled bin.

End users in the EU are legally bound to return used batteries and accumulators. Outside the scope of the EU Directive 2006/66/EC, the applicable regulations must be followed.

Batteries and accumulators can contain hazardous substances which can harm the environment or people's health when improperly stored or disposed of.

After use, the batteries or accumulators contained in Rexroth products must be returned to the country-specific collection systems for proper disposal.

Recycling

Most of the products can be recycled due to their high content of metal. In order to recycle the metal in the best possible way, the products must be disassembled into individual assemblies.

Metals contained in electric and electronic assemblies can also be recycled by means of special separation processes.

Plastic parts of the products may contain flame retardants. These plastic parts are labeled according to EN ISO 1043. They have to be recycled separately or disposed of according to the applicable legal provisions.

11 Troubleshooting

In the event of faults, always observe the information in the project planning and commissioning instructions. Contact the manufacturer, if necessary.

Table 27: Procedure troubleshooting

Malfunction	Error cause	Measures
Motor does not run	Controller enable signal missing	Activate controller enable signal
	Controller fault	Troubleshoot acc. to documentation of controller
	Voltage supply missing	Control voltage supply
	Brake is not released	Check the brake activation

Malfunction	Error cause	Measures
Vibrations	Coupling elements or attachments are poorly balanced	Re-balance
	Adjustment of shaft end attachments (coupling, gearbox, ...) is insufficient	Re-align the attachments
	Mounting screws loose	Tighten and secure the screw connections as specified
Running noise	Foreign bodies within the motor	Stop the motor --> repair by manufacturer
	Bearing is damaged	Stop the motor --> repair by manufacturer
High motor temperatures	Operation outside of rated data	Reduce load and check the dimensioning
	Heat dissipation is impaired	Clean the motor
Motor temperature monitoring is activated		For fan units, clean fan grille and check the fan function
		For liquid cooling, check cooling circuit.
Wrong or defective temperature display	Temperature sensor not connected	Connect temperature sensor
	Temperature sensor defective	Connect backup temperature sensor
		Stop the motor --> repair by manufacturer

12 Appendix

12.1 Extension and modification

12.1.1 Optional accessories

Ready-made connection cables

Table 28: Additional documentation

Title	Document type	Document number
Rexroth Connection Cable	Selection Data	DOK-CONNEC-CABLE*INDRV-AU□□-□□--P

Air-pressure connection

Using motors under adverse circumstances can require a higher degree of protection than the standard protection mode with radial shaft sealing ring (IP65). Especially if motors are used in areas, in which the use of oil-containing cooling lubricants places the highest demands on the tightness of the motors. For these applications, we recommend the use of sealing air in addition to the rotary shaft seal.

Air-pressure connectors are available as accessory for MAD/MAF motors with frame size 100 ... 160 with device connector for power connection.

Table 29: Accessories air-pressure connector kit

Motor frame size MAD/MAF...	Motor flange socket (type)	Designation
100	INS0480	SUP-M01-MHD (MNR R911283006)
130 ... 160	INS0380	SUP-M02-MHD (MNR R911283007)

The proper sealing function of the rotary shaft seal is important for the safe function of the sealing air application. Observe the information in the ➥ Table 2 “Additional documentation ” on page 5 project planning manual “Asynchronous Housing Motors MAD/MAF”.

The assembly instruction is enclosed to the selected accessory.

Gearboxes

MAD/MAF motors are suited for mounting of gearboxes and planetary gearboxes.

In this regard, Bosch Rexroth recommends gearboxes of the GTM series, which are compatible for attachment to the motors. When selecting the gearboxes, refer to the information about the type code of GTM gearboxes.

Table 30: Gearboxes for MAD/MAF motors

Type	Gearbox type	Prerequisites at the motor	Project Planning Manual
GTM	Planetary Gearboxes	Smooth motor shaft	DOK-GEAR**-GTM********-PR□□-□□--P

Clarify with the respective gearbox manufacturer the compatibility and availability of gearboxes of other manufacturers or gearbox types.

Observe the details in the ➥ project planning manual MAD/MAF Asynchronous Housing Motors about permitted shaft load and mounting of drive elements.

12.2 Declaration of conformity

The following declaration of conformity shows the status at the time of printing of these operating instructions. Daily updated declarations of confirmity can be found in the media directory of Bosch Rexroth: ➥ https://www.boschrexroth.com/MediaDirectory, search word: "➥ DCTC-30319-001".

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EU-Konformitätserklärung
EU declaration of conformity

Dok.-Nr. / *Doc. No.*: DCTC-30319-001
Datum / *Date*: 2022-09-21

- ☐ nach Maschinenrichtlinie 2006/42/EG / *in accordance with Machinery Directive 2006/42/EC*
- ☒ nach Niederspannungsrichtlinie 2014/35/EU / *in accordance with Low Voltage Directive 2014/35/EU*
- ☒ nach EMV-Richtlinie 2014/30/EU / *in accordance with EMC Directive 2014/30/EU*
- ☐ nach ATEX-Richtlinie 2014/34/EU / *in accordance with ATEX Directive 2014/34/EU*
- ☐ nach Ökodesign-Richtlinie (ErP) 2009/125/EG (Verordnung …) / *in accordance with Ecodesign Directive (ErP) 2009/125/EC (Comission Regulation …)*
- ☐ nach RoHS-Richtlinie 2011/65/EU / *in accordance with RoHS Directive 2011/65/EU*
  Geltungsbereich RoHS-Richtlinie für Produkte des Herstellers:
  DCTC-30806-006 „Herstellererklärung zur RoHS-Richtlinie 2011/65/EU & 2015/863/EU" /
  Scope of RoHS Directive for products of the manufacturer:
  DCTC-30806-006 "Declaration of compliance to the RoHS Directive 2011/65/EU & 2015/863/EU"

Hiermit erklärt der Hersteller, / *The manufacturer*
Bosch Rexroth AG, Bgm.-Dr.-Nebel-Str. 2, 97816 Lohr a.Main / Germany
dass die nachstehenden Produkte / *hereby declares that the products below*
Bezeichnung / *Name*: 3-PHASE INDUCTION MOTOR

Baureihen / *Series*:					
	MAD100…	MAD130…	MAD160…	MAD180…	MAD225…
	MAF100…	MAF130…	MAF160…	MAF180…	MAF225…

Handelsbezeichnung / *Trade name:* *Rexroth*
ab Herstelldatum / *from the date of manufacture:* 2022-09-21

in Übereinstimmung mit oben genannte(n) Richtlinie(n) entwickelt, konstruiert und gefertigt wurden. / *were developed, designed and manufactured in compliance with the above-mentioned directive(s).*

Die alleinige Verantwortung für die Ausstellung dieser EU-Konformitätserklärung trägt der Hersteller. / *This EU declaration of conformity is issued under the sole responsibility of the manufacturer.*

Angewandte harmonisierte Normen / *Harmonized Standards applied:*

Norm / *Standard*	**Titel / *Name***	**Ausgabe / *Issue***
EN 60034-1 *(IEC 60034-1)*	Drehende elektrische Maschinen – Teil 1: Bemessung und Betriebsverhalten / *Rotating electrical machines – Part 1: Rating and performance*	2010 + Cor.:2010 *(2010, modifiziert)*
EN IEC 60034-5 *(IEC 60034-5)*	Drehende elektrische Maschinen – Teil 5: Schutzarten aufgrund der Gesamtkonstruktion von drehenden elektrischen Maschinen (IP-Code) – Einteilung / *Rotating electrical machines – Part 5: Degrees of protection provided by integral design of rotating electrical machines (IP code) - Classification*	2020 *(2020)*
EN IEC 61800-3 *(IEC 61800-3)*	Drehzahlveränderbare elektrische Antriebssysteme – Teil 3: EMV-Anforderungen einschließlich spezieller Prüfverfahren / *Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods*	2018 *(2017)*

Weitere Erläuterungen / *Further explanations:*

Die Montage- und Installationshinweise gemäß Produktdokumentation sind zu beachten. / *The assembling and installation instructions according to the manual have to be followed.*

Ort / Datum / Unterschrift wie in der original Konformitätserklärung angegeben /
Place / date / signature as indicated in the orignial ***declaration of conformity***

Änderungen im Inhalt der EU-Konformitätserklärung sind vorbehalten. Derzeit gültige Ausgabe auf Anfrage.
We reserve the right to make changes to the content of the EU Declaration of Conformity. Current issue on request.

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Fig. 19: CE declaration of conformity MAD/MAF

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rexroth
A Bosch Company

Bosch Rexroth AG
Bgm.-Dr.-Nebel-Str. 2
97816 Lohr a.Main
Germany
Tel. +49 9352 18 0
Fax +49 9352 18 8400
www.boschrexroth.com/electrics

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