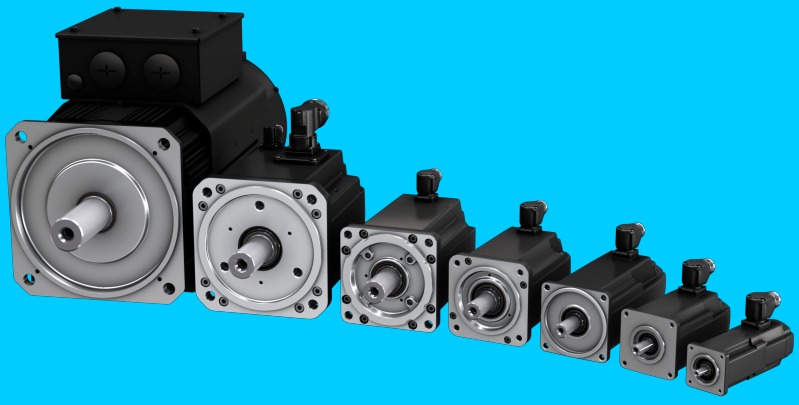
rexroth
A Bosch Company

Operating Instructions
(Translation of the original)

MS2N
Synchronous Servomotors



R911347581, Edition 07

Disclaimer

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

Table of contents

1 About this documentation

1.1 Editions of this documentation

This documentation explains the product characteristics, application possibilities, operating conditions and the operational limits of the motors, contains the technical data of the available motors and provides information on product selection, handling and operation.

Table 1: Record of revisions

Edition	Release date	Notes
01	2015-03	First edition
	2015-05	First edition corrected
02	2016-06	Revision according to project planning manual edition 01
03	2018-04	Revision according to project planning manual edition 03, water cooling
04	2020-10	Extending product range: Frame size 13 Editorial revision
05	2022-02	Terminal boxes, single cable connector M17
06	2023-10	UKCA amended
07	2024-07	Amendment of ctrlX SENSEmotor, encoder JS, JM, MS, MM

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 Z535.6-2011).

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 symbols	Meaning
	Warning against dangerous electric voltage
	Warning against hot surfaces
	Warning against rotating machine parts
	Warning against overhead load
	Electrostatic sensitive devices
	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
	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.
	UKCA means “UK Conformity Assessed”. The UKCA-marking expresses the conformity of a product with all valid statutory requirements of the United Kingdom.
	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

1. Action step one
2. Action step two

➡ Result of an instruction

Please comply with the order of the handling instructions.

Trademark information

HIPERFACE® is a registered trademark of Sick AG 79183 Waldkirch, Germany

EnDat® is a registered trademark of Dr. Johannes Heidenhain GmbH 83301 Traunreut, Germany

ACURO®link is a registered trademark of Hengstler GmbH 78554 Aldingen, Germany

SPEEDCON® iis a registered trademark of Phoenix Contact GmbH & Co. KG 32825 Blomberg, Germany

SpeedTec® is a registered trademark of TE Connectivity Industrial GmbH 94559 Niederwinkling, Germany

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1.3 Further documentation

1.3.1 Drive systems, system components

Table 4: Documentation - Drive systems, system components

Title	Document type	Documentation type[1)]	Material number
ctrlX Drive systems	Project Planning Manual	DOK-XDRV**-X**********-PRxx-EN-P	R911386579
ctrlX DC/DC converter XMV	Application Manual	DOK-XDRV**-XMV********-APxx-EN-P	R911413650
Security Guidelines Electric Drives and Controls	Project Planning Manual	DOK-IWORKS-SECURITY***-PRxx-EN-P	R911342562

Title	Document type	Documentation type[1)]	Material number
Control cabinet Climatization, EMC, Setup, Protection Class, IndraDrive Electric, Rexroth EFC/Fv, Sytronix	Project Planning Manual	DOK-DRIVE*-CABINET****-PRxx-EN-P	➦R911344988

1) In the documentation types, xx is a placeholder for the current issue status of the documentation (example: PR01 means the first issue of the documentation catalog)

1.3.2 Firmware/Runtime

Table 5: Documentation - Firmware

Title	Document type	Documentation type[1)]	Material number
AXS-V-05 Functions	Application Manual	DOK-XDRV**-AXS-05VRS**-APxx-EN-P	➦R911422255
AXS-V-05 (CoE) Functions	Application Manual	DOK-XDRV**-AXS-05VRS*C-APxx-EN-P	➦R911422257
Diagnostic messages of runtime AXS-V-05RS	Reference	DOK-XDRV**-GEN5-DIAG**-RExx-EN-P	R911422251
Parameter/Objects of Runtime AXS-V-05RS	Reference	DOK-XDRV**-GEN5-PARA*C-RExx-EN-P	R911422253
AXS-V-04 Functions	Application Manual	DOK-XDRV**-AXS-04VRS**-APxx-EN-P	➦R911421281
AXS-V-04 (CoE) Functions	Application Manual	DOK-XDRV**-AXS-04VRS*C-APxx-EN-P	➦R911421283
Diagnostic messages of runtime AXS-V-04RS	Reference	DOK-XDRV**-GEN4-DIAG**-RExx-EN-P	➦R911421277
Parameter/Objects of Runtime AXS-V-04RS	Reference	DOK-XDRV**-GEN4-PARA*C-RExx-EN-P	➦R911421279
AXS-V-03 Functions	Application Manual	DOK-XDRV**-AXS-03VRS**-APxx-EN-P	➦R911410073
AXS-V-03 (CoE) Functions	Application Manual	DOK-XDRV**-AXS-03VRS*C-APxx-EN-P	➦R911398021
Diagnostic messages of runtime AXS-V-03RS	Reference	DOK-XDRV**-GEN3-DIAG**-RExx-EN-P	➦R911409763
Parameter of Runtime AXS-V-03RS	Reference	DOK-XDRV**-GEN3-PARA**-RExx-EN-P	➦R911409808
Parameter/Objects of Runtime AXS-V-03RS	Reference	DOK-XDRV**-GEN3-PARA*C-RExx-EN-P	➦R911419643
AXS-V-02 Functions	Application Manual	DOK-XDRV**-AXS-02VRS**-APxx-EN-P	➦R911398021
Diagnostic messages of runtime AXS-V-02RS	Reference	DOK-XDRV**-GEN2-DIAG**-RExx-EN-P	➦R911383776
Parameter of Runtime AXS-V-02RS	Reference	DOK-XDRV**-GEN2-PARA**-RExx-EN-P	➦R911383778

1) In the documentation types, xx is a placeholder for the current issue status of the documentation (example: RE02 means the second issue of a reference document)

1.3.3 Functional safety

Table 6: Documentation - functional safety

Title	Document type	Documentation type[1)]	Material number
Integrated Safety Technology Safe Torque Off	Application Manual	DOK-XDRV**-SI-TX******-APxx-EN-P	➦ R911383774
Integrated Safety Technology SafeMotion	Application Manual	DOK-XDRV**-SI-MX******-APxx-EN-P	➦ R911404905

1) In the documentation types, xx is a placeholder for the current issue status of the documentation (example: AP02 means the second issue of a reference document)

1.3.4 Cable

Table 7: Documentation - Cables

Title	Document type	Documentation type[1)]	Material number
ctrlX Motor Cables and Connectors	Reference	DOK-CONNEC-XDRV*******-RExx-EN-P	➦ R911420100
Motor Cables and Connectors with IndraDrive	Product information	DOK-CONNEC-MS2N*INDRV*-CAxx-EN-P	➦ R911401938
IndraDrive and IndraDyn	Selection Data	DOK-CONNEC-CABLE*INDRV-CAxx-EN-P	➦ R911322949

1) In the documentation types, xx is a placeholder for the current issue status of the documentation (example: CA03 means the third issue of the documentation catalog)

2 Safety instructions

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

EU Directives	
2014/35/EU	Low voltage directive

EN Standards	
EN IEC 60034-5:2020	Rotating electrical machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification (IEC 60034-5:2020)

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 EN 60204-1:2018 Safety of machinery - Electrical equipment of machines -Part 1: General requirements).

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

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

The observance of and compliance with the specifications of the operating instructions (DOK-MOTOR*-MS2N*******-PRRS-**-P) are part of the intended use.

2.1.2 Unintended use

Any use of MS2N 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 unintended use.

Unless explicitly provided for this purpose, the motors may not be used in explosion-hazardous areas.

Direct operation on the three-phase network is forbidden.

2.2 Qualification of personnel

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

All persons working on, with or in the vicinity of an electrical system must be informed of the relevant safety requirements, safety guidelines and internal instructionsEN 50110-1:2013.

2.3 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.

Keep this instructions!

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

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

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

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

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

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

2.4 Product- and technology-dependent safety instructions

2.4.1 Protection from electric voltage

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

Before working:

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

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

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

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

2.4.2 Protection from mechanical danger

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

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

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

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

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

2.4.3 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.

2.4.4 Protection against burns

Risk of burns due to hot motor surfaces!

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

2.4.5 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 MS2N synchronous servomotor contains:

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

4 Identification

4.1 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.

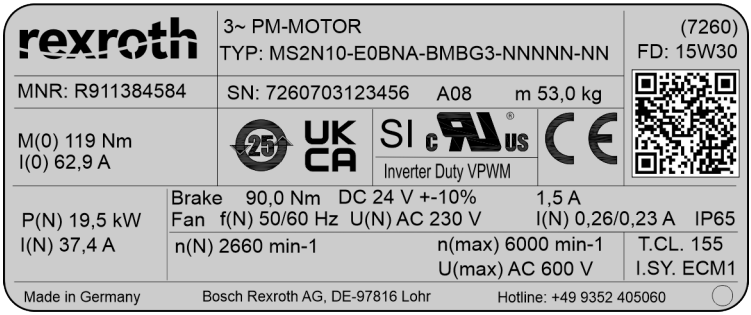


Fig. 1: Type plate MS2N (example)

Table 8: Type plate specification MS2N

Symbol	Meaning
TYPE	Product type code
SN	Serial number
FD	Manufacturing date
P(N)	Rated power - 100K
I(N)	Rated current - 100K
M(0)	Standstill torque - 100K
I(0)	Standstill current - 100K

Symbol	Meaning
Brake	Holding brake data (optional)
n(max)	Maximum speed
U(max)	Maximum voltage UL
IP	Degree of protection IPxx
m	Mass
T.CL.	Thermal class
I.SY.	Insulation system identification
SI	Use in systems for “Integrated Safety Technology” prepared.
Fan	Data motor fan (optional)

The following marks of conformity are used.

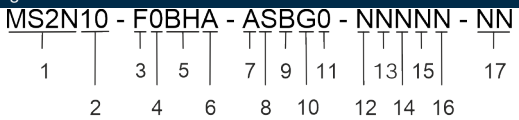
Table 9: Meaning of marks of conformity

Certification mark	Meaning
c UL us	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“.
CE	The CE-marking confirms the conformity of a product according to the declaration of conformity.
UKCA	The UKCA-marking confirms the conformity of a product with relevant regulations.
25	Motors labelled with the symbol EFUP 25 (enviromental-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.

4.2 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



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

Type codes, meaning of the digits	
8	Encoder design
9	Electrical connection
10	Shaft
11	Holding brake
12	Flange exactness
13	Bearings
14	Frame size
15	Coating
16	Other design
17	Special design

5 About this product

5.1 Safety instructions on the product

Please note these safety and prohibitive signs on the motor.

⚠ WARNING	**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.

⚠ WARNING	**Warning against dangerous electric voltage**
	Electric connection may only be established by specialized staff. Tools for electricians (VDE tools) are absolutely necessary. – The installation has to be switched de-energized before operation and de-energization must be ensured via a suitable measuring device. De-energize the machine and secure the mains switch again unintended or unauthorized re-energization. – Open the terminal boxes only in switched-off voltage.

⚠ CAUTION	**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.

5.2 Features and functions

5.2.1 Basic data

Product

3~ PM Motor

Type

MS2N

Ambient temperature during operation

0 ... 40 °C (with derating up to 60 °C)

Type of protection (EN IEC 60034-5:2020)

IP64 without shaft sealing ring,
IP65 with shaft sealing ring,
IP67 with sealing air

Cooling mode(EN 60034-6:1993)

IC410, Self-cooling
IC416, Forced ventilation
IC3W7, Water cooling

Motor design(EN 60034-7:1993 + A1:2001)

IM B5
IM B35 (only MS2N13)

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), optional with keyway (half key balancing according toISO 21940-32:2012)

Concentricity, run-out, alignmentDIN 42955:1981-12)

Tolerance N (standard)
Tolerance R (availability acc. to type code)

Oscillating quantity level EN IEC 60034-14:2018)

Level A up to rated speed

Installation altitude

0 ... 1000 m above sea level (without derating)

Sound pressure level

MS2N03 ... MS2N13: 75 dB(A) +3 dB(A)

Thermal class(EN 60034-1:2010 + Cor.:2010)

155 (F)

Encoder system

Basic performance HIPERFACE®

Capacitive absolute value encoder, sin/cos 1Vss, 16 signal periods as Single- or Multiturn variant

STANDARD Performance ctrlX SENSE^{motor}

Magnetic absolute encoder 22 bit, digital in single or multi-turn version

Standard performance HIPERFACE®

Optical absolute value encoder, sin/cos 1Vss, 128 bit, digital in Single- or Multiturn design

Advanced Performance ACURO®link

Optical absolute value encoder 20 bit, digital in Single- or Multiturn design

High performance ACURO®link

Optical absolute value encoder 24 bit, digital in Single- or Multiturn design

Electrical connection

Single cable connection with

- - M17 circular connector, rotatable, quick lock Speedtec®
- - M23 circular connector, rotatable, quick lock SPEEDCON®

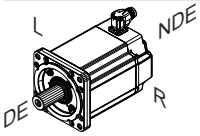
Double cable connection with

- Power connectors M17, M23, M40 (rotatable, quick lock SPEEDCON®), M58 or terminal boxes
- M17 Encoder connector, rotatable, quick lock SPEEDCON®

Motor holding brake

Optional, electrically released U_N 24V DC (±10%)

Motor ends



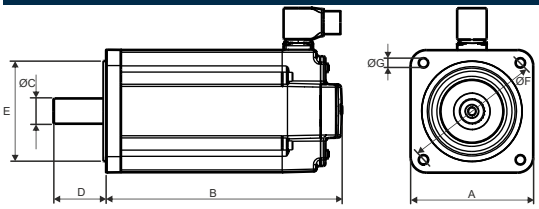
DE	Drive End, A-side
NDE	Non Drive End, B-side
L	Left
R	Right

Remark

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

5.2.2 Mechanical interfaces

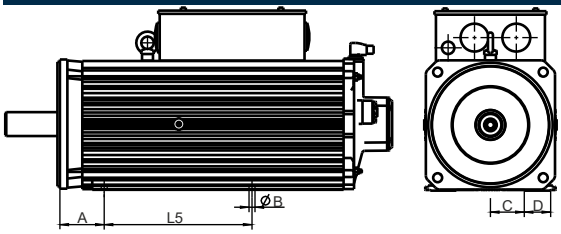
Dimensions (flange)



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]
MS2N03-A	58	1)	9	20	40	63	4.5
MS2N03-B	58	1)	9	20	40	63	4.5
MS2N03-D	58	1)	11	23	40	63	4.5
MS2N04	82	1)	14	30	50	95	6.6
MS2N05	98	1)	19	40	95	115	9
MS2N06	116	1)	24	50	95	130	9
MS2N07	140	1)	32	58	130	165	11
MS2N10	196	1)	38	80	180	215	14
MS2N13	260	1)	48	110	250	300	18

1) Additional documentation see specifications (DOK-MOTOR*-MS2N*******-PRxx-xx-P, Project planning manual)

Dimensions (foot)



Type	A [mm]	L5 Length [mm]	B Bore Ø [mm]	C Distance [mm]	D Distance [mm]
MS2N13-B	89	147	12	68	53
MS2N13-C	89	197	12	68	53
MS2N13-D	89	247	12	68	53
MS2N13-E	89	297	12	68	53

Mounting screws tightening torque						
Screw 1)	M4	M6	M8	M10	M12	M16
Mounting holes ⌀ [mm]	4.5	6.6	9	11 / 12	14	18

Mounting screws tightening torque						
Screw [1)]	M4	M6	M8	M10	M12	M16
Tightening torque M_A[Nm] bei μ_K= 0.12	3.0	10.1	24.6	48	84	206
Washer	-	-	yes	yes	yes	yes

[1)] Screws according toEN ISO 4762:2004 or EN ISO 4014:2011. Fastening class 8.8. The screw lengths depends on material and installation situation. The specified tightening torque must be ensured.

Use the specified screws and washers for flange and foot assembly.

5.2.3 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 MS2N motors:

- Motor-warning temperature (140°C)
- Motor-disconnection temperature (145°C)

For motors with an analog encoder (A, B), the temperature signal is output via the TP(+) and TP(-) connections in the power connection.

For motors with a digital encoder (C, D, H, J, M), the temperature signal is transmitted digitally via the encoder interface (cyclical communication).

Temperature measurement frame size N

In motors with design N, the temperature of the winding is recorded and monitored via PT1000 temperature sensors installed in the motor winding.

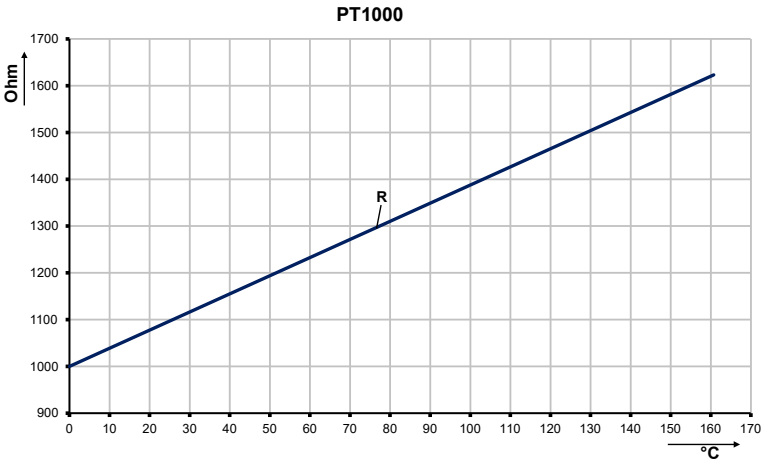


Fig. 2: Characteristic curve PT1000

Temperature measurement frame size A

The temperature of the winding is recorded and monitored in motors with design A via KTY84-130 temperature sensors installed in the motor winding.

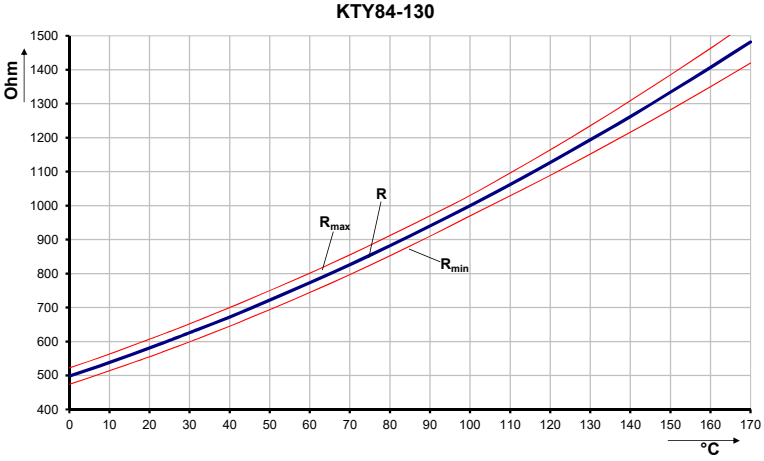


Fig. 3: Characteristic curve KTY84-130

Temperature measurement frame size D

The temperature of the winding is detected and monitored indirectly for type D motors via the temperature sensor in the ctrlX SENSEncoder (availability according to type code).

Temperature evaluation with third-party controllers

When using third-party devices, please refer to the information on implementing the encoder manufacturer's interface.

Hengstler:
ACURO Encoder AD37 series – Functional Safety Item number: 2572032

For motors in design D (ctrlX SENSE encoder), an indirect temperature recording of the winding can only be ensured with the temperature model in drives of Bosch Rexroth.

5.2.4 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 8.5 “Derating in case of deviating ambient conditions” on page 86.

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.

Forced ventilation (IC416)

MS2N motors of size **07**, **10** and **13** are available as forced ventilated designs. The designation is done via the feature cooling mode within the type code:

- „**A**“ 230 V (50 / 60 Hz)
- „**B**“ 115 V (60 Hz)
- „**C**“ 3 × 400 / 480 V (50 / 60 Hz)

In case of force-ventilated motors, the energy dissipation is additionally realized via a fan that is not connected to the motor.

⚠ WARNING	**Damage to persons and machines due to drawing in of hairs, clothes or loose objects.** Before you get closer to operating fan units, take protective measures. Do not wear jewelry, wear tight-fitting clothes and use personal protective equipment (like a hairnet). Tie your hair back. Otherwise the danger exists that hair will get ripped out.

The specified nominal data is reached at ambient temperatures of up to 40 °C. Unhindered drawing in of cooling air and heat dissipation has to be ensured by minimum distances to the machine environment.

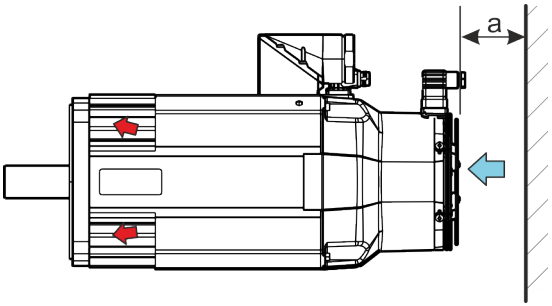


Fig. 4: Minimum distance

a Minimum distance 80 mm

Blowing fans, air flow direction NDE → DE.

Operate fans only in dustfree and dry ambient air. Heated air may not be sucked in again.

Dirt and contaminants can reduce the flow rate of the fans and result in a thermal overload of the motors. The availability of the system can be increased by regular checks and cleaning of the fans and motors. Please ensure access to the motors for maintenance purposes.

Fans are not suited to transfer ambient air,

- containing abrasive particles.
- having a corroding effect (e.g., salt mist).
- containing a high dust concentration (e.g. sawdust).
- with inflammable gas/dust.

Water cooling (IC3W7)

MS2N motors of size **07, 10** and **13** are available as water-cooled designs. The cooling circuit of the motor is designed with stainless steel. The designation is done via the feature cooling mode „**L**“ within the motor type code. The nominal data are achieved at ambient temperatures of up to 40 °C.

Cooling system

The motor power loss P_V transformed to heat is dissipated using the coolant. External cooling units are necessary to operate water-cooled motors.

The cooling unit must be able to dissipated heat of the motors at any time. If several motors are operated on one cooling system, this applies to the sum of the individual power losses. The required coolant pressure must also be able to be achieved at maximum volume flow.

NOTICE	The necessary cooling and pump performance is calculated of the sum of connected motors or heat input, the specified minimum flow and pressure loss. The dimensioning of the cooling system is in the responsibility of the machine manufacturer.

The occurring electro-chemical processes within the cooling system must be minimized via selection of the materials. Do not combine different materials, like copper, brass, iron, zinc and halogenated plastics (e.g. tubes and sealing made of PVC).

Fix coolant ducts and check for their tightness in regular intervals.

Potential equalization

Connect all components within the cooling system (e.g. motor, heat exchanger, pipe system, pump, pressure compensation container, etc.) with a potential equalization. Do the potential equalization with a copper bus bar or copper wire with an appropriate conductor cross-section.

Coolant ducts must not contact live parts. Please observe sufficient insulation according to the regulations valid for the place of installation.

Cleaning the coolant circuit

Inspect and clean (purge) the cooling system at regular intervals as specified in the machine and cooling system manufacturer's maintenance schedule.

Note that the utilization of unsuitable cleaning agents may cause irreversible damage to the motor cooling system. This type of damage does not lie within the responsibility of Bosch Rexroth.

NOTICE	**Damage to the motor cooling system due to unsuitable cleaning agents!** – The only liquids or materials allowed to be used for cleaning and motor cooling are those which do not corrode the motor cooling system or do not react aggressively to the materials used in Bosch Rexroth motors. – Observe the instructions of the manufacturers of the cleaning agent and the cooling system.

Coolants

The coolant must comply with certain criteria and treated accordingly➥ Table on page 25). To ensure corrosion protection and chemical stabilization admix an additive to the cooling water. The selected coolant additives (**biocides**, **inhibitors**) must comply with the materials in the cooling system (e.g. copper, brass, stainless steel, etc.) and minimize the micro-biological growth. Pay attention to environmentally friendly materials.

A cooling with floating water from the supply network is **not** allowed. Floating water can cause sediments (chalk) or corrosion within the cooling system.

Remark

In the case of other used coolants than water (e.g. oil), a performance reduction of the motor can be necessary to dissipate the created power loss.

NOTICE

Motor damage due to missing or incompatible coolant water!

- For this reason, water cooled motors may only be operated as long as coolant supply is ensured.
- Do not use any cooling lubricants or cutting materials from machining processes for cooling.
- Using aggressive coolant additives or additives can lead to irreparable motor damage.

Remark

The dimensioning of the cooling system is in the responsibility of the machine manufacturer.

Adjust the required coolant, especially the material compatibility must be specified with the manufacturer of the cooling unit and the manufacturer of the coolant additives. The basic minimum requirements for the coolant are displayed in the following.

Cooling water quality for motors with internal cooling circuit made of stainless steel.	
pH value (bei 20 °C)	6 ... 9
Total hardness	1.2 ... 2.5 mmol/l
Chloride concentration	< 150 ppm
Sulfate concentration	< 200 ppm
Nitrate concentration	< 50 ppm
Amount solutes	< 350 ppm
Particle size of dirt	≤ 100 µm
Conductivity	< 2000 µS/cm

Coolant temperature

When setting the coolant inlet temperature within a range of 10 ... 40°C (for derating see ➦ Chapter 8.5 “Derating in case of deviating ambient conditions” on page 86) observe the ambient temperature and the existing relative air humidity. To avoid condensation, the coolant inlet temperature must be above the dew point temperature . The following figure shows the dependency of dew point temperature of relative air humidity and air temperature.

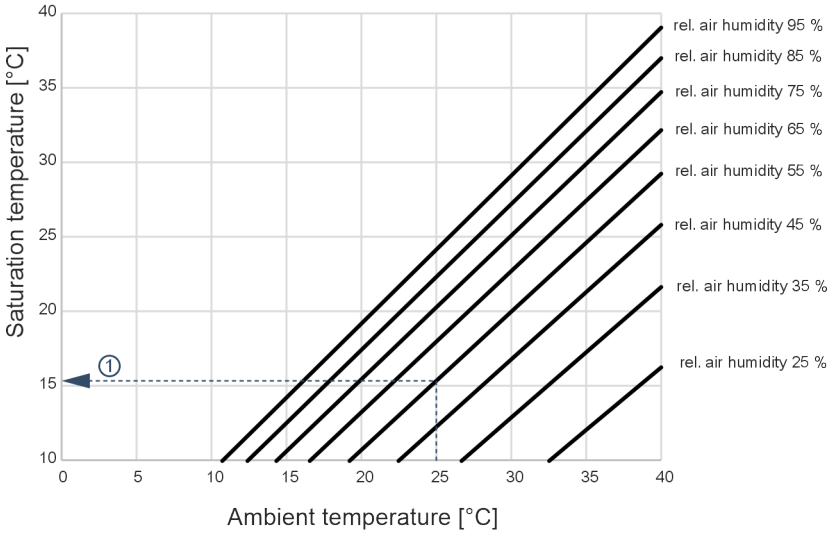


Fig. 5: Dew point temperature depends from ambient temperature and relative air humidity
Example ① Saturation 15.3 °C at ambient temperature of 25°C and relative air humidity of 55%

Remark

To avoid condensation of the motors, the coolant inlet temperature must be above the dew point temperature .

5.2.5 Motor encoder

Introduction

Safety Integrity Level (SIL)

MS2N motors are available with encoder systems with different safety integrity levels (SIL). All components of a safety-related system (e. g. motor, control device, software ...) must be evaluated together in order to execute a safety function and thus achieve and maintain a defined safe state of a system.

⚠ WARNING	**The component is part of a safety-related system! Death, serious injury or damage to property if these instructions are not followed.** Motors with encoder units for functional safety are part of a safety-related system. All components of a safety-related system must be evaluated according to the standards claimed about functional safety. – Carry out a detailed risk analysis to determine an appropriate Safety Integrity Level (SIL) for your specific application based on all applicable standards. – Do not exceed any of the SIL rating data when using this product.

For more information about Integrated Safety technology and the requirements to use motors with encoder systems for Safety technology applications, please refer to the documentation about the drive controller.

Singleturn

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

Multiturn

The multiturn version **"M"** enables absolute, indirect position detection within4096 mechanical motor revolutions (HIPERFACE®, ACURO®link),65,536 mechanical motor revolutions (ctrlX SENSE).

HIPERFACE®

Encoder performance

BASIC

BASIC encoders with encoder performance **"A_"** use a capacitive sampling method. Data output of process data happens analog via SinCos track. Data output of parameter data (electronic type plate) happens digitally via Hiperface®-Protocol. The motor temperature is not transmitted via encoder interface.

STANDARD

STANDARD encoders with encoder performance **"B"** use an optical sampling method. Data output of process data happens analog via SinCos track. Data output of parameter data (electronic type plate) happens digitally via Hiperface®-Protocol. The encoder fulfills the specification for safety technique according to SIL2 and category 3, PL d. The motor temperature is not transmitted via encoder interface.

Functional details

Table 10: Technical data motor encoder HIPERFACE®

Designation			BASIC		STANDARD	
Performance	Symbol	Unit	AM	AS	BM	BS
Encoder interface	-	-	HIPERFACE®			
Encoder signal periods	~/⏃	-	16		128	
Distinguishable rotations	U_{turn}	-	4096	1	4096	1
System accuracy of encoder [1]	∢	"	±520		±120	
System accuracy typical/maximum [2)]	∢	"	±360 / ± 520		±90 / ±120	
Encoder output signal	V_{out}		1Vss			
Encoder voltage supply	$VCC_{Encoder}$	V	7...12			
Encoder max. current consumption	$I_{Encoder}$	mA	50		60	

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

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

Safety data

Table 11: Technical data motor encoder HIPERFACE®

Safety characteristics	Symbol	Unit	AM	AS	BM	BS
Safety integrity level		-	-		SIL 2	
Performance level		-	-		Category 3, PL d	
Mission Time		h	-		175.200 (20 years)	

ACURO®link

Encoder performance

ADVANCED

ADVANCED encoder with encoder performance **"C"** or **"H"** use an optical sampling method. Data output of process and parameter data (electronic type plate) happens digitally via the ACURO®link protocol. The encoder with encoder performance **"C_"** fulfills the specification for safety technique according to SIL 2 and category 3, PL d. The encoder with encoder performance **"H_"** fulfills the specification for safety technique according to SIL 3 and category 3, PL e. The motor temperature is transmitted digitally.

HIGH

HIGH encoders with encoder performance **"D"** use an optical sampling method. Data output of process and parameter data (electronic type plate) happens digitally via the ACURO®link protocol. The encoder with encoder performance “D” fulfills the specifications for safety technique according to SIL 3 and Category 3, PL e. The motor temperature is transmitted digitally.

Functional details

Table 12: Technical data motor encoder ACURO®link

Designation			ADVANCED				HIGH	
Performance	Symbol	Unit	CM	CS	HM	HS	DM	DS
Encoder interface	-	-	ACURO®link					
Functional encoder resolution (singleturn)		-	20 bit				24 bit	
Distinguishable rotations	U_{turn}	-	4096	1	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	

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

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

Safety data

Table 13: Technical data motor encoder ACURO®link

Safety characteristics	Symbol	Unit	CM	CS	HM	HS	DM	DS
Safety integrity level		-	SIL 2		SIL 3			
Performance level		-	Category 3, PL d		Category 3, PL e			
Position resolution for safe position		-	9 bit					
Mission Time		h	175.200 (20 years)					

ctrlX SENSE

Encoder performance

STANDARD

STANDARD encoders with encoder performance **"J"**, **"M"** use a magnetic sampling method. Data output of process and parameter data (electronic type plate) happens digitally via the ctrlX SENSE^{motor} protocol. The encoder with encoder performance “J” fulfills the specifications for safety technique according to SIL 3 and Category 4, PL e. The encoder with encoder performance “M” fulfills the specifications for safety technique according to SIL 2 and Category 3, PL e. The motor temperature is transmitted digitally.

Functional details

Table 14: Technical data motor encoder ctrlX SENSE

Designation			Standard			
Performance	Symbol	Unit	MM	MS	JM	JS
Resolution per revolution			22 bit			
System accuracy of encoder	∢	"	±150			
System accuracy typical/maximum [1)]	∢	"	tbd / ±150			
Number of recordable revolutions	U_{turn}	-	65,536	1	65,536	1
Measuring principle			magnetic			
1) Reachable overall system accuracy by considering the installation mechanics, typical and maximum value.						
Interfaces	**Symbol**	**Unit**	**MM**	**MS**	**JM**	**JS**
Communication interface	-	-	ctrlX SENSE^{motor}			
Maximum initialization time		ms	500			
Electrical data	**Symbol**	**Unit**	**MM**	**MS**	**JM**	**JS**
Voltage supply	$VCC_{Encoder}$	V DC	8...14			
Current consumption	$I_{Encoder}$	mA	140			
Encoder power maximum	$P_{Encoder}$	mW	1200			
• The voltage drop on the cable must be taken into account for the voltage tolerance. • The data specified in the table are valid for the connection points at the encoder. • The power supply source must be a power supply unit with SELV protection in accordance with IEC 60950-1 or PELV in accordance with IEC 60204-1.						
Mechanical data	**Symbol**	**Unit**	**MM**	**MS**	**JM**	**JS**
Moment of inertia of rotor		kg*mm²	0.91			

Safety data

Safe absolute singleturn position

The safe position of a ctrlX SENSE - STANDARD can reflect a mechanical revolution. The multiturn position is not safe.

Table 15: Technical data motor encoder ctrlX SENSE

Safety characteristics	Symbol	Unit	MM	MS	JM	JS
Safety integrity level (IEC 61508)		-	SIL 2		SIL 3	
Category (EN ISO 13849)		-	3		4	
Performance level		-	PL d		PL e	
Safety-related resolution		-	19 bit			
Safe illustratable position area	-	rev.	1			
PFH: Probability of hazardous loss / h	PFH	1/h	1E-09			
Mission Time		h	175.200 (20 years)			
Available safe memory area		kByte	4			
Maximum cable length [1)]		m	75			
Accuracy of safe position (mechanical)			± 1.5°			
Accuracy of safe velocity			±6 %			
Maximum encoder speed [1)]		1/min	12,000			
Angular acceleration [1)]		rad/s²	≤ 250.000			
Realizable safe functions acc. to EN 61800-5-2			**SS1** Safe Stop 1 **SS2** Safe Stop 2 **SOS** Safe Operating stop **SDI** Safe direction **SLS** Safe limited speed **SLI** Safe limited increment **SLA** Safe limited acceleration **SSR** Safe speed range) **SAR** Safe acceleration range			
Realizable safe functions acc. to EN 61800-5-3			**SAP** Safe absolute position (singleturn, within one mechanical revolution)			
			Safe parameter ctrlX SENSE can read and write safe parameters via the non-safety-oriented parameter channel			

1) specified data can be limited due to the design of the motor or drive controller. **Please observe the information provided in the specified documentation**.

⚠ WARNING	**Death, serious injury or material damage due to non-compliance with the ambient conditions**
	The safety-related data of the encoder are only valid if the specified ambient conditions of the motor are complied with. Failure to observe these conditions can lead to malfunction of the encoder, resulting in serious injury or damage to property. Please observe the manufacturer's instructions and ensure compliance with the ambient conditions to ensure safe use of the encoder.
	➦ Chapter 8.3 “Ambient conditions during operation ” on page 85

Notes on maintenance and service measures

Maintenance work on ctrlX SENSE encoders is possible for motors of size 03-10, e.g. to replace the battery on multiturn encoders or to replace the encoder completely. Therefor, take off the motor lid.

⚠ WARNING	**Improper battery change can lead to loss of the safety functions!**
	The battery may only be replaced by specialists or qualified electricians.
	For motors of sizes 03-10 with multiturn encoders, it is possible to replace the battery by opening the motor cover without changing the encoder calibration.
	It is important to ensure that the mechanical connections of the encoder board are not changed when replacing the battery in order to maintain the alignment of the position sensor.

⚠ WARNING	**Loss of safety functions due to opening the shielding box (encoder)!**
	Opening the shielding box (for encoder exchange, for example) can lead to loss of the safety functions.
	The encoder may only be replaced by Rexroth Service or an authorized workshop.
	The encoder must be recalibrated after loosening the screws of the shielding box.
	The encoder must be recalibrated after it has been replaced.

Supported standards

The ctrlX SENSE STANDARD was developed according to the following standards:

- IEC 61800-5-3:2021-02 Adjustable speed electrical power drive systems - Part 5-3: Safety requirements - Functional, electrical and environmental requirements for encoders
- DIN EN 61800-5-2:2017-11 Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional (IEC 61800-5-2:2016); German version EN 61800-5-2:2017
- EN ISO 13849-1:2015 Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2015)
- EN ISO 13849-1:2023 Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2023); German version EN ISO 13849-1:2023
- DIN EN IEC 61784-3:2022-02 Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions (IEC 61784-3:2021); German version EN IEC 61784-3:2021

Further documentation:

Safety Manual ctrlX SENSE parameter, Document Version R02, 2024-05-06 ➦ Safety Manual ctrlX SENSE parameter

Safety Manual ctrlX SENSE communication, Document Version R05, 2024-05-06 ➦ Safety Manual ctrlX SENSE communication

The power supply source must be a power supply unit with SELV protection in accordance with IEC 60950-1 or PELV in accordance with IEC 60204-1. ➦ Table 14 “Technical data motor encoder ctrlX SENSE” on page 30

5.2.6 Degree of protection

The protection type according to EN 60034-5 is determined by the abbreviation IP (International Protection) and two code numbers for the degree of protection. The first code number stands for the degree of protection against contact and ingress of foreign bodies. The second code number stands for the degree of protection against ingress of water.

Standard motors (specification according to type plate)

- **IP64** without shaft sealing ring
- **IP65** with radial shaft sealing ring
- **IP67** with shaft sealing ring and sealing air connection

Additional specifications (not on type plate)

- Motors with fan
  - **IP65** fan motor
  - **IP2X** safety fence fan propeller

5.2.7 Output shaft, balancing and extension elements

Shaft end

Options according to type code

Shaft	Type
Smooth, without shaft sealing ring	H
Smooth, with shaft sealing ring	G
Keyway, without shaft sealing ring	L
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.

Type	Key DIN 6885-A	Centering hole DIN 332 Part 2
MS2N03-B	3 × 3 × 14	DS M3
MS2N03-D	4 × 4 × 16	DS M4
MS2N04	5 × 5 × 20	DS M5
MS2N05	6 × 6 × 32	DS M6
MS2N06	8 × 7 × 40	DS M8
MS2N07	10 × 8 × 45	DS M10
MS2N10	10 × 8 × 70	DS M12
MS2N13	14 × 9 × 80	DS M16

Remark

Keys are not included in the scope of delivery.

The design with shaft sealing ring is optional. The shaft sealing ring affects the degree of protection ➥ Chapter 5.2.6 “Degree of protection ” on page 33. 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

Bosch Rexroth recommends to have these repairs made by Bosch Rexroth Service.

Balancing

MS2N motors with keyway are balanced with ”half key” (half key balancing acc. to DIN ISO 21940-32).

The type of balancing is specified at the shaft front end or the base of the recess with " **H** " for half key balancing.

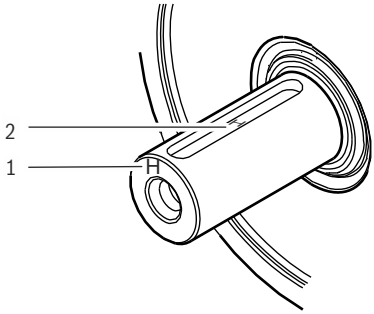


Fig. 6: Identification balancing
1 Identification of balancing at the end face of the shaft
2 Identification of balancing in the base of the recess

Attachment of drive elements

The mode of balancing of drive elements must be adjusted to the motor. Observe the notes about mounting drive elements.

⚠ 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.

Gearbox mounting on motors

The Rexroth gearbox series GTE and GTM are intended for installation at MS2N motors. Refer to the notes regarding the motor and gearbox configuration in .

Observe the instructions in the corresponding manufacturer´s documentation.

Overdetermined bearing

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

Remark

If an 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

- 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.

5.2.8 Holding brake

Holding brakes - Technical data								
Type	Holding torque	Dynamic braking torque	Rated voltage[1)]	Rated current	Maximum connection time	Maximum disconnection time	Moment of inertia of the holding brake	Maximum switched energy
	M_4	M_1	U_N	I_N	t_1	t_2	J_{br}	W_{max}
	Nm	Nm	V	A	ms	ms	kg*m^2	J
MS2N03-A___-___1-____-__	1.80	1.3	24	0.46	8	35	0.0000074	300
MS2N03-B___-___1-____-__	1.80	1.3	24	0.46	8	35	0.0000074	300
MS2N03-D___-___1-____-__	1.80	1.3	24	0.46	8	35	0.0000074	300
MS2N04-B___-___1-____-__	5.00	4.5	24	0.63	30	45	0.0000451	400
MS2N04-C___-___1-____-__	5.00	4.5	24	0.63	30	45	0.0000451	400
MS2N04-D___-___1-____-__	5.00	4.5	24	0.63	30	45	0.0000451	400
MS2N05-B___-___1-____-__	10.00	4.5	24	0.73	30	80	0.0001070	400
MS2N05-C___-___1-____-__	10.00	4.5	24	0.73	30	80	0.0001070	400
MS2N05-D___-___1-____-__	10.00	4.5	24	0.73	30	80	0.0001070	400

Holding brakes - Technical data								
Type	Holding torque	Dynamic braking torque	Rated voltage[1)]	Rated current	Maximum connection time	Maximum disconnection time	Moment of inertia of the holding brake	Maximum switched energy
	M_4	M_1	U_N	I_N	t_1	t_2	J_{br}	W_{max}
	Nm	Nm	V	A	ms	ms	kg*m²	J
MS2N06-B___-___1-____-__	10.00	4.5	24	0.73	30	80	0.0001070	400
MS2N06-C___-___1-____-__	10.00	4.5	24	0.73	30	80	0.0001070	400
MS2N06-D___-___2-____-__	15.00	11	24	0.75	50	135	0.0001400	888
MS2N06-E___-___2-____-__	15.00	11	24	0.75	50	135	0.0001400	888
MS2N07-C___-___1-____-__	20.00	12.5	24	0.78	40	100	0.0002550	340
MS2N07-D___-___2-____-__	36.00	16.5	24	0.94	60	200	0.0004100	850
MS2N07-E___-___2-____-__	36.00	16.5	24	0.94	60	200	0.0004100	850
MS2N10-B___-___1-____-__	33.00	16.5	24	0.94	60	200	0.0004100	850
MS2N10-C___-___2-____-__	53.00	23	24	1.00	70	220	0.0014700	850
MS2N10-D___-___2-____-__	53.00	23	24	1.00	70	220	0.0014700	850
MS2N10-E___-___3-____-__	90.00	33	24	1.50	65	250	0.0027000	1470
MS2N10-F___-___3-____-__	90.00	33	24	1.50	65	250	0.0027000	1470
MS2N13-B___-___1-____-__	115.00	-	24	2.10	100	240	0.005665	4,900
MS2N13-C___-___1-____-__	115.00	-	24	2.10	100	240	0.005670	4,900
MS2N13-D___-___1-____-__	115.00	-	24	2.10	100	240	0.005670	4,900
MS2N13-E___-___1-____-__	115.00	-	24	2.10	100	240	0.005670	4,900
MS2N13-C___-___2-____-__	280.00	-	24	1.70	300	350	0.020000	2,000
MS2N13-D___-___2-____-__	280.00	-	24	1.70	300	350	0.020000	2,000
MS2N13-E___-___2-____-__	280.00	-	24	1.70	300	350	0.020000	2,000

1) Tolerance ± 10%

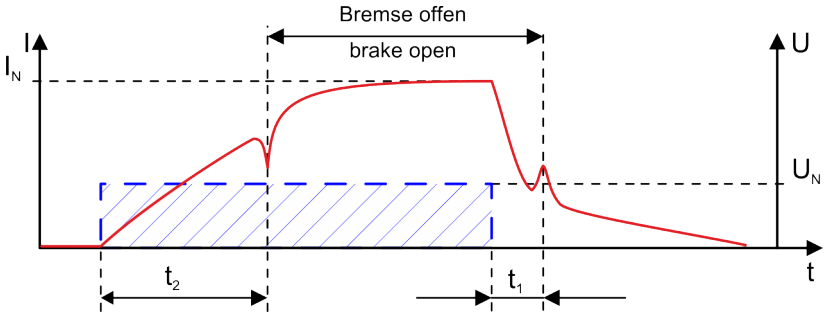


Fig. 7: Switching times of static hold mode

t_1 Connection time (close)

t_2 Disconnection time (open)

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 ≥ 5,000,000
- The holding brakes with emergency stop function are intended to secure motor shafts at standstill. **The holding brakes are no operation brakes to decelerate motors in operation from speed**.
- 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

⚠ CAUTION	**Malfunctions due to wear** Impermissibly high wear due to breaking from speed by exceeding the specified emergency stop properties. Avoid deceleration from speed during setup mode. Using the operating brake to decelerate the rotating motor is not permissible.

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 **24 V DC ±10%** is available at the motor in order to release the holding brake.

⚠ 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 ±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 38.

The holding brakes are intended for direct connection to the IndraDrive controller. A protective circuit to switch inductive loads of holding brakes is integrated in IndraDrive controllers. Please observe when operating of third-party converters that MS2N motors do not have an integrated protective circuit.

Energy saving function for holding brakes

Decrease brake voltage

The control voltage of the holding brake in MS2N 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 MS2N holding brakes, the following conditions apply:

- Maximum decrease of control voltage to $U_N \geq 17\ V_{DC}$
- 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

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 technology

The permanent magnet brake of a MS2N motor 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 individuals by superordinate protective measures such as cordoning off of danger zones using protective fences or grids.

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 safety requirements valid for the case of application and observe the safety requirements during plant design. Comply with national regulations at the installation site of the system.

Commissioning and maintenance instructions

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 (torque wrench) or automatically by means of the software function.

Manually check holding torque (M4)

1. Disconnect the motor from the power supply and secure it against being switched on again.
2. Measure the transferable holding torque (M4) of the holding brake with a torque wrench.

Check holding torque (M4) automatically

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. Contact the Rexroth service department.

5.2.9 Vibration behavior

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

5.2.10 Bearing

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

Table 16: Bearing size MS2N

Type	Bearing size DE	Bearing size NDE	Floating bearing	Fixed bearing
MS2N03	6001	6000	DE	NDE
MS2N04	6003	6001	DE	NDE
MS2N05	6204	6303	DE	NDE
MS2N06	6206	6303	DE	NDE
MS2N07	6207	6205	DE	NDE
MS2N10	6309	6306	DE	NDE
MS2N13	6212	6211	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 according to ➦ Table 17 “Mean speed - basis of calculated grease service life” on page 41:

Table 17: Mean speed - basis of calculated grease service life

Type	Mean speed
MS2N03, -04, -05, -06	≤ 3,500 1/min
MS2N07	≤ 3,000 1/min
MS2N10	≤ 2,000 1/min
MS2N13	≤ 1,800 1/min

The following standard values apply under the specified preconditions for the 60K and 100K operation modes:

L_{10h} in case of operation after S1-60K

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

L_{10h} in case of operation after S1-100K

L_{10h} = 20.000 h, in case of utilization after S1-100K and max. load factor 90% during the runtime.

Remark

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.

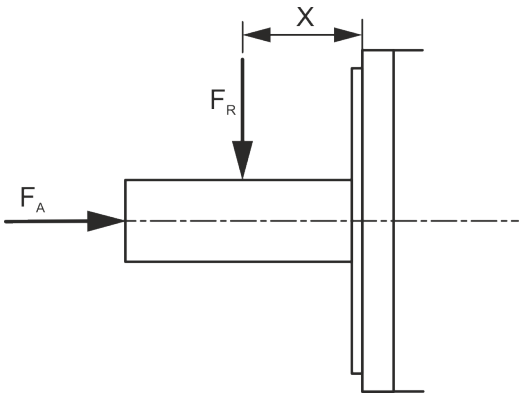


Fig. 8: Point of action of radial force F_R and axial force F_A

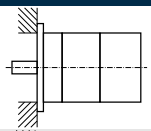
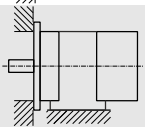
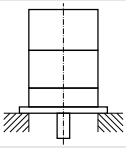
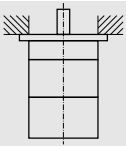
The axial force values are the minimum permissible axial forces F_A without limitations. A detailed dimensioning is only possible if more boundary conditions are known:

- Occurring radial force and axial 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 project planning manual.

5.2.11 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)		
IM B5 / IM 3001		Flange attachment on the drive side of the flange
IM B35 / IM 2001 (only MS2N13)		Foot installation, feet below, with additional flange mounting on drive side of the flange
IM V1 / IM 3011		Flange attachment on the drive side of the flange, drive side facing down
IM V3 / IM 3031		Flange attachment on the drive side of the flange, drive side facing up

Avoid liquid at the drive shaft or the shaft sealing ring in case of vertical installation according to IM V3. For further information regarding the protection class, see ➥ Chapter 5.2.6 “Degree of protection ” on page 33.

5.2.12 Coating

One-layer standard varnish (1K), water-based, in conductive form, RAL9005 jet black

An additional varnish with a coat thickness of max. 40 µm is allowed.

Protect all safety notes (stickers), type plates and open connectors with a painting protection when painting additionally.

5.2.13 Noise emission

The typical sound pressure level Lp(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

MS2N Synchronous servomotors are equipped with windings in toothed coil technology for a compact motor design; typical of toothed coil technology are undershoots and harmonics in the magnetic air gap field. The high number of harmonics and undershaft in connection with the 4 kHz frequency of the converters can lead to magnetic noise stimulation in certain speed ranges, especially if a mechanic motor-self frequency is stimulated velocity-dependent. If this noise is found to be disturbing, a switchover of the PWM clock frequency from 4 kHz to 8 kHz optimized for the motor type can be used. Therewith, the stimulation of motor-self frequencies caused by the 4 kHz frequency can be avoided.

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

The PWM switch (4 kHz / 8 kHz) can be selected and observed during **drive sizing with IndraSize**.

6 Transport and storage

6.1 Storage

General storage conditions

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 follwing table must be observed.

Table 18: 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 6.3 “Shock load during transport und storage ” on page 46

Storage time

The maximum storage duration is 2 years.

Storage durations of more than 6 months require conservation measures by the customer. Treat untreated surfaces, e. g. shaft, flange, with preserving agents.

Irrespective of the storage period, which may also extend beyond the warranty period, the function of the products is maintained if additional measures are observed and implemented during commissioning. Warranty extension is not a consequence.

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

- **> 1 month storage time**
  - Visual inspection of all parts to be damage-free
  - Resurface the holding brake
- **> 6 months storage time (additionally)**
  - Check conservation measures. Renew corrision protection if necessary. Remove the preserving agent before commissioning
- **> 12 months storage time (additionally)**
  - 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 1/min
  - Measure insulation resistance. Dry the winding at a value of < 1 kΩ per volt rated voltage.
- **> 24 months storage time (additionally)**
  - Function test and product revision if necessary by Bosch Rexroth Service

6.2 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 19: Deviations and enhancements of classification (DIN EN IEC 60721-3-2)

Transport	
Ambient temperature	-25 ... +70 °C
Relative humidity	5 ... 75 %
Shock load	➦ Chapter 6.3 “Shock load during transport und storage ” on page 46

Remark

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

Instructions on transport by air

If motor components with permanent magnets are shipped by air, the DGR (**D**angerous **G**oods **R**egulations) 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).

6.2.1 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.

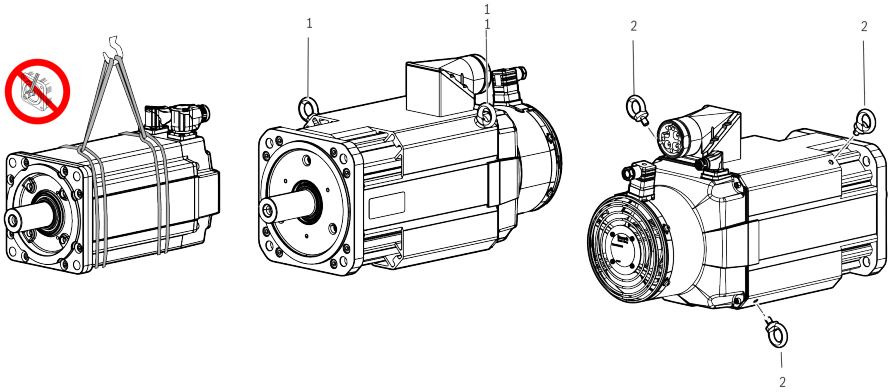


Fig. 9: Lifting and transporting motors

1 Eye bolts (check firm seating before use)
2 Eye bolts alternative position (check firm seat before use)

- 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.

6.3 Shock load during transport und storage

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

Table 20: Permissible shock load for MS2N motors

Frame size	Maximum allowed shock load (11 ms)	
	axial	radial
MS2N03, -04, -05	100 m/s²	1000 m/s²
MS2N06	100 m/s²	500 m/s²
MS2N07	100 m/s²	300 m/s²
MS2N10, -13	100 m/s²	200 m/s²

The specified limit values do not apply to half-sine-shaped single shock load acc. to EN 60068-2-27.

Remark

The specifications do **not apply to motor operation**. Applications with continuous shock load make a case-by-case review necessary.

7 Assembly

7.1 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.

7.2 Foot mounting

Fastening via mounting feet is only available for MS2N13. The screw connection must be adapted to the installation situation (screw length, strength class, screw-in depth, material, ...) The dimensioning of the screw connection is the responsibility of the customer. Before attaching the motors according

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

Remark

The mounting holes and clearances correspond to the general tolerance according to DIN ISO 2768-1 (tolerance class m). Before attaching the motor to the machine, it must be aligned so that the center line of the motor shaft is aligned with the center line of the connecting shaft.

1. Dismount the lower lateral air baffles to have free access to the mounting holes. Only for motors with forced ventilation.
2. Align the motor so that the center line of the motor shaft is aligned with the center line of the machine connecting shaft. To align the motor, use sheet steel strips as a base.
3. Connect the motor firmly to the machine (for tightening torques, see ➥ Chapter 5.2.2 “Mechanical interfaces” on page 19).
4. Reattach the air baffles to the motor.

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

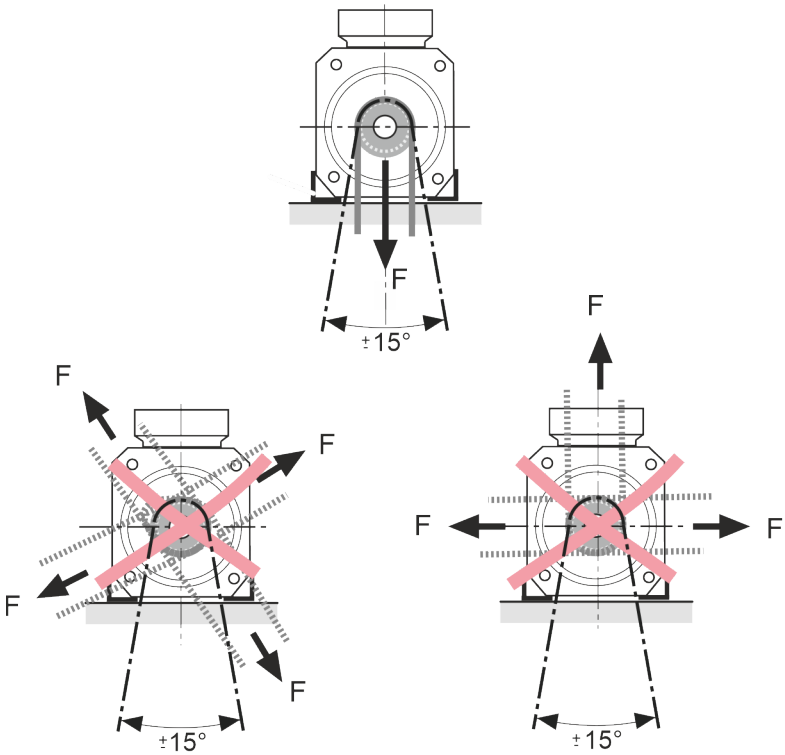


Fig. 10: Force direction at foot mounting

Please note the following in case of foot mounting

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

  Forces taking effect via the gear shaft must be supported against the gear.
- Incorrect installation situations give rise to forces which may cause short-term damage to the motors.

If necessary, consider "flange assembly" as an alternative.

7.3 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

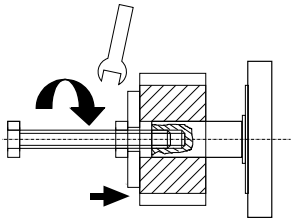


Fig. 11: Fitting the transmission element

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

7.4 Electrical connection

7.4.1 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

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.

7.4.2 Circuit diagram

Single-cable connection for MS2N with encoder (digital C, D, H, J, M) and optional brake

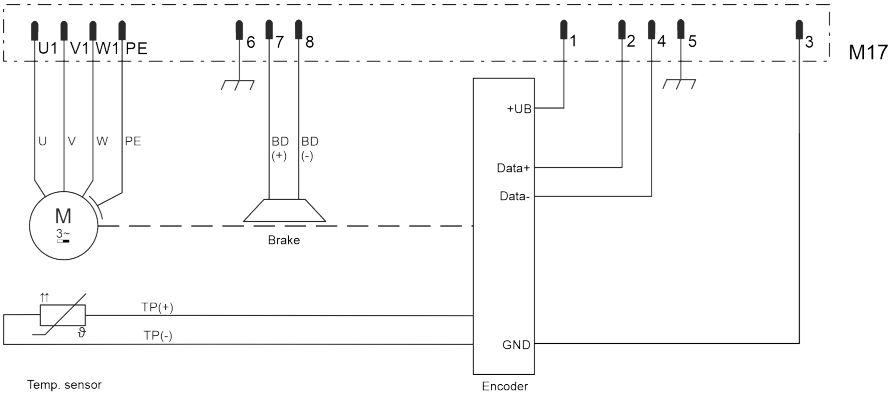


Fig. 12: M17 Single cable connection, digital encoder (C, D, H, J, M) optional brake

Single-cable connection for MS2N with encoder (digital C, D, H, J, M) and optional brake

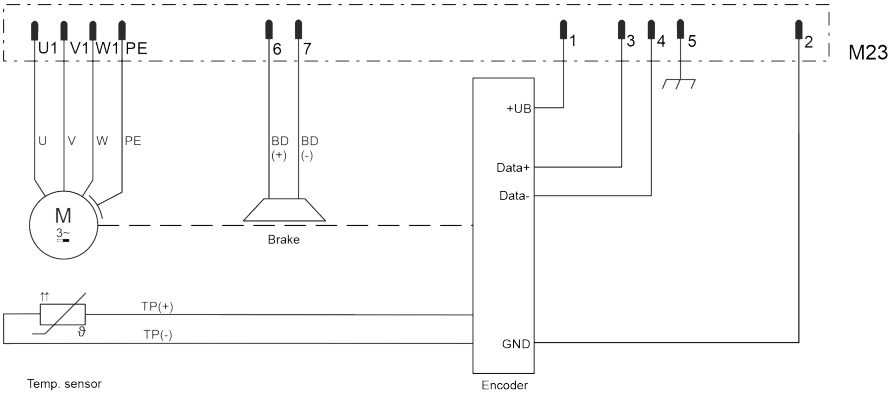


Fig. 13: M23 Single cable connection, digital encoder (C, D, H, J, M) optional brake

Double cable connection for MS2N with encoder (analog A, B) and optional brake

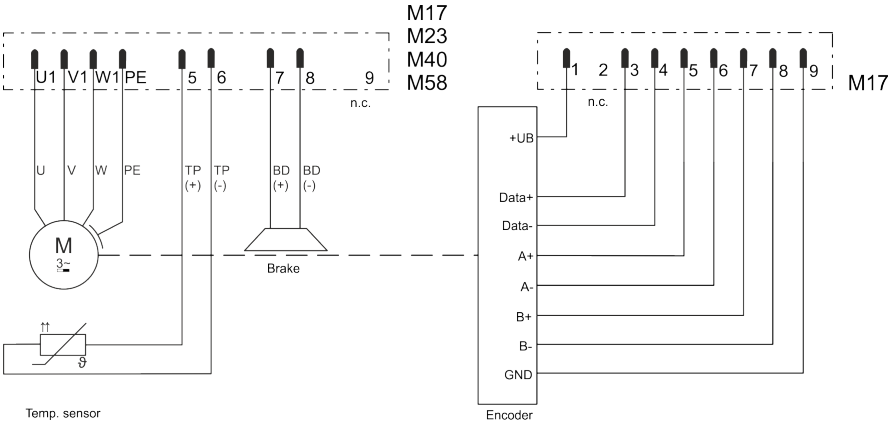


Fig. 14: Double cable connection, analog encoder A, brake optional

Double cable connection for MS2N with encoder (digital C, D, H, J, M) and optional brake

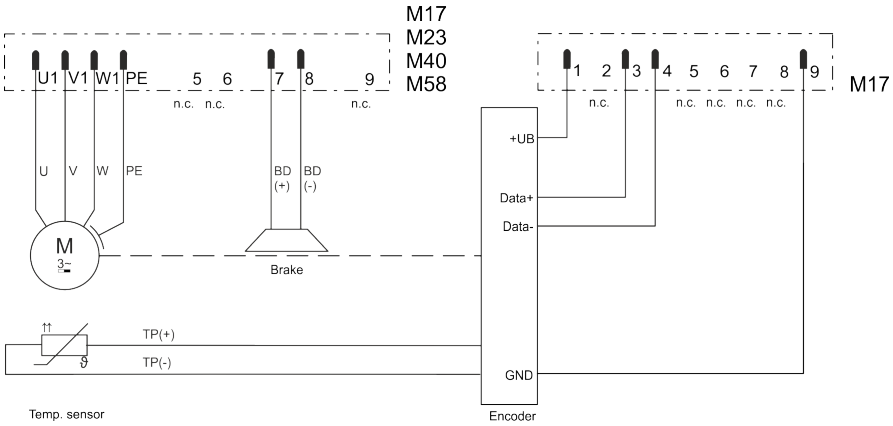


Fig. 15: Double cable connection, digital encoder (C, D H, J, M), optional brake

Double cable connection terminal box for MS2N with encoder (analog A, B) and optional brake

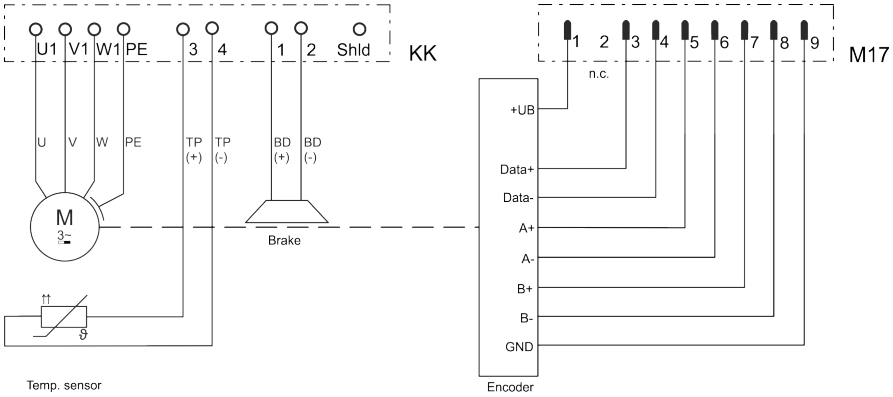


Fig. 16: Double cable connection terminal boxes, analog encoder A, brake optional

Double cable connection for terminal boxes for MS2N with encoder (digital C, D, H, J, M) and optional brake

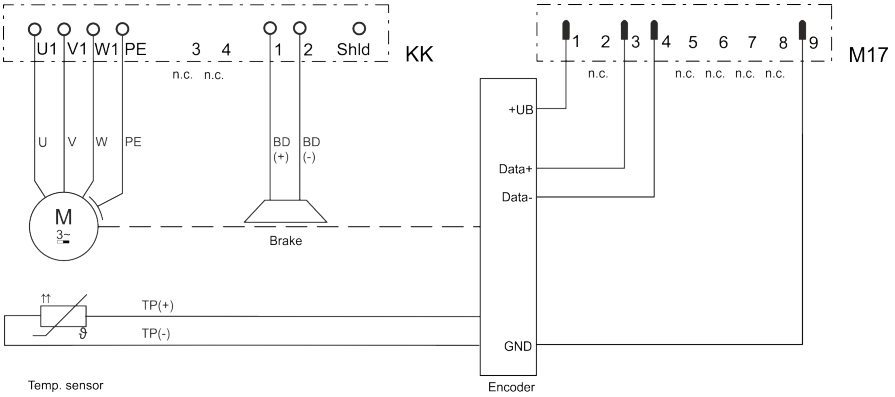


Fig. 17: Double cable connection terminal boxes, digital encoder (C, D, H, J, M), optional brake

Fan 1-phase 115 V

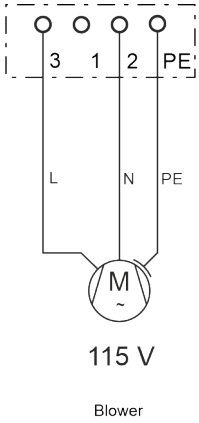


Fig. 18: MS2N Fan connection 115 V

Fan 1-phase 230 V

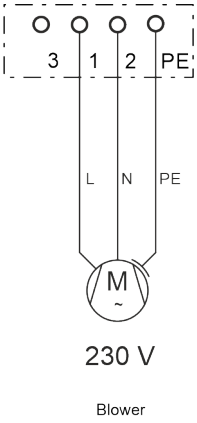


Fig. 19: MS2N Fan connection 230 V

Fan 3-phase 400 / 480 V

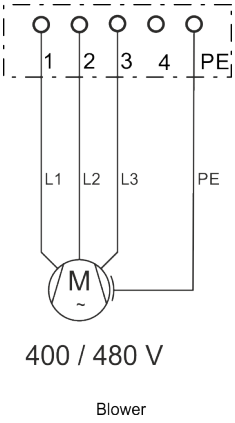
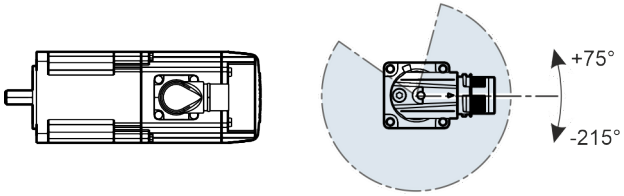


Fig. 20: MS2N Fan connection 400 / 480 V

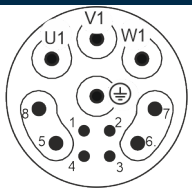
7.4.3 MS2N Electrical connection H

M17 view (single cable connection) / rotation range



Device connector	Single cable connection
Connector size	M17
Output direction	rotatable (max. 10x)
Adjustment torque	4 ... 10 Nm
Locking	SpeedTec

Pol pattern M23 (single cable connection)



Assignment M17 (single cable connection)

MS2N	Encoder C, D, H, J, M	Cable**)
U1	A1	1
V1	A2	2
W1	A3	3
⏚	PE	GNYE
1	+UB	BU
2	Data+	OG
3	GND	WH
4	Data-	YE
5	Shld_Enc	Shld_Enc
6	Shld_BD	Shld_BD
7	BD(+) *)	RD
8	BD(-) *)	BU

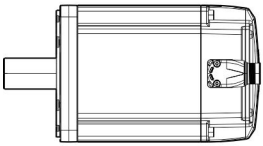
*) n.c. without brake

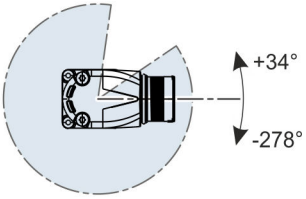
**) Bosch Rexroth types REH, RH2, RHB2

For instructions for assembly about SpeedTec connector refer to➥ Chapter 7.4.17 “SpeedTec connector” on page 74

7.4.4 MS2N Electrical connection S

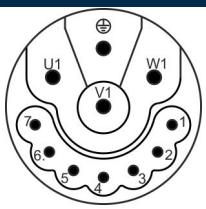
M23 view (single cable connection) / rotation range





Device connector	Single cable connection
Connector size	M23
Output direction	rotatable (max. 10x)
Adjustment torque	4 ... 10 Nm
Locking	SpeedCon

Pol pattern M23 (single cable connection)



Assignment M23 (single cable connection)

MS2N	Encoder C, D, H, J, M	Cable**)
U1	A1	1
V1	A2	2
W1	A3	3
⏚	PE	GNYE
1	+UB	BU
2	GND	WH
3	Data+	OG
4	Data-	YE
5	Shld	Shld
6	BD(+) *)	7
7	BD(-) *)	8

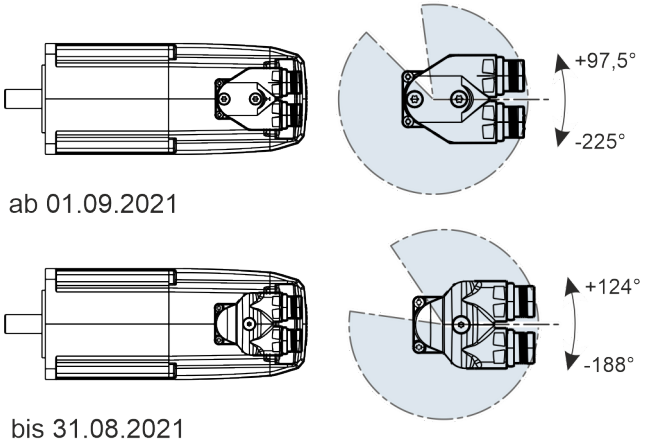
*) n.c. without brake

**) Bosch Rexroth types REH, RH2, RHB2

Note for assembly about SpeedCon connectors, see ➦ Chapter 7.4.16 “SpeedCon connectors” on page 73.

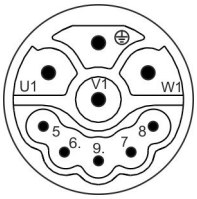
7.4.5 MS2N Electrical connection D

View M17 (double cable connection) / rotating area



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

Pole pattern M17, power



Assignment M17, power (double cable connection)

MS2N	Encoder A, B	Encoder C, D, H, J, M	Cable**)
U1	A1	A1	1 (BN)
V1	A2	A2	2 (BK)
W1	A3	A3	3 (GY)
⏚	PE	PE	GNYE
5	TP(+)	n.c.	5 (PK)
6	TP(-)	n.c.	6 (WH)
7	BD(+) *)	BD(+) *)	7 (RD)
8	BD(-) *)	BD(-) *)	8 (BU)
9	n.c.	n.c.	Shld

Assignment M17, power (double cable connection)			
MS2N	**Encoder A, B**	**Encoder C, D, H, J, M**	**Cable******)**

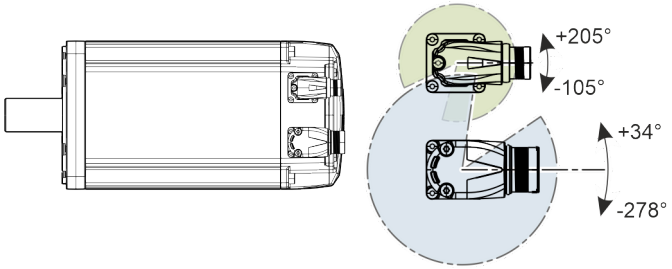
*) n.c. without brake

**) Bosch Rexroth types REL, RL2, RLB2

Note for assembly about SpeedCon connectors, see ➦ Chapter 7.4.16 “SpeedCon connectors” on page 73.

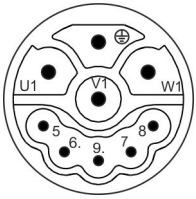
7.4.6 MS2N Electrical connection U

View M23 power, M17 encoder (Dobule cable connection) / rotating area



Device connector	Power	Encoder
Connector size	M23	M17
Output direction	rotatable (max. 10x)	
Adjustment torque	4 ... 10 Nm	2. 6 Nm
Locking	SpeedCon	SpeedCon

Pole pattern M23, power



Assignment M23, power (double cable connection)

MS2N	Encoder A, B	Encoder C, D, H, J, M	Cable**)
U1	A1	A1	1 (BN)
V1	A2	A2	2 (BK)
W1	A3	A3	3 (GY)
⏚	PE	PE	GNYE
5	TP(+)	n.c.	5 (PK)
6	TP(-)	n.c.	6 (WH)
7	BD(+) *)	BD(+) *)	7 (RD)
8	BD(-) *)	BD(-) *)	8 (BU)
9	n.c.	n.c.	Shld

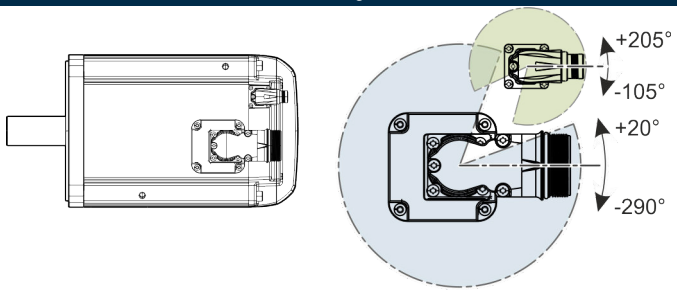
*) n.c. without brake

**) Bosch Rexroth types REL, RL2, RLB2

Note for assembly about SpeedCon connectors, see ➦ Chapter 7.4.16 “SpeedCon connectors” on page 73

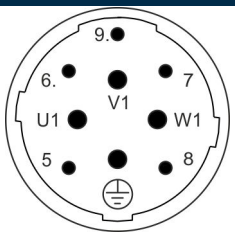
7.4.7 MS2N Electrical connection V

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



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

Pole pattern M40



Assignment M40, power (double cable connection)

MS2N	Encoder A, B	Encoder C, D, H, J, M	Cable**)
U1	A1	A1	1
V1	A2	A2	2
W1	A3	A3	3
⏚	PE	PE	GNYE
5	TP(+)	n.c.	5
6	TP(-)	n.c.	6
7	BD(+) *)	BD(+) *)	7
8	BD(-) *)	BD(-) *)	8
9	n.c.	n.c.	Shld

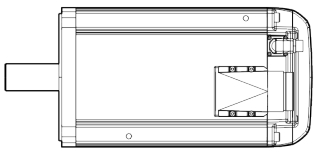
*) n.c. without brake

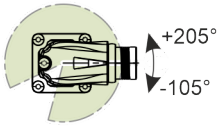
**) Bosch Rexroth types REL, RL2, RLB2

Note for assembly about SpeedCon connectors, see ➦ Chapter 7.4.16 “SpeedCon connectors” on page 73.

7.4.8 MS2N Electrical connection A or B

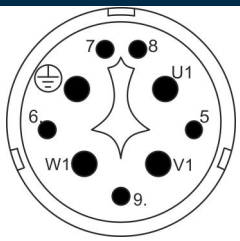
View M58 power, M17 encoder (double cable connection) / rotating area





Device connector	Power	Encoder
Connector size	M58	M17
Output direction	A-side / B-side	rotatable (max. 10x)
Adjustment torque	-	2 ... 6 Nm
Locking	Thread	SpeedCon

Pole pattern M58, power



Assignment M58, power (double cable connection)

MS2N	Encoder A, B	Encoder C, D, H, J, M	Cable**)
U1	A1	A1	1
V1	A2	A2	2
W1	A3	A3	3
⏚	PE	PE	GNYE
5	TP(+)	n.c.	5
6	TP(-)	n.c.	6
7	BD(+) *)	BD(+) *)	7
8	BD(-) *)	BD(-) *)	8
9	n.c.	n.c.	Shld

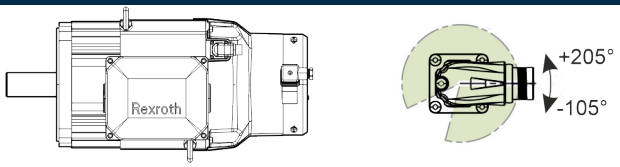
*) n.c. without brake

**) Bosch Rexroth types REL, RL2, RLB2

Note for assembly for M58 connector with thread, see ➥ Chapter 7.4.18 “Plug-in connector with threaded connection” on page 77.

7.4.9 MS2N Electrical connection T

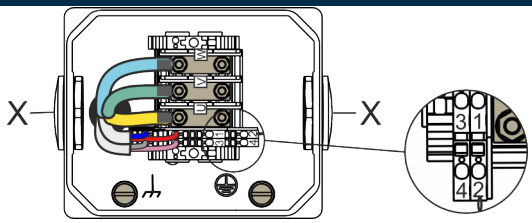
View terminal box T power, M17 encoder (double cable connection) / rotating area



Power	Terminal box
Output direction	A-side / B-side

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

Terminal boxes “T” power



Pin assignment, terminal boxes “T”, power

MS2N	Encoder A, B	Encoder C, D, H, J, M	Cable**)
U	A1	A1	1
V	A2	A2	2
W	A3	A3	3
1	BD(+) *)	BD(+) *)	7
2	BD(-) *)	BD(-) *)	8
3	TP1(+)	n.c.	5
4	TP2(-)	n.c.	6
⏚	PE	PE	GNYE
⏚	Shld	Shld	Shld

*) n.c. without brake

**) Bosch Rexroth types REL, RL2, RLB2

Remark

– Assign not used connection wires within the terminal box.

Technical data, connection points terminal boxes "T", power	
U, V, W	Bolts M5, M_A 2 … 3 Nm Rated cross section 16 mm^2 Rated current 65 A
1-4	Tension spring connection 0.5 … 2.5 mm^2 with wire end ferrule
⏚, ⏚	Screwed connection M8, M_A 3.8 Nm

The cable entries “X” are locked with a dummy plugs, at delivery. For bolted threads refer to the following table.

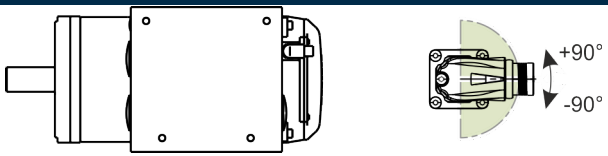
Cable entries "X", terminal boxes "T", power	
Motor	**Size "X"**
MS2N10-C0BHA-__T__-____-__	2 x M32
MS2N10-C0BHB-__T__-____-__	
MS2N10-C0BNA-__T__-____-__	
MS2N10-C0BNB-__T__-____-__	
MS2N10-C0BHL-__T__-____-__	
MS2N10-C0BNL-__T__-____-__	
MS2N10-D0BHA-__T__-____-__	2 x M40
MS2N10-D0BHB-__T__-____-__	
MS2N10-D0BNA-__T__-____-__	
MS2N10-D0BNB-__T__-____-__	
MS2N10-E0BHA-__T__-____-__	
MS2N10-E0BHB-__T__-____-__	
MS2N10-E0BNA-__T__-____-__	
MS2N10-E0BNB-__T__-____-__	
MS2N10-F0BDA-__T__-____-__	
MS2N10-F0BDB-__T__-____-__	
MS2N10-F0BHA-__T__-____-__	
MS2N10-F0BHB-__T__-____-__	
MS2N10-E1BNA-__T__-____-__	
MS2N10-E1BNB-__T__-____-__	
MS2N10-F1BHA-__T__-____-__	
MS2N10-F1BHB-__T__-____-__	
MS2N10-D0BHL-__T__-____-__	
MS2N10-D0BNL-__T__-____-__	
MS2N10-E0BHL-__T__-____-__	

Note for assembly about SpeedCon connectors, see ➦ Chapter 7.4.16 “SpeedCon connectors” on page 73

7.4.10 MS2N Electrical connection C

Rotating area

View terminal box "C" power, M17 encoder (double cable connection) / rotating area

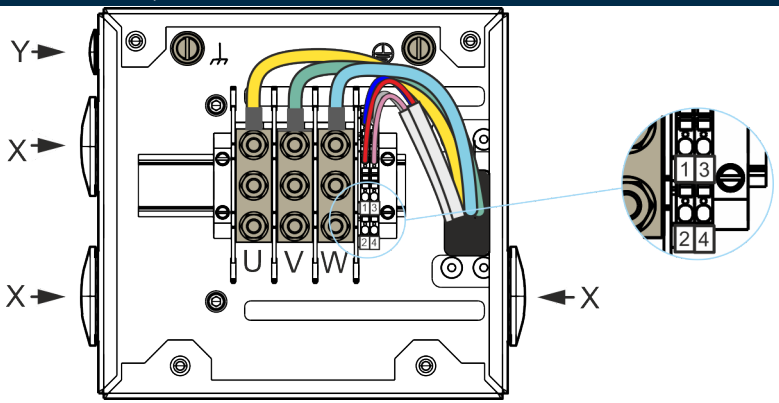


Power	Terminal box
Output direction	A-side / B-side

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

Terminal boxes size "C" (MS2N10)

Terminal boxes "C (MS2N10)", power



Pin assignment, terminal boxes "C (MS2N10)", power

MS2N	Encoder A, B	Encoder C, D, H, J, M	Cable**)
U	A1	A1	1
V	A2	A2	2
W	A3	A3	3
1	BD(+) *)	BD(+) *)	7
2	BD(-) *)	BD(-) *)	8
3	TP1(+)	n.c.	5
4	TP2(-)	n.c.	6

Pin assignment, terminal boxes “C (MS2N10)”, power			
MS2N	Encoder A, B	Encoder C, D, H, J, M	Cable**)
⏚	PE	PE	GNYE
⏚	Shld	Shld	Shld

*) n.c. without brake

**) Bosch Rexroth types REL, RL2, RLB2

Remark

– Assign not used connection wires within the terminal box.

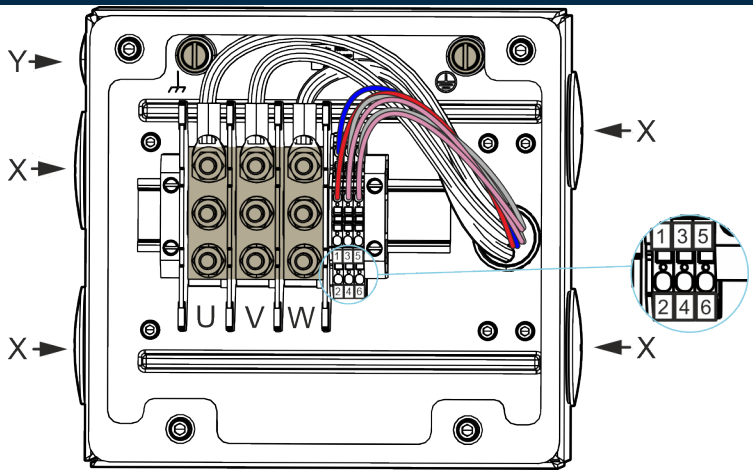
Technica data, connection points terminal boxes "C (MS2N10)", power	
U, V, W	Bolts M8, M_A 6 … 12 Nm
	Rated cross section 50 mm ²
	Rated current 150 A
1-4	Tension spring connection 0.5 … 2.5 mm ² with wire end ferrules
⏚, ⏚	Screwed connection M8, M_A 3.5 Nm

The cable entries “X” and “Y” are locked with dummy plugs, at delivery. For bolted threads refer to the following table.

Cable entries “X” and “Y”, terminal boxes "C (MS2N10)", power		
Motor	Size "X"	Size “Y"
MS2N10-E0BNL-__C__-____-__	3x M50	1x M20
MS2N10-F0BHL-__C__-____-__		
MS2N10-R0BQL-__C__-____-__		

Terminal boxes size “C” (MS2N13)

Terminal boxes “C (MS2N13)”, power



Pin assignment, terminal boxes “C (MS2N13)”, power

MS2N	Encoder A, B	Encoder C, D, H, J, M	Cable**)
U	A1	A1	1
V	A2	A2	2
W	A3	A3	3
1	BD(+) *)	BD(+) *)	7
2	BD(-) *)	BD(-) *)	8
3	TP1(+)	n.c.	5
4	TP2(-)	n.c.	6
⏚	PE	PE	GNYE
⏚	Shld	Shld	Shld

*) n.c. without brake

**) Bosch Rexroth types REL, RL2, RLB2

Remark

– Assign not used connection wires within the terminal box.

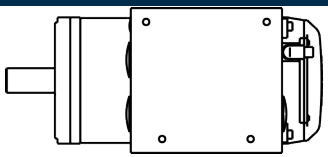
Technical data, connection poins terminal boxes "C (MS2N13)", power	
U, V, W	Bolts M8, M_A 6 ... 12 Nm
	Rated cross section 50 mm ^{2}
	Rated current 150 A
1-4	Tension spring connection 0.5 ... 2.5 mm ^{2} with wire end ferrules
⏚, ⏚	Screwed connection M8, M_A 3.5 Nm

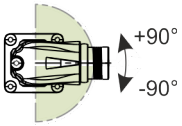
The cable entries “X” and “Y” are locked with dummy plugs, at delivery. For bolted threads refer to the following table.

Cable entries "X" and "Y", terminal boxes "C (MS2N13)", power		
Motor	**Size "X"**	**Size "Y"**
MS2N13-B1BHN-__C__-____-__	4x M50	1x M20
MS2N13-B1BNN-__C__-____-__		
MS2N13-C1BHN-__C__-____-__		
MS2N13-C1BNN-__C__-____-__		
MS2N13-B1BHC-__C__-____-__		
MS2N13-B1BNC-__C__-____-__		
MS2N13-C1BHC-__C__-____-__		
MS2N13-C1BNC-__C__-____-__		
MS2N13-B1BHL-__C__-____-__		
MS2N13-B1BNL-__C__-____-__		
MS2N13-C1BHL-__C__-____-__		
MS2N13-C1BNL-__C__-____-__		

7.4.11 MS2N Electrical connection E

View terminal box "E" power, M17 encoder (double cable connection) / rotating area

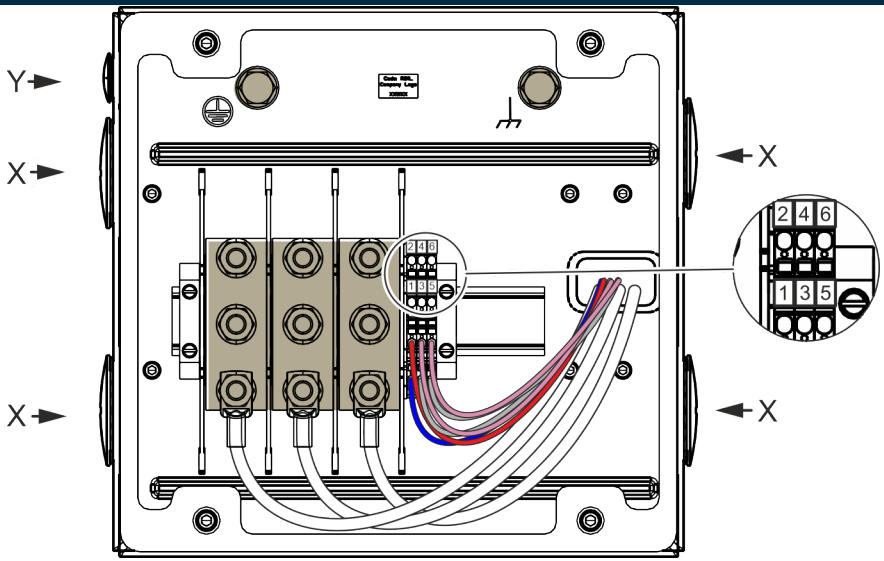




Power	Terminal box
Output direction	A-side / B-side

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

Terminal boxes “E” power



Pin assignment, terminal boxes “E”, power

MS2N	Encoder A, B	Encoder C, D, H, J, M	Cable**)
U	A1	A1	1
V	A2	A2	2
W	A3	A3	3
1	BD(+) *)	BD(+) *)	7
2	BD(-) *)	BD(-) *)	8

Pin assignment, terminal boxes “E”, power			
MS2N	Encoder A, B	Encoder C, D, H, J, M	Cable**)
3	TP1(+)	n.c.	5
4	TP2(-)	n.c.	6
⏚	PE	PE	GNYE
⏚	Shld	Shld	Shld

*) n.c. without brake

**) Bosch Rexroth types REL, RL2, RLB2

Remark

– Assign not used connection wires within the terminal box.

Technical data, connection points terminal boxes "E", power	
U, V, W	Bolts M10, M_A 10 ... 20 Nm Rated cross section 50 6 ... 120 mm^2 Rated current 269 A
1-4	Tension spring connection 0.5 ... 2.5 mm^2 with wire end ferrules
⏚, ⏚	Screwed connection M10, M_A 10 Nm

Remark

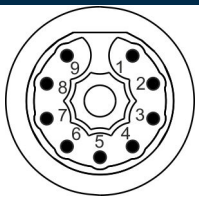
The terminal block can be moved on the top-hat rail in order to be able to wire cable outlet directions optimally. The terminal box is suited for double cabling

The cable entries “X” and “Y” are locked with dummy plugs, at delivery. For bolted threads refer to the following table.

Cable entries "X" and "Y", terminal boxes "T", power		
Motor	Size "X"	Size "Y"
MS2N13-D1BHN-__E__-____-__	4x M50	1x M20
MS2N13-D1BNN-__E__-____-__		
MS2N13-E1BHN-__E__-____-__		
MS2N13-E1BNN-__E__-____-__		
MS2N13-D1BHC-__E__-____-__		
MS2N13-D1BNC-__E__-____-__		
MS2N13-E1BNC-__E__-____-__		
MS2N13-E1BHC-__E__-____-__		
MS2N13-D1BHL-__E__-____-__		
MS2N13-D1BNL-__E__-____-__		
MS2N13-E1BHL-__E__-____-__		
MS2N13-E1BNL-__E__-____-__		

7.4.12 MS2N Electrical connection “Encoder"

Pol pattern M17, encoder (double cable connection)



Assignment M17, encoder (double cable connection)

MS2N	Encoder A, B	Encoder C, D, H, J, M
1	+UB	+UB
2	n.c.	n.c.
3	Data+	Data+
4	Data-	Data-
5	A+	n.c.
6	A-	n.c.
7	B+	n.c.
8	B-	n.c.
9	GND	GND

Note for assembly about SpeedCon connectors, see ➦ Chapter 7.4.16 “SpeedCon connectors” on page 73

7.4.13 Fan 1-phase 115 / 230 V

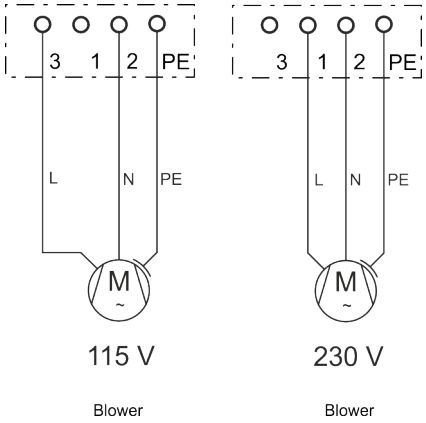


Fig. 21: MS2N Fan connection 115/ 230 V

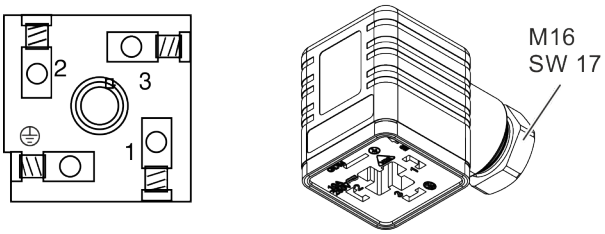


Fig. 22: RLSxxxx_Single components fan connector

Table 21: Connector fan unit for MS2N__-___A (U_N 230 V) / MS2N__-___B (U_N 115 V)

Assignment		Connection
1	L1 230 V	Screwed connection 0.5 ... 1.5 mm²
2	N	
3	L1 115 V	
⏚	PE	

Remark

The plug insert can be mounted in any position into the connector housing. Therewith, the cable output direction can be done in steps of 90 degrees.

Protection by integrated thermal protection

MS2N Fan 115 / 230 V with integrated thermal protection do not need an external motor protective switch.

7.4.14 Fan 3-phase 400 / 480 V

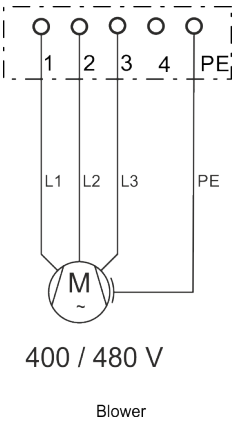


Fig. 23: MS2N Fan connection 400 / 480 V

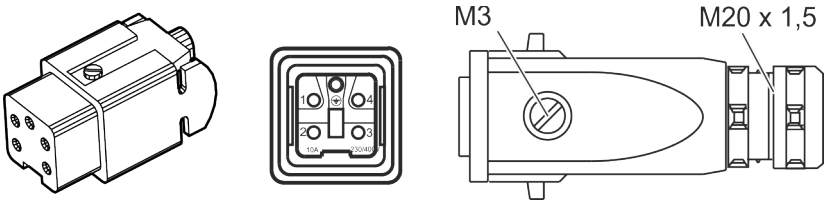


Fig. 24: RLS0782_Single components fan connector

Table 22: Connector fan unit for MS2N__-___C (U_N400 / 480 V)

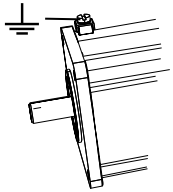
Assignment		Connection
1	L1	0.5 ... 2.5 mm²
2	L2	22 ... 12 AWG
3	L3	Clamping screws M3 / tightening torque 0.5 ... 0.7 Nm
4	n. c.	
⏚	PE	

Protection by motor protection switch

The fan units are connected via adjustable motor protection devices. The motor protection switch must be set to the rated current of the fan unit. When selecting the motor protection switches, make sure that the setting range matches the rated current of the fan unit.

7.4.15 Ground connection

For MS2N motors, an additional grounding connection is provided. Refer to the following data to provide an additional grounding connection.



Ground connection	Screw M5
Clamping range	4 mm² (fine-wired); 6 mm² (single stranded)
Tightening torque	maximum 2 Nm
Mounting notes	The screw terminal block with clamping bracket has to be assigned in a correct way according to EN 60999-1: 2000.

7.4.16 SpeedCon connectors

⚠ WARNING

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

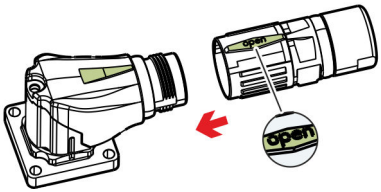
- Only disconnect or connect plug connections when they are dry and de-energized.
- During operation of the system, all plug connections must be firmly locked or screwed tight.

Observe when connecting the flange sockets:

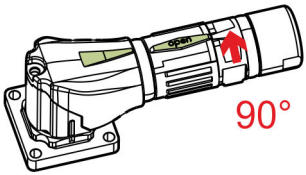
- Protect the device connectors from external force effect.
- Connect the motor to ready-made connection cables.

Connect SpeedCon connectors

Before connecting, please ensure properly measured ready-made connection cables are available. The type, size and cable cross section of the plug-in connector must be adjusted to the motor.



1. Insert power connector in position “open”.



2. Manually tighten the power connector with a rotation by approx. 90°.
3. Check the firm seat of the SpeedCon quick lock by short pull on the connector.
4. Secure the cables, that accruing forces due to cable vibrations onto the connector are prevented.
   ➡ The plug-in connector is ready for use.

7.4.17 SpeedTec connector

⚠ 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 and de-energized. – During operation of the system, all plug connections must be firmly locked or screwed tight.

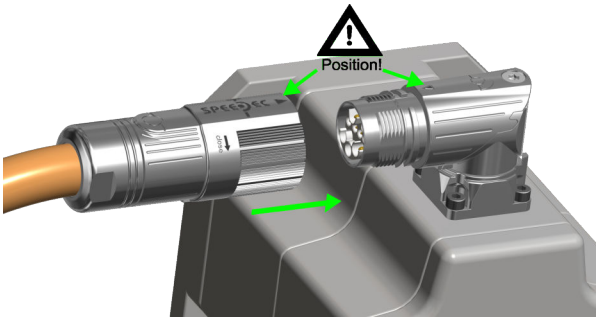
Observe when connecting the flange sockets:

- Protect the device connectors from external force effect.
- Connect the motor to ready-made connection cables.

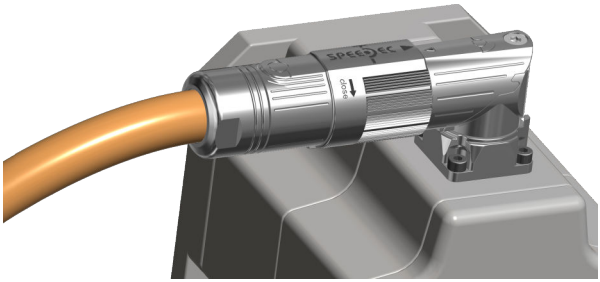
Connect SpeedTec connector

Material: • Hybrid connector, size M17 (RHS1701/CM07)

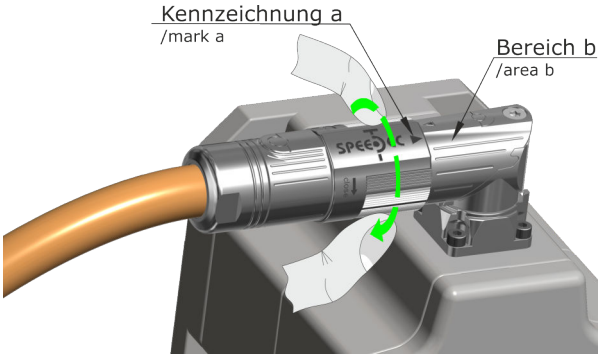
Before connecting, please ensure properly measured ready-made connection cables are available. The type, size and cable cross section of the plug-in connector must be adjusted to the motor.

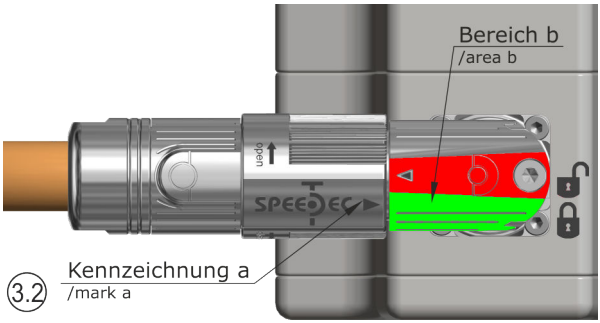


1. Code and mount the connector



2. Attach the connector





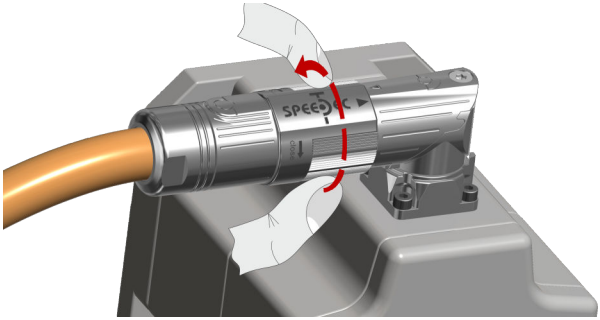
3. Turn the nut clockwise (arrow direction “close”)

   Tightening torque hand-tight or 1.5 Nm. At a minimum, the lock must be turned by approx. 20° (at least 3 clicks), or until the marking a is in the area b.

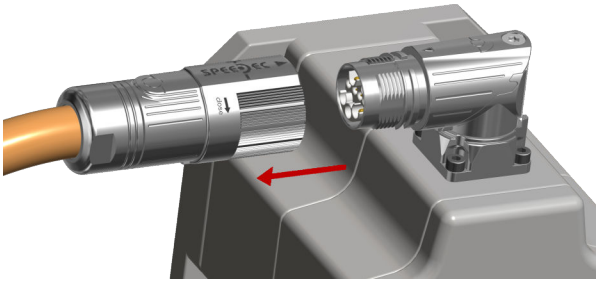
   ➡ Should this position be reached, the connector is safely locked.

4. Secure the cables, that accruing forces due to cable vibrations onto the connector are prevented.

Disconnect SpeedTec connector



1. Turn the nut counterclockwise (arrow direction “open”)



2. Straight and evenly disconnect the connector from the mounting box.
   ➡ The plug is disconnected.

7.4.18 Plug-in connector with threaded connection

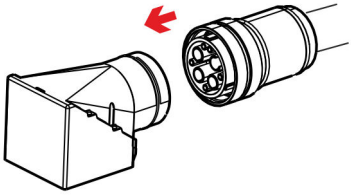
⚠ WARNING	**Risk of personal injury or damage to property due to disconnecting or connecting live plug connections!** – Only disconnect or connect plug connections when they are dry and de-energized. – During operation of the system, all plug connections must be firmly locked or screwed tight.

Observe when connecting the flange sockets:

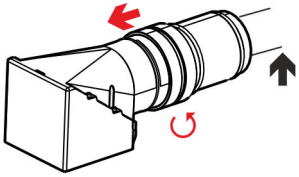
- Protect the device connectors from external force effect.
- Connect the motor to ready-made connection cables.

Connect the plug-in connector with the threaded connector M58

Before connecting, please ensure properly measured ready-made connection cables are available. The type, size and cable cross section of the plug-in connector must be adjusted to the motor.



1. Position power connector at thread.



2. Tighten knurled nut securely, in doing so, retrace cable.
3. Check the firm seat of the connection by short pull on the connector.
4. Secure the cables, that accruing forces due to cable vibrations onto the connector are prevented.
   ➡ The plug-in connector is ready for use.

7.4.19 Connect the terminal box.

⚠ WARNING	Danger to life by high electric voltage!
	– Follow the general installation and safety regulations when working on power installations. – Before start-up, connect the protective conductors on all electric components according to the connection plan. – Install the covers and guards provided for this purpose before switching on. Lock all openings of the terminal box with dummy plugs and close the terminal box with the intended terminal box lid. – Never touch electrical connection points of the components while power is turned on.

Observe when connecting the terminal box:

- Connect or disconnect clamp connections only in de-energized, dry and clean state.
- Connect the motor to ready-made connection cables.
- Remove dummy plug X or Y at the cable entry side.
- Select and tighten the cable gland according to the manufacturer´s details about cable diameters.
- The connections must be established such that a permanent safe electrical connection is ensured.
- Establish a safe protective conductor connection.
- After connecting, lock all openings.

7.5 Connection water cooling

Any installation material, like tubes or mounting clamps are not in the scope of delivery. Choose a supply hose with correct inner diameter.

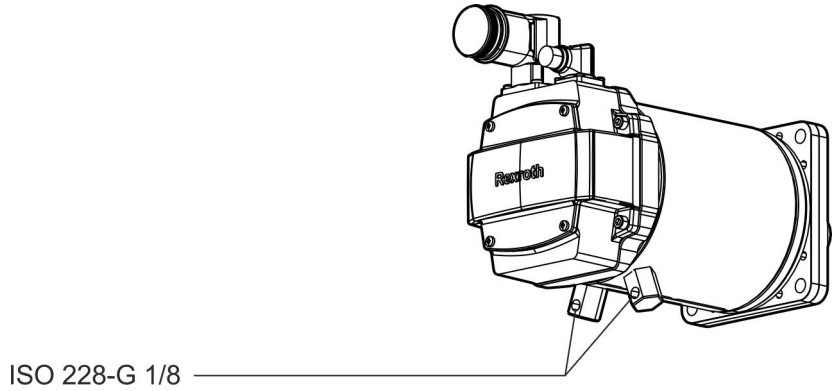


Fig. 25: Coolant connection MS2N07

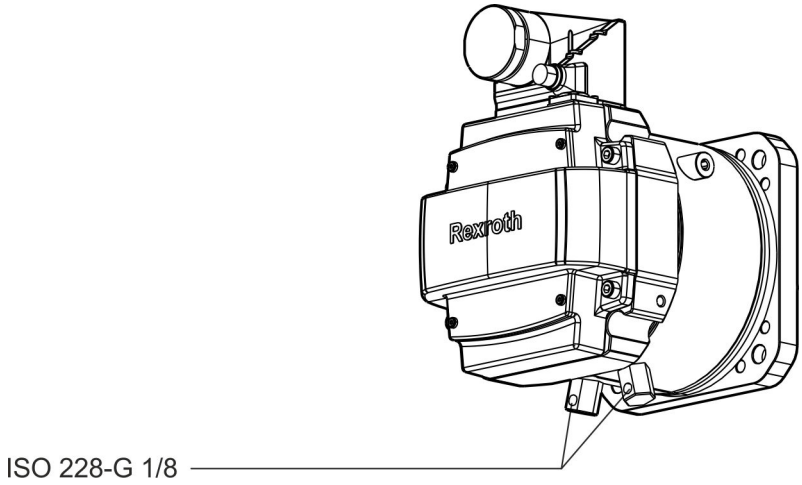


Fig. 26: Coolant connection MS2N10-___L-__B__

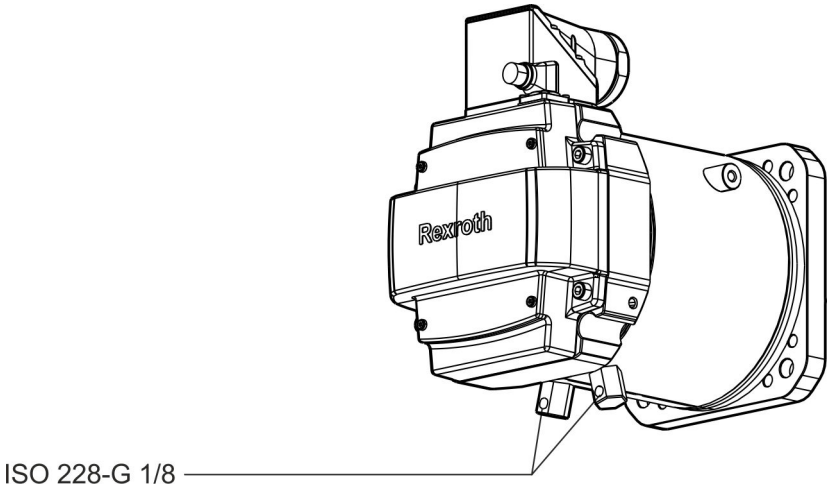


Fig. 27: Coolant connection MS2N10-___L-__A__

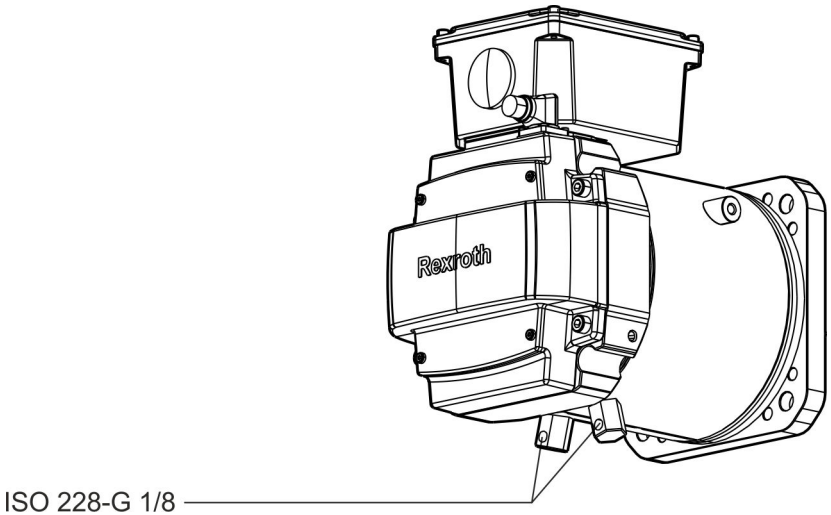


Fig. 28: Coolant connection MS2N10-___L-__T__

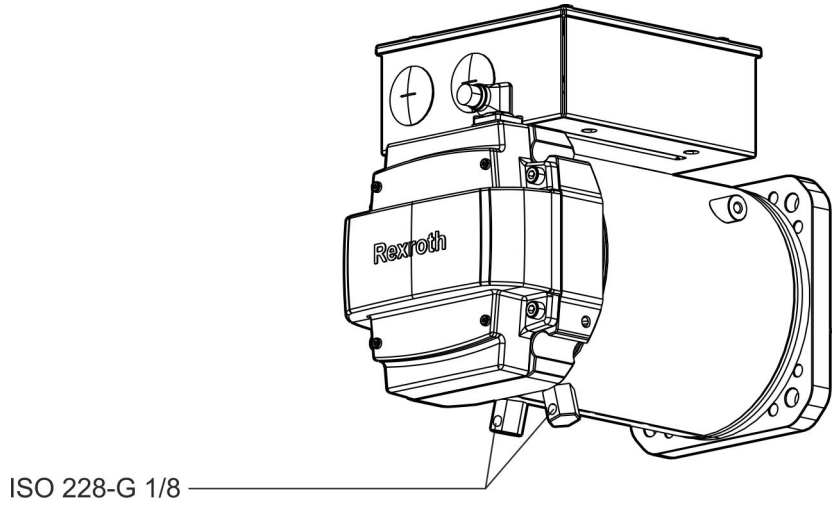


Fig. 29: Coolant connection MS2N10-___L-__C__

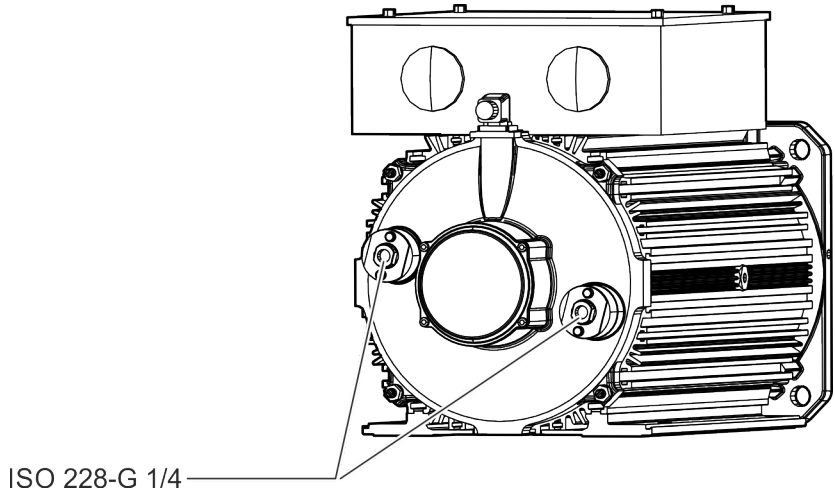


Fig. 30: Coolant connection MS2N13-___L-__E__

Remark

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

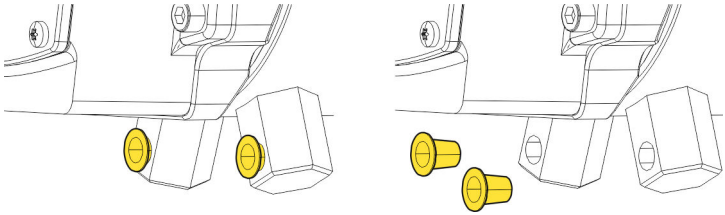


Fig. 31: Protective plug MS2N07, MS2N10 water cooling

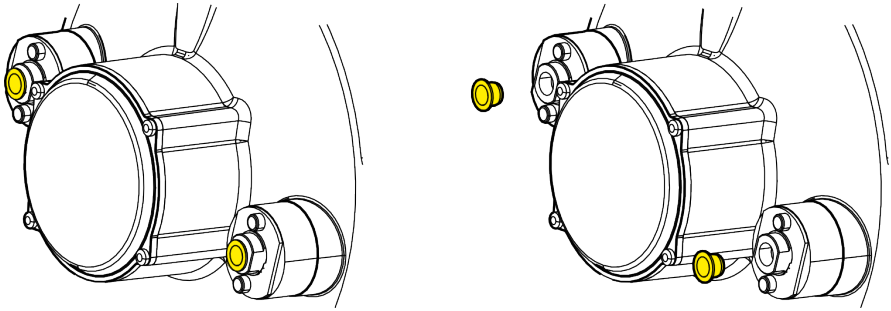


Fig. 32: Protective plug MS2N13 water cooling

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

Table 23: Coolant connection thread, allowed tightening torques and screw-in depths

Motor	Connection	Screw-in depth [mm]	Tightening torque [Nm]
MS2N07	Pipe thread ISO228-G 1/8	10	14 ... 15
MS2N10	Pipe thread ISO228-G 1/8	10	14 ... 15
MS2N13	Pipe thread ISO228-G 1/4	14	18 ... 20

NOTICE

The coolant port threads on the motors may be damaged by incorrect tightening torques!

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

The coolant connections are designed for screw connections with axial sealing.

Bosch Rexroth therefore recommends to use screw connections which contain an O-ring for sealing the screw connection in axial direction.

Seals consisting of hemp, teflon tape or cone-shaped screw connections are not considered to be suitable, as these seals may stress the connection thread at the motor and damage it permanently.

Remark

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

Additionally, record regular monitoring of the proper state of the coolant connection in the maintenance plan of the machine.

7.6 Sealing air connection

The sealing air connection is rotatable. The compressed air hose 4 × 0.75 is not included in the scope of delivery.

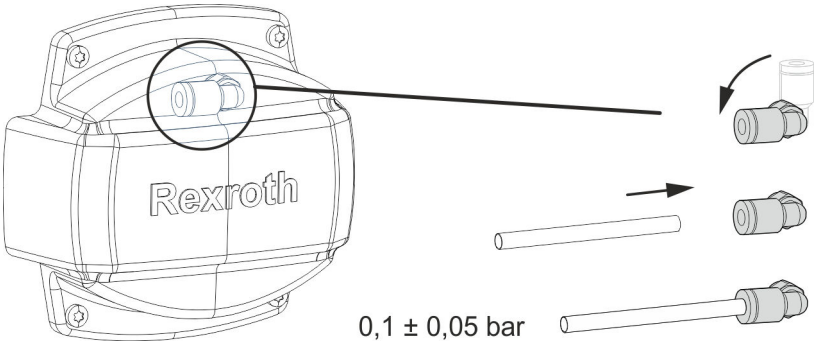


Fig. 33: Connection compressed air hose for using sealing air.

NOTICE	**Damage due to permanent existing liquid on the shaft sealing ring!**
	The use of sealing air does **not** prevent the penetration of continuously existing liquid on the shaft sealing ring (e.g. for open gearboxes). Due to capillary action, gearbox oil can penetrate into the motor and damage it, despite using sealing air.

NOTICE	**Damage due to ingress of dirt!**
	The compressed air gland is not closed upon delivery. Always operate motors with compressed air connection with connected compressed air supply.

8 Commissioning and operation

8.1 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.

8.2 Commissioning

MS2N Motors can only be commissioned with other components (drive controller, control unit).

Prior to commissioning

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

- Storage time of the motor. Depending on the storage time, take measures to ensure safe operation. Run in bearings, resurface the holding brake, ... See .
- Ensure that all device connector are correctly connected and protected against coming loose.
- Ensure that a holding brake voltage of 24 V ±10% is applied to the motor. If necessary, adjust the voltage.

- Check the proper function of the holding brake.
- Ensure that the motor and all participating components of the drive are undamaged.
- Ensure that keys are protected against ejection.

Commissioning

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

Observe the general safety notes.

8.3 Ambient conditions during operation

Climatic conditions are defined in classes according to 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.

A permanent use of the motors is possible when the specified class 3K22 according to EN IEC 60721-3-3:2019 is observed. Deviations and enhancements according to the follwing table must be observed.

Table 24: 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}

8.3.1 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 MS2N motors:

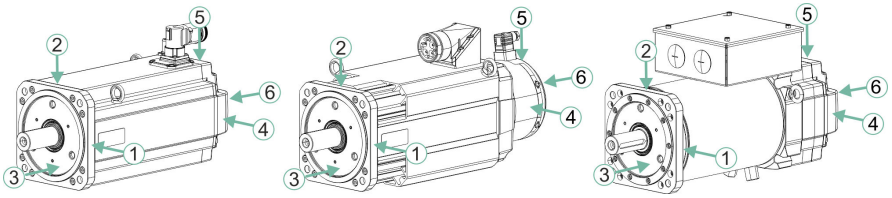


Fig. 34: Vibration load on measuring points

Table 25: Permissible vibration load for MS2N motors

Measuring point, direction	Limit value (10-2000 Hz)		
	Motors	Motors	Motors
	Self-cooling	Forced ventilation	Water cooling
1, 2 (radial motor flange)	30 m/s²	10 m/s²	10 m/s²
4, 5 (radial bearing shield / fan)	50 m/s²	25 m/s²	25 m/s²
3 (axial motor flange)	10 m/s²	10 m/s²	10 m/s²
6 (axial bearing shield / fan)	25 m/s²	25 m/s²	25 m/s²

Check the vibration load on the fan housing in case of forced ventilation. The specified values must not be exceeded.

8.4 Operation

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

Checks during operation:

- Pay attention to exceptional noise.
- Pay attention to increased vibrations.
- Check the motors and fan units for cleanliness.
- Check the tightness of the coolant connections.
- 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 .

8.5 Derating in case of deviating ambient conditions

Reduce high performance data:

1. Reduce the standstill torque $M_{0\ 60K}$ or $M_{0\ 100K}$ specified in the data sheet, with the following factors.

   We have:

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

   $M_{0\ red} = M_{0\ 100K} \times f_{TH\ 100K}$

   $M_{0\ red} = M_{0\ 100K} \times f_{TH\ W}$

2. 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.

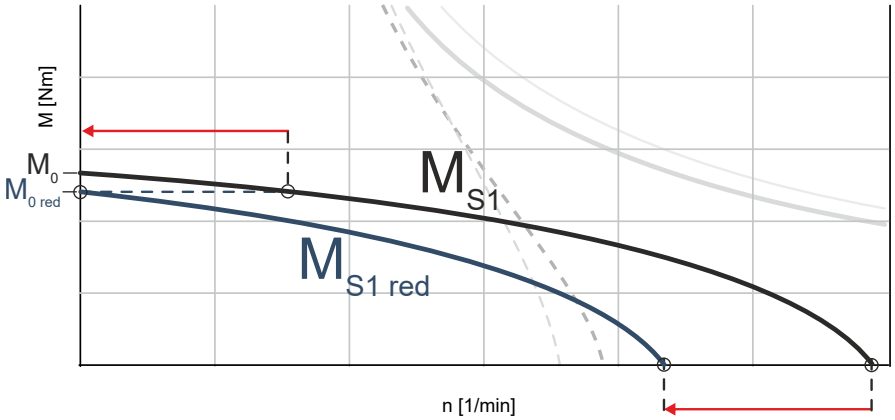


Fig. 35: Determine S1-characteristic curve $M_{S1\ red}$ with derating factor f_{TH}

Table 26: Derating factors for self-cooling 60K

Height [m]	40 °C	45 °C	50°C	55 °C	60 °C
1,000	1.00	0.94	0.88	0.83	0.78
1,500	0.97	0.91	0.85	0.81	0.76
2,000	0.94	0.88	0.83	0.78	0.73
2,500	0.90	0.85	0.79	0.75	0.70
3,000	0.86	0.81	0.76	0.71	0.67

Table 27: Derating factors for self-cooling 100K and forced ventilation

Height [m]	40 °C	45 °C	50°C	55 °C	60 °C
1,000	1.00	0.96	0.92	0.88	0.85
1,500	0.97	0.93	0.89	0.85	0.82
2,000	0.94	0.90	0.86	0.83	0.80
2,500	0.90	0.86	0.83	0.79	0.77
3,000	0.86	0.83	0.79	0.76	0.73

Table 28: Derating factors for water cooling

Height [m]	40 °C	45 °C	50°C	55 °C	60 °C
1,000	1.00	0.96	0.92	0.88	0.85
1,500	0.99	0.95	0.91	0.87	0.84
2,000	0.97	0.93	0.89	0.85	0.82
2,500	0.96	0.92	0.88	0.84	0.81
3,000	0.95	0.91	0.87	0.83	0.80

To avoid condensation of the motors, the coolant supply temperature must be above the dew point temperature .

8.6 Operation on foreign converters

Principally, operating MS2N motors on foreign converters is possible. In the following, the designs and possible adjustment ranges are represented.

⚠ 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 ≤ 5 kV/µs

Maximum allowed limit load:

In the case of critical rate of rise of off-state voltage du/dt ≥ 5 kV/µs, 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 µs
- Rate of rise of off-state voltage du/dt < 8 kV/µs

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 5.2.3 “Thermal motor protection ” on page 20).
  - 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.

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.

9 Maintenance

9.1 Cleaning and servicing

⚠ WARNING

Operations in the vicinity of live parts are extremely dangerous.

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

⚠ WARNING

Personal and material damage during maintenance work in operation!

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

⚠ CAUTION

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

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

Motors

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

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

Connection cables

⚠ WARNING

Electric shock due to contact with live parts!

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

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

9.2 Service repair, maintenance and spare parts

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

NOTICE

Product damage possible, loss of warranty claims!

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

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

For example, the following repairs can be done:

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

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

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

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

Preparing information

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

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

10 Disassembly and exchange

10.1 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

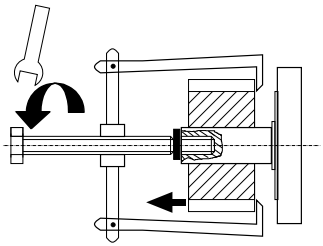


Fig. 36: Remove transmission element

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.

10.2 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.

1. If necessary, note the previous absolute value
2. Open the main switch
3. Make sure the main switch cannot be switched back on
4. 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).
5. Replace the motor

   Remark: Observe the machine manufacturer's instructions when exchanging the motor mechanically.
6. Connect the plug-in connectors and clamping connections
7. 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.

10.3 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.

11 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 therefor 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

12 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	Activating drive enable
	Controller fault	Troubleshoot acc. to documentation of controller
	Voltage supply missing	Control voltage supply
	Brake is not released	Check the brake activation

Fault description	Cause	Remedy
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

Fault description	Cause	Remedy
Running noise	Foreign bodies within the motor	Motor shutdown ⇨ Repair manufacturer
	Bearing is damaged	Motor shutdown ⇨ Repair manufacturer

Fault description	Cause	Remedy
High motor temperatures / Motor temperature monitoring is activated	Operation outside of rated data	Reduce load and check the dimensioning
	Heat dissipation is impaired	• Clean the motor • For fan units, clean fan grille and check the fan function • For liquid cooling, check cooling circuit.

Fault description	Cause	Remedy
Wrong or defective temperature display	Temperature sensor not connected	Connect temperature sensor
	Temperature sensor defective	• Motor shutdown ⇨ Repair manufacturer • Replace temperature sensor • Connect the backup temperature sensor, if any is available.

13 Technical data

13.1 Technical data

Technical data with operating characteristic curves are described in the project planning manual for all motor types.

Additional documentation

MS2N Synchronous servomotors, project planning manual
DOK-MOTOR*-MS2N*******-PRxx-xx-P

14 Appendix

14.1 EU-Declaration of conformity

You will find the current version of the declaration of conformity and available translations in **Bosch Rexroth Download Center**.

➦ Declaration of conformity DCTC-30318-002

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EU-Konformitätserklärung - Original [1]
EU Declaration of Conformity

Dok.-Nr. / *Doc. No.*: DCTC-30318-002 [1.1]
Datum / *Date*: 2024-04-30 [1.2]

☐ nach Maschinenrichtlinie 2006/42/EG / *in accordance with Machinery Directive 2006/42/EC* [2.1]
(ABl. L 157, 09.06.2006, S. 24 / *OJ L 157, 09/06/2006, p. 24)*

☒ nach Niederspannungsrichtlinie 2014/35/EU / *in accordance with Low Voltage Directive 2014/35/EU* [2.2]
(ABl. L 96, 29.03.2014, S. 357 / OJ *L 96, 29/03/2014, p. 357)*

☒ nach EMV-Richtlinie 2014/30/EU / *in accordance with EMC Directive 2014/30/EU* [2.3]
(ABl. L 96, 29.03.2014, S. 79 / OJ *L 96, 29/03/2014, p. 79)*

☐ nach ATEX-Richtlinie 2014/34/EU / *in accordance with ATEX Directive 2014/34/EU* [2.4]
(ABl. L 96, 29.03.2014, S. 309 / OJ *L 174, 1/07/2011, p. 88)*

☐ nach Ökodesign-Richtlinie (ErP) 2009/125/EG / *in accordance with Ecodesign Directive (ErP) 2009/125/EC* [2.5]
(ABl. L 285, 31.10.2009, S. 10 / *OJ L 285, 31/10/2009, p. 10*

☐ und nach Ökodesign-Verordnung (EU) 2019/1781 / *and in accordance with the Ecodesign Regulation (EU) 2019/1781* (ABl. L 272, 25.10.2019, S. 74 */; OJ L L272, 25/10/2019, p. 74)*

☐ und nach Ökodesign-Verordnung (EU) 2019/2021 / *and in accordance with the Ecodesign Regulation (EU) 2019/2021* (ABl. L 315, 05.12.2019, S. 241 */; OJ L L315, 05/12/2019, p. 241)*

☐ Produkt im Geltungsbereich der RoHS-Richtlinie 2011/65/EU / *Product in the scope of RoHS Directive 2011/65/EU:* [2.6]
nach RoHS-Richtlinie 2011/65/EU / *in accordance with RoHS Directive 2011/65/EU*
(ABl. L 174, 01.07.2011, S. 88 / *OJ L 174, 1/07/2011, p. 88)*

☐ Produkt nicht im Geltungsbereich der RoHS-Richtlinie 2011/65/EU / *Product not in the scope of RoHS Directive 2011/65/EU:* [2.7]
Produkt erfüllt die Anforderungen zur Stoffbeschränkung der Richtlinie / *Product meets the substance restriction requirements of the Directive*

Geltungsbereich RoHS-Richtlinie für Produkte des Herstellers: DCTC-30806-006 „Herstellererklärung zur RoHS-Richtlinie 2011/65/EU & 2015/863/EU" / *Scope of RoHS Directive for products of the manufacturer: DCTC-30806-006 "Declaration of compliance to the RoHS Directive 2011/65/EU & 2015/863/EU"* [2.8]

EU-Konformitätserklärung - Original
EU Declaration of Conformity

DCTC-30318-002 : 2024-04-30

Der Hersteller / *the manufacturer:* **Bosch Rexroth AG**
Bgm.-Dr.-Nebel-Str. 2
97816 Lohr a.Main / Germany [3]

erklärt hiermit, dass das nachstehende Produkt / *hereby declares that the product below* [4]

Bezeichnung / *Name:* 3~ PM-MOTOR [5]

Bestellbezeichnung / *ordering code:* [5.2]

MS2N03**********
MS2N04**********
MS2N05**********
MS2N06**********
MS2N07**********
MS2N10**********
MS2N13**********
MS2N16**********

* = 0-9, A-Z, "blank" or "-"

Handelsbezeichnung / *Trade name:* Rexroth [5.4]

ab Herstelldatum / *from the date of manufacture:* 2024-04-30 [5.5]

in Übereinstimmung mit oben genannte(n) Richtlinie(n) entwickelt, konstruiert und gefertigt wurde. / *was developed, designed, and manufactured in compliance with the above-mentioned directive(s).* [6]

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.* [6.1]

Angewendete harmonisierte Normen bzw. sonstige technische Normen und Vorschriften / *Applied harmonized standards or other technical standards and regulations:* [7]

Norm / *Standard*	[8]	**Titel / *Name***	[8.1]	**Ausgabe / *Issue***	[8.2]
EN 60034-1		Drehende elektrische Maschinen – Teil 1: Bemessung und Betriebsverhalten *Rotating electrical machines – Part 1: Rating and performance*		2010 Cor. 2010	
EN IEC 60034-5		Drehende elektrische Maschinen – Teil 5: Schutzarten aufgrund der Gesamtkonstruktion von drehenden elektrischen Maschinen (IP-Code) – Einteilung *Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification*		2020	
EN 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	

Weitere Erläuterungen / *Further explanations:* *[12]*

Die Montage- und Installationshinweise, gemäß Produktdokumentation sind zu beachten / *[13]*
The assembling and installation instructions according to the manual must be followed

Lohr a.Main		2024-04-30		ppa.	DocuSigned by: Dr. Falk Zwicker FED49EEC88EE42B...
Ort / *place*	*[14]*	Datum / *date*	*[14.1]*		Dr. Falk Zwicker Kaufmännische Werkleitung / *Commercial Plant Manager* *[14.2]*
				i.V. / p.p.	DocuSigned by: 9535C1EB85AE4AF...
					Dr. Hans-Jürgen Wehner *Product Owner Servo Motors and Gear boxes* *[14.3]*

Änderungen im Inhalt der EU-Konformitätserklärung sind vorbehalten. Die aktuelle Version finden Sie im Bosch Rexroth Medienverzeichnis als Download oder erhalten diese auf Anfrage über Ihren Bosch Rexroth Ansprechpartner / *[15]*
We reserve the right to make changes to the content of the EU Declaration of Conformity. The current issue is available as download in Bosch Rexroth Media Directory or on request from your Bosch Rexroth contact person

14.2 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-30318-032".

14.3 UL / CSA

The UL/CSA conformity of MS2N motors can be found on the type plate of the motors.

The MS2N motor listing with the UL file number E335445 can be found under ➦ www.ul.com

14.4 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/

14.5 China Energy Label (CEL)

Fig. 37: China Energy Label, Example MS2N

The **China Energy Label (CEL)** contains details about energy efficiency class and about energy use. Affected permanent magnet synchronous motors exported to China must be classified according to GB 30253-2013. Registered Bosch Rexroth motors are provided with the CEL marking and can be verified via the QR code on the product-specific web pages (CEL Registered products).

Registered Bosch Rexroth products (Chinese website)

➦ MS2N Self-cooling - Grade 2

➦ MS2N Forced ventilation - Grade 2

Affected products may only be market in China after a CEL classification of the product has been passed. **In case of not listed motor types, please contact Bosch Rexroth.**

Permanent magnet synchronous motors affected by CEL

- PM synchronous motors up to 1,000V
- Operation with (frequency-) converter
- Power range: 0.55 kW – 90 kW
- Speed range: 500 U/min – 3000 U/min

Permanent magnet synchronous (exceptions) not effected by CEL

- Motors with brakes
- Water-cooled motors
- Motors with integrated gearbox
- Motors outside of power and speed range

Index

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R911347581