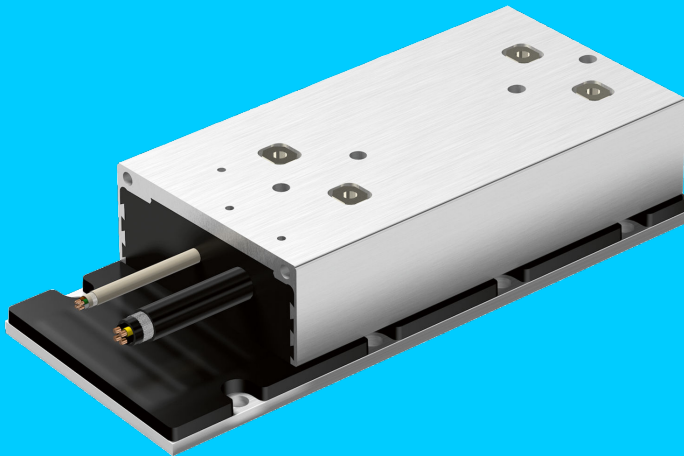


ML3

Self-Cooled Linear Motors



Copyright

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All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.

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.

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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	Notes
01	06/2018	First edition
02	12/2018	Update of technical data with motor characteristic curves
03	05/2019	Update of technical data, dimension sheets and assembly notes
04	10/2021	EAC label removed
05	06/2023	ML3P11-R and ML3V added; UKCA amended
06	11/2024	Selection connection cables amended; chapter "Additional instruction" removed. Instead, the reader is referred to Rexroth Motors Safety Notes (R911340694) .

1.3 Additional documentation

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

Table 2: Applicable documents

Title	Document type	Document number
 ML3 Self-cooled linear motors	Project Planning Manual	DOK-MOTOR*-ML3x*****-PR□□-□□-P
 ML3V...CP Special product Secondary parts - suitable for vacuum	Project Planning Manual	DOK-MOTOR*-ML3V*****-PR□□-□□-P
 Electromagnetic Compatibility (EMC) in Drive and Control Systems	Project Planning Manual	DOK-GENERL-EMV*****-PR□□-□□-P
 Documentation about special products are available on demand.		

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.

	Non-compliance with this safety instructions will result in death or severe personal injury.
	Non-compliance with this safety instructions can result in death or severe personal injury.
	Non-compliance with this safety instructions can result in moderate or minor personal injury.
	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.	Numbered instruction:
2.	The numbers show that the action steps must be taken one after the other.
3.	
	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 be 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 instructions EN 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 certain persons. The machine operator must sufficiently protect personnel working in these areas from possibly occurring damage by suitable measures (e.g. warning notes, protective clothes, designation of the danger zone).

Electro magnetic and magnetic fields!

Observe the country-specific regulations. For Germany, please observe the specifications of the occupational insurance association BGV B11 and BGR B11 regarding "electromagnetic fields".

Danger for persons with active body aids or passive metallic implants and for pregnant women.

- For persons with active body aids (like heart pacemakers), passive metallic implants (like hip prosthesis) and pregnant women possible hazards exist due to electromagnetic or magnetic fields in direct environment of electric drive and control components and the corresponding live conductors.

Access into these areas can be dangerous for these persons:

- Areas, in which components of electrical drive and control systems and corresponding live conductors are mounted, activated or operated.
- Areas in which motor parts with permanent magnets are stored, repaired or assembled.
- Above mentioned persons must contact their attending physician before entering these areas.
- Please observe the valid industrial safety regulations for plants which are fitted with components of electrical drive and control systems and corresponding live conductors.

Risk of destruction of sensitive parts! Data loss!

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

Crushing hazard of fingers and hand due to heavy attractive forces of the magnets!

The attractive forces of the permanent magnets influence all magnetizable materials. Especially in an area < 100 mm, the attractive forces rise. Loose or not fastened components made of magnetizable materials can abruptly and inadvertently attracted with the permanent magnets.

- Extreme caution during handling of motor components with permanent magnets. Do never underestimate strong attractive forces.
- Never work alone.
- Use personal safety equipment (e.g. protective gloves, protective glasses).

- Do not unpack several motor components with permanent magnets or directly place them side by side at your working space.
- Unpack single motor components with permanent magnets immediately prior mounting and mount them immediately.
- Do not bring magnetized or magnetizable materials in the area of permanent magnets. If using magnetizable tools cannot be avoided, hold on the tool very tight, move carefully and observe the attractive force effect of the permanent magnets.

Behavior in the case of accidents with permanent magnets

During work with permanent magnets, the following emergency tools must be ready to use in the case of an accident to release impacted body parts (like fingers, hands, arms a.s.o.):

- Hammer (3-5kg) made of non-magnetized material like brass
- Minimum 2 wedges with approx. 10 - 15 ° lip angles made of non-magnetized material like brass, wood or similar to impact driving into the cutting slit.

In the case of an accident:

- Keep calm!
- If the machine is live, immediately de-energize (emergency button).
- Give first aid or request appropriate help (e.g. emergency doctor).
- Separate inherent parts via emergency tools to loose clamped body parts, like fingers, hand, foot, for example.
 - Therefore, beat the wedges with a hammer into the cutting slit to free the caught body parts.

2.5.4 Protection during handling and assembly

Motor components with permanent magnets(e.g. secondary parts of a synchronous linear motor or rotor of a synchronous kit motor) create very strong attractive forces from ferromagnetic parts like further motor components with permanent magnets or parts of iron, nickel or cobalt.

Please observe the safety notes about strong attractive forces of permanent magnets under ➔ Chapter 2.5.3 “Protection against magnetic and electromagnetic fields” on page 12.

The attractive forces of the permanent magnets influence all magnetizable materials. Especially in an area < 100 mm, the attractive forces rise. Surrounding components can abruptly and inadvertently be attracted by the permanent magnets. Apart from crushing hazard, even the danger of chipping recalcitrant material, causing eye injury, exists.

Use the origin package of the motor components for transport and storage only. The origin package of Rexroth is constructed in such a way that the motor components with the permanent magnets are positioned within the package with suitable distance, providing that the package is correctly used.

Observe the following instructions during unpacking and handling.

- Instruct the personal with regard to the danger.
- Use personal safety equipment (e.g. protective gloves, protective glasses).
- Store all components in its origin package until assembly and for transport.
- Do only work on clean working spaces in which no ferromagnetic parts exist.

- If possible, use non-magnetic tools, e.g. made from aluminum or brass.
- Remove only one motor component from the package and secure it on your working space against slipping, rolling away.

Instruct all participating persons about the dangers and if necessary, expand the preliminary instructions.

Store the original package of the motor components with permanent magnets

Store the original package for later use.

In the case of reuse, ensure a good readability of the safety notes on the package. They must not be paste over!

Risk of injuries due to improper handling! Bodily injury due to crushing, scissors, cutting, punching!

- Observe the instructions on the package.
- Store the motor components with permanent magnets in the original package, only.
- Do not internally store or transport the motor components unpacked.
- Observe the accident prevention regulations.
- Use suitable assembly and transport equipment.
- Prevent clamping and squeezing by means of suitable measures.
- Use suitable tools, if necessary use special tools.
- Properly use lifting devices and tools.
- Use suitable safety equipment (like protective helmets, protective glasses, safety shoes, protective gloves).
- Never walk under hanging loads.
- Immediately remove spill on the ground, otherwise risk of falling!

2.5.5 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.

2.5.6 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 motor components are individually packaged in a box. For identification, the package is marked with a label similar to the type plate with the type designation of the components.



At delivery, immediately check if the supplied components match with the delivery note. The forwarder must be promptly informed of any damage on the packaging and goods, which is detected on delivery. Start-up of damaged goods is prohibited.

Scope of delivery ML3P primary part

The scope of delivery of a primary part contains:

- Primary part in origin package
- Safety instructions
- Additional type plate



For legal reasons, the enclosed type plate does not contain a CSA mark.

Scope of delivery of secondary parts ML3S and ML3V

On delivery, all secondary parts are fitted with magnetic transport and assembly protection. It consists of a rubber mat with a thickness of approx. 5 mm connected with a ferromagnetic cover plate. For safety reasons, the transport and assembly protection should not be removed from the secondary parts until installation. When using the protection cover, make sure that the rubber side is always in contact with the magnets.

The scope of delivery of a secondary part contains:

- Secondary part in origin package
- Safety instructions
- Type plate

At delivery, ML3V are packed separately. To ensure clean room conditions, both the transport and assembly protectors and the secondary part are sealed gas-tight in a plastic bag.



The cover plates mounted on the ML3V for additional mechanical protection of the magnets must not be dismantled under any circumstances, not even for the purpose of maintenance. In such a case, the warranty expires.

4 About this product

4.1 Technical features

Product Three phase synchronous motor

Manufacturer Bosch Rexroth Electric Drives and Controls GmbH

Buergermeister-Dr.-Nebel-Straße 2
97816 Lohr a. Main / Germany



R911389762, Edition 06

Type plate primary part

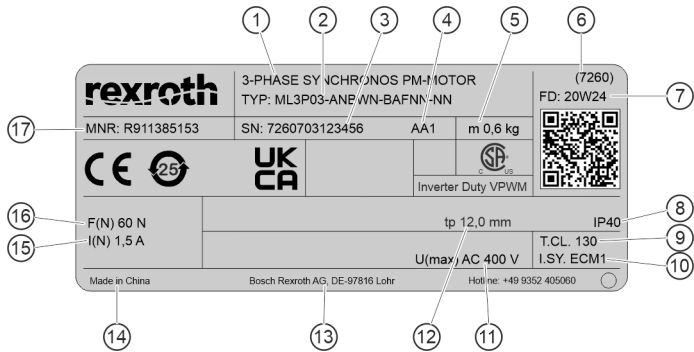


Fig. 2: Type plate ML3P (example)

- | | |
|--|-----------------------------------|
| 1 Motor type | 9 Thermal class |
| 2 Type designation | 10 Insulation system |
| 3 Serial number | 11 Maximum voltage CSA |
| 4 Revision state | 12 Pole pitch |
| 5 Mass | 13 Company address |
| 6 Factory number | 14 Designation of origin |
| 7 Manufacturing date (20W24 = year 2020 /
calender week 24) | 15 Rated current |
| 8 Degree of protection by housing | 16 Continuous force at standstill |
| | 17 Material number |

4.2.2 Identification secondary part

The secondary part can be identified by means of an engraved serial number.

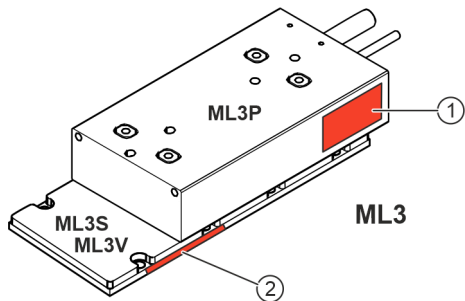


Fig. 3: Position of component designation

- ① Position of the type plate on the primary part
- ② Position of engraved serial number on the secondary part

Type plate secondary part

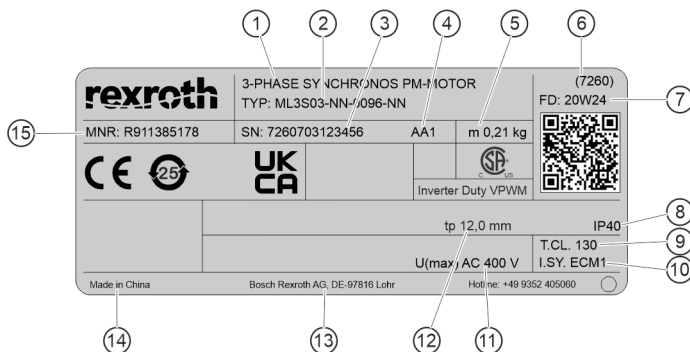


Fig. 4: Type plate ML3S (example)

- | | |
|--|-----------------------------------|
| 1 Motor type | 8 Degree of protection by housing |
| 2 Type designation | 9 Thermal class |
| 3 Serial number | 10 Insulation system |
| 4 Revision state | 11 Maximum voltage CSA |
| 5 Mass | 12 Pole pitch |
| 6 Factory number | 13 Company address |
| 7 Manufacturing date (20W24 = year 2020 /
calendar week 24) | 14 Designation of origin |
| | 15 Material number |

4.2.3 Certifications

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.

CSA



The mark of conformity of the Canadian test center for the American and Canadian market identifies approved component parts which are part of a bigger product or system. The CSA label with the number 271353 is applied to the motor type plate.

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

 Motors of the ML3 series are according to the specifications of standard SJ/T11364 and they have an EFUP (Environmentally friendly use period) of 25 years. A corresponding labeling is in preparation. For more information, refer to https://www.boschrexroth.com.cn/zh/cn/home_2/china_rohs2 in section "Kit motors".

UKCA Certification

 ML3 motors fulfill the requirements acc. to UKCA. The appropriate identification of the motors is specified on the motor type plate.

5 Transport and storage

5.1 Notes about transport

 **CAUTION**

**Strong attractive forces on the permanent magnets on the secondary part!
Risk of injury and danger of crushing body parts by magnetic forces!**

Please note the safety instructions [Chapter 2.5.3 "Protection against magnetic and electromagnetic fields"](#) on page 12 and [chapter. 2.5.4.](#)

5.1.1 Environmental conditions

Environmental conditions during transport

Transport our products only in their original package. Also refer to the specific ambient factors to protect the products from transport damage.

Based on EN IEC 60721-3-2:2018, 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 4: Allowed classes of environmental conditions during transport according to EN IEC 60721-3-2:2018

Classification type	Class
climatic environmental conditions	2K11
environmental conditions	2B1
classification of chemically active materials	2C1
classification of mechanically active materials	2S5
climatic 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 5: Permissible ambient conditions deviating from EN IEC 60721-3-2:2018

Environmental factor	Unit	Value
Temperature	°C	-25 ... +70 ¹⁾
Relative air humidity	%	5 ... 75 ¹⁾
Absolute air humidity	g/m³	1 ... 29 ¹⁾

1) Deviating from EN IEC 60721-3-2:2018



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

5.1.2 Transport to the machine (internal)

⚠ CAUTION

Risk of injuries and / or damage when handling secondary parts of synchronous linear motors!

- When handling secondary parts, please observe the warnings under [Chapter 2.5.4](#) and make sure that they are kept.
- Remove the transport and assembly protection of the secondary parts just before or during the assembly. Make sure that no small ferromagnetic parts like screws get into contact with the magnets or secondary parts.



- The ML3 motor components can be transported by hand. The mass of the single components is 0.6 kg up to 18.2 kg, depending from their frame size.
- Transport the secondary part in its original packing to the place of assembly and let it be packed until it must be mounted. Store the original packing after assembly of the secondary part for further use (e.g. re-storage or return). Observe a proper state and good visibility of the affixed warning notes.

NOTICE

Never touch the connection points of electrostatic sensitive devices!

Mounted components (e.g. KTY) can contain parts susceptible to electrical discharge (ESD).

Observe ESD safety measures.

⚠ WARNING

Material damage due to improper handling during transport!

Do not lift or move the primary part on the cable strand.

5.1.3 Transport by air freight

Instructions on transport by air

⚠ CAUTION

Possible influence of plane electronic on board through magnet fields!

If motor components are not forwarded in the unopened Rexroth original packaging, applicable packaging and transport regulations must be observed (IATA 953).

This involves, for example:

- Secondary parts of synchronous linear motors
- Rotors of synchronous kit motors
- Rotors of synchronous housing motors (if these are dispatched as motor component, i.e. separate from the stator or motor housing, in service cases)

For details on the maximum allowed magnetic field strengths as well as information on measurement methods for these magnetic field strengths, please refer to the current IATA DGR.

5.2 Storage instructions

5.2.1 Notes about storage of ML3P and ML3S

Environmental conditions during storage

NOTICE	Damage or destruction of motor components due to improperly handling during storage and transport!
	– Use the original packaging for permanent storage. – 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:

- in their original packaging
- 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 6: 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 7: 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/m ³	1 ... 29 ¹⁾

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

5.2.2 Notes about storage of ML3V

Table 8: 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	None
Classification of mechanically active materials	1S10
Classification of mechanical environmental conditions	1M12

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 9: 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⁾

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

5.2.3 Notes about storage time

Storage times of motors and cables

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 10: Measures before commissioning motors that have been stored over a prolonged period of time

Storage time	Measures prior to commissioning
< 1 year	Visual inspection of all parts to be damage-free
1 ... > 5 years	Visual inspection of all parts to be damage-free
	Check the electric contacts to verify that they are free from corrosion
	Measure insulation resistance. Dry the winding at a value of < 1kOhm per volt rated voltage.

Table 11: 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 General notes on assembly

The following points must be considered or checked before starting the assembly work:

- Observation of the necessary installation sizes (see project planning manual of the motor)
- Machine construction fulfills the requests for mounting (stiffness, attractive force, feed and acceleration force, etc.) and is prepared for installation of the motor components.
- Clean screw-on surfaces between machine and motor components
- Installation of motor components by skilled personnel only
- Compliance of danger and safety notes is guaranteed.

6.1.1 Installation of motor components



The machine manufacturer has to consider the special character of his construction and must work out special mounting instructions for the motor components primary and secondary part. The machine manufacturer's mounting instructions are the only binding guidelines.

The range and order of installation of motor components is depending on the machine construction or the available space in the machine. Also, the arrangement of the motor components plays a significant role.

The project planning manuals of ML3 and ML3V contain suggestions and important notes about assembly of the motor components. This suggestion can be understood as a guideline to estimate the necessary assembly effort and to prepare the necessary implements for assembly.

The following points must be considered or checked before starting the assembly work:

- Machine construction fulfills the requirements for mounting (stiffness, attractive force, feed and acceleration force, etc.)
- Observation of the necessary installation sizes for the motor components
- Clean screw-on surfaces between machine and motor components
- Installation of motor components by skilled personnel only
- Compliance of danger and safety notes is guaranteed.

6.1.2 Screw lock

All screwed connections must be secured against potential impacts and vibrations during operation of the machine. A suitable and field-tested screw lock for all metal thread connections is, e.g., Loctite 243.

Loctite 243 is a liquid screw lock (medium-hard) and is applied to the parts to be mounted immediately prior to assembly. For detailed information on correct handling and processing, please refer to the manufacturer's data sheets under ➔ www.loctite.de. The manufacturer's homepage also provides information on hardening accelerators or other screw locks.



When using ML3V in a vacuum, do not use a liquid screw lock. Still valid: All screwed connections must be secured against potential impacts and vibrations during operation of the machine. Please check which measure is suitable in the vacuum environment.

6.2 Mechanical assembly

6.2.1 Air gap and aligning

Parallelism and symmetry

When mounting primary and secondary parts, their position is specified by the holes or threads within the machine slide and prepared within the machine bed. If all installation dimensions were adhered to, the correct arrangement of both motor components to each other results. Take the values of installation dimensions from the following table → Tab. 12 and → Tab. 13.

The exact dimensions and specifications for form and position tolerances can be taken from Fig. 6

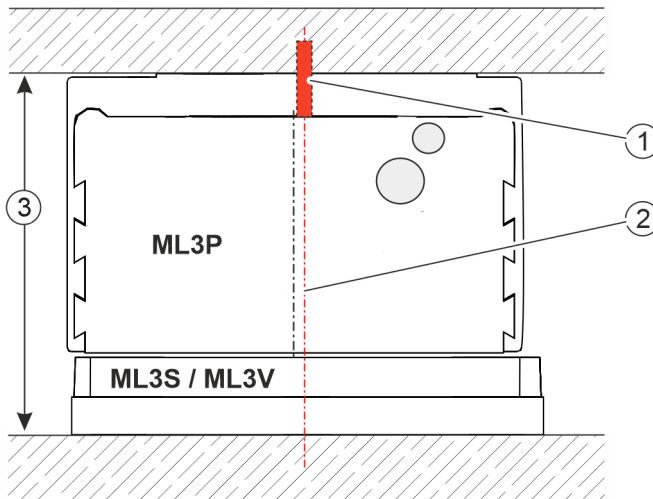


Fig. 5: Aligning the motor components

- ① Dowel holes within the primary part
- ② Magnetic and mechanic center line of the magnetic plate
- ③ Installation height



The primary part is not symmetrically placed over the secondary part, as the winding within the primary part is not centered.

Installation height

Due to keeping the specified installation height at the bottom of the secondary part up to the top of the primary part, the necessary air gap arises and the motor reaches its projected power data.

NOTICE

Motor damage due to insufficient air gap between primary and secondary part!

After assembly, check the free movement of the motor components to each other immediately. Therefore, move the versatile motor components by hand over the complete travel length. The versatile motor components must be freely movable at each position over the total travel length - without any contact to fixed motor components. This check can detect faulty assembly in time (e.g. dirt under the assembly surfaces, faulty installation dimensions, insufficient machine rigidity etc.).



The following specifications on the air gap refer to the use of secondary parts ML3S without cover plate and ML3V with pre-assembled cover plate.

If cover plates are used for ML3S, the air gap must be increased by the thickness of the cover plates → “Installation height with cover plate (option for ML3S only)” on page 26Tab. .

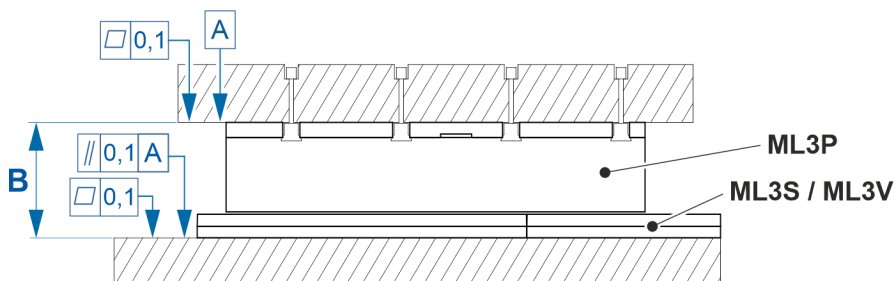


Fig. 6: Values for levelness and parallelism

B Installation height

Table 12: Installation height ML3 motors without cover plate

Frame size	Installation height B
ML3P03 and ML3S03	40 mm ± 0.1 mm
ML3P06 and ML3S06	40 mm ± 0.1 mm
ML3P11-D, -E, -F, -H, -L and ML3S11	45 mm ± 0.1 mm
ML3P11-R and ML3S11	47 mm ± 0.1 mm
ML3P03 and ML3V03	44.3 mm ± 0.1 mm
ML3P06 and ML3V06	tbd

Installation height with cover plate (option for ML3S only)

The plate dimensions are to be selected according to the following table:

Table 13: Installation height ML3 motors with cover plate

Frame size	Thickness	Cover plate Width	Installation height “B” with cover plate
ML3P03 and ML3S03	0.1 ± 0.02 mm	50 mm (49.8 - 50.5 mm)	40.12 ± 0.1 mm
ML3P06 and ML3S06		80 mm (79.8 - 80.5 mm)	

Frame size	Thickness	Cover plate Width	Installation height “B” with cover plate
ML3P11-D, -E, -F, -H, -L and ML3S11	0.15 ± 0.02 mm	130 mm (129.8 - 130.5 mm)	45.17 ± 0.1 mm
ML3P11-R and ML3S11			47.17 ± 0.1 mm

NOTICE

Damage or destruction of motor components due to use of cover plates!

- If the installation height of the motor is not adjusted when a cover plate is used (increased), motor components of the ML3 may be damaged or destroyed.
- The cover plate must be earthed according to the state of the art. The ML3S may not be used for this purpose.

Air gap

After assembly of the motor components, we recommend to check the minimum air gap between primary and secondary part.

For this reason, insert a test strip made of non-magnetic material (copper, plastics, etc.) with a thickness of

- **0.4 ... 0.5 mm**

into the air gap between primary and secondary part. The test strip must be versatile in the air gap on every position of the total length via the complete surface of the primary part.

This measure ensures the minimum necessary air gap between the motor components. This check can detect faulty assembly in time (e.g. dirt under the assembly surfaces, faulty installation dimensions, insufficient machine rigidity etc.).

NOTICE

If the installation height and thus the height of the air gap is exceeded above the tolerances, this leads to an exponential deterioration of the linear motor specifications. A too small air gap can lead to damage or destruction of the motor.

ML3P encapsulation - increased air gap

When operating in a vacuum, the primary part ML3P must be encapsulated, as explained at the beginning. Therefore, additional installation space is required in the area of the air gap. This additional installation space must be added to the installation height “B” in ➔ Tab. 12 and safely tolerated.



The encapsulation in the area between ML3P and ML3V increases the electromagnetically effective air gap. This leads to a reduction in feed and attraction forces and thus changes the characteristics of the engine's operating behavior. Please take this into account during project planning and selection of the motor components.

6.2.2 Assembly of secondary part segments

Assembly ML3S

⚠ WARNING

Danger due to permanent magnets!

- Health hazard for persons with heart pacemakers, metallic implants and hearing aids in direct environment of permanent magnets.
- Crushing hazard of fingers and hand due to heavy attractive forces of the magnets.
- Risk of destruction of sensitive parts like watches, credit cards, ...



To fasten the secondary parts, it is only allowed to use new, unused screws.

- Only use specified screws (see ➔ Tab.). 14).
- Tighten all screws with the necessary tightening torque.
- Lock screw connection with Loctite 243, for example (observe the notes of the adhesive manufacturer).
- When using dowels, ensure that they do not protrude more than specified in the dimension sheets. The secondary part could be damaged.
- After assembly, check that there are no foreign objects on the secondary part.

Cleaning

Basically, the ML3 components (primary part and secondary part) do not require cleaning before assembly. If cleaning should nevertheless be carried out, use a dry cloth for this purpose. In addition, isopropanol or acetone may be used as a cleaning agent for the ML3V.

Before mounting the motor components to the machine structure, the screw-on surfaces must be cleaned and free of oil and grease.

Arrangement and fastening

Short distances consisting of a maximum of 6 ML3S can be built up by placing the secondary parts next to each other. If distances of more than 2m are provided or are analog Hall units used, ensure correctly aligned secondary parts by using dowel holes and dowel pins (also refer to ➔ Fig.). 4).

Table 14: Mounting screws with tightening torque for ML3S secondary part

Frame size	Screw size	Screw-in depths	Strength class	Tightening torque (+/- 10%)
ML3S03	M5x10 (DIN EN 7984)	min. 6.5 mm	8.8	6.1 Nm
ML3S06				
ML3S11	M5x16 (DIN EN ISO 4762)			

The calculation of screw connection for fastening the secondary part are based on the assumption that the screwing surface of the secondary part and the screwing surface of the machine is clean and the secondary part is screwed in direct contact with the machine.



- In certain cases, it is not possible to screw the secondary part in direct contact with the machine as additional materials like distance plates, thermal grease and so on, are between the secondary part and the machine. Then a sufficient fastening of the screw connection must be ensured by the machine manufacturer.
- The effect of liquid screw lock is damaged by loosening or re-tightening of screws (e.g. due to torque tests) and must be renewed. Observe the instructions of the adhesive manufacturer about correct screw lock.

Dowels on ML3S



The dowel holes of the ML3 components are designed as free fit. For this reason, dowels cannot be pressurized into these holes. The dowel pin holes in the machine design should be designed as press fits in order to press in the dowel pins and thus be able to fix them securely.

Table 15: Dowels for ML3S secondary part

Frame size	Dowels (rust-free)
ML3S03 ... 11	5h8 (with internal thread M3 for disassembly)



When using dowels, ensure that they do not protrude more than specified in the dimension sheets. This can lead to damaged secondary parts.

Segmented secondary part

⚠ WARNING

Risk of injuries or material damage due to attractive or repulsive force at concatenation of secondary part segments!

- Secure against uncontrolled movement
- Observe correct concatenation of secondary part segments
- Remove the transport or assembly protection only when or after mounting into the machine

If several secondary part segments are used over the whole travel length, keep the poles and the flush direction at concatenation according to the following figure.

A correct assembly can be ensured as follows:

- Pressurize dowels into the holes of the machine bed.
 When using dowels, ensure that they do not protrude more than specified in the dimension sheets. This can lead to damaged secondary parts.
- Place the secondary part in such a way that the dowels grab into the secondary part and set down slowly.
- Fasten the secondary part with screws.

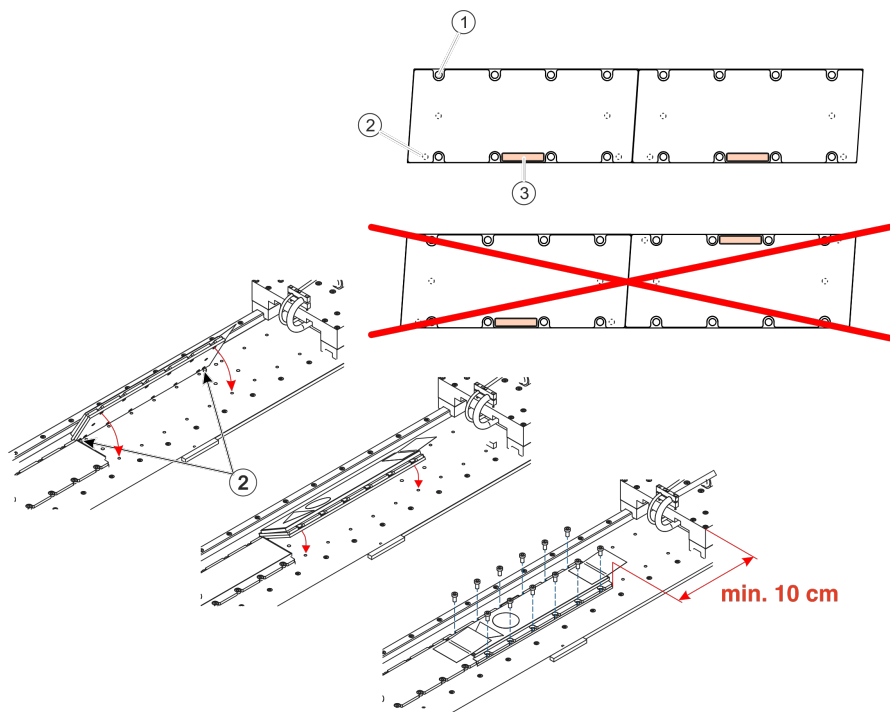


Fig. 7: Screw-on holes, dowel holes and reference marks

- ① Screw-on holes
- ② Dowel holes (blind hole at the bottom)
- f Reference marks

4. ➔ As necessary, install additional secondary parts in the same order. The secondary part that is installed last must have a minimum clearance of 10 cm to the primary part.

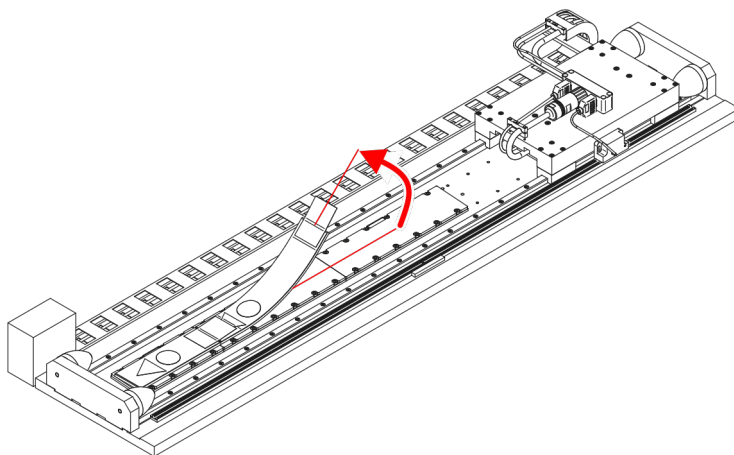


Fig. 8: Remove protective plates

- 5.** ➞ Remove the transport and assembly protection from installed secondary parts.

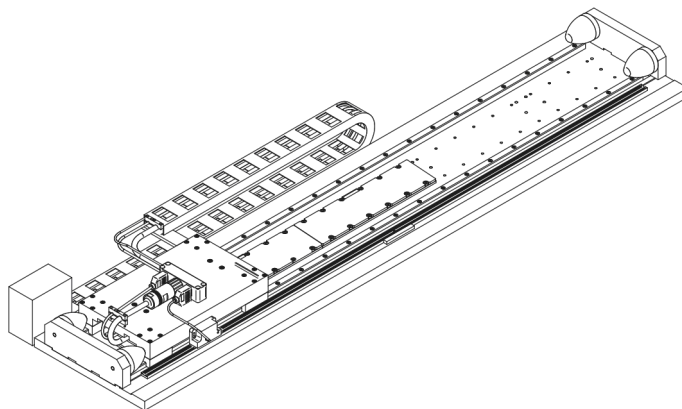


Fig. 9: Secure the slide

- 6.** ➞ Position the slide with the primary part over the assembled secondary part and lock it against unintended movement.
- 7.** ➞ Assemble the remaining secondary parts according to working step 1 - 3.
Afterwards, remove the transport and assembly protection.

Cover plate installation (option for ML3S)

Notes

A stainless-steel cover plate can be installed at the ML3S for protection against dirt.



If cover plates are used, it must be ensured that the required air gap between the motor components is maintained. To achieve this, the installation height must be increased by the thickness of the cover plate. Please also observe the information provided in ➔ Chapter 6.2.1.

Tools required for installation:

- Safety gloves
- Cutter for cutting of the strip
- Measuring device for testing of the shielding

⚠ CAUTION

The stainless steel cover strip may have sharp corners and edges!

Wear protective gloves when handling the cover plate.

Installation

A cover plate can be installed after removal of the transport and assembly protection at the ML3S. Make sure that the entire length is clear. Due to the high magnetic attraction, the cover strip is firmly attached to the magnetic plates. To position the strip, unroll it. Respectively, roll it up to remove it.



Unrolling and rolling up of the strip should be performed by two persons.

- ➔ If not already done, remove the transport and assembly protection from the ML3S.
- ➔ Position the slide at one end of the axis to uncover the majority of the magnetic strip.

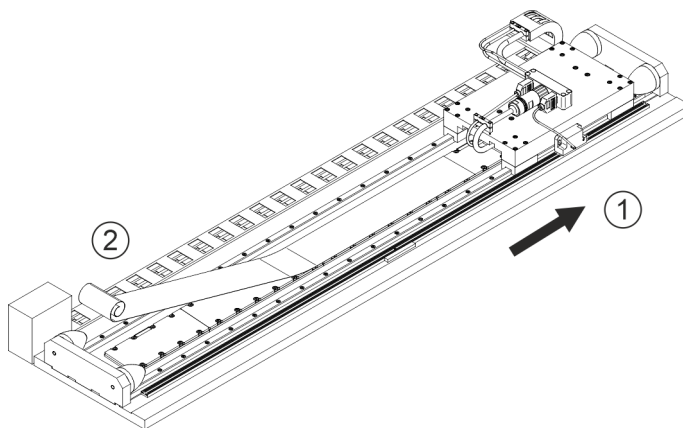


Fig. 10: Cover plate assembly 1v3

- ➔ Unroll the strip over the free part of the magnetic strip.

4. ➞ Move the slide to the center of the axis

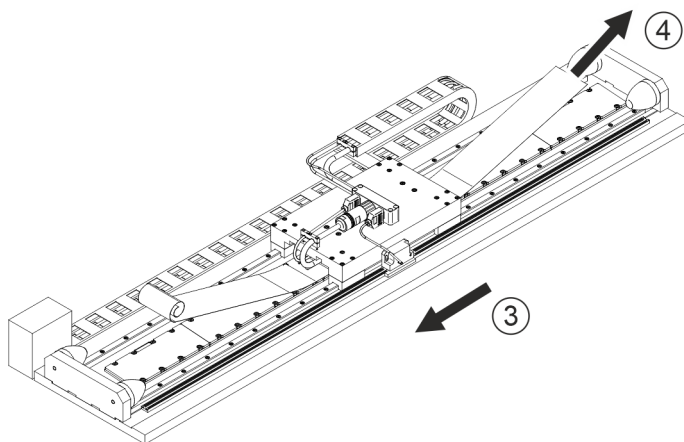


Fig. 11: Cover plate assembly 2v3

5. ➞ Pull up the two ends of the cover strip in such a way that only a small section of the strip (under the slide) is in contact with the magnetic strip.

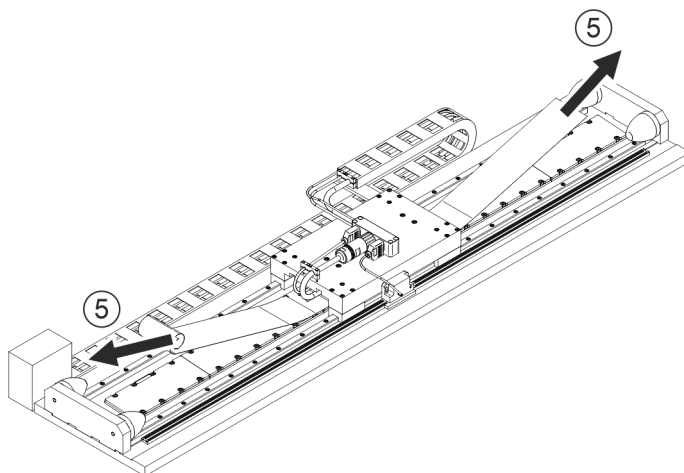


Fig. 12: Cover plate assembly 3v3

6. ➞ In this position, the cover strip can be moved over the magnetic strip. Position the strip in such a way that small sections protrude on both sides.

⚠ Make sure that the magnets are mounted at a slight angle. The cover strip must be cut off in this angle to ensure flush alignment with the end of the magnetic strip.

7. → Remove any excessive length and precisely align the strip. The cover strip should at least reach up to the end of the magnetic plates.

ⓘ The magnetic strip does not serve as conductive grounding connection of the cover strip. Ensure grounding in accordance with the machine safety standard and check this before commissioning.

Assembly ML3V

⚠ WARNING

Danger due to permanent magnets!

- Health hazard for persons with heart pacemakers, metallic implants and hearing aids in direct environment of permanent magnets.
- Crushing hazard of fingers and hand due to heavy attractive forces of the magnets.
- Risk of destruction of sensitive parts like watches, credit cards, ...



To fasten the secondary parts, it is only allowed to use new, unused screws.

- Do only use screws specified in → Tab. specified screws.
- Tighten all screws with the necessary tightening torque.
- Lock screw connections.
- When using dowels, ensure that they do not protrude more than specified in the dimension sheets. The secondary part could be damaged.
- After assembly, check that there are no foreign objects on the secondary part.

Cleaning

Basically, the ML3 components (primary part and secondary part) do not require cleaning before assembly. If cleaning should nevertheless be carried out, use a dry cloth for this purpose. In addition, isopropanol or acetone may be used as a cleaning agent for the ML3V.

Before mounting the motor components to the machine structure, the screw-on surfaces must be cleaned and free of oil and grease.

Arrangement and fastening

Short distances consisting of a maximum of 6 ML3V can be built up by placing the secondary parts next to each other. If distances of more than 2m are provided or are analog Hall units used, ensure correctly aligned secondary parts by using dowel holes and dowel pins (also refer to → Fig. 5).

Table 16: Mounting screws with tightening torque for ML3V secondary part

Frame size	Screw size	Screw-in depths	Strength class	Tightening torque (+/- 10%)
ML3V03	M5x10 (DIN EN 7984)	min. 6.5 mm	8.8	6.1 Nm
ML3V06				

The calculation of screw connection for fastening the secondary part are based on the assumption that the screwing surface of the secondary part and the screwing surface of the machine is clean and the secondary part is screwed in direct contact with the machine.



- In certain cases, it is not possible to screw the secondary part in direct contact with the machine as additional materials like distance plates are between the secondary part and the machine. Then a sufficient fastening of the screw connection must be ensured by the machine manufacturer.
- When using ML3V in a vacuum, do not use a liquid screw lock. Still valid: All screwed connections must be secured against potential impacts and vibrations during operation of the machine. Please check which measure is suitable in the vacuum environment.

Dowels on ML3V



The dowel holes of the ML3 components are designed as free fit. For this reason, dowels cannot be pressurized into these holes. The dowel pin holes in the machine design should be designed as press fits in order to press in the dowel pins and thus be able to fix them securely.

Table 17: Dowels for ML3V secondary parts

Frame size	Dowels (rust-free)
ML3V03	5h8
ML3V06	(with internal thread M3 for disassembly)

NOTICE

When using dowels, ensure that they do not protrude more than specified in the dimension sheets. This can lead to damaged secondary parts.

Segmented secondary part

CAUTION

Risk of injuries or material damage due to attractive or repulsive force at concatenation of secondary part segments!

- Secure against uncontrolled movement
- Observe correct concatenation of secondary part segments
- Remove the transport or assembly protection only when or after mounting into the machine

If several secondary part segments are used over the whole travel length, keep the poles and the flush direction at concatenation according to the following figure.



The following figures from ➔ Fig. 5 to ➔ Fig. 7 do not represent a vacuum setup for the primary part. An encapsulation of the primary part is not illustrated. However, the assembly of the secondary part is basically the same.

A correct assembly can be ensured as follows:

- ➔ If several secondary parts are used, prepare and mount them so that the reference marking is always in the same position.
- ➔ Pressurize dowels into the holes of the machine bed.

NOTICE

When using dowels, ensure that they do not protrude more than specified in the dimension sheets. This can lead to damaged secondary parts.

- ➔ Place the secondary part in such a way that the dowels grab into the secondary part and set down slowly.

4. ➔ Fasten the secondary part by using screws from below.

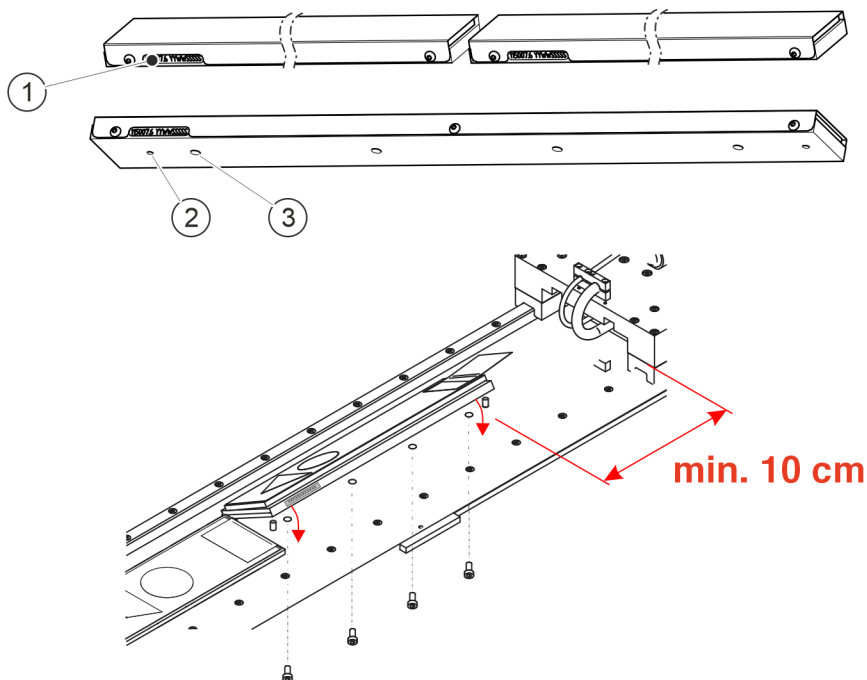


Fig. 13: Screw-on holes, dowel holes and reference marks

- ① Reference marks
- ② Dowel holes (blind hole at the bottom)
- f Screw-on holes (blind hole at the bottom)

5. ➔ As necessary, install additional secondary parts in the same order. The secondary part that is installed last must have a minimum clearance of 10 cm to the primary part.

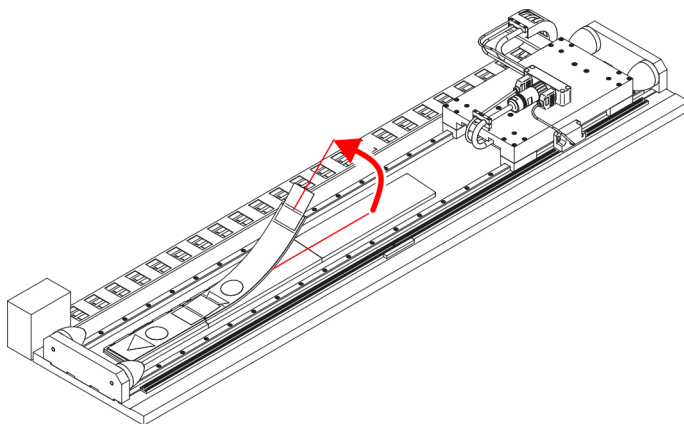


Fig. 14: Remove protective plates

- 6.** → Remove the transport and assembly protection from installed secondary parts.

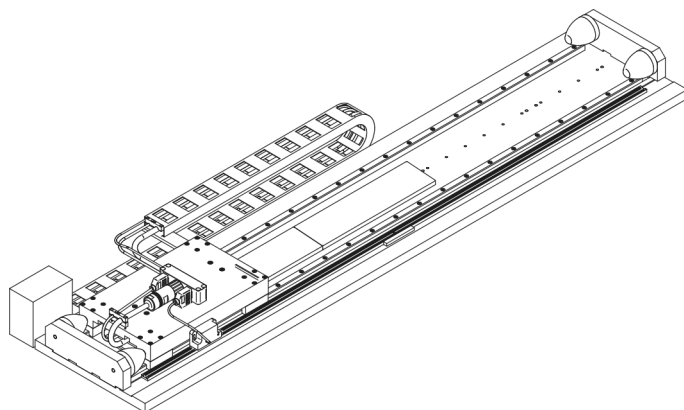


Fig. 15: Secure the slide

- 7.** → Position the slide with the primary part over the assembled secondary part and lock it against unintended movement.
- 8.** → Assemble the remaining secondary parts according to working step 1 - 3.
Afterwards, remove the transport and assembly protection.

6.2.3 Assembly of primary parts



To fasten the primary part, only new, unused screws must be used.

- Do only use screws specified in ➔ Tab. 18
- Tighten all screws with the necessary tightening torque.
In addition, each screw connection must be secured, e.g. with Loctite 243 (follow the instructions of the adhesive manufacturer).
- When using dowels, ensure that they do not protrude more than specified in the dimension sheets. The primary part could be damaged.
- After assembly, check if any foreign bodies exist between primary and secondary part.

Cleaning

Basically, the ML3 components (primary part and secondary part) do not require cleaning before assembly. If cleaning should nevertheless be carried out, use a dry cloth for this purpose. In addition, isopropanol or acetone may be used as a cleaning agent for the ML3V.

Before mounting the motor components to the machine structure, the screw-on surfaces must be cleaned and free of oil and grease.

Fastening screws

Table 18: Mounting screws with tightening torque

Frame size	Screw size	Screw-in depths	Strength class	Tightening torque (± 10 %)
ML3P03	M4 (DIN EN ISO 4762)	min. 4 mm	8.8	3.1 Nm
ML3P06	M5 (DIN EN ISO 4762)	max. 5 mm		6.1 Nm
ML3P11	M5 (DIN EN ISO 4762)	min. 4.5 mm max. 6 mm		6.1 Nm

Dowels

Table 19: Dowels for ML3P primary part

Frame size	Dowels (rust-free)
ML3P03 ... 11	5h8 (with internal thread M3 for disassembly)



The dowel holes of the ML3 components are designed as free fit. For this reason, dowels cannot be pressurized into these holes. The dowel pin holes in the machine design should be designed as press fits in order to press in the dowel pins and thus be able to fix them securely.

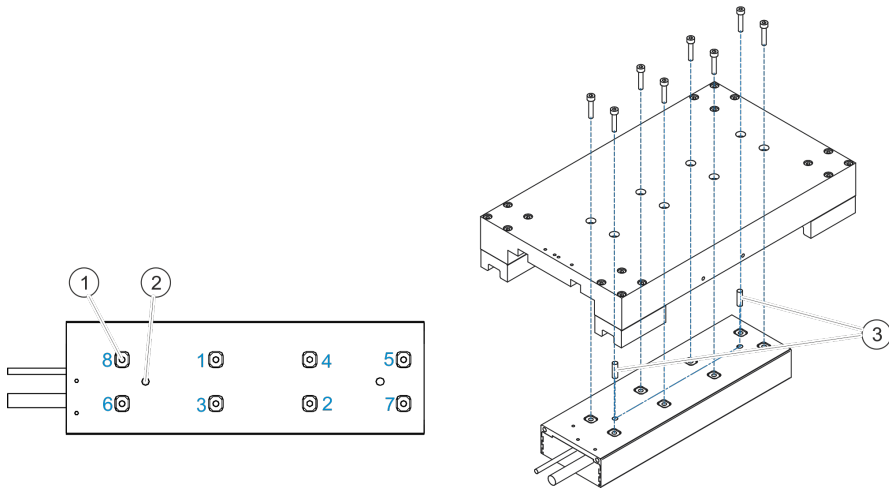


Fig. 16: Tightening sequence fastening screws of primary part

- ① Fastening tread
- ② Dowel holes (blind holes)
- ③ Dowels

1 / 2 / 3 ... Tightening sequence

The screw-on surfaces must be cleaned and be free of grease before the primary parts can be screwed on the machine construction.

Mounting instructions:

1. ➔ Pressurize dowels into the holes of the machine construction.
2. ➔ Place the primary part in such a way that the dowels grab into the primary part and set down slowly.

NOTICE

When using dowels, ensure that they do not protrude more than specified in the dimension sheets. This can lead to damage of the primary part.

3. ➔ Fasten the primary part with screws 1, 2, 3 ...x crosswise until the primary part is in contact with the slide.

4. ➔ Tighten all screws in the same tightening sequence with the nominal tightening torque.



The effect of liquid screw lock is damaged by loosening or re-tightening of screws (e.g. due to torque tests) and must be renewed. Observe the instructions of the adhesive manufacturer about correct screw lock.

6.2.4 Hall unit installation (option)

Analog Hall unit

The preferred installation position of the Hall unit is at the slide at the front end of the primary part with the cable outlet (see Fig. 17). The Hall unit is aligned at the side of the coil unit. For further installation positions and information on commutation or calculation of parameter P-0-0508, refer to [Table 2 "Applicable documents" on page 6Tab.](#)



For installation of the analog Hall unit at frame size MLP11, a spacer (see dimension "Z") is required between the Hall unit and the contact surface of the primary part.

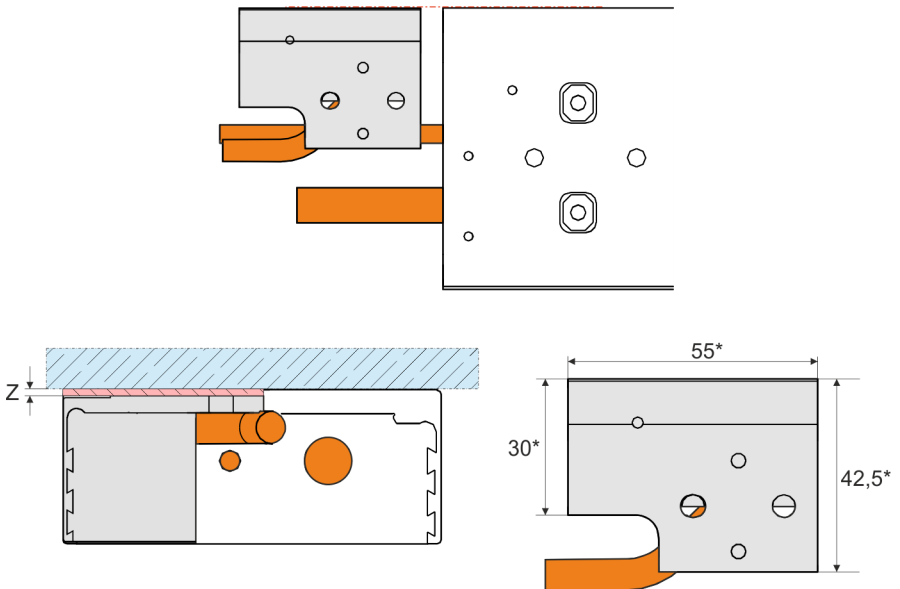


Fig. 17: Preferred installation position for the analog Hall unit

* For tolerances refer to dimension sheet in ML3 project planning manual

Z Dimensions for spacer thickness

Table 20: Installation requirements of analog Hall unit

ML3P...	Spacer "Z"	Rotation to the motion axis [degrees]	Alignment to the side of the primary part	Screws	Tightening torque (+/- 10%)	Dowel pins
03	-	0.5	± 1 mm	M4	3.1 Nm	Ø 5 F8
06	-					
11	1					

Digital Hall unit

The preferred installation position of the Hall unit is at the slide at the front end of the primary part with the cable outlet (see Fig. 18). The Hall unit is aligned at the side of the coil unit. For further installation positions and information on commutation or calculation of parameter P-0-0509, see ➔ Table 2 “Applicable documents” on page 6Tab.

 For installation of the digital Hall unit, a spacer (see dimension "Z") is required between the Hall unit and the contact surface of the primary part.

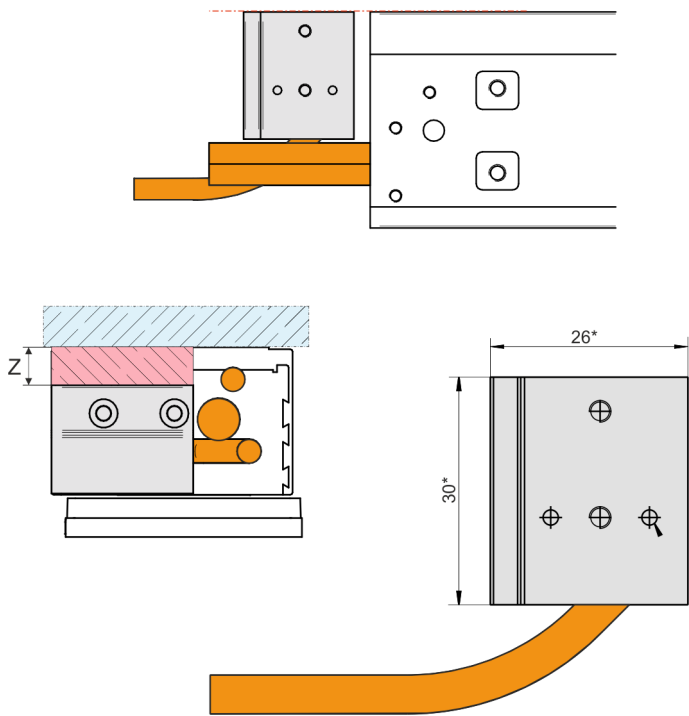


Fig. 18: Preferred installation position for the digital Hall unit

* For tolerances refer to dimension sheet in ML3 project planning manual

Z Dimensions for spacer thickness

Table 21: Installation requirements of digital Hall unit

ML3P...	Spacer "Z"	Rotation to the motion axis [degrees]	Alignment to the side of the primary part	Screws	Tightening torque (+/- 10%)	Dowel pins
03	8.4 mm	0.5	± 1 mm	M3	1.3 Nm	Ø 5 F8

ML3P...	Spacer "Z"	Rotation to the motion axis [degrees]	Alignment to the side of the primary part	Screws	Tightening torque (+/- 10%)	Dowel pins
06	8.4 mm					
11	9.4 mm					

6.3 Electrical connection

6.3.1 Connection cable on primary part

The electrical connection of the primary part is done via two shielded connection cables, which are fixed with the primary part. These connection cables can be shorted according to the machine requirements and be prepared with a connector or a clamping point.

For connection of primary parts to the Rexroth controller, Rexroth offers a wide range of connectors and ready-made cables as accessories. All cables and connectors are perfectly fitted for the products and their requirements. For connection of the primary part with these extending cables, a connector has to be applied at the connection cables. Please note that self-assembled cables or cable systems of other manufactures may not comply with these requirements. Bosch Rexroth shall not be held responsible for resulting malfunctions or damages.



Ensure that the complete machine fulfills all necessary regulations, especially EN 60204.

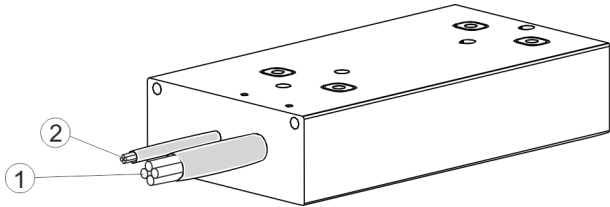


Fig. 19: Connection cable on primary part

- ① Connection cable power
- ② Connection cables temperature sensors

Table 22: ML3P connection cables

Connection cables	Cable lengths	Suitable for drag chains	ML3P03	ML3P06	ML3P11
Power	1 m	No	-	✓	✓
	3 m	yes	✓	-	-
Temperature	1 m	No	-	✓	✓
	3 m	No	✓	-	-

Table 23: Wire designation of power connection cable

Power	Wire color / - designation	
3-phase	L1	BK / 1

Power		Wire color / - designation
	L2	BK / 2
	L3	BK / 3
Grounding conductor	PE	GNYE
Shield		Metal braiding

Table 24: Wire designation of temperature sensor connection cable

Temperature sensor		Wire color
	PTC110-EK	WH
		BN
	KTY83-122	GN
		YE
Shield		Metal braiding

Table 25: Connection cable

Connection cable power					
Primary part	Cross section [mm²]	Cable diameter [mm]	Bending radius		Weight [kg/m]
			static [mm]	dynamic [mm]	
ML3P03	4 x 1.0	8.3	33.2	83	
ML3P06-B...					
ML3P06-C...					
ML3P06-D...	4 x 1.0	9.6	57.6	Not permitted	0.18
ML3P06-E...					
ML3P06-F...					
ML3P06-HNBKN					
ML3P06-HNBRN					
ML3P11-D...					
ML3P11-E...	4 x 2.5	11.4	68.4	Not permitted	0.27
ML3P11-F...					
ML3P11-H...					
ML3P11-L...					
ML3P11-R...	4 x 6.0	15.8	94.8	Not permitted	0.6

Table 26: Temperature connection cables

Temperature connection cables					
Primary part	Cross section [mm²]	Cable diameter [mm]	Bending radius		Weight [kg/m]
			static [mm]	dynamic [mm]	
ML3P03					
ML3P06	4 x 0.14	4.3	25.8	Not permitted	0.033
ML3P11					



The power connection cable at the primary part is designed for a continuous current at standstill I_0 for installation mode A. The cross-section of the extending power cable has to be selected according to the actual maximum effective current load. The cross sections of both cables may deviate.

6.3.2 Routing of connection cables

NOTICE

Damage of the connection cables and the motor by dynamic bending loads!

The connection cables of the primary parts ML3P06 and ML3P11 and the temperature sensor cables of all ML3P may not be laid into drag chains. Installation in a cable carrier is only allowed for a cable lead after a junction suitable for energy or drag chains.

NOTICE

Avoid bending, pulling and pushing loads as well as continuous movements of the connection cable at the point where the cable exits from the primary part. Any load of this kind can lead to irreparable damage (e.g. cable break) on the primary part!

If a fixed installation is not possible, equip the connection cable of the Hall unit with strain relief (for example, see Fig. 20) to protect the cable and the primary part from irreparable damage (e.g. cable break).



If grounding of the secondary parts cannot be ensured due to installation in the customer-side machine construction, the ML3S are to be connected in compliance with DIN VDE 0100-410 to the potential of the protective conductor.



For ML3P03, the junction can also be positioned between drive controller and cable carrier.

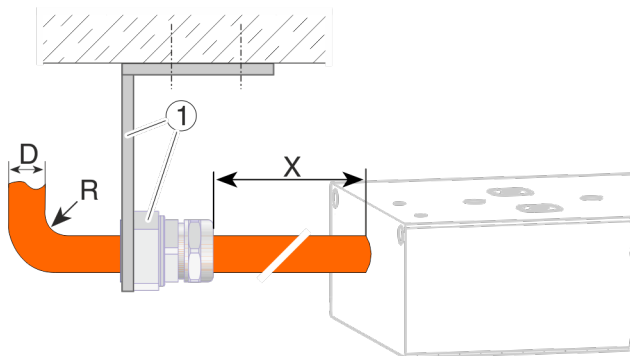


Fig. 20: Example for strain relief of connection cable (only valid for ML3P03)

Dimension "x" Minimum distance 5 mm

① Strain relief clamp (example) at MLP03 primary part

D Diameter of connection cable

R Allowed bending radius

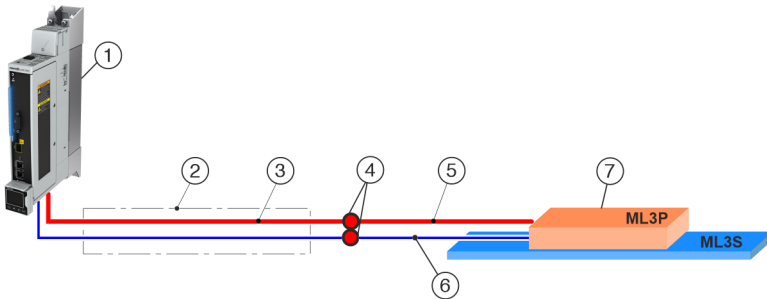


Fig. 21: Routing connection cable of primary part

- | | |
|---|----------------------------------|
| ① Drive controller | ⑤ Connection cable (power) |
| ② Energy chain | ⑥ Connection cable (temperature) |
| ③ Power cables | ⑦ ML3P primary part |
| ④ Junction (e.g. connector, terminal boxes) | |

Parallel motor connection

When connecting a motor parallel on a drive controller, the following possibilities exist to assembly the motor cable.

- Installation of two separate parallel cables (Fig.) 23)
- Installation of a collective cable with higher cross section (Fig.) 24)

The first possibility offers the benefit of smaller bending radii. The whole cross section of parallel installed cables must be according to the increased cross section for parallel motor connections.

Power connection for single arrangement

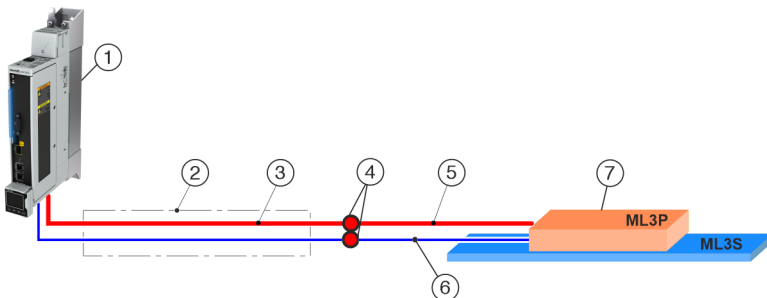


Fig. 22: Power connection for single arrangement

- | | |
|--------------------|---|
| ① Drive controller | ④ Junction (e.g. connector, terminal boxes) |
| ② Energy chain | ⑤ Connection cable (power) |
| ③ Power cables | |

- ⑥ Connection cable (temperature)
- ⑦ ML3P primary part

Power connection for parallel arrangement, separate connection cable

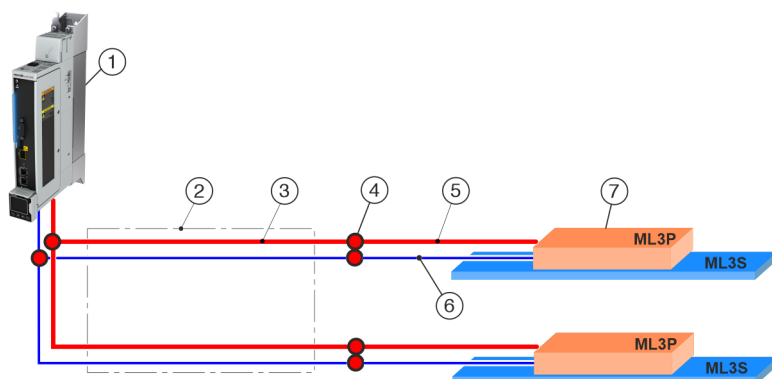


Fig. 23: Parallel arrangement, separate power cables

- ① Drive controller
- ② Energy chain
- ③ Power cables
- ④ Junction (e.g. connector, terminal boxes)
- ⑤ Connection cable (power)
- ⑥ Connection cable (temperature)
- ⑦ ML3P primary part

Power connection at parallel arrangement, collective power cable with higher cross section

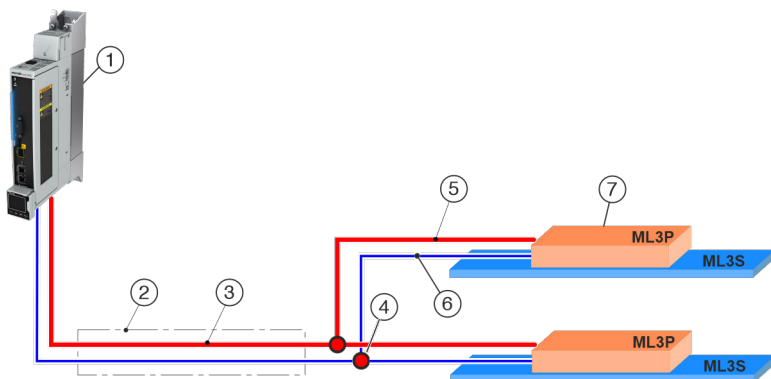


Fig. 24: Parallel arrangement, collective power cable

- | | |
|---|----------------------------------|
| ① Drive controller | ⑤ Connection cable (power) |
| ② Energy chain | ⑥ Connection cable (temperature) |
| ③ Power cables | ⑦ ML3P primary part |
| ④ Junction (e.g. connector, terminal boxes) | |

6.3.3 Electrical connection

Before connection of the primary parts, observe the information on suitability for drag chains of individual connection cables at the primary part in ➔ Chapter 6.3.1. Cables that are not suitable for drag chains must be routed in a fixed installation (see ➔ Chapter “Routing of connection cables”) From this junction, extending connection cables suitable for drag chains may be routed through the energy chain or the machine construction.

To connect the primary parts, the following options are available:

- Connection with connector and cable by Rexroth
- Connection with connector and cable (layout by customer)
- Connection with terminal box (layout by the customer)



When using Rexroth controllers and connection techniques, only the one temperature sensor can be connected and evaluated at the controller.

Connection with connector and cable by Rexroth

A coordinated range of connector sets and ready-made power cables is available for connecting the ML3 motors to Rexroth controllers. Also refer to the instructions in ➔ Tab. 27. In order to be able to connect Rexroth power cables to the motor, the motor connection cable must first be assembled by the customer, taking into account the installation situation.



For the assembly, a special tool is required:
Crimping tool R913072332 (manufacturer ID C0.236.00).

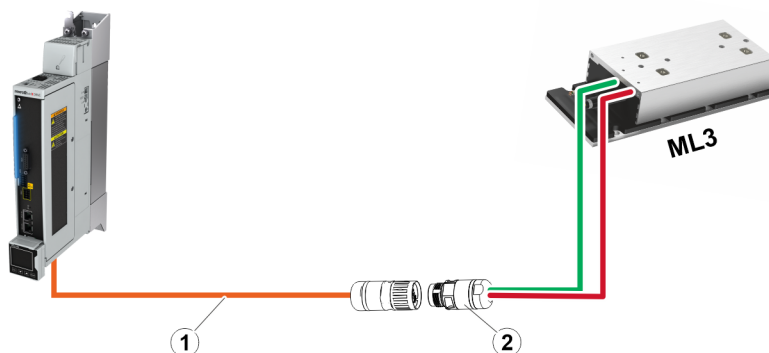
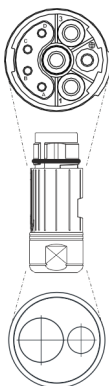


Fig. 25: Motor connection with combo plug

- ① Power cable (see ➔ Tab.) 27)
- ② Connector (connector set to assemble the connecting cable on the motor (refer to ➔ Tab.) 27)

Table 27: Connectors and power cables to connect the ML3P

Primary part	Connector set for Motor connection cable	Power cables	Power Extension cable
ML3P03-...	RLS2352/CUB3 R911398822	ctrlX RLC2-xxxBGB-NN-xxx,x (0.75 mm ²)	RLC1-532BGB-NN-xxx,x (0.75 mm ²)
ML3P06-B...	RLS2362/CUB3 R911398823	RLC2-xxxECB-NN-xxx,x (2.5 mm ²)	RLC1-532ECB-NN-xxx,x (2.5 mm ²)
ML3P06-C...			
ML3P06-D...	RLS2372/CUB3 R911398824	IndraDrive RLC1-xxxBGB-NN-xxx,x (0.75 mm ²) RLC1-xxxECB-NN-xxx,x (2.5 mm ²)	
ML3P06-E...			
ML3P06-F...			
ML3P06-HNBK			
ML3P06-HNBR			
ML3P11-D...			
ML3P11-E...			
ML3P11-F...			
ML3P11-H...			
ML3P11-L...			
ML3P11-R...	RLS4052/CUB3 R911423737	ctrlX RLC2-xxxGDB-NN-xxx,x (6.0 mm ²) IndraDrive / IndraDrive	RLC2-542GDB-NN-xxx,x (6.0 mm ²)

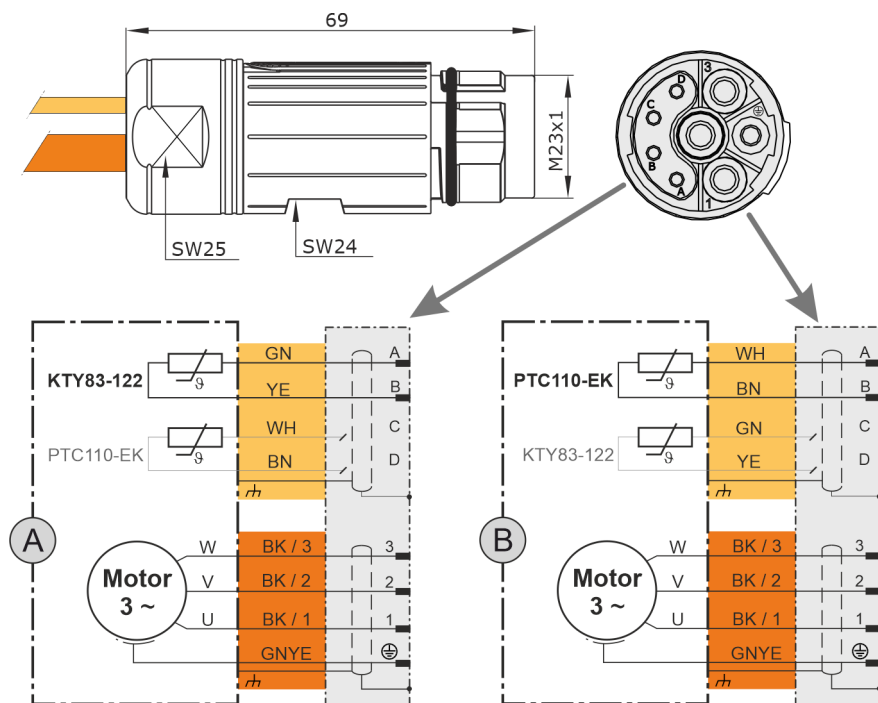




The extended cables are assigned to the connection at Rexroth controllers in the following catalog:

Motor cables and connectors (R911420099).

Pin assignment of the connection cables RLS23x2/CUB3



Pin assignment of RLS4052/CUB3 connector

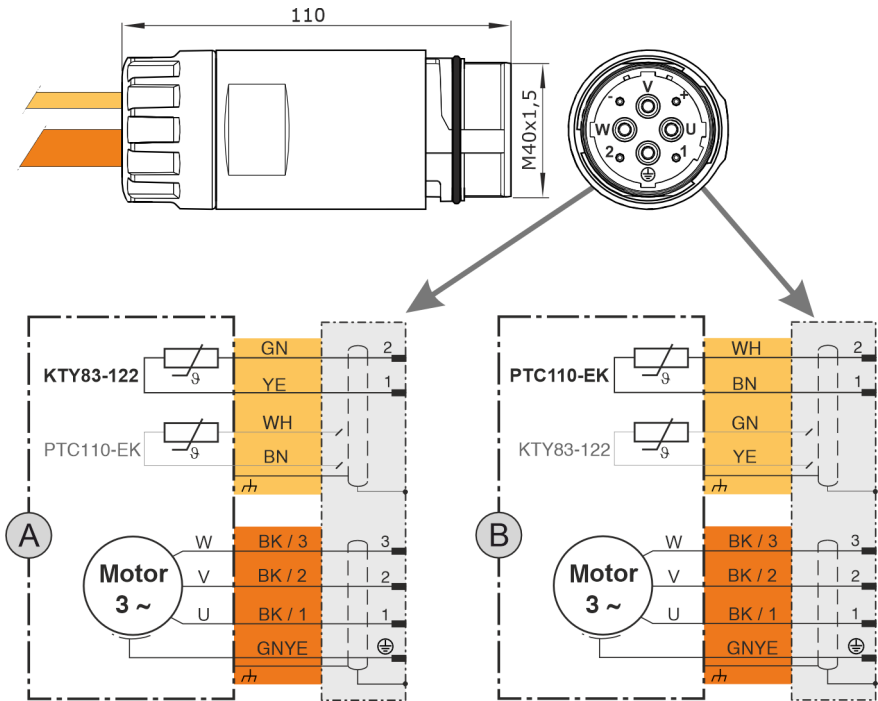


Fig. 27: Pin assignment of the M40 combo plug

- Ⓐ Pin assignment of the temperature sensor evaluation KTY83-122
- Ⓑ Pin assignment of the temperature sensor evaluation PTC110-EK

Mounting flange for connector gland

To feed the connector through to the machine, the following connectors can be fitted with a folding flange. The flange can be ordered as an accessory.

Table 28: Mounting flange for connector gland

Mounting flange for Connector gland	Connector size	Designation
	M23	CONNECTOR ACCESSORIES
		Z-SONS**-MONTAGEFLANSCH M23 TE R911404525
	M40	CONNECTOR ACCESSORIES
		Z-SONS**-MONTAGEFLANSCH M40 TE R911326767

Connection with connector and cable by third party manufacturers

If the motors are not connected using connectors and cables by Rexroth, the customer has to provide all required components. The wire designation required for the assembly can be found under ➔ [Chapter 6.3.1](#).



Please note that self-assembled cables or cable systems of other manufactures may not comply with these requirements. Rexroth shall not be held responsible for resulting malfunction states or damage.

Connection via terminal boxes

The terminal box is not part of the motor delivery. If the motors are not connected using connectors and cables but via a terminal box, the customer has to provide all required components.



Please note that self-assembled cables or cable systems of other manufactures may not comply with these requirements. Rexroth shall not be held responsible for resulting malfunction states or damage.

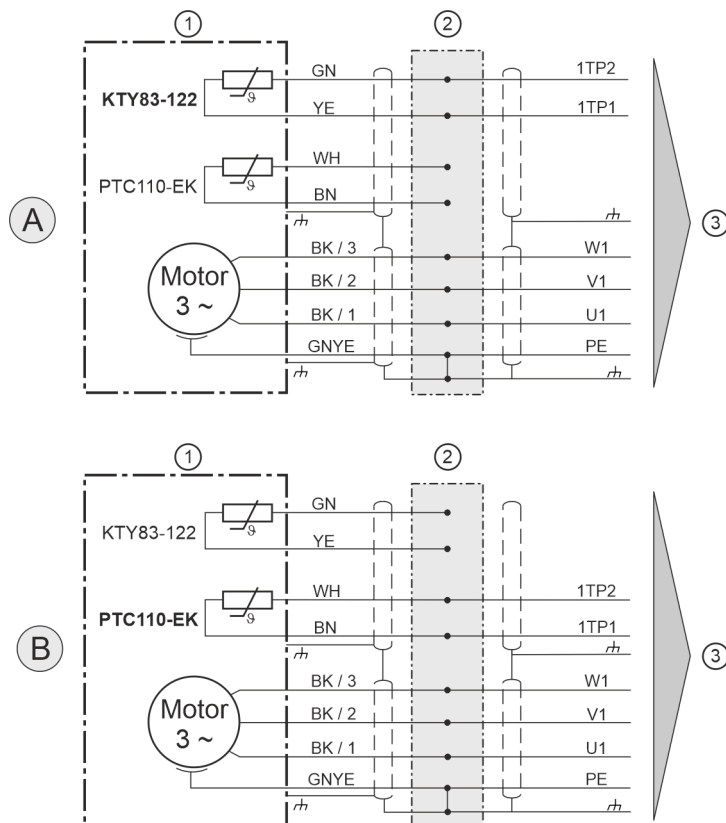


Fig. 28: Connection example terminal box

- Ⓐ Contact assignment of the temperature sensor evaluation KTY83-122
- Ⓑ Contact assignment of the temperature sensor evaluation PTC110-EK
- ① ML3P primary part
- ② Terminal box
- ③ Controller

Routing of connection cables

NOTICE

Damage of the connection cables and the motor by dynamic bending loads!

The connection cables of the primary parts ML3P06 and ML3P11 and the temperature sensor cables of all ML3P may not be laid into drag chains. Installation in a cable carrier is only allowed for a cable lead after a junction suitable for energy or drag chains.

NOTICE

Avoid bending, pulling and pushing loads as well as continuous movements of the connection cable at the point where the cable exits from the primary part. Any load of this kind can lead to irreparable damage (e.g. cable break) on the primary part!

If a fixed installation is not possible, equip the connection cable of the Hall unit with strain relief (for example, see Fig. 29) to protect the cable and the primary part from irreparable damage (e.g. cable break).



If grounding of the secondary parts cannot be ensured due to installation in the customer-side machine construction, the ML3S are to be connected in compliance with DIN VDE 0100-410 to the potential of the protective conductor/Protective conductor.

Strain relief clamp

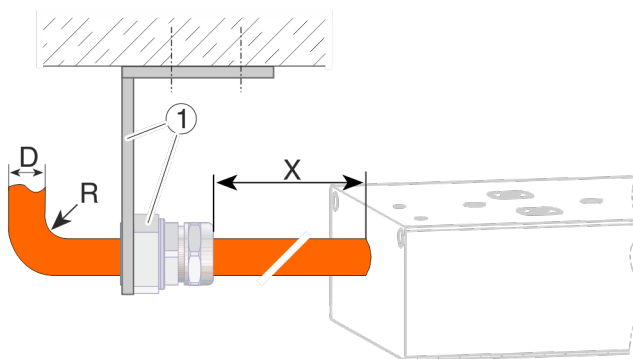


Fig. 29: Example for strain relief of connection cable (only valid for ML3P03)

Dimension "x" Minimum distance 5 mm

① Strain relief clamp (example) at MLP03 primary part

D Diameter of connection cable

R Allowed bending radius

Parallel motor connection

When connecting a motor parallel on a drive controller, the following possibilities exist to assembly the motor cable.

- Installation of two separate parallel cables (→ Fig.)
- Installation of a collective cable with higher cross section (→ Fig.)

The first possibility offers the benefit of smaller bending radii. The whole cross section of parallel installed cables must be according to the increased cross section for parallel motor connections.

Power connection for single arrangement

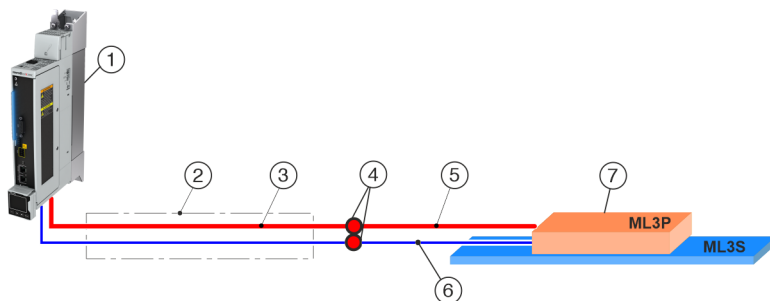


Fig. 30: Power connection for single arrangement

- | | |
|---|--------------------------|
| ① Drive controller | ⑤ Connection power |
| ② Energy chain | ⑥ Connection temperature |
| ③ Power cables | ⑦ Motor ML3 |
| ④ Junction (e.g. connector, terminal boxes) | |

Power connection for parallel arrangement, separate connection cable

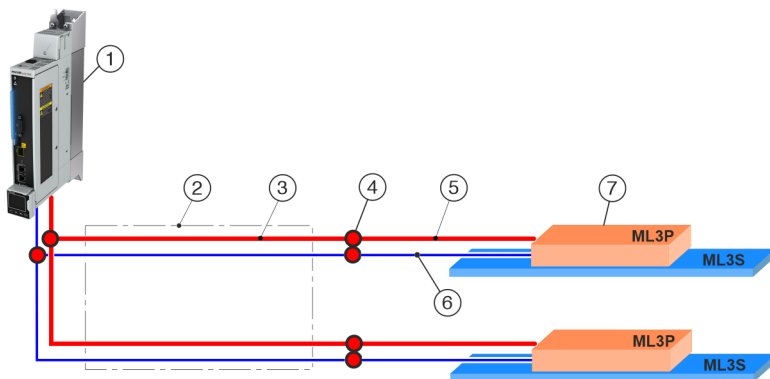


Fig. 31: Parallel arrangement, separate power cables

- | | |
|---|--------------------------|
| ① Drive controller | ⑤ Connection power |
| ② Energy chain | ⑥ Connection temperature |
| ③ Power cables | ⑦ ML3P primary part |
| ④ Junction (e.g. connector, terminal boxes) | |

Power connection at parallel arrangement, collective power cable with higher cross section

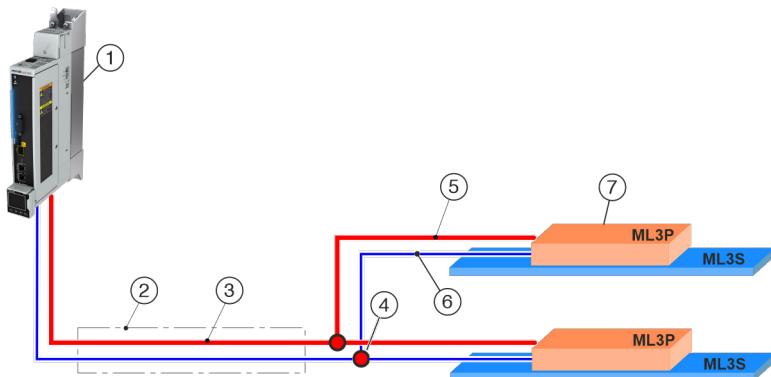


Fig. 32: Parallel arrangement, collective power cable

- | | |
|---|--------------------------|
| ① Drive controller | ⑤ Connection power |
| ② Energy chain | ⑥ Connection temperature |
| ③ Power cables | ⑦ ML3P primary part |
| ④ Junction (e.g. connector, terminal boxes) | |



For ML3P03, the junction can also be positioned between drive controller and cable carrier.

Connection designations at Rexroth controller

Single arrangement

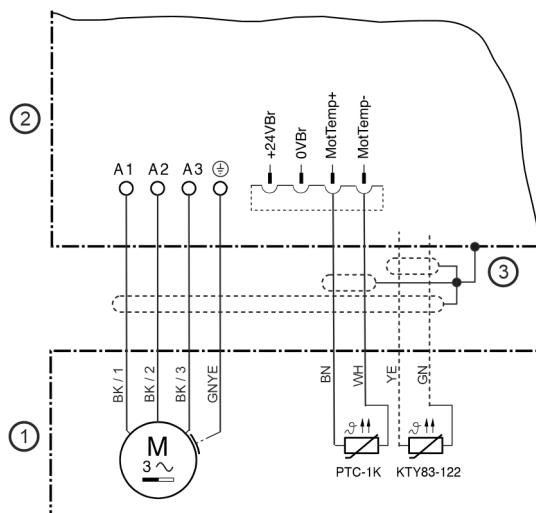


Fig. 33: Connection on drive controller - single arrangement primary part

- ① ML3P primary part
- ② Rexroth - controller
- ③ Shield connection on the controller

Parallel connection

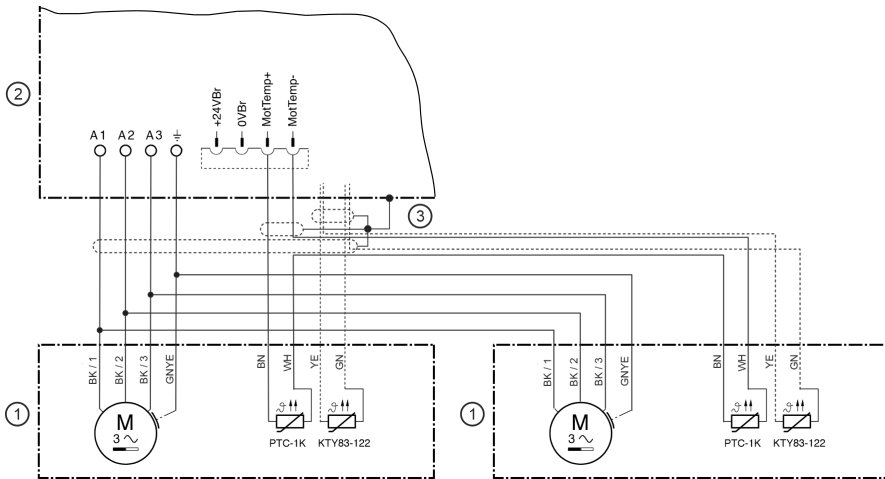


Fig. 34: Connection on drive controller - parallel connection primary parts



For electrical connection of primary parts in parallel arrangement, refer to the ML3 project planning manual for commissioning and parameterization.

6.3.4 Connection temperature sensors

The motor temperature is monitored by

- Temperature sensor (motor) and
- Temperature model (controller)

and ensures the best protection of motors against irreversible damage by thermal overload.

Further notes on the temperature sensors and motor temperature monitoring can be found in the ML3 project planning manual.

The connection of temperature sensors is done, as illustrated in Fig. 26 and Fig. 28.

6.4 Electrical connection of Hall unit (optional)

6.4.1 Connection cables Hall units

The connection cable of the Hall unit is generally routed next to the connection cables of the primary part. After motor installation, the cable of the Hall unit can be shortened to the required length and be assembled with a D-sub connector, for example. See also [Chapter 6.4.2 "Dimensioning of the Hall unit connection cable"](#) on page 59.

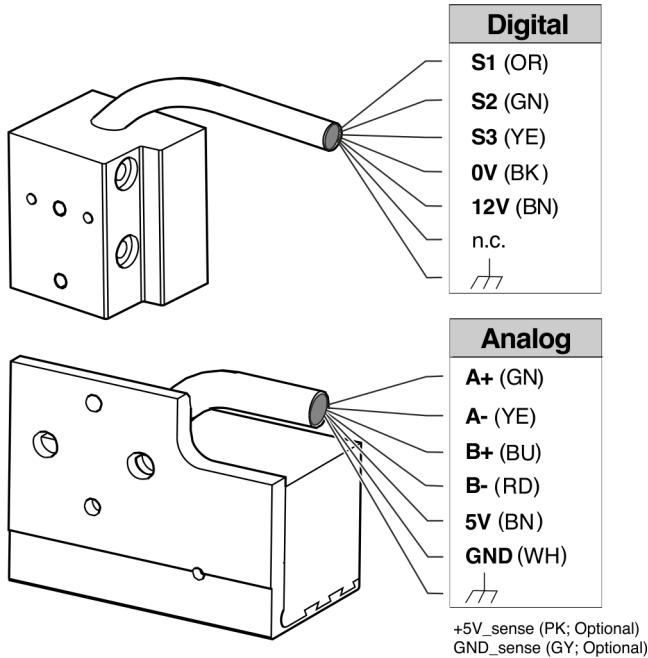


Fig. 35: Wire designation connection cable Hall unit

Table 29: Connection cables Hall units

Hall unit	Diameter / length	Wire cross section	Allowed bending radius [R]
Analoge	6.2 mm / 3 m	4x 2x 0.14 mm ²	6x D (37.2 mm)
Digital	5.0 mm / 1.2 m	6x 0.14 mm ²	7.5x D (37.5 mm)

NOTICE	Avoid bending, pulling and pushing loads as well as continuous movements of the connection cable at the Hall unit. This type of loads can lead to irreparable damage (e.g. cable break)! The connection cable of the Hall unit can be attached to the power cable by means of cable ties if the power cable is already equipped with strain relief. If a fixed installation is not possible, equip the connection cable of the Hall unit with strain relief (for example, see Fig. 29) to protect the cable and the primary part from any damage (e.g. cable break).
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i The Hall unit is a component that may be damaged by ESD. For this reason, the Hall unit is packed in an ESD protection bag on delivery. Before connecting the Hall unit, take appropriate measures for ESD protection (ESD = electrostatic discharge).

6.4.2 Dimensioning of the Hall unit connection cable

Before the Hall unit can be connected, the connection cable of the Hall unit must be equipped with a D-SUB connector with pins. The assignment of the connector depends on the type of hall unit (digital or analog).

Table 30: Pin assignment D-SUB connector to connect the Hall unit

PIN	Connection cable Hall unit	
	Analoge (D-SUB 9-pin)	Digital (D-SUB 9-pin)
1	/	12 V (BN)
2	A+ (GN)	S1 (OR)
3	A- (YE)	/
4	0V (WH)	S2 (GN)
5	B+ (BU)	0V (BK)
6	B- (RD)	/
7	5V (BN)	/
8	/	S3 (YE)
9	/	/
Connector housing	Cable shield	Cable shield

6.4.3 Digital Hall unit connection



Observe the information on the SHL03.1 adapter box in documentation DOK-INDRV*-HCS01*****-PRxx-xx-P, MNR R911322210.

For connection of a digital Hall unit in combination with an incremental length measuring system to a Rexroth controller, the **SHL03.1 adapter box** has to be used.

The SHL03.1 brings both incoming signal cables of Hall unit and length measuring system together and redirects their signals via a single connection cable to the drive controller for encoder evaluation.

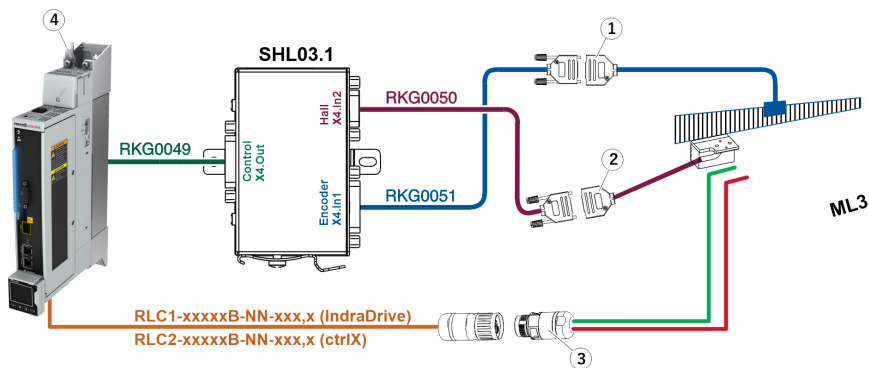


Fig. 36: Connection overview of ML3P with digital Hall unit

① RGS0006 (D-sub connector 15-pin) Device connector

② Device connector RGS0006 (D-SUB connector, 9-pin)

③ Power and temperature connection points

RKG0049 Adapter box ↔ encoder evaluation on drive controller

RKG0050 Digital Hall unit ↔ adapter box (max. cable length 30 m)

RKG0051 Length measuring system ↔ Adapter box

6.4.4 Analog Hall unit connection

To connect an absolute measuring system and an analog Hall unit, a shelf with 2 encoder interfaces in the Rexroth controller is required.

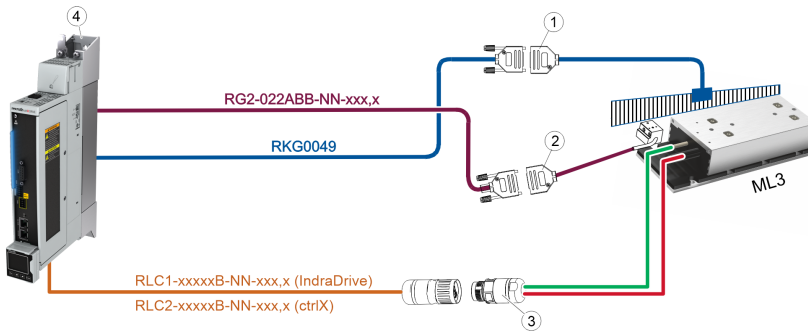


Fig. 37: Connection overview of ML3P with analog Hall unit

- ① Device connector RGS0006 (D-SUB connector, 15-pin)
- ② Device connector RGS0005 (D-SUB connector, 9-pin)
- ③ Power and temperature connection points
- RG2-022ABB... Analog Hall unit ↔ Encoder evaluation at drive controller
- RKG0051 Length measuring system ↔ Encoder evaluation at drive controller

6.5 Length measuring system



The length measuring system is not in the scope of delivery of the motor and must be prepared and assembled by the machine manufacturer.

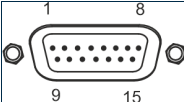
Setting the encoder polarity depends on the direction of rotation of the primary part and must be parameterized at start-up of the controller. Also observe the manufacturer's instruction of the length measuring system.

To connect an incremental length measuring system on a Rexroth controller or on the adapter box SHL03.1, Bosch Rexroth provides two connection cables.

- **RKG0049**
For connection of the length measuring system directly on the controller
- **RKG0051**
To connect the length measuring system on the SHL03.1

To use this connection cable, fit the connection cable on the incremental length measuring system with a compatible device connector (RGS0006).

Table 31: Pin assignment at RGS0006 to connect the length measuring system

		Signal	Function
1		GND_shld	Connection signal shields (inner shields)
2		A+	Track A positive
3		A -	Track A negative
4		GND_Encoder	Reference potential voltage supplies
5		B+	Track B positive
6		B-	Track B negative
7 ... 8		n.c.	/
9		R+	Reference track positive
10		R-	Reference track negative
11		VCC_Encoder (12 V)	Encoder supply 12 V
12		VCC_Encoder (5 V)	Encoder supply 5 V
13 / 14		n.c.	/
15		Sense-	Feedback of reference potential (Sense line)
Connector housing		/	Outer shield

7 Commissioning and operation

7.1 Safety

⚠ WARNING

High electric voltage! Danger to life, risk of injury by electric shock!

- Life parts are dangerous.
- Do not open any covers or flange sockets during operation.
- Do not connect or disconnect plug-connectors and connection clamps.

⚠ WARNING

Risk of injuries due to moving machine 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

7.2.1 Classification

Environmental conditions during operation

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 32: 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 ¹⁾
Classification of biological environmental conditions	3B1
Classification of mechanically active materials	3S6
Classification of mechanical environmental conditions	3M12
Classification of chemical environmental conditions	None ²⁾

1) Deviating from class 3K22, the values from ➔ Tab. 34 permitted.

2) To avoid damages on ML3V, a cleaning with IPA or acetone is allowed, only.

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 33: Allowed operation conditions

Environmental factor	Unit	Value
Temperature	°C	0 ... +40 ¹⁾
Relative air humidity	%	5 ... 95 ¹⁾
Absolute air humidity	g/m ³	1 ... 29 ¹⁾
Installation altitude	m	up to 1,000 m above sea level

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

Table 34: Permitted climatic environmental conditions ML3V

Environmental factor	Value ¹⁾
High air temperature for ML3V□□-N□-□□□□-□□	120 °C)
High air temperature for ML3V□□-N□-□□□□-□□	150 °C
Temperature change rate	< 0.5 °C/s = 30 °C/min
Thermal cycles with < 0.5 °C/s	< 100

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

Temperatur gradient

The temperature gradient specifies the maximum temperature difference at any two points of an ML3V. The temperature gradient must not exceed 10 % of the temperature difference within one cycle ΔT_{cycle} .

$$\Delta T_{ML3V} = T_{\max} (ML3V) - T_{\min} (ML3V) \leq 0.1 \times \Delta T_{cycle}$$

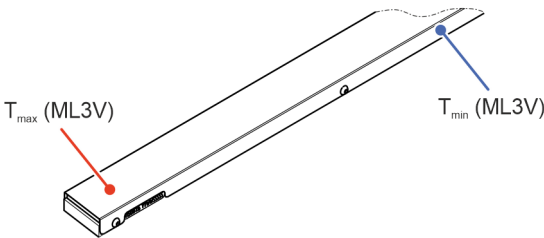


Fig. 38: Temperatur gradient ML3V

Mechanical operating conditions

NOTICE	Should the ML3V be bent, this bending must be limited to a maximum of 0.1 mm. Basically, do not drop ML3V. Unpacked, a maximum drop height of 25 mm must never be exceeded. ML3V must not be subjected to shocks or impacts.
---------------	--

Additional operation conditions



Note that the following limits apply generally and must be observed throughout the entire life cycle.

Influences	Remark
Deformation of mounting surfaces	Due to deformation of the mounting surfaces, e.g. as a result of thermal expansion, the tolerance of the flatness must not exceed 0.1 mm
Bending during operation	If the ML3V are additionally bent during operation due to external influences, this bending must be limited to a maximum of 0.1 mm.
Drop height during operation	If the ML3V should fall when assembled, e.g. on a slide with it, the maximum drop height must not exceed 25 mm.

Residual Gas Analysis

In order to operate ML3V in vacuum environments, detailed information regarding outgassing may be required. General statements for all variants of the ML3V cannot be made, since outgassing depends on the mechanical design.

Secondary part	CxHy v ¹⁾ [mBar*l/sm]	CxHy nv ²⁾ [mBar*l/sm]	Water ³⁾ [mBar*l/sm]	Sum ⁴⁾ [mBar*l/sm]
ML3V03-NB-□□□□-CP	2,68E-08	8,85E-09	8,33E-05	1,88E-04
ML3V06-SB-□□□□-CP			tbd	

1) CxHy v = Volatile hydrocarbons

2) CxHy nv = Non-volatile hydrocarbons

3) Water = H₂O

4) Total amount of outgased substances

7.3 Commissioning



The motor can be operated only after installation and parameterization into a machine. For start up, please observe the documentation of all system components. For detailed start up procedure of the motors refer to the project planning manual and the respective documentation about drive controller or firmware description.

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

- Make sure that the motor is mechanically and electrically connected correctly.
- Ensure that the motor and all participating components of the drive are undamaged (e.g. length measuring system).
- Make sure that the axis can freely move over the whole traverse path.
- Please observe the general safety instructions on the protection against hazardous movements
→ Chapter. 2.5.2.

7.4 Operation

During operation, keep the ambient and operation conditions and technical data specified in the project planning manual.

Checks during operation:

- ▶ Pay attention to exceptional noise.
- ▶ Pay attention to increased vibrations.
- ▶ Check the motor for cleanliness.
- ▶ Check the monitoring devices and diagnostic / error messages of the controllers.



Immediately decommission the drive when deviations from normal operation exist.

7.5 Operation with third-party controllers

Rate of rise of voltage

The electrical insulation 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.



Use a dry and clean cloth to clean the ML3V. In addition, isopropanol or acetone may be used as a cleaning agent.

Insufficient heat dissipation can have undesirable consequences. The bearing lifetime 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

Increase availability with regular preventive maintenance measures. Observe the machine manufacturer's instructions in the machine maintenance plan and the maintenance measures described below.

The following points should be observed and if necessary restored during the preventive check of motor and auxiliary components:

- Noticeable sound during operation
- Scratches on primary and secondary part
- State of power and encoder cables in a drag chain.
- State of length measuring system (e.g. contamination)
- State of guides (e.g. deterioration of linear guides)

Table 35: Maintenance measures

Measure	Interval
Check the mechanical and electrical connections.	According to the specifications in the machine maintenance plan, but at least every 1000 operating hours.

Measure	Interval
Check the machine for smooth running, vibrations and bearing noise.	According to the specifications in the machine maintenance plan, but at least every 1000 operating hours.



In general, ensure sufficient cleanliness in the motor installation space to prevent dirt (e.g. chips, grinding dust, grease through guides, etc.) from getting into the air gap between the primary and secondary parts.

Our worldwide service network provides an optimized and efficient support. Our experts offer you advice and assistance should you have any queries. You can contact us **24/7**.

Service Germany

Our technology-oriented Competence Center in Lohr, Germany, is responsible for all your service-related queries for electric drives and controls.

Contact the **Service Helpdesk & Hotline** under:

Table 36: Service Helpdesk

Telephone:	+49 9352 40 5060
Fax:	+49 9352 18 4941
Email:	↗ service.svc@boschrexroth.de
Internet:	↗ www.boschrexroth.com

Additional information on service, repair (e.g. delivery addresses) and training can be found on our internet sites.

Service worldwide

Outside Germany, please contact your local service office first. For hotline numbers refer to the sales office addresses on the Internet.

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, e-mail address)

9 Disassembly

9.1 General notes about disassembly

▲ DANGER

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.
- Before starting disassembly, secure the machine against unforeseeable movements and against unauthorized operation.
- Before dismounting the motor and the supply lines, secure them against dropping or moving and disconnect the mechanical connections only thereafter.

▲ WARNING

High electric voltage! Danger to life, risk of injury by electric shock!

- Life parts are dangerous.
 - Do not open any covers or flange sockets during operation.
 - Do not connect or disconnect plug-connectors and connection clamps.

▲ WARNING

Danger due to permanent magnets!

- Health hazard for persons with heart pacemakers, metallic implants and hearing aids in direct environment of permanent magnets.
- Crushing hazard of fingers and hand due to heavy attractive forces of the magnets.
- Risk of destruction of sensitive parts like watches, credit cards, ...



The machine manufacturer must observe the special features of the construction and create a special disassembly instruction for the motor components. Only this disassembly instruction of the machine manufacturer is binding.

Basic procedure for disassembly:

- 1.** ➞ Use the machine-side control commands to decelerate the drive to a controlled standstill.
- 2.** ➞ Switch off the power and control voltage of the controller.
- 3.** ➞ Switch off the main switch of the machine and deactivate external systems according to the instructions of the manufacturer.
- 4.** ➞ Secure the machine against accidental movements and against unauthorized operation.
- 5.** ➞ Wait until the discharge time of the electrical systems has elapsed and then disconnect all electrical connections. Secure electric cables and contacts against contact with other electrical parts.
- 6.** ➞ Remove dirt, chips and other any kind of residues from the motor.
- 7.** ➞ Before dismounting the motor and the supply lines, secure them against dropping or moving and disconnect the mechanical connections only thereafter.

8. → Store or transport the motor components, in particular the secondary part of a linear motor or the rotor of a rotary kit motor, in the original packaging again immediately after removal. Please observe the safety notes when handling the secondary part.
9. → If necessary, record all measures in the commissioning log or machine maintenance plan.

9.2 Replace the motor

▲ WARNING

Electric shock due to live parts with more than 50 V!

Replacement may only be performed by personnel trained and qualified to work on or with electrical equipment.



The motor must be replaced by a motor of identical type. This is the only way to ensure that all parameterizations can remain unchanged. Moreover, repeated acceptance within the scope of the "Integrated safety technology" is not necessary.

1. → If necessary, note the previous absolute value
2. → Open the main switch
3. → Make sure the main switch cannot be switched back on
4. → Disconnection plug connections
 1. When exchanging the motor, close open plug sides of power connections with protection caps if moistening with coolant/lubricant or soiling must be expected (allowed soiling degree according to EN 50178: 2).
5. → Replace the motor
 1. Observe the machine manufacturer's instructions when exchanging the motor mechanically.
6. → Re-establish the plug connections
7. → Re-establish the dimensional reference

▲ WARNING

Risk of accidents due to unintentional movements! If servo axes are provided with an indirect measurement system via the motor encoder, the dimensional reference is lost after motor replacement!

For this reason, the reference to the machine coordinate system must be re-established.

10 Environmental protection and disposal

Disposal of the motor components can be done according to the applicable legal process in normal recycling process.

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.

Basic components

Basically, our motors consist of the following components:

- Steel, stainless steel, aluminum, copper, brass
- Plastic parts, insulation and composite material
- Electronic components
- Permanent magnets

Plastic parts of the products may contain flame retardants. These plastic parts are labeled according to EN ISO 1043-1:2011 + A1:2016. They have to be recycled separately or disposed of according to the applicable legal provisions.

Magnets

⚠ WARNING



Danger due to permanent magnets!

- Health hazard for persons with heart pacemakers, metallic implants and hearing aids in direct environment of permanent magnets.
- Crushing hazard of fingers and hand due to heavy attractive forces of the magnets.
- Risk of destruction of sensitive parts like watches, credit cards, ...



Remark

The permanent magnets must be demagnetized before disposal to avoid injuries or damage. The demagnetization is reached via thermal treatment. The duration of the treatment depends on the size (guide value: 300 °C, 30 min).

Packaging

Our packaging materials do not contain any problematic materials and can therefore be easily disposed. Packaging materials are: wood, cardboard and polystyrene.

Batteries and accumulators



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. The batteries or accumulators must be returned to the country-specific collection systems for proper disposal.

Disposal by the manufacturer

Our products can be returned to us for disposal. However, this requires that the products are free from oil, grease or other dirt. The motor components must be returned in a suitable packaging (origin package if possible). In the case of a transport by air freight, please observe the dangerous goods regulations (IATA) for the secondary part.

Send the products to the following address, carriage free:

Bosch Rexroth AG
Bgm.-Dr.-Nebel-Str. 2
97816 Lohr a.Main, Germany

11 Troubleshooting

11.1 Procedure

Possible causes for failures of motors can be restricted to the following areas:

- Motor cooling and temperature behavior
- Internal temperature sensor
- Mechanical damage of the motor
- Mechanical connection to machine

The lengths measuring system and the temperature sensor are monitored by the controller or the control unit; corresponding diagnostic messages are displayed. Observe the instructions in the corresponding documentation.

The sections below describe examples of some fault statesFault states along with possible causes. This list is not exhaustive.

Table 37: States of disturbance

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
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	Lock screw connections acc. to specifications
Running noise	Motor damage due to insufficient air gap between primary and secondary part!	Stop the motor --> repair by manufacturer

Malfunction	Error cause	Measures
High motor temperatures Motor temperature monitoring is activated Wrong or defective temperature display	Guides or motor bearing defective	Stop the motor --> repair by manufacturer
	Operation outside of rated data	Reduce load and check the dimensioning
	Heat dissipation is impaired	Clean the motor For liquid cooling, check cooling circuit.
	Temperature sensor not connected	Connect temperature sensor
	Temperature sensor defective	Connect backup temperature sensor (if existing) Stop the motor --> repair by manufacturer



In the case of malfunctions or troubleshooting, please observe the notes in the project planning manual, too. Contact the manufacturer, if necessary.

12 Appendix

12.1 Declaration of conformity

12.1.1 EU declaration of conformity



EU-Konformitätserklärung
EU declaration of conformity

Dok.-Nr. / Doc. No.: DCTC-30336-001
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 (Commission Regulation ...)
 - ☐ Produkt im Geltungsbereich der RoHS-Richtlinie 2011/65/EU / Product in the scope of RoHS Directive 2011/65/EU; nach RoHS-Richtlinie 2011/65/EU / in accordance with RoHS Directive 2011/65/EU
 - ☒ Produkt nicht im Geltungsbereich der RoHS-Richtlinie 2011/65/EU / Product not in the scope of RoHS Directive 2011/65/EU; Produkt erfüllt die Anforderungen zur Stoffbeschränkung der Richtlinie / Product meets the substance restriction requirements of the directive
- 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 SYNCHRONOUS MOTOR

Baureihen / Series:	Primärteil / primary part	Sekundärteil / secondary part	Sekundärteil / secondary part
ML3...03...	ML3P03...	ML3S03...	ML3V03...
ML3...06...	ML3P06...	ML3S06...	ML3V06...
ML3...11...	ML3P11...	ML3S11...	ML3V11...

Handelsbezeichnung / Trade name: Rexroth
ab Herstellungsdatum / 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.

Fig. 39: CE declaration of conformity (DE/EN page 1/2)

EU-Konformitätserklärung - Original**EU declaration of conformity**

Seite / Page 2/2

DCTC-30336-001 : 2022-09-21

Angewendete harmonisierte Normen bzw. sonstige technische Normen und Vorschriften. /

Applied harmonized standards or other technical standards and regulations:

Norm / Standard	Titel / Name	Ausgabe / Issue
EN 60034-1 (IEC 60034-1)	Drehende elektrische Maschinen – Teil 1: Bemessung und Betriebsverhalten / <i>Rotating electrical machines – Part 1: Rating and performance</i>	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 / <i>Rotating electrical machines – Part 5: Degrees of protection provided by integral design of rotating electrical machines (IP code) - Classification</i>	2020 (2020)
EN IEC 61800-3 (IEC 61800-3)	Drehzahlveränderbare elektrische Antriebe – Teil 3: EMV-Anforderungen einschließlich spezieller Prüfverfahren / <i>Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods</i>	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 / Unterschriften wie in der originalen Konformitätserklärung angegeben.*****Place / date / signature as indicated in the original declaration.***

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.

Fig. 40: CE declaration of conformity (DE/EN page 2/2)

12.1.2 UKCA Declaration of conformity



UK Declaration of Conformity

Doc. No.: DCTC-30336-031
Date: 2022-08-16

- ☐ in accordance with Supply of Machinery (Safety) Regulation 2008, S.I. 2008/1597
- ☒ in accordance with Electrical Equipment (Safety) Regulation 2016, S.I. 2016/1101
- ☒ in accordance with Electromagnetic Compatibility Regulation 2016, S.I. 2016/1091
- ☐ in accordance with Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016, S.I. 2016/1107
- ☐ in accordance with Ecodesign for Energy-Related Products and Energy Information (Amendment) (EU Exit) Regulations 2019, S.I. 2019/539
- ☐ Product in the scope of RoHS Directive 2011/65/EU:
in accordance with Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012, S.I. 2012/3032
- ☒ Product not in the scope of RoHS Directive 2011/65/EU:
Product meets the substance restriction requirements of the directive
Scope of RoHS Directive for products of the manufacturer: DCTC-30336-006 „Declaration of compliance to the RoHS Directive 2011/65/EU & 2015/863/EU“

The manufacturer
Bosch Rexroth AG, Bgm.-Dr.-Nebel-Str. 2, 97816 Lohr a.Main / Germany
hereby declares that the products below

© Bosch Rexroth AG 2022

Name:	3-PHASE SYNCHRONOUS MOTOR			
Series:		Primary part	Secondary part	Secondary part
	ML3...03...	ML3P03...	ML3S03...	ML3V03...
	ML3...06...	ML3P06...	ML3S06...	ML3V06...
	ML3...11...	ML3P11...	ML3S11...	ML3V11...

Trade name: Rexroth
from the date of manufacture: 2022-08-16

were developed, designed and manufactured in compliance with the above-mentioned statutory instrument(s).
This UK Declaration of Conformity is issued under the sole responsibility of the manufacturer.
Designated Standards or other technical standards and regulations applied:

Standard	Name	Issue
EN 60034-1	Rotating electrical machines – Part 1: Rating and performance	2010 + Cor.:2010
EN 60034-5	Rotating electrical machines – Part 5: Degrees of protection provided by integral design of rotating electrical machines (IP code) - Classification	2001/A1:2007
EN 61800-3	Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods	2004/A1:2012

Further explanations:
The assembling and installation instructions according to the manual have to be followed.

Place/date/signature as indicated indicated in the original declaration.

We reserve the right to make changes to the content of the UK Declaration of Conformity. Current issue on request.

Fig. 41: UKCA Declaration of conformity

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