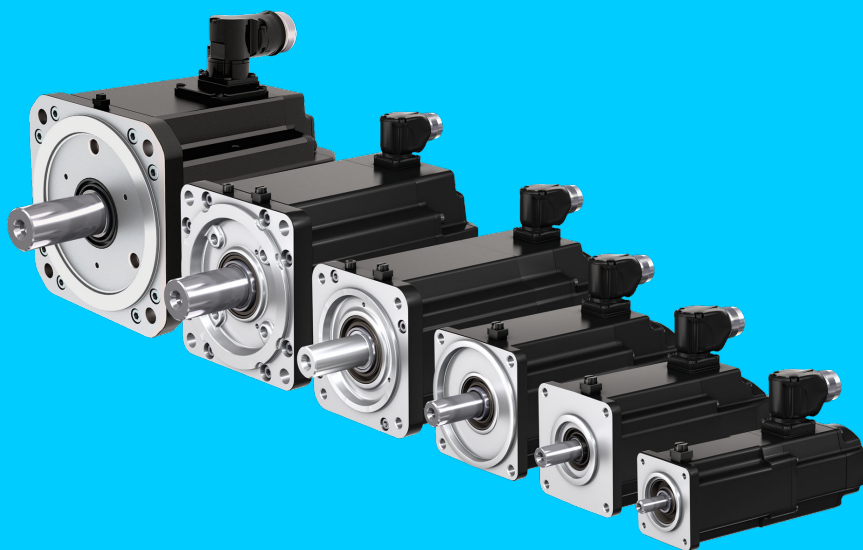


MS2E Synchronous Servomotors

ATEX



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1 About this documentation

1.1 Edition and purpose of this documentation

This instruction must be observed by assemblers, operators, service engineers and facility operators. It contains notes about handling a motor. Before operating motors, read this operating instruction to ensure a safe and smooth functionality and a long motor lifetime.

Table 1: Record of revisions

Edition	Release date	Notes
01	11/2018	First edition
02	07/2020	Amended frame size MS2E10
03	01/2022	Revision, modified topic electrostatics
04	06/2023	UKCA Conformity added Revised conditions on use

1.2 Presentation of information

Safety instructions

The safety instructions in this documentation include signal words (danger, warning, caution, note) and a signal symbol (acc. to ANSI Z535.6-2006).

The signal word is intended to draw your attention to the safety instructions and describes the seriousness of the danger. The warning triangle with exclamation mark indicates the danger for persons.

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

Non-compliance with this safety instructions **can** result in moderate or minor personal injury.

NOTICE

Non-compliance with this safety instructions **can** result in material damage.

Safety symbols

In the documentation, the following internationally standardized safety signs and graphic symbols are used. The meaning of the symbols is described in the table.

Table 2: Meaning of safety signs

Safety sym- bols	Meaning
	Warning against dangerous electric voltage
	Warning against hot surfaces
	Warning against rotating machine parts
	Warning against overhead load
	Electrostatic sensitive devices

Safety sym- Meaning bols



Prohibited for persons with active implantable medical devices (AIMD) or passive metallic implants (body aids) as well as for pregnant women



Do not carry along metal parts or clocks.



Hammer scales are forbidden

Meaning of symbols

Table 3: Meaning of symbols

Symbol	Meaning
	Reference to supplementary documentation
	Explosion protection identification
	The UL Recognized Component Mark identifies recognized component parts which are components of a bigger product or system.
	The letters "C" and "E" stand for "Conformité Européenne". The CE-marking expresses the conformity of a product with relevant EC-regulations.
	Components for the use in systems for "integrated safety technique" prepared.
	The symbol indicating "separate collection" for all batteries and accumulators is the crossed-out wheeled bin.

Markup

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

Remark: 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

Instruction

- Instruction
 - Result of one instruction

Instruction multilevel

- Action step one
- Action step two
 - Result of an instruction

Please comply with the order of the handling instructions.

2 Safety instructions

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

Keep this instructions!

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

2.1 Important directions on use

2.1.1 Intended use

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

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

EU Product standard

EN 60034-1:2010 + Cor.:2010	Rotating electrical machines - Part 1: Rating and performance (IEC 60034-1:2010, modified)
-----------------------------	--

Valid within EU / UK

EU/UK Directives

2014/34/EU	ATEX Directive
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UKSI 2016: 1107 (as amended UK Directive
by UKSI 2019: 696)

EN Standards

EN IEC 60079-0:2018/AC:2020	Explosive atmospheres - Part 0: Equipment - General requirements (IEC 60079-0:2017)
EN IEC 60079-7:2015/A1:2018	Explosive atmospheres - Part 7: Equipment protection by increased safety "e" (IEC 60079-7:2015/A1:2017)
EN 60079-31:2014	Explosive atmospheres - Part 31: Equipment dust ignition protection by enclosure "t" (IEC 60079-31:2013)

The observance of and compliance with the specifications of the operating instructions (DOK-MOTOR*-MS2E*****-PRRS-**-P) are part of the intended use.

The here described motors are only allowed to be used in an area for components for Group II, Category 3G/3D or Gc, Dc.

- where no explosive atmosphere can occur during **normal operation**, as this is avoided by ventilation and monitoring.
- where explosive atmosphere can occasionally occur in an **event of fault** and this atmosphere can be eliminated and intercepted by the user immediately after occurrence. Thus the explosive atmosphere appears rarely and for a short period of time.

This corresponds to the use of motors in **zone 2** and **zone 22**.

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 2006/42/EC and DIN EN 60204-1 (safety of machines).

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 motors must be left in their original state. It is not allowed to do any constructional modifications. In the case of contravention, applicability according to intended use will expire (e.g. safety technique or ATEX conformity...).

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

2.1.2 Unintended use

Any use of the MS2E motors outside of the specified fields of application or under operating conditions and technical data other than those specified in this documentation is considered to be inappropriate use.

Direct operation on the three-phase network is forbidden.

2.2 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.

Within the meaning of explosion protection, the plant application, selection of devices and their construction must be made by persons whose education contained instruction in several ignition protection types and installation techniques, correct regulations and rules as well as general principles of zoning. The person must be competent to do the mode of work. Qualification of personnel contains knowledge and observance of the specifications in EN 60079-14:2014 Explosive atmospheres - Part 14: Electrical installations design, selection and erection (IEC 60079-14:2013) (). The personnel must be trained in regular intervals.

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 (Operation of electrical installations - Part 1: General requirements).

2.3 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.

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.

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.

2.4 Product- and technology-dependent safety instructions

2.4.1 Protection against explosion hazard



Product use only in hazardous areas according to the specified labeling on the product

This product is only allowed to be used in an area of use which is specified on the type plate according to the explosion protection standards. In the case of several ATEX designations labelled on the type plate, likewise gas and dust protection, please observe that during operation only

one hazardous atmosphere occurs (no combination of several). Simultaneous occurrence of gas and dust Ex atmospheres is not permitted.

Do any maintenance in non-hazard atmosphere.

Observe the conditions on use

Observe the notes in the application conditions and do not exceed the specified limit values.

Observe residual risks

Specified residual risks and special using conditions must be evaluated by the plant manufacturer and operator according to the product application. This makes own measures necessary to prevent risks.

2.4.2 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.

2.4.3 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.

2.4.4 Protection against magnetic and electromagnetic fields

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

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

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

- For persons with active body aids (like heart pacemakers), passive metallic implants (like hip prosthesis) and pregnant women possible hazards exist due to electro magnetic 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.

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

- Handle only with protective gloves.

Risk of destruction of sensitive parts! 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.

2.4.5 Protection against ignitable electrostatic discharges

Danger of explosion due to electrostatic discharge

Electrostatic discharges may ignite gases, vapors and dust. Electrostatic charges may be caused e.g. by the following processes:

- electrostatic painting
- pneumatically conveyed dust or bulk material

- hydraulically conveyed or flowing liquids and droplets
- mechanically driven belts, brushes and films, etc.

Danger of explosion due to highly charge-generating processes

Highly charge-generating processes may cause bush discharges or propagating bush discharges and lead to explosions. This must be prevented. This, in turn, may lead to death, severe injury and damage to property.

Carry out cleaning work only with a moist cloth

Clean the motor with a moist cloth to avoid electrostatic charge. Rubbing with non-conductive materials must be avoided to prevent electrostatic charges resulting in ignition hazards.

2.4.6 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.

2.4.7 Electrostatic sensitive devices (ESD)

The 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 wires or contacts of the connection cable of temperature sensors without being electrostatically discharged or grounded.

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

3 Scope of delivery

The scope of delivery of a MS2E synchronous servomotor contains:

- Motor in original package
- Additional type plate
- Safety notes and instructions on use
- Operating instructions
- Protective coverings for output shaft and connection points
- Accompanying papers

On delivery, immediately verify whether the delivered goods are those specified on 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.

The electrical connection is done by means of SpeedCon plug-in connectors. The permissible ambient temperature range is: 0°C ... 40 °C

4 Explosion protection

4.1 Product description

The MS2E03, -04, -05, -06, -07, 10 synchronous servomotors are used for operation with **VPWM** inverters (**V** = voltage DC link inverter) and PWM control methods (**Pulse-Width-Modulation**)(**Versorgung durch Umrichter / For converter operation**). Labeling on the type plate is "**Inverter Duty VPWM**". The motors are certified for gases and dusts.

The ignition protection type for gases, vapors is according to the protection principle "Increased safety" **Ex ec**.

The ignition protection type for dust is according to the protection principle "Protection by housing" **Ex tc**.

The housing design is made of aluminum / aluminum die casting. Cooling is done via heat exchange of the open coolant circuit by temperature difference between housing and surrounding coolant (self-cooling).

The motors can be fitted with an additional holding brake and with a Multiturn or Singleturn encoder.

4.2 ATEX labeling for MS2E motors (gas)

MS2E motors are suited for use in hazardous areas with gas atmosphere according to the following labeling.

Ⓔ II 3G Ex ec IIB T155°C (T3) Gc X

Table 4: ATEX labeling und significance (gas)

Sign	Meaning
Ⓔ	Symbol Ex
II	Equipment group II which is suitable for all potentially explosive areas other than firedamp-endangered excavations
3	Device category 3 means, equipment in this category is intended for use in areas in which explosive atmospheres caused by gases, vapors, fog, dust/air mixtures are unlikely to occur or, if they do occur, are likely to do so only infrequently and for a short period only.
G	G = Gas
Ex	The European standard for explosion protection has been applied.
ec	Ignition protection type "Increased safety" for EPL Gc
IIB	Explosion group
T 155 °C	Maximum surface temperature of the motor
(T3)	Temperature class T3 <200°C
Gc	Device protection level (EPL) classification Gc for advanced safety level for use in potentially gas explosive atmospheres where there is no ignition risk during normal operation or have any additional safety measures which ensure in the event of foreseeable faults/malfunctions no ignition risk exists.
X	Labeling "Special conditions on use"

Explosion protection

4.3 ATEX labeling for MS2E motors (dust)

MS2E motors are suited for use in hazardous areas with gas atmosphere according to the following labeling.

⚠ II 3D Ex tc IIIC T155°C Dc X

Table 5: ATEX labeling und significance (dust)

Sign	Meaning
⚠	Symbol Ex
II	Equipment group II which is suitable for all potentially explosive areas other than firedamp-endangered excavations
3	Device category 3 means, equipment in this category is intended for use in areas in which explosive atmospheres caused by gases, vapors, fog, dust/air mixtures are unlikely to occur or, if they do occur, are likely to do so only rarely and for a short period only.
D	D = dust
Ex	The European standard for explosion protection has been applied.
tc	Ignition protection type "Protection by housing" for EPL Dc
IIIC	Dust group
T 155 °C	Maximum surface temperature of the motor housing
Dc	Device protection level (EPL) classification Dc for advanced safety level for use in potentially flammable atmospheres where there is no ignition risk during normal operation or have any additional safety measures which ensure in the event of foreseeable faults/malfunctions no ignition risk exists.
X	Labeling "Special conditions on use"

4.4 Special conditions on use "X"

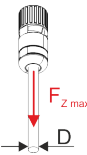
The ATEX designation for MS2E motors, specified in the declaration of conformity and on the type plate, is labeled with an "X" at the end. Please observe the following special conditions for a safe operation of the motors in your construction:

Ambient temperature

Limited ambient temperature area according to EN IEC 60079-0:2018/AC:2020. The allowed area of ambient temperature for MS2E motors is 0 ... 40 °C (with de-rating 0 ... 60 °C ➔ Chapter 9.5 "Derating in case of deviating ambient conditions." on page 42).

Tensile load

Limited values for tensile load according to EN IEC 60079-0:2018/AC:2020. It is not allowed to exceed the specified tensile stress values of the cables connected using connectors. The maximum allowed values are determined in the following context.



$$F_{Z \max} = 20 \text{ [N/mm]} \times D \times 0,25$$

$$F_{Z \max} : D : \frac{[\text{N}]}{[\text{mm}]}$$

Fig. 1: Determination of maximum tensile load of connection cables

$F_{Z \max}$ Tensile load of connection cable (maximum value)

D Cable outer jacket diameter (maximum value)

⚠ WARNING

Danger of explosion due to exalted tensile load of connection cables

Adherence of specified limits.

Mechanical fastening of cable ends (e.g. use cable clamps, ...).

Impact strength

The impact strength of the plug connectors on MS2E motors correspond to a low degree of mechanical danger acc. to EN IEC 60079-0:2018/AC:2020, Tab. 15, line b).

Impact strength of plug connectors

⚠ WARNING

Danger of explosion due to mechanical hazard of plug connectors.

Prevent impact effects on the motors, connectors and cables with higher degree of mechanical danger by additional devices or design changes on the machine.

Provide arrangements to protect the plug-in connector mechanically (e.g. covers, protective plates, ...).

The impact strength of the plug connectors on MS2E motors correspond to a low degree of mechanical danger acc. to EN IEC 60079-0:2018/AC:2020, Tab. 15, line b). Principally, a mechanical hazard can be excluded without using an impact protection cover.

The risk of mechanical endangerment onto the plug-in connectors on motors and cables due to impact from different directions must therefore be evaluated by the user.

The plug-in connectors fulfill the requirements about impact strength according to the following table.

Table 6: Mechanical hazard plug connectors

Plug-in connector	Impact strength of plug-in connectors satisfies low degree of mechanical hazard, in the case of impact from ...		
	Top	Side	Below
M17 ¹	✓	✓	✗
M23 ²	✓	✓	✗
M40 ³	✓	✓	✗

¹ with mounted plug connector protective cover SUP-M02-MS2E

² with mounted plug connector protective cover SUP-M01-MS2E

³ with mounted plug connector protective cover SUP-M03-MS2E

- Avoid possible impact effects on motors, electrical connections and connectors during machine design.
- Do a risk evaluation about mechanical hazard for motors, connectors and cables in the machine due to impacts from different directions.
- If necessary, assemble the plug connector protective covers SUP-M0x-MS2E.
➔ Chapter 8.3.8 “Plug connector protective cover” on page 38

Avoid electrostatic charge resulting in propagating brush discharges

The type plate and the warning labels of MS2E motors are made of plastic foil and limited conducting (disruptive voltage > 4 kV, see EN IEC 60079-0:2018/AC:2020). Follow the instructions below.

⚠ WARNING

Danger of explosion due to propagating brush discharges

Do a risk evaluation about occurrence of highly charge-generating processes with the danger of propagating brush discharges.

Avoid propagating brush discharges or provide measures to avoid propagating brush discharges.

➔ Chapter 2.4.5 “Protection against ignitable electrostatic discharges” on page 11

Maintenance and repair

Maintenance and repair of motors must exclusively be done by the certified Rexroth service.

4.5 Conditions for use of MS2E motors in Equipment Group II, Category 3.

⚠ WARNING

Explosion hazard and danger to life, or substantial property damage!

All used **components and accessory parts** must fulfill the requirements for explosion protection according to the 2014/34/EU directive.

The **conditions on use** given in this documentation must be taken into account for any project planning and be observed during operation.

⚠ WARNING

Risk of personal injury or damage to property due to disconnecting or connecting live plug connections!

- Only disconnect or connect plug connections when they are dry, clean and de-energized.
- During operation of the system, all plug connections must be firmly locked or screwed tight.

4.5.1 Maximum housing temperature

In the case of intended use, the maximum housing temperature is significantly below 155 °C. Observe external heat and cooling sources when determining the operation temperature. Project-specific electrical/thermal evaluations must be carried out by the customer if they deviate from the Bosch Rexroth specification. If necessary, project-specific metrological verifications are required that reflect the actual ambient conditions at the place of use.

4.5.2 Connection conditions

The motors can be operated with Rexroth controllers (ctrlX / IndraDrive). In the case of using drive controllers of other manufacturers, the following special conditions must be fulfilled ➔ Chapter 9.6 “Operation on foreign converters” on page 44.

4.5.3 Plug-in connectors

Make sure the environment is dry and clean when connecting or disconnecting connectors.

Ignition sparks can occur, when motor connectors are disconnected or connected under load.

4.5.4 Ground conductor

The motors must be grounded via a motor cable and via a second separate ground conductor with minimum **4 mm²** cross section. Check the proper installation of the protective and ground conductor connection before startup.

- Protective conductor motor cable
- Ground conductor see ➔ Chapter 8.3.5 “Ground connection” on page 37

The redundant protective conductor installation ensures a safe drain of occurring discharge currents even in error case (e.g. at interrupted protective conductor).

4.5.5 Corrosion

Prevent motor corrosion which can occur due to aggressive substances like certain coolants and lubricants as well as cutting oils or salt mist.

4.5.6 Switch-off

Energies stored in the intermediate circuit have to be reduced or insulated as soon as possible through the activation of the emergency stop device, so that in the case of a failure the risk of an effect into the danger zone is reduced (ATEX directive 2014/34/EU).

For example, this can be achieved as follows:

- Reduce the energy via an intermediate short circuit. For information about functionality and availability, refer to the documentation of the control device; when using third-party inverters, contact the manufacturer.
- Isolation of the energies before they are transferred into the potentially explosive atmosphere by isolating the voltage of the lines and motors present in the potentially explosive atmosphere.

4.5.7 Holding brake

Use the optional holding brake in **normal operation** only in standstill time.

Malfuction

Only in an **event of fault**, i.e. in the case of a fault in the system, may the brake be activated when the motor is turning, e.g. in order to prevent a dangerous lowering of vertical axes. In this case, sparks may be generated in the brake and increased temperatures may occur within the motor. When a fault occurs, the operator must eliminate it immediately.

Functional test

Before commissioning and when operating the motor periodically, the functions of the brake are to be tested with a suitable braking test according to the risk analysis of the plant operator. Further information and data can be found in the respective functional descriptions of the drive controller firmware.

For further general notes about holding brakes see ➔ [Chapter 6.2.8 "Holding brake"](#) on page 26.

4.5.8 Acceptance test

Before initial start-up of the system or after changing a motor, check your installation with regard to the directives according to

EN IEC 60079-0:2018/AC:2020. The acceptance report must confirm compliance with the instructions and conditions of use given here.

4.5.9 Residual risks

The existing residual risks are to be observed by the user, when the installation is designed.

- Overstress
 - When the motor is overloaded, including cases where errors in the mechanical or electrical equipment of the machine cause such overloading, high temperatures may occur that result in explosion hazards.
- Operation in explosive dust atmosphere.
 - An operation in explosive dust-atmosphere can build a layer on the motor during a residence time, which does no longer ensure a sufficient motor cooling.
- Grounding and discharge currents
 - Variable-speed drive systems cause unavoidable discharge currents. Please observe a proper installation of protective conductor and potential equalization line. In the case of interrupted protective conductor and potential equalization line due to occurring error cases during operation or faulty connections can raise sparks on transition points.
- Temperature control
 - The failure of the single-channel temperature monitor in the device system may occur, as the result of an error, and might not be detected, even if the motor is operated within the normal temperature range and load cycle.

5 Identification

5.1 Type plate

The type plate contains all essential electrical data, the serial number, date of manufacture, mark of conformity as well as the information provided by the manufacturer.



Fig. 2: Type plate MS2E (example)

Table 7: Type plate specification MS2E

Symbol	Meaning
TYPE	Motor type
SN	Serial number
P(N)	Rated power - 60K
I(N)	Rated current - 60K
n(N)	Rated speed - 60K
M(0)	Standstill torque - 60K
I(0)	Standstill current - 60K
Ex	ATEX labeling explosion protection (gas)
Ex	ATEX labeling explosion protection (dust)
Brake	Holding brake data (optional)
FD	Manufacturing date
n(max)	Maximum speed
U(max)	Maximum voltage UL
IP65	Degree of protection IPxx
m	Mass
T.CL.	Thermal class
I.SY.	Insulation system identification
SI	Use in systems for "Integrated Safety Technology" prepared

The following marks of conformity are used:

Table 8: Meaning of marks of conformity

Certification mark	Meaning
	The UL Recognized Component Mark (UL recognized) identifies recognized component parts which are components of a bigger product or system. The recognition relates on Standards UL 1004-1 „Rotating electrical machines –General requirements“, UL 1004-6 „Servo and stepper motors“, CSA C22.2 No. 100 „Motors and generators“.
	The CE-marking confirms the conformity of a product according to the declaration of conformity.
	The UKCA-marking confirms the conformity of a product with relevant regulations.
	Motors labelled with the symbol EFUP 25 (environmental-friendly use period) can be used for 25 years as intended before substances limited in their concentration according to China RoHS2 may leak and subsequently pose a risk to environment and health.

5.2 Type code

The type code is printed onto the type plate of the motor. For the meaning of the type code refer to the following details.

Type codes, meaning of the digits												
MS2E06 - C0BRN - CMSG1 - NNNNN - NN												
1	3	5	7	9	11	13	15	17				
		2	4	6	8	10	12	14	16			
1	Product											
2	Frame size											
3	Frame length											
4	Characteristics of moment of inertia of the rotor											
5	Winding code											
6	Cooling											
7	Encoder performance											
8	Encoder design											
9	Electrical connection											
10	Shaft											
11	Holding brake											
12	Flange exactness											
13	Bearings											

Type codes, meaning of the digits	
14	Frame size
15	Coating
16	Other design
17	Special design

6 About this product

6.1 Safety instructions on the product

Please note the safety and prohibitive sign on the motor. The sign significance is explained in the following.

Table 9: Safety instructions on the product

Information	Meaning
	Hot surfaces with temperatures over 60 °C may cause burns Let the motors cool down before working on the motors or in close proximity to the motors. The thermal time constant stated in the technical data is a measure for the cooling time. Cooling down can require up to 140 minutes. - Wear safety gloves. - Do not work on hot surfaces.
	Motor damage due to strikes onto the motor shaft Do not strike the shaft end and do not exceed the allowed axial and radial forces of the motor.

 **WARNING**

RISK OF EXPLOSION!

- DO NOT SEPARATE WHEN ENERGIZED
- POTENTIAL ELECTROSTATIC CHARGING HAZARD - SEE INSTRUCTIONS
- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT
- Motor cables must have a minimum temperature stability of 80 °C (176 °F)

 **WARNING**

Explosion hazard!

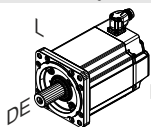
- NEVER DISCONNECT PLUG CONNECTORS UNDER LOAD
- DANGER DUE TO ELECTROSTATIC DISCHARGES - SEE OPERATING INSTRUCTIONS
- DO NOT OPEN INSIDE A POTENTIALLY EXPLOSIVE ATMOSPHERE
- Use motor cables with a thermal stability of at least 80 °C (176 °F)

About this product

6.2 Features and functions

6.2.1 Basic data

Product	3~ PM motor
Type	MS2E
Ambient temperature during operation	0 ... 40 °C (without de-rating)
Type of protection	IP65 with shaft sealing ring (EN 60529:1991 + A1:2000 + A2:2013)
Cooling mode	IC410, Self-cooling (EN 60034-6:1993)
Motor design	IM B5 (EN 60034-7:1993 + A1:2001)
Coating	Varnish RAL 9005
Flange	similar to DIN 42948:1965-11
Shaft end	Cylindrical (DIN 748-3), centering hole with thread "DS" (DIN 332-2:1983-05), With keyway (half key balancing according to ISO 21940-32:2012)
Concentricity, run-out, alignment	Standard tolerance N (DIN 42955:1981-12)
Oscillating quantity level	Level A (EN 60079-14:2014) up to rated speed
Installation altitude	0 ... 1,000 m above MSL (without derating)
Sound pressure level	MS2E03 ... MS2E10: 75 dB(A) +3 dB(A)
Thermal class	155 (F) (EN 60034-1)
Encoder system	Advanced Performance ACURO®link Optical absolute value encoder 20 bit, digital in single or multiturn variant High performance ACURO®link Optical absolute value encoder 24 bit, digital in Single- or Multiturn design
Electrical connection	M23 Single cable connection , (rotatable, quick lock SPEEDCON®) Double cable connection (only MS2E10) with M40 Power connectors (rotatable, quick lock SPEEDCON®) Encoder connector M17 (rotatable, quick lock SPEEDCON®)
Holding brake (option)	Electrically released U _N 24V DC (±10%)
Motor ends	



Drive End, A-side
Non Drive End, B-side
Left
Right

Remark: In the case of special design, details named in the operating instructions can deviate. In this case, order the supplementary documentation.

6.2.2 Mechanical interfaces

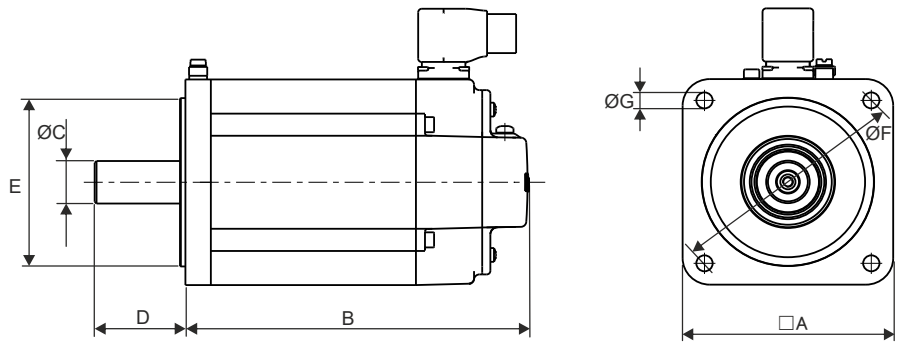


Table 10: Mechanical interface flange, shaft

Type	A Flange [mm]	B Length [mm]	C Shaft Ø [mm]	D Shaft length [mm]	E Centering collar [mm]	F Hole circle [mm]	G Mounting holes [mm]
MS2E03-B	58	*)	9	20	40	63	4.5
MS2E03-D	58	*)	11	23	40	63	4.5
MS2E04	82	*)	14	30	50	95	6.6
MS2E05	98	*)	19	40	95	115	9
MS2E06	116	*)	24	50	95	130	9
MS2E07	140	*)	32	58	130	165	11
MS2E10	196	*)	38	80	180	215	14
*) see specifications							

Table 11: Tightening torque of mounting screws

Screw	M4	M6	M8	M10	M12	M14
Mounting holes $\varnothing$ [mm]	4.5	6.6	9	11	14	18
Tightening torque M_A [Nm] at $\mu_K = 0.12$	3.0	10.1	24.6	48	84	206
Washer DIN EN ISO 28738	-	-	yes	yes	yes	yes

- Use specified screws and washers for fastening the motors.
- Tighten the screws with the specified torque.

6.2.3 Thermal motor protection

The motor temperature is monitored by two systems that are operated independently of each other. The mounted **temperature sensor** and the drive-internal **temperature model** ensure the best protection of motors against thermal overload.

The threshold values for motor temperature monitoring are contained in the encoder data memory and are read in and monitored automatically during the operation with Rexroth controllers. Threshold values for MS2E motors are:

- Motor-warning temperature (125°C)
- Motor-disconnection temperature (130°C)

Table 12: MS2E temperature sensor

Motor	Temperature sensor
MS2EXX-XXXXX-XXXX-XXNXX-XX	PT1000

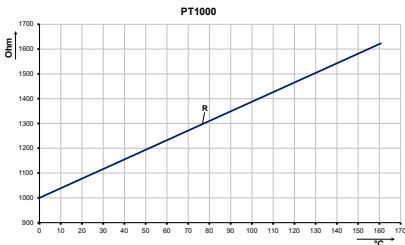


Fig. 3: Characteristic curve PT1000

In case of motors with digital encoder (E/F), the resistance values are transmitted digitally via the encoder interface (cyclic communication).

6.2.4 Cooling mode

Self-cooling (IC410)

In case of self-cooling motors, the heat dissipation is realized via natural convection and radiation to the ambient air as well as by heat conduction to the machine construction.

The specified nominal data is reached at ambient temperatures of up to 40 °C. Unhindered vertical convection has to be ensured by a sufficient distance of 100 mm to adjacent components. Any usage at increased ambient temperature (0 ... 60°C) is possible. Please note the details in ➔ [Chapter 9.5 “Derating in case of deviating ambient conditions.”](#) on page 42.

Pollution of the surface of the motor reduces heat dissipation and can result in thermal overload. The availability of the system can be increased by regular checks and cleaning of the motors. Please ensure access to the motors for maintenance purposes.

6.2.5 Encoder

ADVANCED-Encoder “ **Cx** ” use an optical sampling method. Data output of process and parameter data (electronic type plate) happens digitally via ACURO®link-Protocol. The encoder “ **Cx** ” fulfills the specification for safety technique according to SIL 2 and PL d. Temperature signals are transmitted digitally via the encoder interface.

HIGH-Encoder “ **Dx** ” uses an optical sampling method. Data output of process and parameter data (electronic type plate) happens digitally via ACURO®link-Protocol. The encoder “ **Dx** ” fulfill the specifications for safety technique according to SIL 3 and PL e. Temperature signals are transmitted digitally via the encoder interface.

The singleturn design allows absolute, indirect position recording within one mechanical motor rotation.

The multiturn design allows absolute, indirect position recording within 4096 mechanical motor rotations.

Technical data of encoder

Table 13: Technical data of encoder

Designation	Symbol	Unit	Encoder			
			CM	CS	DM	DS
Encoder interface	-	-	ACURO®link			
Functional encoder resolution (singleturn)	-	-	20 bit		24 bit	
Distinguishable rotations	U_{turn}	-	4096	1	4096	1
System accuracy of encoder ¹	✱	"	± 36		± 20	
System accuracy typical/maximum ²⁾	✱	"	± 50 / ± 70		± 20 / ± 30	
Encoder voltage supply	VCC Encoder	V	7...12			
Encoder max. current consumption	I Encoder	mA	60		130	
Functional safety						
Safety integrity level		-	SIL 2		SIL 3	
Performance level		-	PL d		PL e	

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1) The installation mechanics can sporadically influence the accuracy of the overall system.

2) Reachable overall system accuracy by taking the installation mechanics into consideration, typical and maximum value.

For additional notes about integrated safety technique and prerequisites for using motors with encoder systems for using safety technique with IndraDrive refer to **Rexroth IndraDrive Integrated Safety Technology "Safe Motion" DOK-INDRV*-SI3*SMO-VRS-APxx-xx-P**.

6.2.6 Degree of protection

The protection type according to EN 60529:1991 + A1:2000 + A2:2013 is determined by the abbreviation IP (International Protection) and two code numbers for the degree of protection. The first reference number stands for the degree of protection against contact and ingress of foreign bodies, the second one stands for the degree of protection against ingress of water.

Standard motors (specification according to type plate)

- IP65 with shaft sealing ring

6.2.7 Output shaft, balancing and extension elements

Shaft end

Table 14: Options according to type code

Shaft	Type
Smooth, with shaft sealing ring	G

Shaft	Type
Keyway, with shaft sealing ring	K

Smooth shaft

Cylindrical shaft end according to DIN 748-3 with frontal centering hole with "DS" thread according to DIN 332-2.

The standard design for a non-positive shaft-hub connection without play and excellent smooth running. Use clamping sets, pressure sleeves or clamping elements for coupling the machine elements to be driven.

Shaft with keyway

Cylindrical shaft end according to DIN 748-3 with frontal centering hole with "DS" thread according to DIN 332-2 and keyway.

The keyway design allows form-locking transmission of torques with constant direction and low requirements on the shaft-hub connection.

The machine elements to be driven have to be secured in axial direction via the centering hole.

Table 15: Keyway and centering holes

Type	Key DIN 6885-A	Centering hole DIN 332 Part 2
MS2E03-B	3×3×14	DS M3
MS2E03-D	4×4×16	DS M4
MS2E04	5×5×20	DS M5
MS2E05	6×6×32	DS M6
MS2E06	8×7×40	DS M8
MS2E07	10×8×45	DS M10
MS2E10	10×8×70	DS M12

 **Remark:** Keys are not included in the scope of delivery.

We recommend regular visual inspections on shaft sealing rings. Depending on operating conditions, signs of wear may appear after 5,000 operating hours. If necessary, replace the shaft sealing rings.

 **Remark:** We recommend to have these repairs made by Bosch Rexroth Service.

Balancing

MS2E motors with key are balanced with “half key”. Half key balancing according to DIN ISO 21940-32.

The balancing type is specified at the shaft front end with “H” for half key balancing.

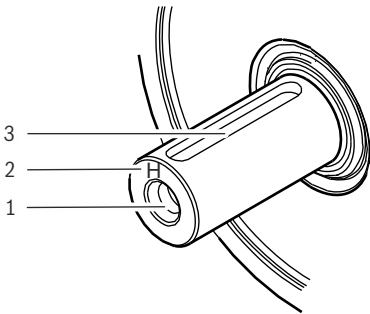


Fig. 4: Shaft end

- 1 Centering hole
- 2 Labeling balancing
- 3 Keyway

Attachment of drive elements

Observe the notes about mounting drive elements.

Explosion protection

When mounting drive elements, check their suitability and keep the ATEX directives during operation. Selecting of all mounting components underlies the sole responsibility of the plant manufacturer or operator.

 WARNING

Explosion hazard and danger to life, or substantial property damage!

The totality of a motor-machine combination must comply with the specifications for explosion protection according to Directive 2014/34/EU.

Please observe the notes within the product documentation of the used components when projecting and during operation.

Gearboxes with approvals for use in hazardous areas according to Directive 2014/34/EU for the attachment to MS2E motors are delivered by Rexroth neither separately nor mounted on motors.

⚠ CAUTION

Ingressing fluid may damage the motor!

Fluids (e.g., cooling lubricants, gear oil, etc.) may not be present at the output shaft.

When attaching gearboxes, only use gearboxes with a closed (oil-tight) lubrication system. Gearbox oil should not be in permanent contact with the shaft sealing ring of the motors.

- a shift in the position of the axis, if the driving pinions are not axially fixed on the machine side.
- a thermally dependent component of the axial force, if the driving pinions are axially fixed on the machine side. This causes the risk of exceeding the maximum permissible axial force or of the gear backlash increasing to an impermissible degree.
- Damage of the NDE bearing by exceeding the maximum permissible axial force.

Remark: It is recommended to use drive elements with integrated bearings and mount them on the motor shaft via axially compensating couplings.

Overdetermined bearing

When installing drive elements, avoid overdetermined bearing as impermissibly high bearing reactions can be generated due to unfavorable tolerance ratios.

Remark: If overdetermined arrangement of bearings cannot be avoided, please contact Bosch Rexroth.

Couplings

The machine construction and the drive elements used must be carefully adapted to the motor type so as to make sure that the load limits of the shaft and the bearing are not exceeded.

Remark: When extremely stiff couplings are attached, the revolving radial force may cause an impermissibly high load on the shaft and bearing.

Bevel gear pinion or helical drive pinion

Due to thermal expansion, the DE side of the drive shaft can be displaced by up to 0.6 mm in relation to the motor housing. If helical drive pinions or bevel gear pinions directly attached to the output shaft are used, this change in the lengths will lead to

6.2.8 Holding brake

⚠ WARNING

Danger to life or high damage to property, ignition and explosion hazard due to inappropriate use!

In order to prevent danger due to ignitable gases or explosive dust-air mixtures in the vicinity of the motors, the user must make sure that the holding brake does not present a source of ignition in the normal service. For this reason, the holding brake must never be used outside the design parameters and operating conditions!

- Any commissioning and maintenance works must only be carried out in non-explosive environments.
- The brakes must be designed so as to fulfill their function in normal service, if they are installed and used as intended.
- The holding brake integrated in the motor must only be used at standstill and never as EMERGENCY STOP brake to stop the motor, see P-0-0119, Optimal shutdown (Indra-Drive firmware - functional description).
- The holding brake must not be used to brake or stop the motor or coupled loads from higher speeds or velocities.

MS2E motors can optionally be provided with permanent magnet brakes. The backlash-free holding brakes are operated according to the “electrically-released” principle (closed-circuit principle) and open upon applying the switching voltage.

- Number of operating cycles $\geq 5,000,000$
- The holding brakes with emergency stop function are intended to secure motor shafts at standstill (normal operation). **The holding brakes are no operation brakes to decelerate motors in operation from speed.**
- Emergency stop situations are not a normal operation.
- In case of an emergency stop or voltage drop, the brake operation is only allowed to a limited extend. Up to 500 breaking cycles from speed 3000 1/min can be performed, whereas the maximum switched energy per emergency stop of the brake must not be exceeded. The number of brake applications per hour is 20, whereas a uniform scheduling is a precondition. For specifications about the max. switched energy per emergency stop, see ➔ Chapter “Technical data holding brakes” on page 28
- Idle time after an emergency stop before restarting ≥ 3 minutes.

⚠ CAUTION

Malfunctions due to wear

Impermissibly high wear due to breaking from speed by exceeding the specified emergency stop properties.

Ensure the functionality of the brake in normal operation, due to voltage control, current monitoring, cyclic control of the brake holding torque, for example.

The rated voltage to apply the brakes is 24VDC $\pm$ 10%.

The voltage supply of the holding brake has to be designed so as to guarantee under the worst installation and operation conditions that a sufficient voltage **24VDC $\pm$ 10%** is available at the motor in order to release the holding brake.

The voltage drop ΔU on the brake supply can approximately be calculated for copper conductors using the following formula:

$$\Delta U = \rho_{Cu} \cdot \left(\frac{2 \cdot l}{q} \right) \cdot I_N$$

Fig. 5: Voltage drop of brake supply for Cu (copper) conductor

ΔU Voltage drop [V]

ρ_{Cu} Specific resistance of copper [$\Omega \cdot \text{mm}^2/\text{m}$]

l Cable length [m]

q Conductor cross-section [mm^2]

I_N Rated current [A]

⚠ CAUTION

Malfunction in case of exceeded tolerance of the rated voltage (switching voltage)

For safe switching of the holding brake, a rated voltage of **24 V DC $\pm$ 10%** is required at the motor.

Ensure correct dimensioning of the supply wires (wire length and cross-section) for the holding brake.

The control voltage can be reduced using the energy saving function after safely releasing the brake, see ➔ Chapter “Energy saving function for holding brakes” on page 29.

The holding brake in the motor is intended for direct connection to the IndraDrive controller.

The protective circuit for switching holding brakes (inductive load) is not integrated in the MS2E motors; in Bosch Rexroth drive systems it is integrated in the control units.

Technical data holding brakes

Table 16: Technical data holding brakes

Type	Holding torque	Dynamic braking torque	Rated voltage ¹⁾	Rated current	Maximum connection time	Maximum disconnection time	Maximum switched energy
	M_4	M_1	U_N	I_N	t_1	t_2	W_{max}
	Nm	Nm	V	A	ms	ms	J
MS2E03-B _ _ _ 1- _ _ _	1.80	1.3	24	0.46	8	35	300
MS2E03-D _ _ _ 1- _ _ _	1.80	1.3	24	0.46	8	35	300
MS2E04-B _ _ _ 1- _ _ _	5.00	4.5	24	0.63	30	45	400
MS2E04-C _ _ _ 1- _ _ _	5.00	4.5	24	0.63	30	45	400
MS2E05-B _ _ _ 1- _ _ _	10.00	4.5	24	0.73	30	80	400
MS2E05-C _ _ _ 1- _ _ _	10.00	4.5	24	0.73	30	80	400
MS2E05-D _ _ _ 1- _ _ _	10.00	4.5	24	0.73	30	80	400
MS2E06-C _ _ _ 1- _ _ _	10.00	4.5	24	0.73	30	80	400
MS2E06-D _ _ _ 2- _ _ _	15.00	11	24	0.75	50	135	888
MS2E06-E _ _ _ 2- _ _ _	15.00	11	24	0.75	50	135	888
MS2E07-C _ _ _ 1- _ _ _	20.00	12.5	24	0.78	40	100	340
MS2E07-D _ _ _ 2- _ _ _	36.00	16.5	24	0.94	60	200	850
MS2E07-E _ _ _ 2- _ _ _	36.00	16.5	24	0.94	60	200	850
MS2E10-C _ _ _ 2- _ _ _	53.00	23	24	1.00	70	220	850
MS2E10-D _ _ _ 2- _ _ _	53.00	23	24	1.00	70	220	850
MS2E10-E _ _ _ 3- _ _ _	90.00	33	24	1.50	65	250	1470

1) Tolerance $\pm 10\%$

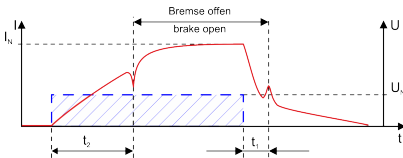


Fig. 6: Switching times of static hold mode

t_1 Connection time (close)
 t_2 Disconnection time (open)

Sizing holding brakes

Static sizing

Check the load torque (M_6) with the available holding torque (M_4). The load torque has to be smaller than the holding torque. In case of unsafe assumed load, use a sufficient safety factor.

$$M_4 \geq S \cdot M_6$$

Fig. 7: Static load torque

M_4 Brake torque [Nm]
 M_6 Load torque [Nm]
 S Safety factor

Dynamic sizing if emergency stop

In case of an emergency stop, the load torque (M_6) has to be smaller than the minimum dynamic torque (M_1) of the brake. Otherwise the dynamic brake torque is not sufficient to set the axis to standstill.

$$M_1 \geq S \cdot M_6$$

Fig. 8: Dynamic load torque

M_1 Dynamic torque [Nm]
 M_6 Load torque [Nm]
 S Safety factor

If a mass has to be decelerated within a specified time or after a certain distance, the additional mass moment of inertia of the complete system (J_{ges}) has to be taken into consideration.

$$t_{Br} = \frac{J_{ges} \cdot n}{9,55 \cdot (M_1 \pm M_6)}$$

Fig. 9: Shutdown time

t_{Br} Deceleration time [s]
 n Nominal speed [1/min]
 M_1 Dynamic torque [Nm]
 M_6 Load torque [Nm]
 J_{ges} Moment of inertia of complete system [kgm²]
 J_{rot} Moment of inertia of motor [kgm²]
 J_{fremd} External inertia [kgm²]

The specified formula refers to idealized, linear correlations and can thus only be used for estimation purposes. A load torque M_6 inhibiting the brake application is displayed with “-”, a brake application supporting the load torque M_6 is displayed with “+”.

Thermal dimensioning

The brake can be thermally overexerted due to multiple repetitive brake applications (breaking capacity).

$$W_{max} > \frac{M_1}{M_1 - M_6} \cdot \frac{J_{ges} \cdot n^2}{182,5}$$

Fig. 10: Maximum switched energy

W_{max} Maximum switched energy [J]
 n Nominal speed [1/min]
 M_1 Dynamic torque [Nm]
 M_6 Load torque [Nm]
 J_{ges} Moment of inertia of complete system [kgm²]

Energy saving function for holding brakes

Decrease brake voltage

The control voltage of the holding brake in MS2E holding brakes can be reduced after executing the switching operation “Open brake” by using control modules (e.g. brake control module HAT02.1-003). By decreasing the control voltage, energy can be saved of up to 50% and the self-heating of the motor can be reduced.

To decrease the control voltage of MS2E holding brakes, the following conditions apply:

- Maximum decrease of control voltage to $U_N \geq 17$ V DC at the motor.
- Waiting time after releasing the holding brake is at least 200 ms
- Decreasing the control voltage by voltage control or pulse width modulation with a PWM cycle frequency ≥ 4 kHz
- Ensure the functionality of the holding brake.

Remark: Refer to the instructions in the control module documentation.

Refer to the notes for dimensioning of the cable length and cable cross-section of brake cables.

Safety and personal protection

The permanent magnet brake of MS2E motors is no safety brake. This means, a torque reduction by non-influenceable disturbance factors can occur. Especially for use in vertical axes.

⚠ WARNING**Grievous bodily harm due to dangerous movements from falling or dropping axes!**

Secure vertical axes against dropping or sinking after switching off by e.g.:

- Mechanical locking of the vertical axis
- External brake, arrestor, clamping device.
- Weight compensation of the axes

The holding brake itself is not suitable for personal protection. Ensure protection of persons by superordinate fail-safe measures, like block danger zones via safety fences.

For European countries, additionally comply with the following standards and guidelines, e.g.

- EN ISO 13849-1:2015 "Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2015)" and EN ISO 13849-2:2012 "Safety of machinery. Safety-related parts of control systems. General principles for design"
- Information sheet no. 005 "Gravity-loaded axes (vertical axes)" published by: DGUV Fachbereich Holz und Metall (German Employer's Liability Insurance Association Wood and Metal)

Determine the complete safety requirements valid for the specific case of application and observe them during plant design. Comply with all applicable national regulations!

Functionality test**⚠ WARNING****Danger of explosion at maintenance work and check operation**

Do maintenance work only outside of hazardous areas.

Ensure that no hazardous gas or dust atmosphere exists during grind in procedures.

That is why the function and the holding brakes have to be checked in regular intervals and malfunctions must be removed in an appropriate period.

The braking effect can be reduced by:

- Corrosion on friction surfaces, vapor and sediment
- Over voltages and too high temperatures
- Wear (increasing the air gap between armature and pole)

The holding brake functionality can be checked mechanically by hand or automatically by means of the software function.

Manually check holding torque (M4)

- 1.** ➤ De-energize the motor and ensure it cannot be restarted.
- 2.** ➤ Measure the transferable holding torque (M4) of the holding brake with a torque wrench.

Check holding torque (M4) using the software function

For Bosch Rexroth drive controller

- Start the P-0-0541, C2100 Command Holding system check in drive controller. The efficiency of the holding brake and the opened state are checked by starting the routine.

- If the holding torque (M4) is **not achieved**, the resurfacing routine can be used to reconstitute the holding torque. If you have any questions about grind in parameters, contact Bosch Rexroth service.

6.2.9 Vibration behavior

The oscillation behavior corresponds to oscillating quantity level A according to EN IEC 60034-14:2018 up to the rated speed.

6.2.10 Bearing

The motors are equipped with a deep-groove ball bearing with high-temperature grease for prelubrication.

Table 17: Bearing size MS2E

Type	Bearing size DE	Bearing size NDE	Floating bearing	Fixed bearing
MS2E03	6001	6000	DE	NDE
MS2E04	6003	6001	DE	NDE
MS2E05	6204	6303	DE	NDE
MS2E06	6206	6303	DE	NDE
MS2E07	6207	6205	DE	NDE
MS2E10	6308	6306	DE	NDE

Bearing service life

The bearing lifetime is an important criterion for the availability of motors. The operating conditions influence the bearing service life L_{10h} considerably.

The following boundary conditions apply to the bearing service life L_{10h} :

- Operation within the specified permissible loads (radial and axial force)
- Operation within the permissible ambient conditions (temperature range 0 ... 40 °C, vibration, and so on)
- Operation within the thermally permissible operating characteristic curve

The bearing lifetime also depends on the service life of the grease. A calculated grease service life was used for the mentioned specifications, taking into consideration the following boundary conditions.

- Horizontal installation
- Low vibration and impact loads
- No oscillating bearing movement < 180°
- Mean speed ➔ Table 18 "Mean speed - basis of calculated grease service life" on page 31

Table 18: Mean speed - basis of calculated grease service life

Type	Mean speed
MS2E03, -04, -05, -06	≤ 3500 1/min

Type	Mean speed
MS2E07	≤ 3000 1/min
MS2E10	≤ 2000 1/min

The following standard values apply under the specified preconditions:

$L_{10h} = 30.000$ h, in case of utilization after S1-60K and max. load factor 95% during the runtime.

⚠ When exceeding or not complying with these conditions, a reduced service life is to be expected.

Explanation of radial and axial force

During operation, both radial and axial forces act upon the motor shaft and the motor bearing. The permissible radial force F_R in distance x from the shaft shoulder and the mean speed is specified in the radial force diagrams.

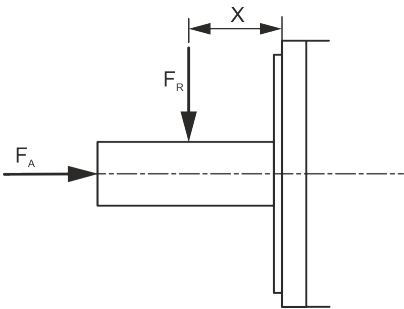


Fig. 11: Point of action of radial force F_R and axial force F_A

The axial force values are the minimum permissible axial forces F_A without limitations. A detailed dimensioning is only possible if more boundary conditions are known:

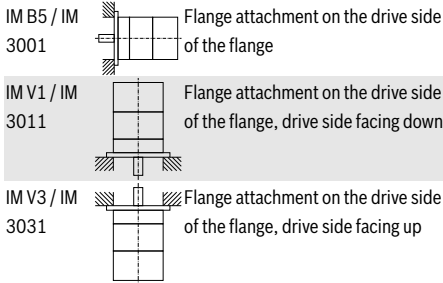
- Axial and radial force with force application point
- Installation position (horizontal, vertical with the shaft end pointing to the top or bottom)
- Mean speed

For radial force diagrams, refer to the technical data

6.2.11 Frame size, installation type

The motors can be installed horizontally and vertically with the shaft end pointing to the top or bottom. The mounting variants comply with the IM code according to EN 60034-7:1993 + A1:2001 for design and installation type.

Code I / Code II (EN 60034-7:1993 + A1:2001)



Avoid liquid at the drive shaft or the shaft sealing ring in case of vertical installation according to IM V3.

6.2.12 Coating

One-layer standard varnish (1K), waterbased, in conductive form, RAL9005 jet black, nominal thickness 40 µm.

⚠ WARNING

Danger of explosion due to improper change of the surface characteristics.

An additional varnish on motors for hazardous areas is not allowed in order not to negatively influence the surface characteristics (like e.g. insulation resistance, electrostatic charging).

6.2.13 Noise emission

The typical sound pressure level $L_p(A)$ is specified for the speed range 0 rpm up to the rated speed. The installation situation affects the noise emission.

🔊 Noise reduction by switching the PWM frequency: Noise can occur even at low frequency or speed. The excitation of the motor natural frequency by the PWM standard frequency of 4kHz is speed-dependent and the larger the motor, the higher the speed at which the noise occurs. By changing the PWM frequency of the control unit to 8 kHz, the excitation of motor natural frequencies can be prevented if required.

If necessary, use the setting options on the control unit.

IndraDrive Parameter P-0-0062 "Switching speed for speed-dependent PWM switching" is available from firmware versions MPx-20V17. The default value of the parameter is 0.

ctrlX:CAN parameter inverter power section: Velocity-dependent PWM switching 0x2120:04 P-0-0062

7 Transport and storage

7.1 Storage

Store the motors in their original packaging in a dry, dust-free, vibration-free and light-protected place without direct solar radiation. Please observe classes 1K21, 1B1, 1C1, 1S10, 1M11 specified for storage acc. to DIN EN 60721-3-1.

Deviations and enhancements according to the following table must be observed.

Table 19: Deviations and enhancements of classification (DIN EN IEC 60721-3-1)

Bearing	
Ambient temperature	-25 ... +55 °C
Relative air humidity	5 ... 75 %
Absolute air humidity	1 ... 29 g/m³
Direct solar radiation	Not permitted
Shock load	➔ Chapter 7.3 "Shock load during transport und storage" on page 34

NOTICE

Damage due to moisture and humidity!

- Protect the products from dampness and corrosion.
- Store them only in rainproof and dry rooms.

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. Warranty extension is not a consequence.

Table 20: Measures before commissioning motors that have been stored over a prolonged period of time

Storage time / months	Measures for commissioning
> 1 > 12 > 60	• Visual inspection of all parts to be damage-free • Resurface the holding brake • Check the electric contacts to verify that they are free from corrosion • Let the motor run in without load for one hour at 800 ... 1000 rpm. • Measure insulation resistance. Dry the winding at a value of < 1kOhm per volt rated voltage. • Replace bearings • Replace encoder

7.2 Transport

The motors must be transported in their original package taking classes 2K11, 2B1, 2C1, 2S5, 2M4 specified acc. to DIN EN 60721-3-2 into account.

Deviations and enhancements according to the follwing table must be observed.

Table 21: Deviations and enhancements of classification (DIN EN IEC 60721-3-2)

Transport	
Ambient temperature	-25 ... +70 °C
Relative humidity	5 ... 75 %

Transport	
Shock load	➔ Chapter 7.3 "Shock load during transport und storage " on page 34

Instructions on transport by air

If motor components with permanent magnets are shipped by air, the DGR (Dangerous Goods Regulations) of the IATA (International Air Transport Association) for hazardous materials of class 9 which also include magnetized substances and objects has to be complied with. 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 (see chapter 3.9.2.2).

7.2.1 Instructions on machine transport

NOTICE

Never touch the connection points of electrostatic sensitive devices!

- Mounted components (e.g. temperature sensors, encoder) can contain parts susceptible to electrical discharge. Observe the ESD safety measures.

⚠ WARNING

Risk of injury and material damage due to improper handling during transport!

- Only use hoisting gear suited for the weight of the motors. Use lifting sling belts or lifting eye bolts. Secure the lifting eye bolts before use.
Never walk under hanging loads.
- Do not lift the motor at the shaft or on the optional fan housing.
- Use suitable protective equipment and protective clothing during transport, and wear safety shoes.

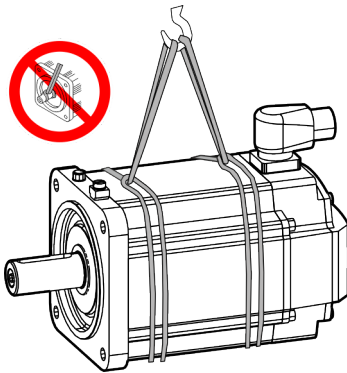


Fig. 12: Lifting and transporting motors

- Before transporting the motor, determine the weight of the motor. For more details about motor weight, please refer to the type plate or the project planning manual (Technical data).
- Adjust the carrying capacity of the lifting device to the motor weight.
- If provided by the manufacturer, all lifting eye bolts must be used and tightened before use.
- Avoid increased transport vibrations.
- Remove any existing transport locks prior to commissioning and keep them.

7.3 Shock load during transport and storage

Function-impairing effects are avoided as long as the specified limits are complied with.

Table 22: Permissible shock load for MS2E motors

Frame size	Maximum allowed shock load (11 ms)	
	Axial	radial
MS2E03, -04, -05	100 m/s ²	1,000 m/s ²
MS2E06	100 m/s ²	500 m/s ²
MS2E07	100 m/s ²	300 m/s ²
MS2E10	100 m/s ²	200 m/s ²

8 Assembly

8.1 Flange assembly

NOTICE

Motor damage due to ingress of liquids!

Liquid which exists over a longer period on the shaft sealing ring of the output shaft can ingress into the motor and cause damage.

- Ensure that liquid cannot be present at the output shaft.
- Do not mount any open gearboxes (gearboxes that are not hermetically sealed).

Use all motor mounting holes to mount the motor safely to the machine. For details on mounting holes, please refer to the dimension sheets.

- If coupling is direct, ensure that the support is plane and the orientation is precise.
- Avoid pinching or jamming the centering collar on the motor side.
- Avoid damaging the receptacle fit on the plant side.
- Use screws and washers for flange fastening → Chapter 6.2.2 “Mechanical interfaces” on page 21.

8.2 Assemble transmission elements

NOTICE

Motor damage due to strikes onto the motor shaft

Do not strike the shaft end and do not exceed the allowed axial and radial forces of the motor.



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

- Avoid inadmissible belt tensions. Please consider the allowed radial and axial forces in the project planning manuals.
- The balancing state of transmission elements must comply with the full-key balancing of the motors.

Fitting

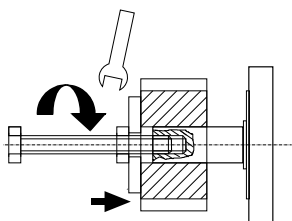


Fig. 13: Fitting the transmission element

- Use the centering hole for fitting transmission elements. For details on centering holes, please refer to the specifications.
- Heat the transmission element, if necessary.

8.3 Electrical connection

8.3.1 Electrical connection general notes

⚠ WARNING

Danger! Electric voltage! Operations in the vicinity of live parts are extremely dangerous.

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

⚠ WARNING

Risk of explosion due to improper handling during motor connection!

Make sure that the motor is only connected in de-energized state and a non-explosive atmosphere.

Before working on the system, always use a suitable measuring device (e.g. multimeter) to check whether any parts of the system are still under residual voltage (e.g. caused by residual energies of capacitors in filters and drive units etc.) their discharge times are to be waited for.

The connection between the protective conductor terminal and the operating ground must be made before any other connections.

The connection or terminal points to or on the control unit must be located outside the potentially explosive atmosphere or must be approved for use in potentially explosive atmospheres.

⚠ WARNING

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

While the rotor is rotating, motors with permanent magnet excitation create a voltage > 60 V at the motor connections.

Any work may only be carried out while the motor is at standstill.

Never connect or disconnect plug connectors under load!

NOTICE

Never touch the connection points of electrostatic sensitive devices!

- Mounted components e.g. temperature sensor, encoder) can contain parts susceptible to electrical discharge (ESD). Observe ESD safety measures.

The electrical connection of MS2E motors consists of the following components:

- Circular connectors for power and encoder connection
- Equipotential bonding conductor (ground conductor)

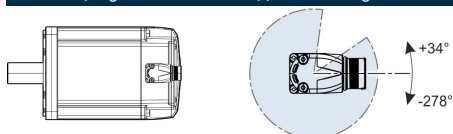
Use shielded connection lines.

The protective conductor connection is made via the protective conductor routed in the ready-made power cable. An additional connector of a grounded earth conduction or a potential equalization line for Ex motors is required according to EN IEC 60079-0:2018/AC:2020 MS2E motors must be grounded via an additional connection part (protective earth terminal at the motor flange). Ground terminal cross section see ➔ Chapter 8.3.5 "Ground connection" on page 37.

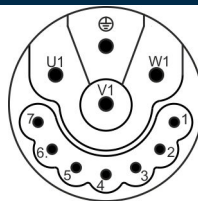
Furthermore, the instructions according to EN 60079-14:2014 must be observed during electrical connection and commissioning.

8.3.2 MS2E Electrical connection "S"

M23 view (single cable connection) / rotation range



Device connector	Single cable connection
Connector size	M23
Output direction	rotatable (max. 10x)
Adjustment torque	4 ... 10 Nm
Locking	SpeedCon
Connector size M23, Pin assignment of single cable connection), Encoder Cx	

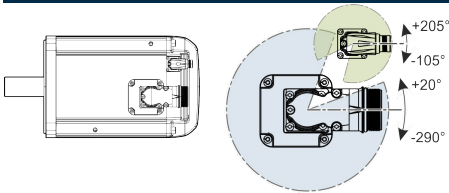


Pole pattern M23

Pin	Signal
U1	A1
V1	A2
W1	A3
	PE
1	+UB
2	GND
3	Data+
4	Data-
5	Shld
6	BD(+) ^{*)}
7	BD(-) ^{*)}
^{*)} n.c. for a motor without holding brake	

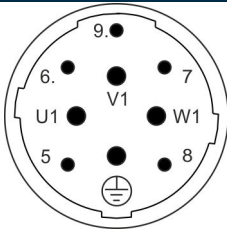
8.3.3 MS2E Electrical connection
“V”

View M40 power, M17 encoder (double cable connection) / rotating area



Device connector	Power	Encoder
Connector size	M40	M17
Output direction	rotatable (max. 10x)	rotatable (max. 10x)
Adjustment torque	12 ... 18 Nm	2 ... 6 Nm
Locking	SpeedCon	SpeedCon

Connector size M40, pin assignment of single cable connection, encoder Cx, Dx



Pole pattern M40

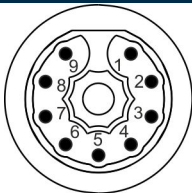
Pin	Signal
U1	A1
V1	A2
W1	A3
	PE
5	n.c.
6	n.c.
7	BD(+) ^{*)}
8	BD(-) ^{*)}
9	n.c.

^{*)} n.c. for a motor without holding brake

Note for assembly about SpeedCon connectors, see

8.3.4 MS2E Electrical connection
“Encoder”

Pol pattern M17, encoder (double cable connection), encoder Cx, Dx

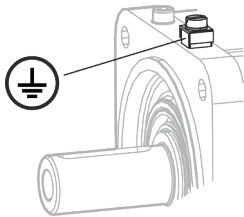


Pin	Signal
1	+UB
2	n.c.
3	Data+
4	Data-
5	n.c.
6	n.c.
7	n.c.
8	n.c.
9	GND

Note for assembly about SpeedCon connectors, see ➔ Chapter 8.3.9 “Connect flange socket” on page 40

8.3.5 Ground connection

Motors for hazardous areas must be grounded via a separate ground conductor and a grounding conductor within the motor power cable. An additional connection clamp is provided on the motor flange to connect the grounding conductor.



Ground connection	Screw M5
Nominal cross-section	4 mm²

Ground connection	Screw M5
Clamping range	4 mm² (fine-wired); 6 mm² (single stranded)
Tightening torque	2 Nm

8.3.6 Shielding concept

Converter-fed drives can generate high-frequency discharge currents in motor cables and motors. By using shielded cables and a large-area, low-impedance connection of the shield connections at motor and controller, impedances can be minimized and the discharge currents can be lead from the motor to the controller. Ready-made cables of Bosch Rexroth are designed and tested according to the requirements of installed motor components.

For more information about Electromagnetic compatibility (EMC), refer to the project planning manual of the respective drive system.

8.3.7 Protective cable glands for connectors

At delivery, the connectors are locked with protective cable glands, which meet the requirements for ATEX applications. The cable gland protects the motor from humidity, dirt and mechanical damage.

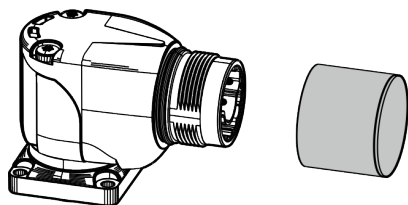


Fig. 14: Protective cable glands

Remove the protective cable glands right before connecting the mating connector. Always use protective cable glands, if no plug-connector is connected (e.g. storage and maintenance).

8.3.8 Plug connector protective cover

The plug connector protective cover fulfills the required protection against impact onto the plug connector according to the ATEX directive. In the special conditions on use X we refer to the responsibility of the plant manufacturer to do a risk evaluation.

NOTICE

Loss of protective function! Replace the damaged connector protective cover.

Immediately replace the connector protective cover after an impact to ensure the required device safety according to EN IEC 60079-0:2018/AC:2020.

Optionally, the connector protective cover can be used as disassembly protection. It fulfills the required protection against unintended loosening the plug connector during motor operation according to the ATEX directive. The connector can be disassembled only if the protective cover is removed. Assembly tools are required to remove the protective cover. Unintended loosening of the connector under load is excluded, if the protective cover is assembled.

Order number	Designation	Size
R911404719	SUP-M02-MS2E	M17
R911392284	SUP-M01-MS2E	M23
R911412835	SUP-M03-MS2E	M40

Assemble connector protective cover

To assemble the connector protective cover, prepare the fitting panel. Deviate the base (0500 A) and bend the connector protective cover in the specified order into the specified form as follows.

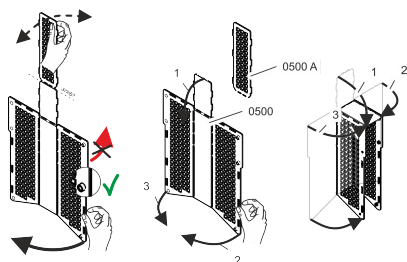


Fig. 15: Prepare connector protective cover

Position the connector protective cover over the motor connector. Observe that the output direction of the connector is adjusted to a 90° position.

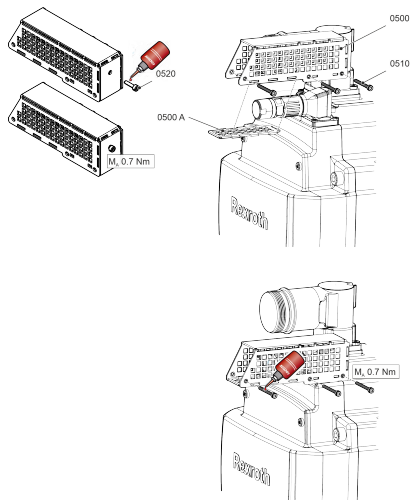


Fig. 16: Assemble plug connector protective cover M17

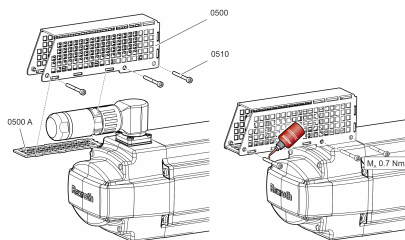


Fig. 17: Assemble plug connector protective cover M23

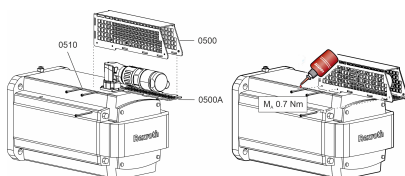


Fig. 18: Plug connector protective cover M40 assembly

The connector protection cover can be mounted when the rotatable connector is set in a 90° position.

1. ➔ Position the connector protective cover onto the plug connector
2. ➔ Join the base (0500A) form-fitting into the grooves of the protective cover (0500).

3. ➤ Tighten (tightening torque 0.7 Nm) the fastening screws (0510)

For M17 connectors tighten assembly screws (0520) with tightening torque of 0.7 Nm

Use moderate screw lock (e.g. Loctite 243) for all screws.

⚠ CAUTION

Limited functionality due to wrong assembly: Observe the correct position of the plug connector protective cover.

Make sure that the connector protection cover is positively clamped to the square of the connector flange.

- ➔ The connector protective cover is ready to use.

8.3.9 Connect flange socket

Observe when connecting the flange socket:

- Connect or disconnect plug connections only in de-energized, dry and clean state.
- Connect the motor with the ready-made connection cable.
- Protect the connector from external force effect.
- Observe the general installation conditions.

⚠ Please observe the special conditions on use "X" for tensile load and impact test.

➔ Chapter 4.4 "Special conditions on use "X"" on page 14

Mounting instruction plug connector

1. ➤ Connect the cable connector to the motor connector. Observe, the knurled nut of the cable connector in "open" position. Only in this position, the cable connector can be slid on. Avoid any kind of force.
2. ➤ Tighten the knurled nut of the cable connector with a 90° turn.

3. ➤ Check the firm seat of the SpeedCon quick lock by short pull on the connector.

4. ➤ Secure the cable to prevent accruing forces due to cable vibrations onto the connector.

SUP-M01-MS2E plug connector protective cover is available as an optional accessory.

9 Commissioning and operation

9.1 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.
Never connect or disconnect plug connectors under load!

⚠ WARNING

Risk of injury due to rotating motor shaft!

- Do not remove any covers, machine parts or protection devices during operation.
Do not enter the range of movement of the machine. Avoid unintended access for persons, due to
 - 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.

All persons working with motors (responsible persons, mechanics and planners) must have knowledge, skills and competence according to EN 60079-14:2014.

9.2 Commissioning

Commissioning in potentially explosive atmospheres is prohibited until it has been ascertained that the overall system corresponds to the demands and certification conditions for explosion protection.

MS2E motors can only be commissioned with other components (drive controller, control unit).

Prior to commissioning

Make sure you have the documentations of all used products ready.

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

- Ensure that the motor and all participating components of the drive are undamaged.
- Storage time of the motor. Depending on the storage time, take measures to ensure safe operation. Run in bearings, resurface the holding brake, ... See table ➔ Chapter 7.1 "Storage" on page 32.
- Make sure that all mechanical and electrical connections (temperature sensor, potential equalization conductor, ...) are properly connected and secured against loosening.

- Ensure that a holding brake voltage of 24 V $\pm$ 10% is applied to the motor. If necessary, adjust the voltage.
- Check the proper function of the holding brake.
- **Do not** do the grinding procedure in hazardous ambience.
- Ensure that keys are protected against ejection.

Enable the safety devices and monitoring systems of the machine.

Commissioning

Once all requirements are met, proceed as follows:

- Commission the drive system according to the instructions of the corresponding product documentation. The respective information can be found in the functional description of the drive controllers.
- Record all measures taken in the commissioning log.

Observe the general and technology-dependent safety instructions in this documentation.

For commissioning of the controllers and control systems, additional steps may be required. The inspection of the functioning and performance of the systems is not object of these Operating Instructions; instead, it is carried out within the framework of the commissioning of the machine as a whole. Comply with the information and instructions of the machine manufacturer.

9.3 Ambient conditions during operation

Climatic conditions are defined in classes according to DIN EN IEC 60721. The classes are differentiated in the areas storage, transport and operation. They are based on long-term experiences and take all influencing variables into account, e.g., air temperature and air humidity.

Derating in case of deviating ambient conditions.

A permanent use of the motors is possible when the specified class 3K22 according to DIN EN IEC 60721-3-3 is observed. Deviations and enhancements according to the following table must be observed.

Table 23: Ambient conditions

Operation	
Installation altitude	0 ... 1,000 m above MSL
Ambient temperature	0 ... +40 °C
Relative humidity	5 ... 95 %
Absolute humidity	1 ... 29 g/m ³

9.3.1 Vibration load during operation

Vibrations are sine-wave oscillations in stationary use, which vary in their effect on the resistance of the motors depending on their intensity.

The specified limit values are valid for frequencies of 10-2000 Hz during stimulation on the motor flange. Limitations can be necessary for occurring resonances depending on the application and installation situation.

The following limit values apply according to EN 60068-2-6 for MS2E motors:

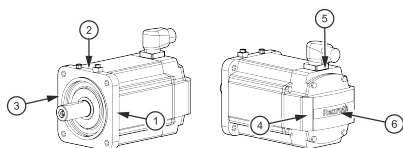


Fig. 19: Vibration load on measuring points

Table 24: Allowed vibration load MS2E motors.

Direction	Measuring point	Limit value (10-2000 Hz) Self-cooling
radial	1, 2 (radial motor flange)	30 m/s ²
	4, 5 (radial bearing shield)	50 m/s ²
Axial	3 (axial motor flange)	10 m/s ²
	6 (axial bearing shield)	25 m/s ²

The specified values must not be exceeded.

9.4 Operation

During operation, keep the ambient and operation conditions and technical data specified in the operating instruction and 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.

Decommission the drive when deviations from normal operation exist. For further procedure refer to ➔ Chapter 13 “Eliminate malfunction” on page 50.

9.5 Derating in case of deviating ambient conditions.

Reduce high performance data:

- Reduce the standstill torque $M_{0\ 60K}$, specified in the data sheet, with the following factors.

We have:

$$M_{0\ red} = M_{0\ 60K} \times f_{TH\ 60K}$$

- Pan the S1-characteristic curve M_{S1} parallel to the speed axis to the junction of the S1-characteristic curve and to the calculated point $M_{0\ red}$ on the torque axis.

- The determined characteristic curve $M_{S1\ red}$ shows approximately the S1-characteristic curve with appropriate derating.

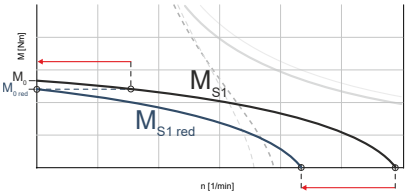


Fig. 20: Determine S1-characteristic curve M_{S1}
 red with derating factor f_{TH}

Table 25: Derating factors for self-cooling 60K

Height [m]	40 °C	45 °C	50 °C	55 °C	60 °C
1000	1.00	0.94	0.88	0.83	0.78
1500	0.97	0.91	0.85	0.81	0.76
2000	0.94	0.88	0.83	0.78	0.73
2500	0.90	0.85	0.79	0.75	0.70
3000	0.86	0.81	0.76	0.71	0.67

9.6 Operation on foreign converters

Principally, operating MS2E motors on foreign converters is possible, but the following requirements and limitations on foreign converters must be observed.

The MS2E motors are used for operation with **VPWM** inverters (**V** = voltage DC link inverter) and PWM control methods (**Pulse-Width-Modulation**)(**Versorgung durch Umrichter / For converter operation**). The designation at the type plate is "**Inverter Duty VPWM**".

▲ WARNING

Danger of explosion or material damage due to overload!

Observe the following requirements for safe motor operation on foreign converters. Connection of all necessary sensors and additional devices for a safe operation and their evaluation lies in the sole responsibility of the plant manufacturer or operator.

Requirements on the power output stage

- Converter with pulse width modulation
- Pulse frequency 4 kHz ...16 kHz

Voltage load of the motor

During converter operation, the motor underlies a higher voltage load (insulation system, bearing) than on a sinusoidal source voltage only.

Standard values for peak voltage and rate of rise of voltage:

- Peak voltage U_{pk} on motor clamps ≤ 1.56 kV
- Rate of rise of voltage $du/dt \leq 5$ kV/ μ s

Maximum allowed limit load:

In the case of critical rate of rise of off-state voltage $du/dt \geq 5$ kV/ μ s, the limit values (peak voltage, voltage rise time) according to limit curves A according to **DIN VDE 0530-25 (VDE 0530-25):2009-08 (Figure 14 Limit curve A)**

must be kept. Therefore, observe the limit values for voltage rise time and critical rate of rise of off-state voltage.

Limit values for voltage rise time and critical rate of rise of off-state voltage:

- Voltage rise time > 0.17 μ s
- Rate of rise of off-state voltage $du/dt < 8$ kV/ μ s

Monitoring functions

- Speed monitoring of maximum permissible speed
- The motor load must not exceed the allowed continuous operation characteristic curve. The converter setting data for controlling and monitoring must comply with the type code data.
- Temperature control to protect from thermal overload
 - The temperature sensor of the motor winding must be connected and evaluated on the converter (ensure monitoring function, observe polarity of temperature sensor, limit switch-off temperature according to ➔ Chapter 6.2.3 "Thermal motor protection" on page 22).
 - Temperature model or I^2t -monitoring within converter. Due to the coupling time of the temperature sensor, an additional suitable temperature model or an I^2t -monitoring must be used.

Switch-off

Please observe the notes in section .

Requirements for motor operation with holding brake

- Ensure the brake functionality during normal operation due to voltage control, current monitoring, cyclic control of the brake holding torque, for example.
- Provide an external or an integrated protective circuit within the foreign converter to switch the holding brake (inductive load).

- Never use the holding brake of the motor as an operating brake.
- Idle time after an emergency stop before restarting ≥ 3 minutes.

General notes

- The motors must be grounded via a motor cable and via a second separate ground conductor with minimum **4 mm²** cross section. Check that the position of the grounded conductor is fixed before commissioning.
- Use cables with a thermal stability of at least 80°C (176°F).
- Plug connector: Never connect or disconnect plug connectors under load!
- Connect and operate MS2E motors only with origin connection accessories. Use ready-made cables by Bosch Rexroth or with origin connectors ready-made connection cables. In the case of self-assembled cables, observe the notes about tensile load in the section "Special conditions "X" " in chapter ➔ Chapter 4.4 "Special conditions on use "X"" on page 14.

⚠ WARNING

Danger of explosion due to exalted tensile load of connection cables

Adherence of specified limits.

Mechanical fastening of cable ends (e.g. use cable clamps, ...).

- The plant manufacturer and operator is responsible for test and documentation of the tensile load.
- Observe the limit values for bearing load. If necessary, change the bearing according to ➔ Chapter "Bearing service life " on page 31.

After maintenance and repair work, Bosch Rexroth always recommends to do a safety and functionality test on basis of the risk analysis provided by the customer (e.g. for thermal protection, holding brake).

10 Maintenance

10.1 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, at regular intervals (after one year at the latest), you should clean the surface of the motors in order to achieve a sufficiently large heat radiation surface.

If the cooling fins are partially covered with dirt, sufficient heat dissipation via the ambient air is no longer possible.

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



Clean the motor with a moist cloth to avoid electrostatic charge only. Rubbing with non-conductive materials must be avoided to prevent electrostatic charges resulting in ignition hazards.

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.

10.2 Service repair, maintenance and spare parts

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

MS2E may only repaired in the manufacturer's works or in a workshop authorized by Rexroth. The following repairs, for example, can be carried out in authorized workshops:

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

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

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

Telephone: **+49 (0) 9352 40 50 60**

Fax: **+49 (0) 9352 18 49 41**

Email: service.svc@boschrexroth.de

Internet: ➔ <https://www.boschrexroth.com>

Preparing information

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

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

11 Disassembly and exchange

11.1 Tools required

NOTICE

Motor damage due to strikes onto the motor shaft

- Do not strike the shaft end and do not exceed the allowed axial and radial forces of the motor.



Use suitable tools when disassembling transmission elements.

Pulling off

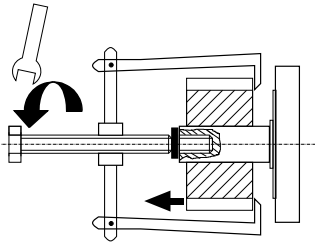


Fig. 21: Remove transmission element

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

11.2 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.

Remark: The motor should be replaced by a motor of identical type. This is the only way to ensure that all parameterizations can remain unchanged.

- If necessary, note the previous absolute value
- Open the main switch
- Make sure the main switch cannot be switched back on
- Disconnect the plug-in connectors and clamping connections

Remark: 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 2 according to EN 50178:1997).

- Replace the motor

Remark: Observe the machine manufacturer's instructions when exchanging the motor mechanically.

- Connect the plug-in connectors and clamping connections
- Re-establish the dimensional reference

⚠ WARNING

Risk of accidents

due to unintentional axis movements! If servo axes are provided with an indirect position measuring system via the motor encoder, the dimensional reference is lost after motor replacement!

Restore dimensional reference to the machine coordinate system after replacing the motor.

11.3 Preparing storage

Before storing motors, the protective covers attached to the motor at the time of delivery must be attached to connectors on the shaft.

12 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

13 Eliminate malfunction

As a matter of principle, the instructions in the project planning and commissioning manuals must be followed in case of failures and errors. Contact the manufacturer, if necessary.

Fault description	Cause	Remedy
Motor does not run	Controller enable signal missing	Activate controller enable signal
	Controller fault	Troubleshoot acc. to documentation of controller
	Voltage supply missing	Control voltage supply
	Brake is not released	Check the brake activation
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	Foreign bodies within the motor	Stop the motor ➔ repair by manufacturer
	Bearing is damaged	Stop the motor ➔ repair by manufacturer
High motor temperatures; motor temperature monitoring is activated	Operation outside the parameters	Reduce load and check the dimensioning
	Heat dissipation is impaired	Clean the motor

As a matter of principle, the instructions in the project planning and commissioning manuals must be followed in case of failures and errors. Contact the manufacturer, if necessary.

14 Technical data

14.1 Technical data

Technical data and operating characteristic curves are described in the project planning manual for all motor types. Please, refer to the following documentation for relevant information.

MS2E Synchronous Servomotors, Project planning manual, DOK-MOTOR*-MS2E*****-PRxx-xx-P



15 Conformity

15.1 EU Declaration of Conformity



EU-Konformitätserklärung - Original
EU declaration of conformity

Dok.-Nr. / Doc. No.: DCTC-30502-002
Datum / Date: 2021-12-22

- ☐ 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 Druckgeräte-Richtlinie 2014/68/EU / in accordance with Pressure Equipment Directive 2014/68/EU
- ☒ nach ATEX-Richtlinie 2014/34/EU / in accordance with ATEX Directive 2014/34/EU
- ☐ nach RoHS-Richtlinie 2011/65/EU / in accordance with RoHS Directive 2011/65/EU

Hiermit erklärt der Hersteller, / The manufacturer
Bosch Rexroth AG, Bgm.-Dr.-Nebel-Str. 2, 97816 Lohr am Main / Germany

dass die nachstehenden Produkte / hereby declares that the products below

Bezeichnung:	3- PM-MOTOR		
Baureihen /	MS2E03-.....-NN-NN	MS2E04-.....-NN-NN	MS2E05-.....-NN-NN
Series:	MS2E06-.....-NN-NN	MS2E07-.....-NN-NN	MS2E10-.....-NN-NN

Handelsbezeichnung / Trade name: Rexroth
ab Herstellungsdatum / from the date of manufacture: 2021-09-01

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

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

Angewandte harmonisierte Normen / Harmonized Standards applied:

Norm / Standard	Titel / Name	Ausgabe / Issue
EN IEC 60079-0 (IEC 60079-0)	Explosionsgefährdete Bereiche – Teil 0: Geräte – Allgemeine Anforderungen / Explosive atmospheres – Part 0: Equipment – General requirements	2018 (2017)
EN IEC 60079-7 (IEC 60079-7)	Explosionsgefährdete Bereiche – Teil 7: Geräteschutz durch erhöhte Sicherheit „e“ / Explosive atmospheres – Part 7: Equipment protection by increased safety „e“	2015+A1:2018 (2015+A1:2017)
EN 60079-31 (IEC 60079-31)	Explosionsgefährdete Bereiche – Teil 31: Geräte-Staubexplosionsschutz durch Gehäuse „t“ / Explosive atmospheres – Part 31: Equipment dust ignition protection by enclosure “t”	2014 (2013)
EN IEC 61800-3 (IEC 61800-3)	Drehzahlveränderbare elektrische Antriebssysteme – Teil 3: EMV- Anforderungen einschließlich spezieller Prüfverfahren / Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods	2018 (2017)

EU-Konformitätserklärung - Original
EU declaration of conformitySeite Page 2 / 2
DCTC-30502-002 : 2021-12-22

Die Motoren haben folgende Kennzeichnungen / the motors have the following markings:

- Ⓔ II 3G Ex ec IIB T155°C (T3) Gc X
Ⓔ II 3D Ex tc IIIC T155°C Dc X

„X“ weist auf besondere Verwendungsbedingungen hin. Diese sind in der Betriebsanleitung definiert. /
“X” indicates special conditions of use. These are defined in the instructions.

Weitere Erläuterungen / Further explanations:

Das Produkt ist ausschließlich zum Einbau in eine Maschine bestimmt.

Der bestimmungsgemäße Gebrauch des Produktes setzt die Einhaltung der Benutzungsbestimmungen und Anwendungsbedingungen, die in der Betriebsanleitung (DOK-MOTOR*-MS2E*NN****-ITRS-xx-x) angegeben werden, durch den Nutzer voraus.

The product is intended solely for installation in a machine.

For the product to be used as intended the user must comply with the provisions of use and conditions of application laid down in the instructions (DOK-MOTOR-MS2E*NN****-ITRS-xx-x).*

<u>Lohr a.Main</u>	<u>2021-12-22</u>	<u>ppa.</u>	<u>i.V.</u>
Ort / Place	Datum / Date	Uwe Czychy Werkleitung LoP2 / Plant Manager LoP2	Dr. Hans-Jürgen Wehner Leitung Entwicklung Motoren / Head of Development Motors

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.

15.2 UK Declaration of conformity



The products fulfill the requirements of "Product or Protective System Intended for use in Potentially Explosive Atmospheres UKSI 2016:1107 (as amended by UKSI 2019:696) – Schedule 3A, Part 1".

The UK Declaration of Conformity can be found in the Bosch Rexroth Media Directory: ➔ www.boschrexroth.com/MediaDirectory, keyword: ➔ "DCTC-30502-032".

15.3 UL/CSA



The UL/CSA conformity of MS2E motors can be found on the type plate of the motors.

MS2E motors are "UL Recognized". Information can be found under UL file number E335445 on the website ➔ www.ul.com.

15.4 China RoHS 2



The China RoHS 2 conformity can be found on the type plate of the motors.

Information about listing:
➔ <https://www.boschrexroth.com.cn/zh/cn/certificates/china-rohs2/>

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