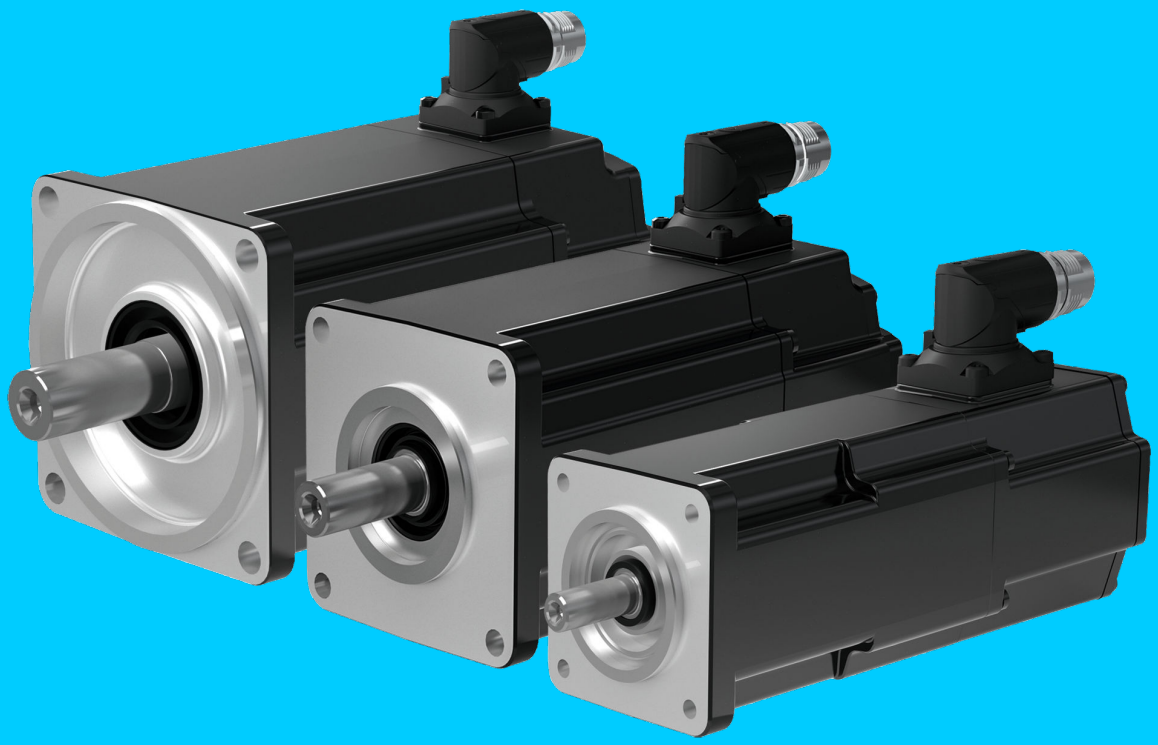
DBR AUTOMATION

rexroth
A Bosch Company

Project Planning Manual

MS2S

Synchronous Servomotors



R911410075, Edition 01

Liability

The specified data is intended for product description purposes only and shall not be deemed to be a guaranteed characteristic unless expressly stipulated in the contract. All rights are reserved with respect to the content of this documentation and the availability of the product.

DOK-MOTOR*-MS2S*******-PR01-EN-P DC-AE/EPI5 (jw, mb)

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1 About this documentation

1.1 Purpose and editions of this documentation

This documentation is for technicians, service engineers and users. 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
DOK-MOTOR*-MS2S*******-PR01-EN-P	07/2021	First edition

1.2 Presentation of information

Safety instructions

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

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

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

Safety symbols

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

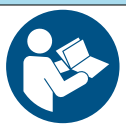
Table 2: Meaning of safety signs

Safety symbols	Meaning
	Warning against dangerous electric voltage
	Warning against hot surfaces
	Warning against rotating machine parts
	Warning against overhead load
	Electrostatic sensitive devices
	No access for persons with cardiac pacemakers or implanted defibrillators.
	Do not carry along metal parts or clocks.

Safety symbols	Meaning
	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 “Communautes Européennes”. The CE-marking expresses the conformity of a product with relevant EC-regulations.
	Components for the use in systems for “integrated safety technique” prepared.
	The symbol indicating "separate collection" for all batteries and accumulators is the crossed-out wheeled bin.

Markup

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

Reference to supplementary documentation

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

ctrlX®, ctrlX DRIVE®, ctrlX SENSE® are registered trademarks of Bosch Rexroth AG

SpeedTec® is a registered trademark of the TE Connectivity Ltd.

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

Standards	
EN 60034-1	Rating and performance behavior
EN 60034-5	Type of protection

Directives	
2014/35/EU	Low voltage directive

The machine manufacturer must evaluate the electric and mechanic safety as well as environmental influences in the assembled state of the machine according to the Machine Directive 2006/42/EC and DIN EN 60204-1 (safety of machines) using the motors.

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.

2.1.2 Unintended use

Any use of MS2S motors outside of the specified fields of application or under operating conditions and technical data other than those specified in this documentation is considered to be inappropriate use.

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 instructions (EN 50110-1).

2.3 General safety instructions

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

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

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

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

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

2.4 Product- and technology-dependent safety instructions

2.4.1 Protection 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.

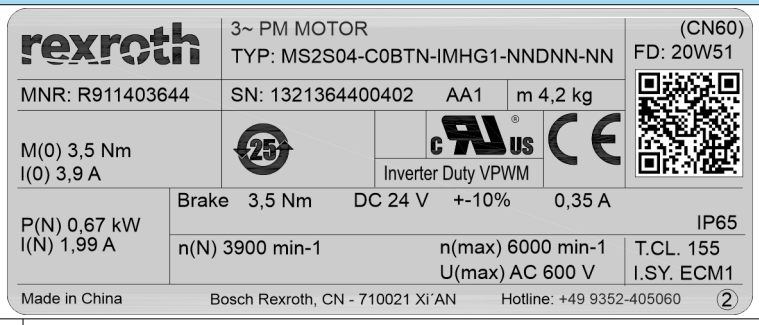
Remark

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

3 Identification

3.1 Type plate

The type plate contains all relevant product data.

Type plate (example)


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
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

The following marks of conformity are used:

Table 4: Meaning of marks of conformity

Certification mark	Meaning
CE	Conformity is according to low-voltage directive 2014/35/EU , EN 60034-1, EN 60034-5.
c UL us	The UL Recognized Component Mark identifies recognized component parts which are components of a bigger product or system
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.

3.2 Safety instructions on the product

Please note the safety and prohibitive sign on the motor.

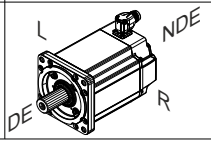
Table 5: Safety sign on the product

Safety symbols	Meaning
	**Hot surfaces with temperatures over 60 °C may cause burns** Let the motors cool down before working on the motors or in close proximity to the motors. The thermal time constant stated in the technical data is a measure for the cooling time. Cooling down can require up to 140 minutes. - Wear safety gloves. - Do not work on hot surfaces.

Safety symbols	Meaning
	**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 unintendet or unauthorized re-energization.
	**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.

4 Features and functions

4.1 Basic data

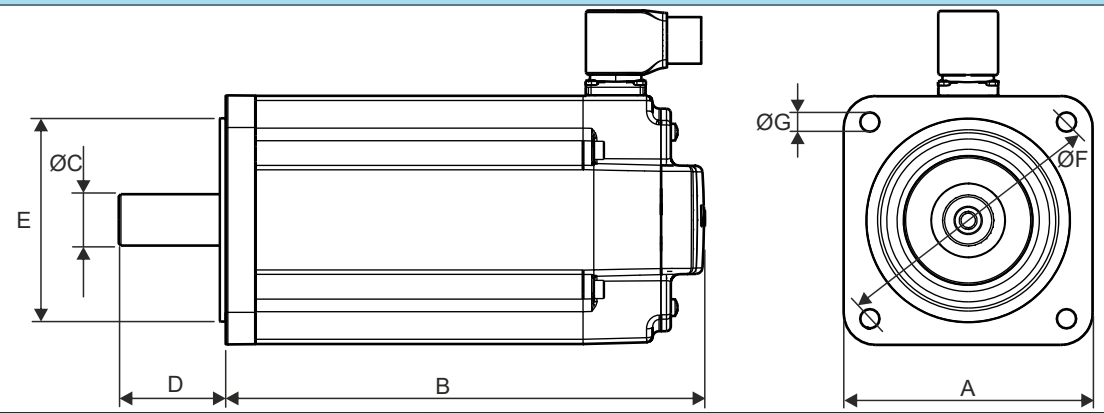
Product	3~ PM motor
Type	MS2S
Ambient temperature during operation	0 ... 40 °C (with derating up to 60 °C)
Protection class (EN 60034-5)	IP65 with shaft sealing ring
Cooling mode (EN 60034-6)	IC410, Self-cooling
Motor design (EN 60034-7)	IM B5
Coating	Varnish RAL 9005
Flange	similar to DIN 42948
Shaft end	Cylindrical (DIN 748 part 3), centering hole with thread “DS” (DIN 332 part 2),
Concentricity, run-out, alignment	Standard tolerance N (DIN 42955)
Oscillating quantity level	Level A (EN 60034-14) up to the rated speed
Installation altitude	0 ... 1,000 m above sea level (without derating)
Sound pressure level	MS2S03 ... MS2S05: 75 dB(A) +3 dB(A)
Thermal class	155 (F) (EN 60034-1)
Encoder system	**Basic Performance ctrlX SENSE** motor Magnetic 18 bit encoder, digital in Multiturn design for operation on ctrlX controllers
Electrical connection	**Single cable connection** with circular connector M17, rotatable, quick lock SpeedTec®
Holding brake (option)	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.

4.2 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]
MS2S03	58	1)	9	20	40	63	4.5
MS2S04	82	1)	14	30	50	95	6.6
MS2S05	98	1)	19	40	95	115	9
1) See dimensions							

Use the following screws and washers for flange assembly.

Screws according to DIN EN ISO 4762 or DIN EN ISO 4014. Property class 8.8
The screw lengths depends on material and installation situation. The specified tightening torque must be ensured.

Table 6: Tightening torque of mounting screws

Screw	M4	M6	M8
Mounting holes Ø [mm]	4.5	6.6	9
Tightening torque M_A[Nm] at μ_K= 0.12	3.0	10.1	24.6
Washer	-	-	yes

4.3 Winding code

The speed to the corresponding winding designations are standard values. The specified rated speed can deviate from the specified in the technical data sheet. The speed is determined to define the winding designation on which the standstill torque - 100 K ($M_{S1\ 100\ K}$) on the voltage limit characteristic curve $U_{ZK\ 1}$ is reached (tolerance range ca. ± 250 1/min).

Table 7: Winding code acc. to type code (speed at DC bus voltage UZK 1)

Winding code	Nominal speed [1/min]
BT	6000
BY	9000

4.4 Thermal motor protection

The motor temperature is monitored via a sensor-based, drive-internal temperature model and ensures a high level of protection for the 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 MS2S motors are:

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

4.5 Cooling mode

4.5.1 Self-cooling (IC410)

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

The specified nominal data is reached at ambient temperatures of up to 40 °C. Unhindered vertical convection has to be ensured by a sufficient distance of 100 mm to adjacent components. Any usage at increased ambient temperature (0 ... 60°C) is possible. Please note the details in ➦Chapter 9.2 “Derating in case of deviating ambient conditions” on page 62.

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.

4.6 Encoder

BASIC encoders " **Ix** " use a magnetic sampling method. Data output of process and parameter data (electronic type plate) happens digitally via ctrlX SENSE^{motor} protocol. The motor temperature is transmitted digitally.

The multiturn design allows absolute, indirect position recording within 65,536 mechanical motor rotations.

Table 8: Technical data of encoder

Designation	Symbol	Unit	Encoder
			IM
Encoder interface	-	-	ctrlX SENSE^{motor}
Functional encoder resolution (singleturn)		-	18 bit
Distinguishable rotations	U_{turn}	-	65,536
Maximum system accuracy of encoder [1)]	∢	''	± 360
Encoder voltage supply	$VCC_{Encoder}$	V	8...12
Encoder max. current consumption	$I_{Encoder}$	mA	130
1) The installation mechanics can sporadically influence the accuracy of the overall system.			

Remark

These motors are suited for applications with STO safety function within the electric drive system with ctrlX DRIVE according to EN IEC 61800-5-2.

4.7 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)

- **IP65** with shaft sealing ring

4.8 Output shaft, balancing and extension elements

4.8.1 Shaft end

Options according to type code

Shaft	Type
Smooth, with shaft sealing ring	G

Smooth shaft

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

Type	Centering hole DIN 332 Part 2
MS2S03	DS M3
MS2S04	DS M5
MS2S05	DS M6

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.

The shaft sealing ring affects the degree of protection. 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.

4.8.2 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.

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 0.25 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.

4.9 Holding brake

MS2S motors can optionally be provided with spring force brakes. The holding brakes operate according to the “electrically-released” principle (closed-circuit principle) and open upon applying the switching voltage.

- The service life (switching cycles) of spring force brakes depends on the number of start-stop cycles. With spring force brakes, there is always startup wear, since an air cushion must first build up between the lining and the friction surfaces when the speed increases. This wear can be increased by accelerations of the friction disk, e.g. in the case of a vertical arrangement (acceleration due to gravity) or by external centrifugal forces, whereby in this case only one friction lining side is affected in most cases.
- 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 ➦ Chapter 4.9.1 “Technical data holding brakes” on page 20

⚠ 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.

The rated voltage to apply the brakes is 24 V DC ±10%.

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

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

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

Fig. 1: Voltage drop of brake supply for Cu (copper) conductor
ΔU Voltage drop [V]
ρ_{Cu} Specific resistance of copper [Ω*mm²/m]
l Cable length [m]
q Wire cross section [mm²]
I_N Rated current [A]

⚠ CAUTION

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

For safe switching of the holding brake, a rated voltage of **24 V DC ±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.

The holding brakes are intended for direct connection to the ctrlX controllers. A protective circuit to switch inductive loads of holding brakes is integrated in ctrlX controllers.

4.9.1 Technical data holding brakes

Type	Holding torque	Rated voltage [1]	Rated current	Maximum connection time	Maximum disconnection time	Moment of inertia of the holding brake	Maximum switched energy
	M4 Nm	U_N V	I_N A	t_1 ms	t_2 ms	J_{br} kg*m²	W_{max} J
MS2S03-B0BYN-___1-____-__	1.50	24	0.31	20	60	0.0000018	120
MS2S03-C0BYN-___1-____-__	1.50	24	0.31	20	60	0.0000018	120
MS2S04-B0BTN-___1-____-__	3.50	24	0.35	30	85	0.0000075	200
MS2S04-C0BTN-___1-____-__	3.50	24	0.35	30	85	0.0000075	200
MS2S05-B0BTN-___1-____-__	7.20	24	0.60	30	120	0.0000230	500
MS2S05-C0BTN-___1-____-__	7.20	24	0.60	30	120	0.0000230	500
							Latest amendment: 2020-11-18

[1] Tolerance ± 10%, measured on terminal or junction of the motor

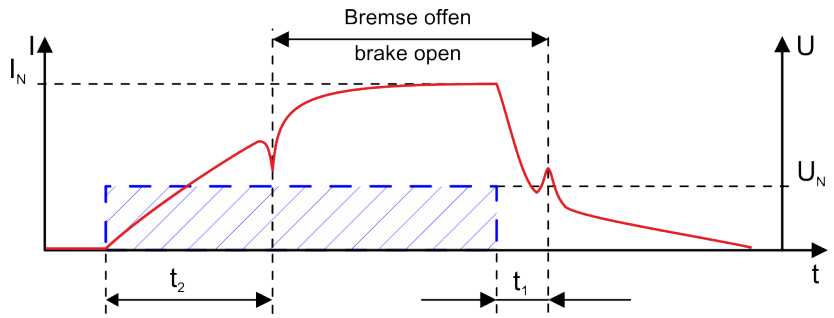


Fig. 2: Switching times of static hold mode
t_1 Connection time (close)
t_2 Disconnection time (open)

4.9.2 Energy saving function (Eco mode) for holding brakes

Decrease brake voltage

The control voltage of the holding brake in MS2S holding brakes can be reduced after executing the switching operation “Open brake”. 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 MS2S holding brakes, the following conditions apply:

- Maximum decrease of control voltage to U_N 17 V
- 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

Remark

Refer to the instructions in the control module documentation.

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

4.9.3 Properties

The permanent magnet holding brakes optionally used in MS2S motors operate according to the closed-circuit principle. Non-operative holding brakes are closed and open when reaching the release voltage. To ensure safe functioning of the brake, the rated voltage at the brake (24 V DC ±10%) has to be ensured. Please note the installation conditions such as ambient temperature, cable length, cable cross-section and the laying type.

The holding brake is used to hold the motor shaft in case of motor standstill. Using the operating brake to decelerate the rotating motor is not permissible.

4.9.4 Holding brakes safety instructions

The spring force brake of MS2S motors is no safety brake. This means, a torque reduction by non-influenceable disturbance factors can occur. Especially for use in vertical axes.

⚠ WARNING	**Grievous bodily harm due to dangerous movements from falling or dropping axes!**
	Secure vertical axes against dropping or sinking after switching off by e.g.: – Mechanical locking of the vertical axis – External brake, arrestor, clamping device. – Weight compensation of the axes

The holding brake itself is not suitable for personal protection. Ensure protection of 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 954; ISO 13849-1 and ISO 13849-2 Safety-related parts of control units
- 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.

4.9.5 Holding brake - 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.

4.10 Flange exactness

The properties concentricity, run-out and alignment are defined in the flange accuracy. By default, MS2S motors are equipped with tolerance N. The labeling is done in the motor type designation. See also .

4.10.1 Concentricity tolerance of the shaft end

Table 9: Concentricity tolerance regarding the shaft diameter for MS2S motors

Diameter shaft end [d]	Concentricity tolerance in [mm]
	N
9	0.03
14	0.035
19	0.04

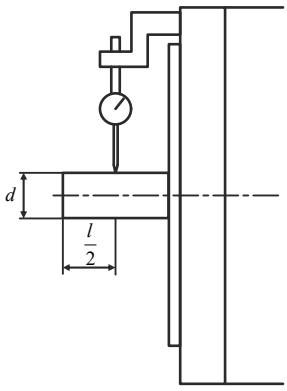


Fig. 3: Measuring system of concentricity tolerance

Measurement takes place in distance *l/2* (shaft end center), rectangular to the motor flange.

4.10.2 Concentricity and alignment

Table 10: Coaxiality and alignment tolerance related to the centering diameter in MS2S motors

Centering diameter [mm]	Concentricity and alignment tolerance in [mm]
	N
40, 50, 95	0.08

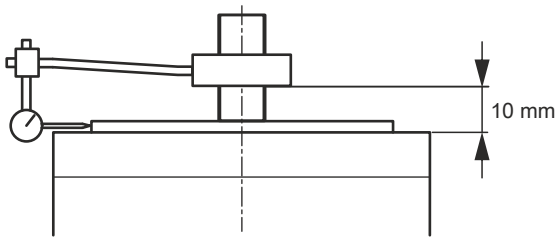


Fig. 4: Measuring system of coaxiality

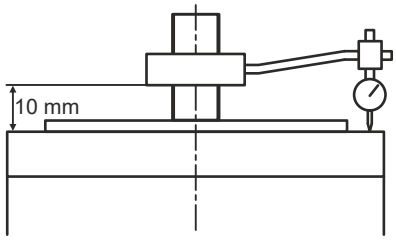


Fig. 5: Measuring system of alignment

The coaxiality and the alignment are measured in vertical motor position to exclude the influence of gravitational forces.

4.11 Vibration behavior

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

4.12 Bearing

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

Table 11: Bearing size MS2S

Type	Bearing size DE	Bearing size NDE	Floating bearing	Fixed bearing
MS2S03	6001	6000	DE	NDE
MS2S04	6003	6001	DE	NDE
MS2S05	6,204	6,303	DE	NDE

4.12.1 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 12 “Mean speed - basis of calculated grease service life” on page 24:

Table 12: Mean speed - basis of calculated grease service life

Type	Mean speed
MS2S03, -04, -05	≤ 3500 1/min

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

L_{10h} during operation

L_{10h} = 20.000 h, in case of utilization with max. load factor 90% during the runtime.

Remark

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

4.12.2 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.

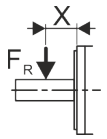


Fig. 6: Point of action of radial force F_R and axial force F_A

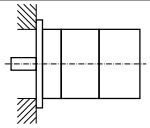
The axial force values are the minimum permissible axial forces F_A without limitations. A detailed dimensioning is only possible if more boundary conditions are known:

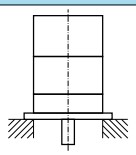
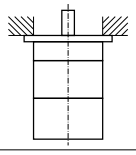
- Occurring radial force and axial force with force application point
- Installation position (horizontal, vertical with the shaft end pointing to the top or bottom)
- Mean speed

For radial force diagrams, refer to the technical data

4.13 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 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

Code I / Code II (EN 60034-7)		
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 4.7 “Degree of protection ” on page 17.

4.14 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.

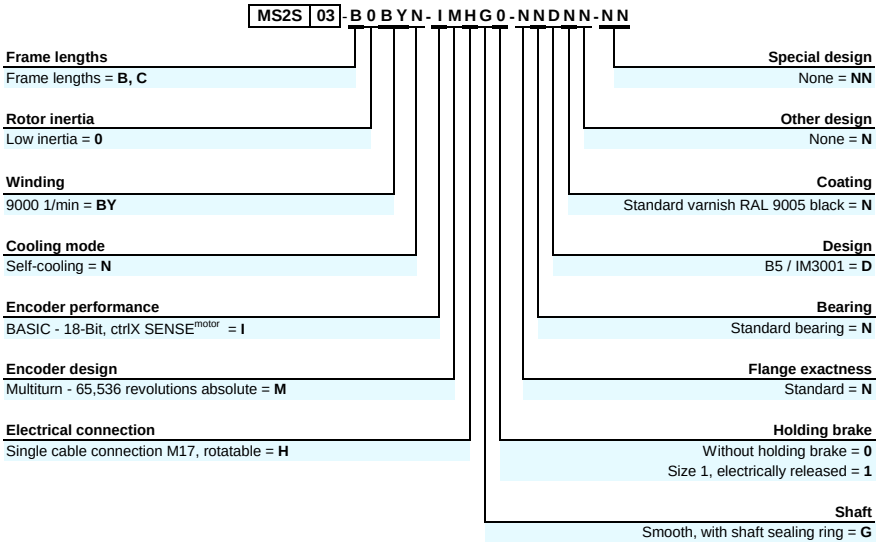
4.15 Noise emission

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.

5 Type codes

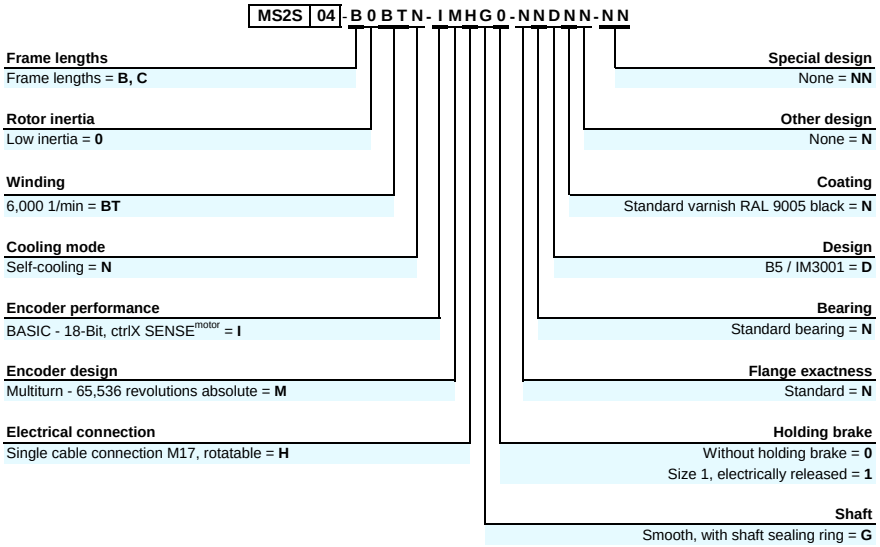
5.1 MS2S03 Type code

Features



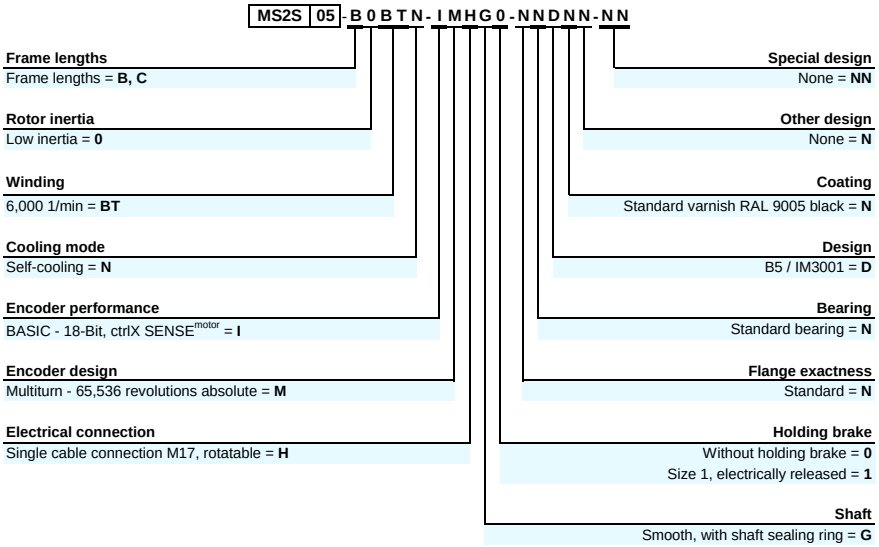
5.2 MS2S04 Type code

Features



5.3 MS2S05 Type code

Features



6 Operating areas and characteristic curves

6.1 Operating area

The permissible operating ranges for MS2S motors are defined for ambient temperatures of 0 ... 40 °C and installation altitudes up to 1000 m above MSL. The operating areas are characterized by characteristic curve fields.

- Limit curves (intermitted operation, voltage limit without/with field weakening)
- S1-100 K continuous operation curve (overtemperature 100 K at the winding)
- S1-60 K continuous operation curves (overtemperature 60 K at the housing)

The individual characteristic curves are described in the following figure.

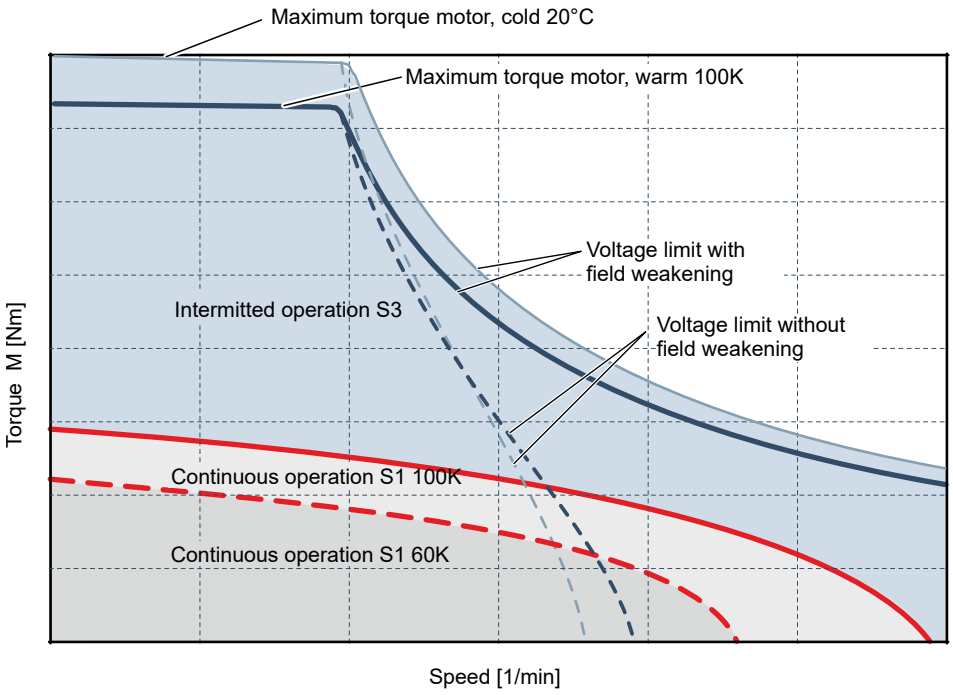


Fig. 7: Operating areas MS2S motors

The thermal motor installation determines the degree of power loss, discharged via the flange. The rated data for 100K and 60K specified in the technical data apply to the following installation conditions:

Table 13: Installation conditions for utilization according to the specified characteristic curves

Type	100 K data (not thermally insulated)	60 K data (thermally insulated)[1]
	Steel plate L x W x H [mm]	Aluminum plate L x W x H [mm]
MS2S03, -04	100 x 220 x 40	140 × 210 × 10
MS2S05	350 x 350 x 30	300 × 240 × 15

- 1) insulated with laminated paper FR-2, material thickness 2 mm

Remark

In case of ambient temperatures above 40 °C and installation altitudes of 1000 m above MSL, the high performance data have to be reduced .

6.1.1 Continuous operation S1

The S1-100 K characteristic curve represents the permissible limits of motor winding during continuous operation. For a lower thermal utilization, e.g.

- in case of unfavorable harnessing of heat of the flange mounting
- in order to limit the housing temperature to 100 °C
- in order to avoid unfavorable heating of the machine by the motor
- in order to increase the motor (e.g. motor/encoder bearing) reliability

Bosch Rexroth recommends to select the S1-60K characteristic curve. The characteristic curves are specified for S1-100K and S1-60K. The motor utilization is predominantly influenced by the installation situation.

NOTICE

Property damage due to thermal overload

Motors in continuous operation application must not be operated above the specified characteristic curve limits S1-60 K or S1-100 K.

6.1.2 Periodic intermitted operation S3

During periodic intermittent operation, the motor can tolerate a higher load depending on the ON time.

6.1.3 Operation in field weakening

Field weakening operation of MS2S motors is possible with IndraDrive controllers.

6.1.4 Motor torque during operation at standstill

In applications such as joining or press machines, where motors have to produce torque continuously asymmetrical currents when the motor is in standstill (close angular range) will flow in the motor windings. This can result in motor overload during continuous operation. The values specified in the data sheet have to be reduced according to the following table. The continuous torque that can be output at standstill M_0* can be calculated by multiplying the data sheet values with the subsequent reduction factors F_0.

$$M_0^* = F_0 \cdot M_0$$

Reduction factor F0

Table 14: Reduction factor F_0

Type	Cooling mode	Frame length	
		B	C
MS2S03, -04, -05	Self-cooling 60K	0.95	
	Self-cooling 100K	0.85	

6.2 Characteristic curves for DC bus voltage

The technical data sheets contain characteristic curves for two typical DC bus voltages. Depending on the DC bus voltage, the characteristic curves result.

Remark

S1 continuous operation curves depend on the DC bus voltage. The rated data specified on the nameplate are defined for the operating case with U_{ZK2} (compareFig. 8 “Characteristic curve specifications” on page 34).

The characteristic curve apply to:

Table 15: DC bus voltages

Controller	Line voltage	DC bus
ctrlX	3 × 400 V ($U_{ZK\,1}$)	uncontrolled
	3 × 400 ... 480 V ($U_{ZK\,2}$)	controlled

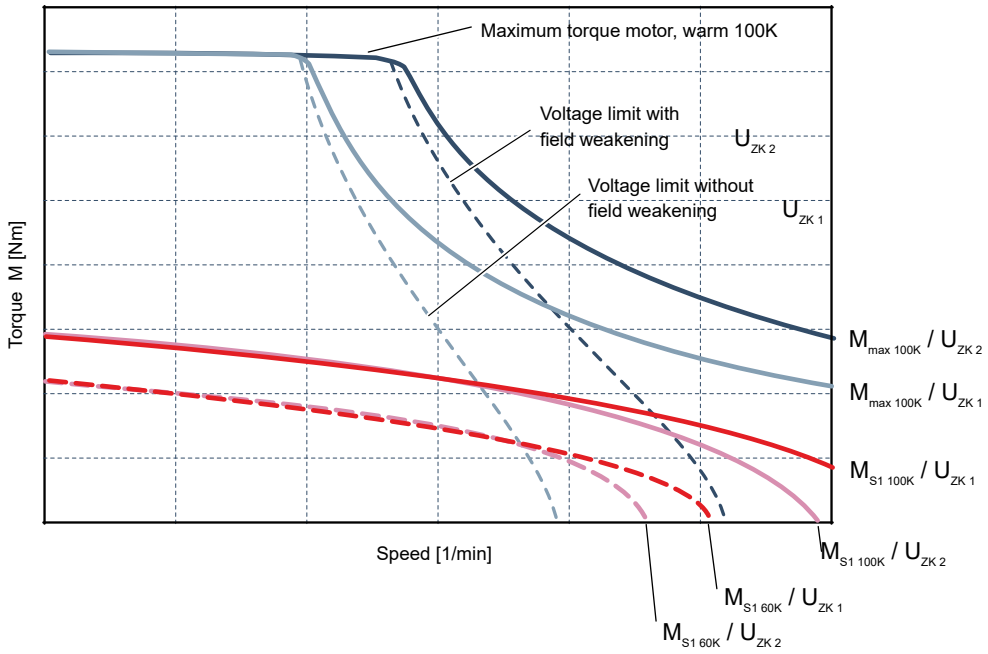


Fig. 8: Characteristic curve specifications

The specified characteristic curves are typical standard values. The actual performance data of a drive axis are subject to manufacturing-related tolerances.

6.3 Rated data

Rated data are defined for the following conditions:

- Rated speed is determined by the DC bus voltage $U_{ZK\,1}$. The voltage limit or the point of optimal performance are relevant variables to specify the rated speed.
- Rated data are applied to the rated speed and to the S1 continuous operation characteristics at $M_{S1\,100\,K}$ / $U_{ZK\,2}$

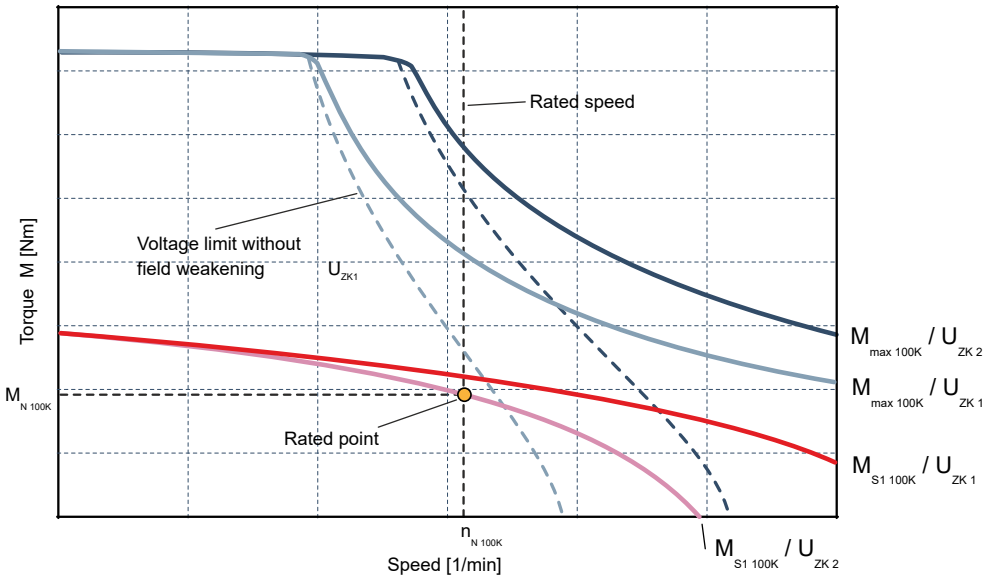


Fig. 9: Rated point

In case of motors with high speeds, the rated point of the characteristic voltage limit curve $U_{ZK\,1}$ can be displayed in the direction of the point of origin.

The rated data are specified on type place of the motors as well as in the technical data sheet.

6.4 Tolerances

The values specified in the technical data are subject to a natural dispersion. Observe the tolerance specifications for the following parameters.

Table 16: Tolerance specifications of the motor data

Designation	Symbol	Tolerance value
Standstill torque - 60 K	$M_{0\,60K}$	± 5%
Standstill torque - 100 K	$M_{0\,100K}$	± 5%
Rotor inertia	J_{rot}	± 10%
Rated torque - 100 K	$M_{N\,100K}$	± 5%
Rated power - 100 K	$P_{N\,100K}$	± 5%
Maximum torque 20 °C (cold)	$M_{max\,20°C}$	± 5%
Maximum torque - 100 K (warm)	$M_{max\,100K}$	± 5%
Torque constant at 20 °C	K_m	± 5%
Voltage constant at 20 °C	K_E	± 5%

6.5 Temperature influence and tolerance

The torque-speed characteristic curves are specified for cold motors ($M_{max\ 20°C}$) as well as for motors at rated-load operating temperature ($M_{max\ 100\ K}$). Following figure shows the influence of motor temperature and material variation caused by manufacturing tolerances.

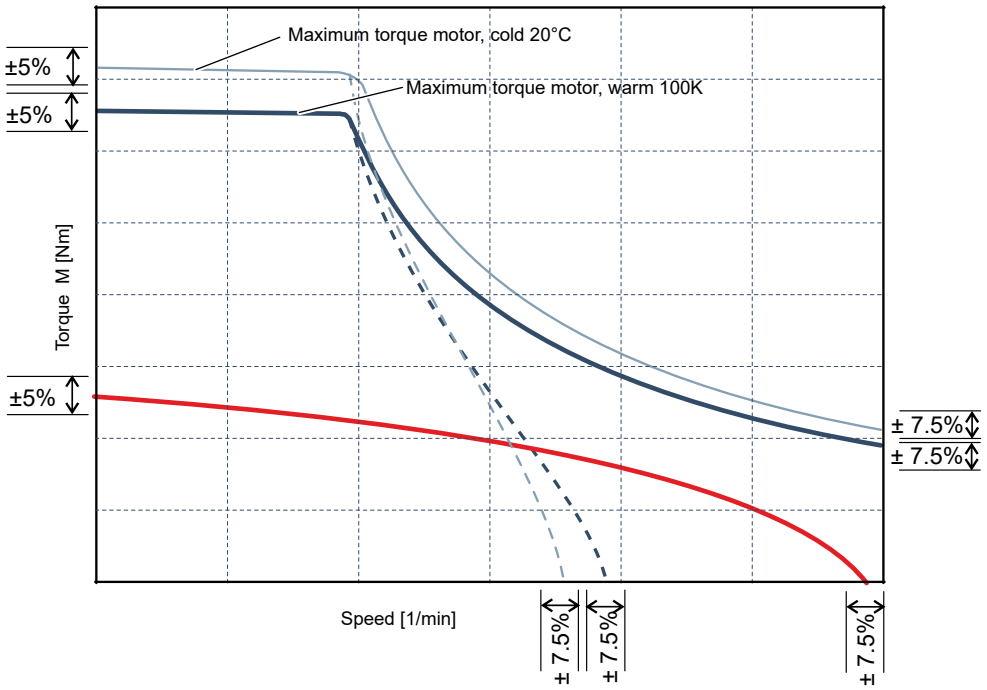


Fig. 10: Temperature influence and tolerance

The specified tolerances apply to MS2S motors with controlled and uncontrolled infeed.

6.6 IndraSize

By using the IndraSize software, drive controllers, motors and mechanic gearboxes can be easily sized. The engineering tool covers the entire range of Rexroth drives and motors. Calculate the characteristic curves for your application with IndraSize: ➦www.boschrexroth.com/indraSize

6.7 ctrlX Configurator

The **ctrlX Configurator** fully supports the ctrlX AUTOMATION portfolio and enables individual configuration of automation solutions - easily, quickly, and reliably. Without profound knowledge, desired system topologies can be graphically created and requested by the user.
➦ctrlX Configurator

7 Technical data

7.1 MS2S03

7.1.1 Self-cooling

MS2S03-B0BYN

Designation	Symbol	Unit	MS2S03-B0BYN-___0-_N	MS2S03-B0BYN-___1-_N
Standstill torque - 60K [1]	$M_{0\ 60K}$	Nm	0.73	
Standstill current - 60K	$I_{0\ 60K}$	A	1.3	
Standstill torque - 100K [1]	$M_{0\ 100K}$	Nm	0.92	
Standstill current - 100K	$I_{0\ 100K}$	A	1.63	
Moment of inertia of rotor [1]	J_{rot}	kg*m²	0.00002	0.0000218
Rated speed - 100K	$n_{N\ 100K}$	1/min	6,630	
Rated torque - 100K [1]	$M_{N\ 100K}$	Nm	0.54	
Rated current - 100K	$I_{N\ 100K}$	A	1.06	
Rated power - 100K [1]	$P_{N\ 100K}$	kW	0.37	
Maximum torque 20 °C (cold) [1]	$M_{max\ 20°C}$	Nm	3.75	
Maximum torque 100K (warm) [1]	$M_{max\ 100K}$	Nm	3.46	
Maximum current	$I_{max(eff)}$	A	7.1	
Maximum speed (electrical)	$n_{max\ el}$	1/min	9,000	
Maximum speed (mechanical)	$n_{max\ mech}$	1/min	9,000	
Number of pole pairs	p		5	
Torque constant at 20 °C [1]	K_m	Nm/A	0.62	
Voltage constant at 20 °C [1]	K_E	V/1000 min^{-1}	37.4	
Winding resistance at 20 °C	R_{12}	Ohm	14.0	
Winding inductance	L_{12_min}	mH	20.6	
Leakage capacitance of the component	C_{ab}	nF	0.83	
Thermal time constant of winding	T_{th_W}	s	12.1	
Thermal time constant of motor	T_{th_M}	min	11.3	
Mass	m_{mot}	kg	1.4	1.8
Holding brake				
Holding torque	M_4	Nm	0	1.50
Rated voltage	U_N	V	0	24
Rated current	I_N	A	0	0.31
Maximum connection time	t_1	ms	0	20
Maximum disconnection time	t_2	ms	0	60
1) For tolerance details refer to ➦chapter 6.4 “Tolerances”				

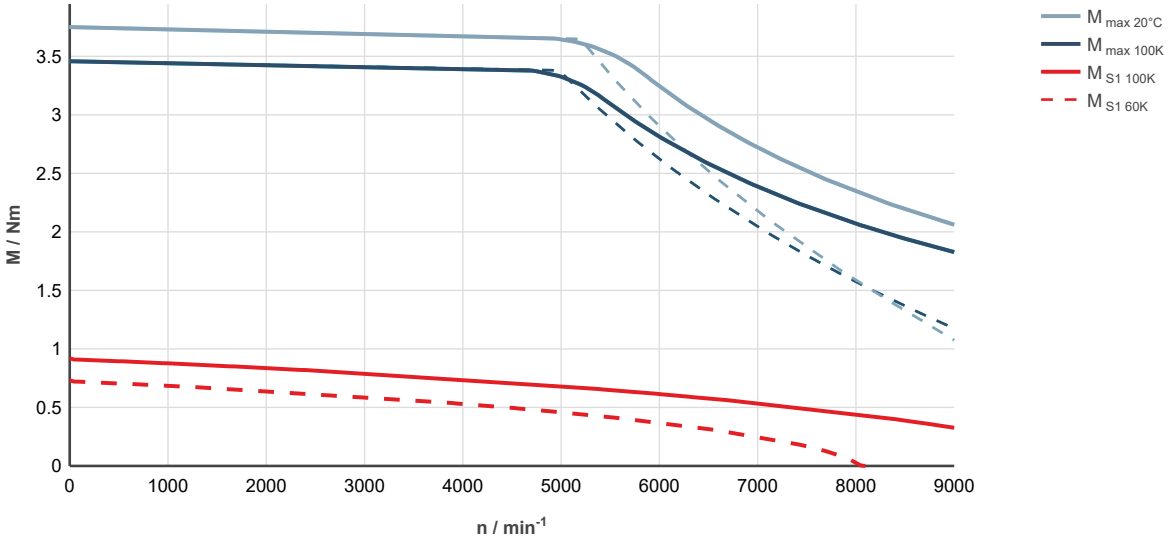


Fig. 11: MS2S03-B0BYN-___0-____-__, ctrlX DRIVE, uncontrolled supply 3 × AC 400 V

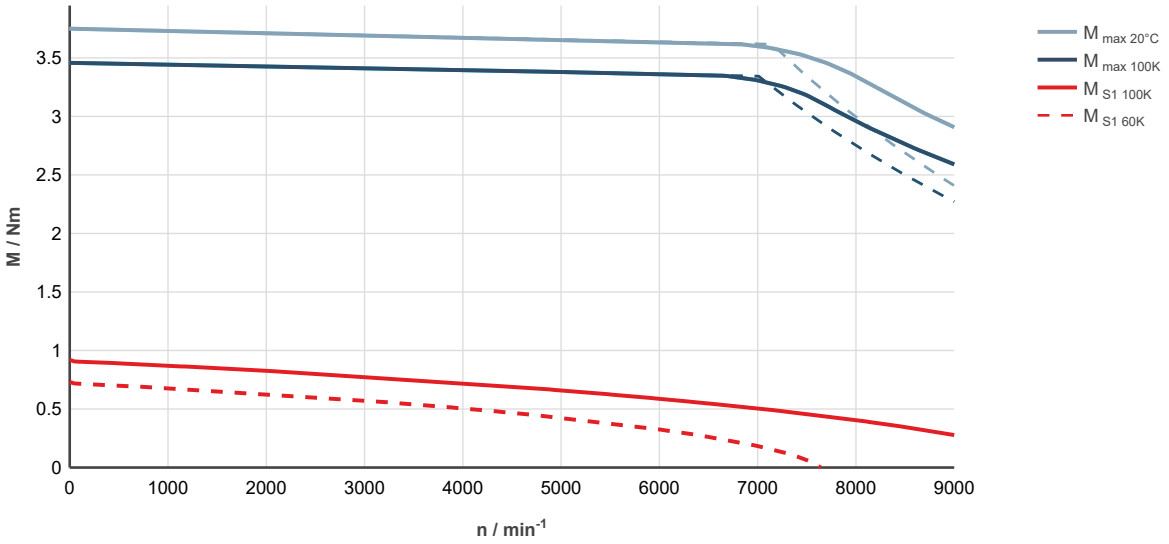


Fig. 12: MS2S03-B0BYN-___0-____-__, ctrlX DRIVE, controlled supply 3 x AC 400 ... 480 V

MS2S03-C0BYN

Designation	Symbol	Unit	MS2S03-C0BYN-___0-_N	MS2S03-C0BYN-___1-_N
Standstill torque - 60K [1]	$M_{0\ 60K}$	Nm	1.22	
Standstill current - 60K	$I_{0\ 60K}$	A	2.16	
Standstill torque - 100K [1]	$M_{0\ 100K}$	Nm	1.55	
Standstill current - 100K	$I_{0\ 100K}$	A	2.75	
Moment of inertia of rotor [1]	J_{rot}	$kg*m^2$	0.000033	0.0000348
Rated speed - 100K	$n_{N\ 100K}$	1/min	5,370	
Rated torque - 100K [1]	$M_{N\ 100K}$	Nm	0.80	
Rated current - 100K	$I_{N\ 100K}$	A	1.56	
Rated power - 100K [1]	$P_{N\ 100K}$	kW	0.45	
Maximum torque 20 °C (cold) [1]	$M_{max\ 20°C}$	Nm	7.0	
Maximum torque 100K (warm) [1]	$M_{max\ 100K}$	Nm	6.45	
Maximum current	$I_{max(eff)}$	A	13.0	
Maximum speed (electrical)	$n_{max\ el}$	1/min	9,000	
Maximum speed (mechanical)	$n_{max\ mech}$	1/min	9,000	
Number of pole pairs	p		5	
Torque constant at 20 °C [1]	K_m	Nm/A	0.61	
Voltage constant at 20 °C [1]	K_E	V/1000 min^{-1}	36.2	
Winding resistance at 20 °C	R_{12}	Ohm	5.55	
Winding inductance	L_{12_min}	mH	9.3	
Leakage capacitance of the component	C_{ab}	nF	1.6	
Thermal time constant of winding	T_{th_W}	s	12.1	
Thermal time constant of motor	T_{th_M}	min	15.0	
Mass	m_{mot}	kg	1.9	2.3
Holding brake				
Holding torque	M_4	Nm	0	1.50
Rated voltage	U_N	V	0	24
Rated current	I_N	A	0	0.31
Maximum connection time	t_1	ms	0	20
Maximum disconnection time	t_2	ms	0	60
1) For tolerance details refer to ➦chapter 6.4 “Tolerances”				

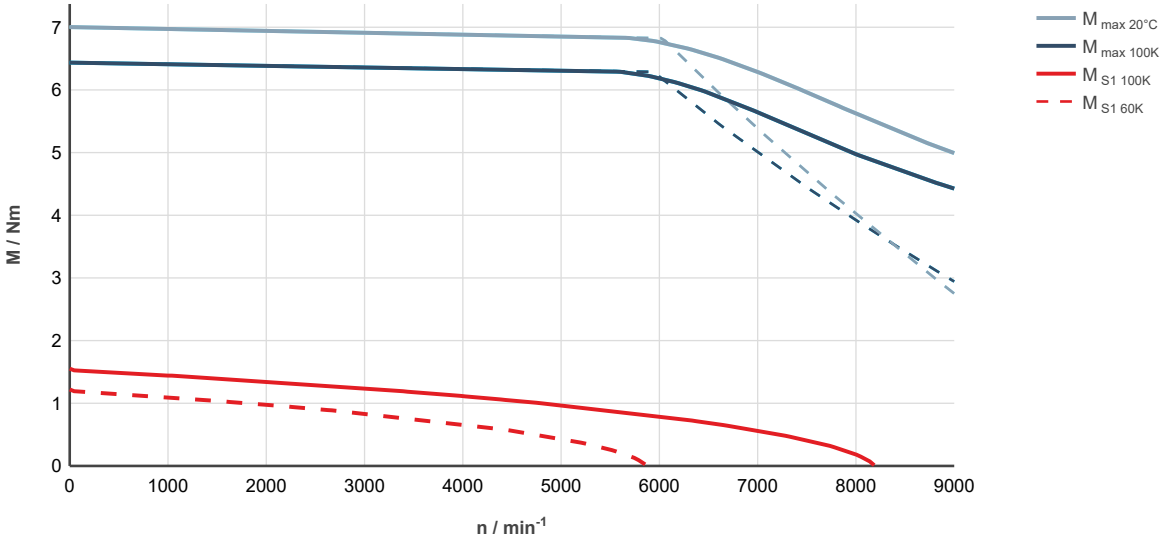


Fig. 13: MS2S03-C0BYN-___0-____-__, ctrlX DRIVE, uncontrolled supply 3 × AC 400 V

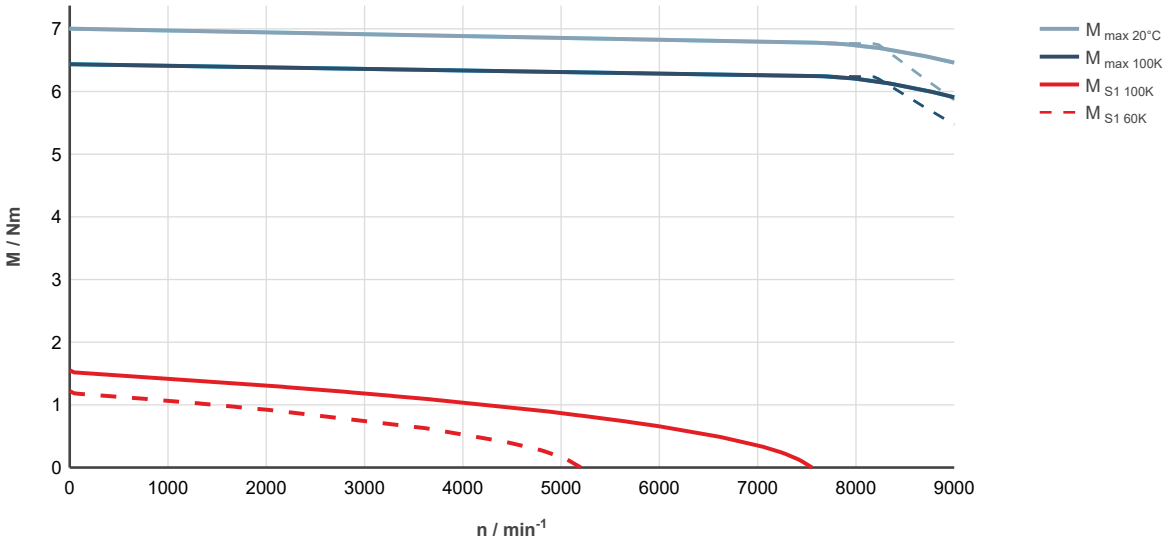
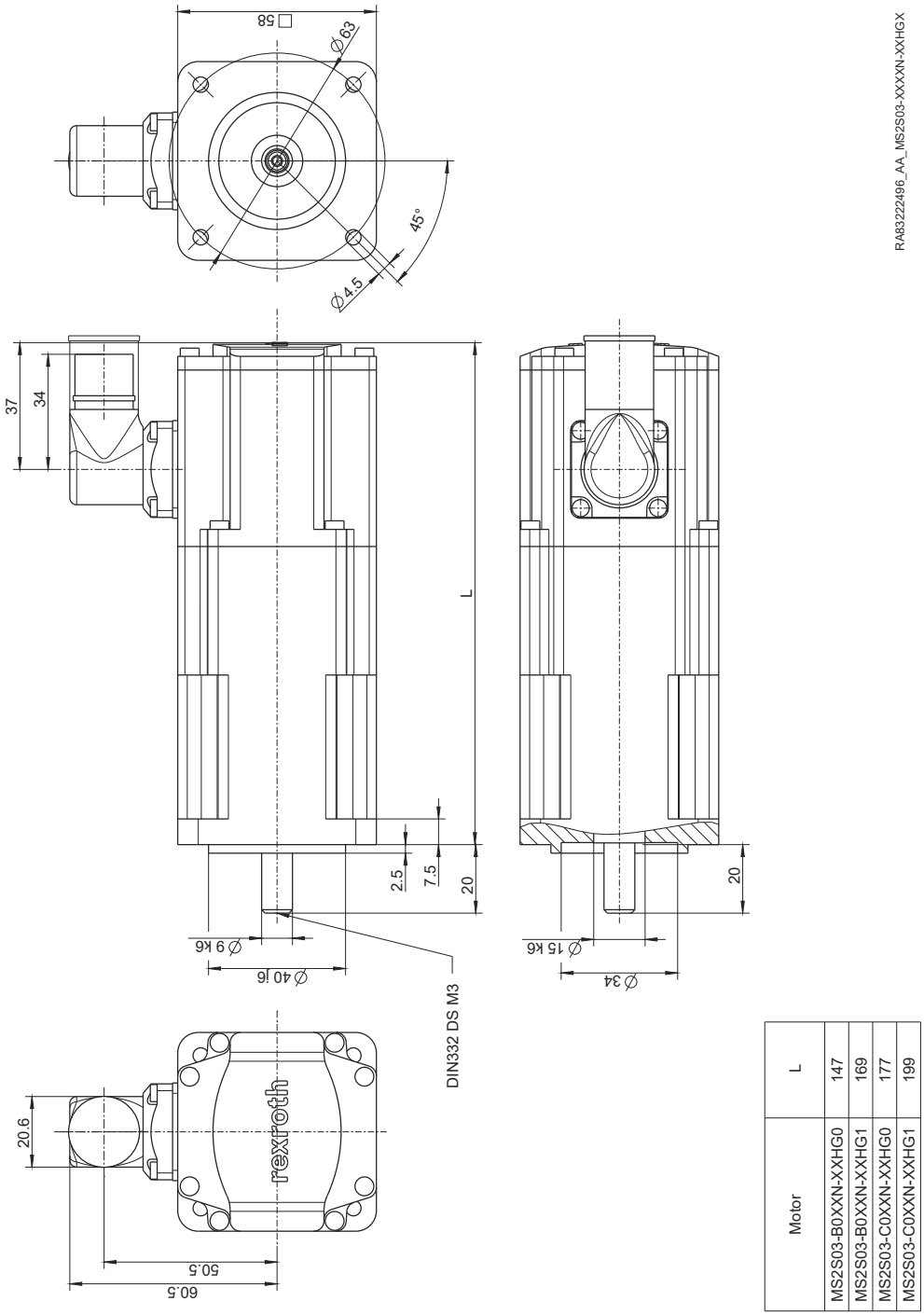


Fig. 14: MS2S03-C0BYN-___0-____-__, ctrlX DRIVE, controlled supply 3 x AC 400 ... 480 V

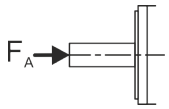
7.1.2 MS2S03 Self-cooling specifications



Motor	L
MS2S03-B0XXN-XXHG0	147
MS2S03-B0XXN-XXHG1	169
MS2S03-C0XXN-XXHG0	177
MS2S03-C0XXN-XXHG1	199

Fig. 15: RA83222496_AA_MS2S03-XXXXN-XXHGX_-90G

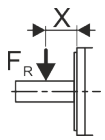
7.1.3 MS2S03 Axial force



Axial forces F_A only allowed after a detailed dimensioning by your distribution partner at Bosch Rexroth. For evaluation purposes, please specify the following information:

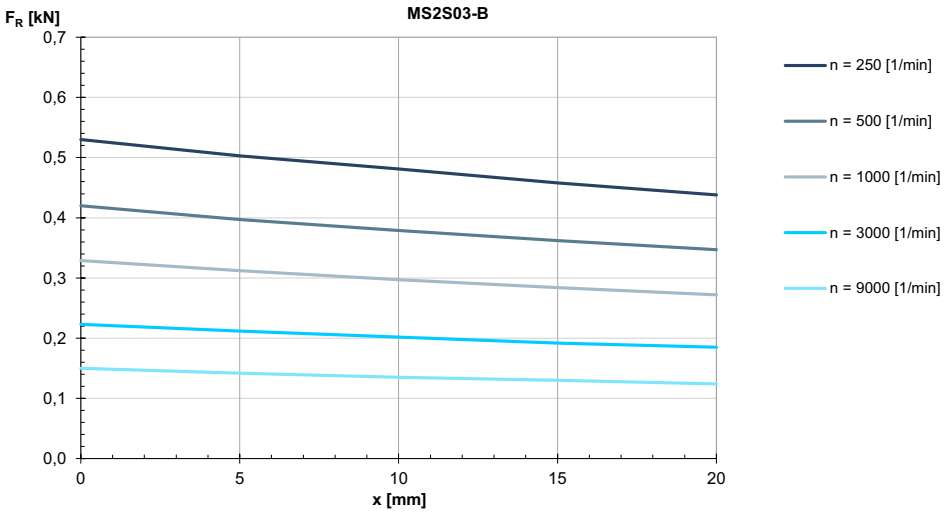
- Axial and radial force with force application point
- Installation position (horizontal, vertical with the shaft end pointing to the top or bottom)
- Mean speed

7.1.4 MS2S03 Radial force

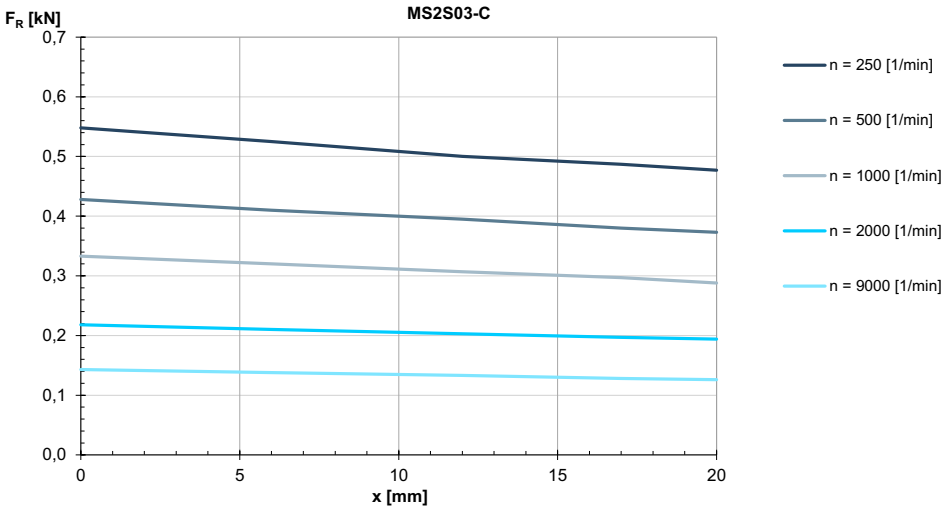


The permissible radial force F_R is specified in distance x from the shaft shoulder, depending on the mean speed in the following diagram.

Radial force in distance x from the shaft shoulder at a nominal bearing service life of Lh10 = 20.000 h



Radial force in distance x from the shaft shoulder at a nominal bearing service life of Lh10 = 20.000 h



7.2 MS2S04

7.2.1 Self-cooling

MS2S04-B0BTN

Designation	Symbol	Unit	MS2S04-B0BTN-___0-_N	MS2S04-B0BTN-___1-_N
Standstill torque - 60K [1]	$M_{0\ 60K}$	Nm	1.73	
Standstill current - 60K	$I_{0\ 60K}$	A	2.23	
Standstill torque - 100K [1]	$M_{0\ 100K}$	Nm	2.10	
Standstill current - 100K	$I_{0\ 100K}$	A	2.72	
Moment of inertia of rotor [1]	J_{rot}	$kg*m^2$	0.00006	0.0000675
Rated speed - 100K	$n_{N\ 100K}$	1/min	5,000	
Rated torque - 100K [1]	$M_{N\ 100K}$	Nm	1.12	
Rated current - 100K	$I_{N\ 100K}$	A	1.58	
Rated power - 100K [1]	$P_{N\ 100K}$	kW	0.58	
Maximum torque 20 °C (cold) [1]	$M_{max\ 20°C}$	Nm	6.30	
Maximum torque 100K (warm) [1]	$M_{max\ 100K}$	Nm	5.85	
Maximum current	$I_{max(eff)}$	A	9.9	
Maximum speed (electrical)	$n_{max\ el}$	1/min	6,000	
Maximum speed (mechanical)	$n_{max\ mech}$	1/min	6,000	
Number of pole pairs	p		5	
Torque constant at 20 °C [1]	K_m	Nm/A	0.85	
Voltage constant at 20 °C [1]	K_E	V/1000 min^{-1}	50.0	
Winding resistance at 20 °C	R_{12}	Ohm	6.37	
Winding inductance	L_{12_min}	mH	27.5	
Leakage capacitance of the component	C_{ab}	nF	1.1	
Thermal time constant of winding	T_{th_W}	s	32.0	
Thermal time constant of motor	T_{th_M}	min	12.7	
Mass	m_{mot}	kg	2.7	3.4
Holding brake				
Holding torque	M_4	Nm	0	3.50
Rated voltage	U_N	V	0	24
Rated current	I_N	A	0	0.35
Maximum connection time	t_1	ms	0	30
Maximum disconnection time	t_2	ms	0	85
1) For tolerance details refer to ➦chapter 6.4 “Tolerances”				

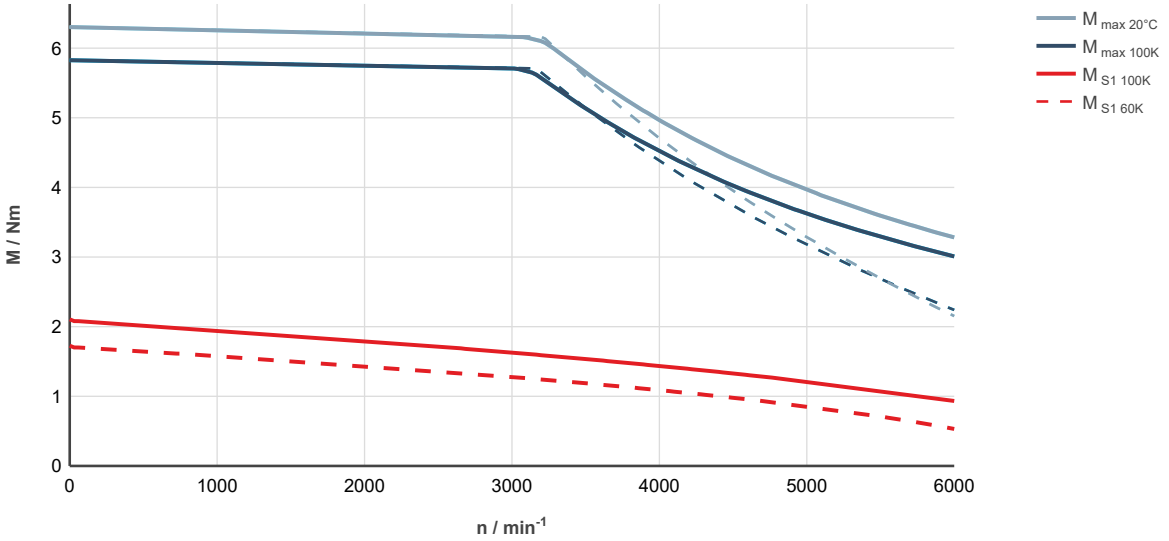


Fig. 16: MS2S04-B0BTN-___0-____-__, ctrlX DRIVE, uncontrolled supply 3 × AC 400 V

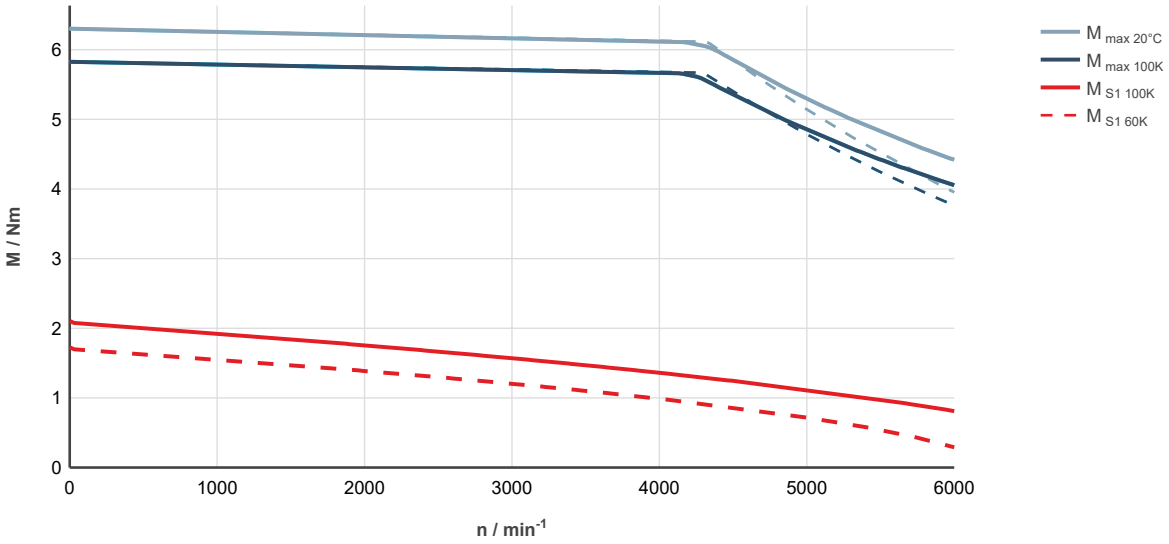


Fig. 17: MS2S04-B0BTN-___0-____-__, ctrlX DRIVE, controlled supply 3 x AC 400 ... 480 V

MS2S04-C0BTN

Designation	Symbol	Unit	MS2S04-C0BTN-___0-_N	MS2S04-C0BTN-___1-_N
Standstill torque - 60K [1]	$M_{0\ 60K}$	Nm	2.80	
Standstill current - 60K	$I_{0\ 60K}$	A	3.12	
Standstill torque - 100K [1]	$M_{0\ 100K}$	Nm	3.50	
Standstill current - 100K	$I_{0\ 100K}$	A	3.9	
Moment of inertia of rotor [1]	J_{rot}	$kg*m^2$	0.0001	0.0001075
Rated speed - 100K	$n_{N\ 100K}$	1/min	4,000	
Rated torque - 100K [1]	$M_{N\ 100K}$	Nm	1.72	
Rated current - 100K	$I_{N\ 100K}$	A	2.09	
Rated power - 100K [1]	$P_{N\ 100K}$	kW	0.72	
Maximum torque 20 °C (cold) [1]	$M_{max\ 20°C}$	Nm	12.8	
Maximum torque 100K (warm) [1]	$M_{max\ 100K}$	Nm	11.8	
Maximum current	$I_{max(eff)}$	A	17.3	
Maximum speed (electrical)	$n_{max\ el}$	1/min	6,000	
Maximum speed (mechanical)	$n_{max\ mech}$	1/min	6,000	
Number of pole pairs	p		5	
Torque constant at 20 °C [1]	K_m	Nm/A	0.97	
Voltage constant at 20 °C [1]	K_E	V/1000 min^{-1}	59.8	
Winding resistance at 20 °C	R_{12}	Ohm	3.42	
Winding inductance	L_{12_min}	mH	17.9	
Leakage capacitance of the component	C_{ab}	nF	1.8	
Thermal time constant of winding	T_{th_W}	s	32.0	
Thermal time constant of motor	T_{th_M}	min	16.0	
Mass	m_{mot}	kg	3.7	4.4
Holding brake				
Holding torque	M_4	Nm	0	3.50
Rated voltage	U_N	V	0	24
Rated current	I_N	A	0	0.35
Maximum connection time	t_1	ms	0	30
Maximum disconnection time	t_2	ms	0	85
1) For tolerance details refer to ➦chapter 6.4 “Tolerances”				

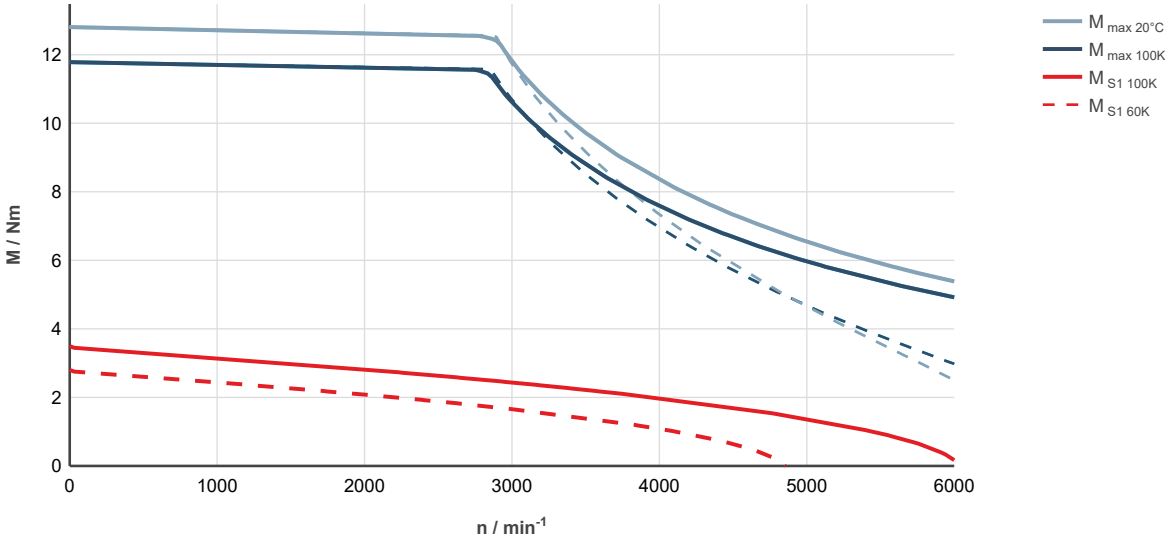


Fig. 18: MS2S04-C0BTN-___0-____-__, ctrlX DRIVE, uncontrolled supply 3 × AC 400 V

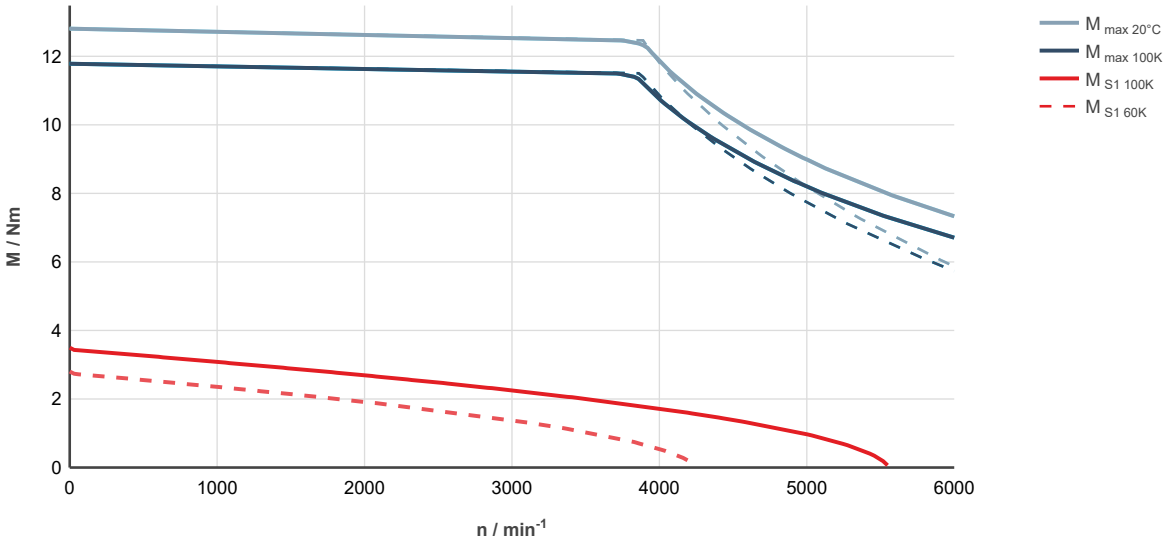
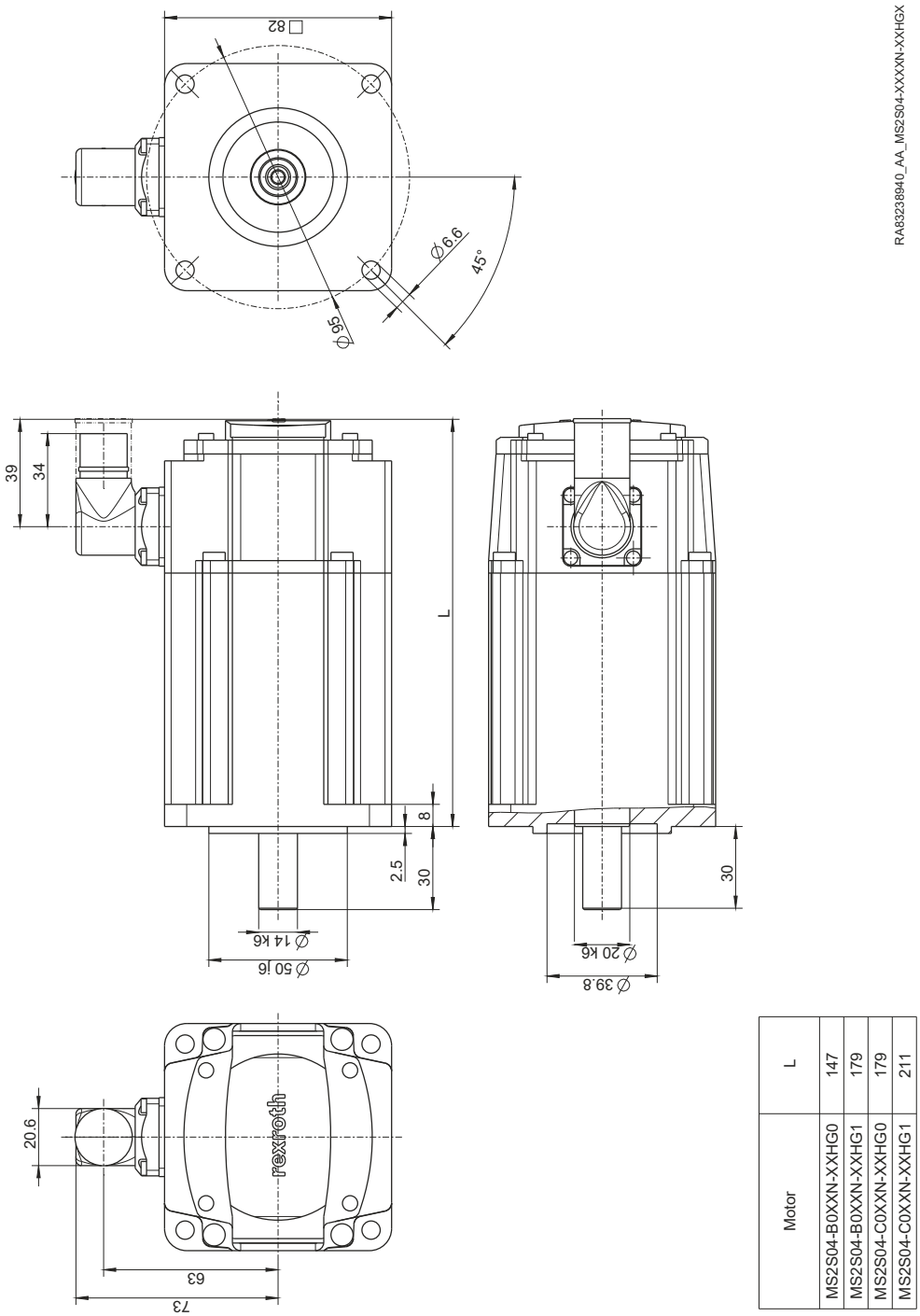


Fig. 19: MS2S04-C0BTN-___0-____-__, ctrlX DRIVE, controlled supply 3 x AC 400 ... 480 V

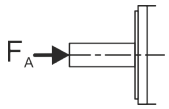
7.2.2 MS2S04 Self-cooling specifications



Motor	L
MS2S04-B0XXN-XXHG0	147
MS2S04-B0XXN-XXHG1	179
MS2S04-C0XXN-XXHG0	179
MS2S04-C0XXN-XXHG1	211

Fig. 20: RA83238940_AA_MS2S04-XXXXN-XXHGX_-90G

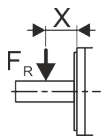
7.2.3 MS2S04 Axial force



Axial forces F_A are permissible without limitation up to 30 N. Higher axial forces only after a detailed dimensioning by your distribution partner at Bosch Rexroth. For evaluation purposes, please specify the following information:

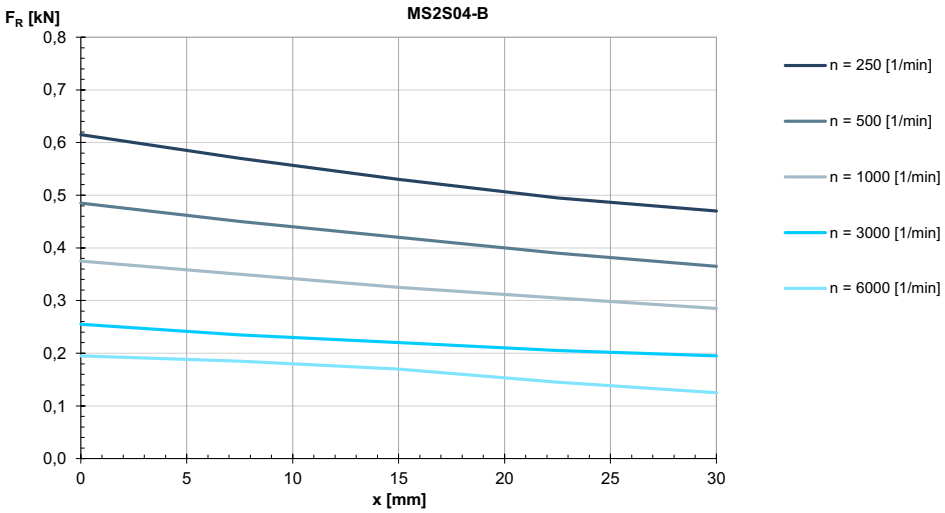
- Axial and radial force with force application point
- Installation position (horizontal, vertical with the shaft end pointing to the top or bottom)
- Mean speed

7.2.4 MS2S04 Radial force

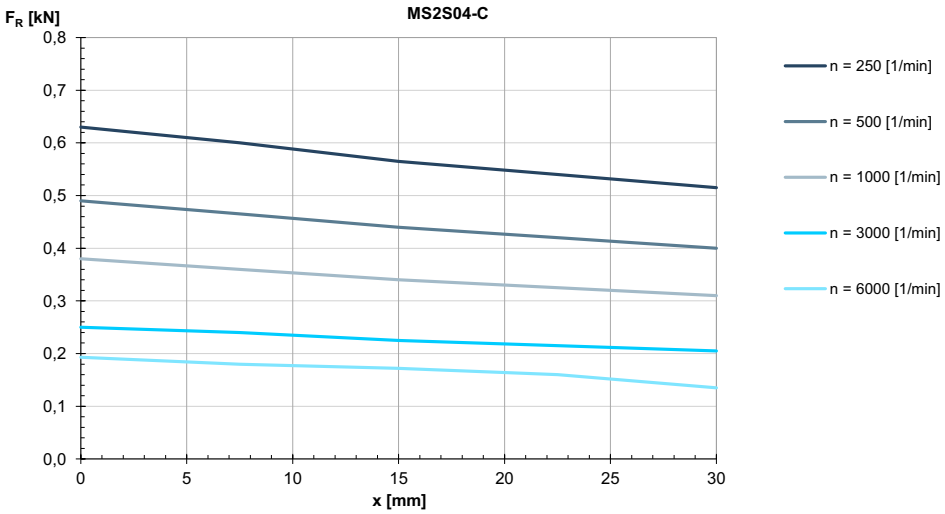


The permissible radial force F_R is specified in distance x from the shaft shoulder, depending on the mean speed in the following diagram.

Radial force in distance x from the shaft shoulder at a nominal bearing service life of Lh10 = 20.000 h



Radial force in distance x from the shaft shoulder at a nominal bearing service life of Lh10 = 20.000 h



7.3 MS2S05

7.3.1 Self-cooling

MS2S05-B0BTN

Designation	Symbol	Unit	MS2S05-B0BTN-___0-_N	MS2S05-B0BTN-___1-_N
Standstill torque - 60K [1]	$M_{0\ 60K}$	Nm	3.75	
Standstill current - 60K	$I_{0\ 60K}$	A	4.58	
Standstill torque - 100K [1]	$M_{0\ 100K}$	Nm	4.45	
Standstill current - 100K	$I_{0\ 100K}$	A	5.5	
Moment of inertia of rotor [1]	J_{rot}	kg*m²	0.00015	0.000173
Rated speed - 100K	$n_{N\ 100K}$	1/min	5,390	
Rated torque - 100K [1]	$M_{N\ 100K}$	Nm	2.42	
Rated current - 100K	$I_{N\ 100K}$	A	3.19	
Rated power - 100K [1]	$P_{N\ 100K}$	kW	1.37	
Maximum torque 20 °C (cold) [1]	$M_{max\ 20°C}$	Nm	11.55	
Maximum torque 100K (warm) [1]	$M_{max\ 100K}$	Nm	10.65	
Maximum current	$I_{max(eff)}$	A	16.8	
Maximum speed (electrical)	$n_{max\ el}$	1/min	6,000	
Maximum speed (mechanical)	$n_{max\ mech}$	1/min	6,000	
Number of pole pairs	p		5	
Torque constant at 20 °C [1]	K_m	Nm/A	0.89	
Voltage constant at 20 °C [1]	K_E	V/1000 min^{-1}	54.2	
Winding resistance at 20 °C	R_{12}	Ohm	2.68	
Winding inductance	L_{12_min}	mH	15.8	
Leakage capacitance of the component	C_{ab}	nF	1.21	
Thermal time constant of winding	T_{th_W}	s	34.0	
Thermal time constant of motor	T_{th_M}	min	12.7	
Mass	m_{mot}	kg	4.0	5.1
Holding brake				
Holding torque	M_4	Nm	0	7.20
Rated voltage	U_N	V	0	24
Rated current	I_N	A	0	0.60
Maximum connection time	t_1	ms	0	30
Maximum disconnection time	t_2	ms	0	120
1) For tolerance details refer to ➦chapter 6.4 “Tolerances”				

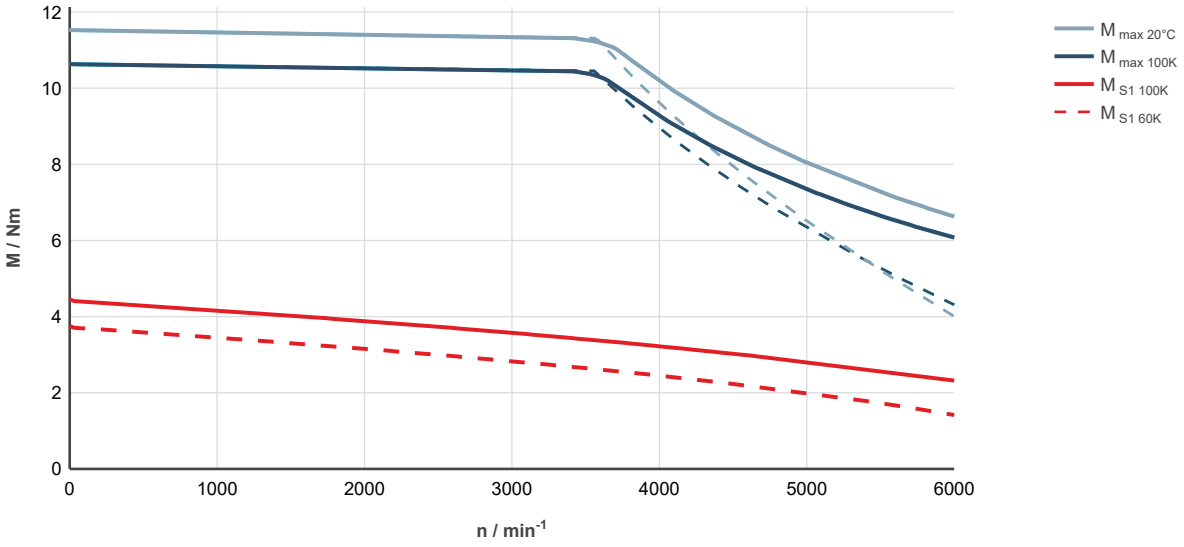


Fig. 21: MS2S05-B0BTN-___0-____-__, ctrlX DRIVE, uncontrolled supply 3 × AC 400 V

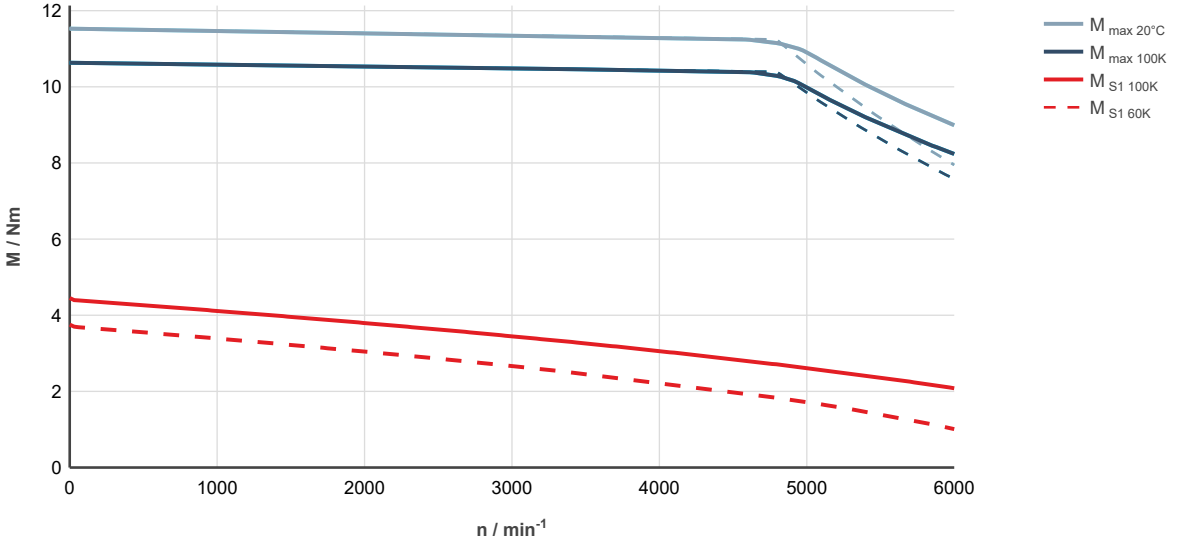


Fig. 22: MS2S05-B0BTN-___0-____-__, ctrlX DRIVE, controlled supply 3 x AC 400 ... 480 V

MS2S05-C0BTN

Designation	Symbol	Unit	MS2S05-C0BTN-___0-_N	MS2S05-C0BTN-___1-_N
Standstill torque - 60K 1)	$M_{0\ 60K}$	Nm	6.00	
Standstill current - 60K	$I_{0\ 60K}$	A	6.9	
Standstill torque - 100K 1)	$M_{0\ 100K}$	Nm	7.15	
Standstill current - 100K	$I_{0\ 100K}$	A	8.3	
Moment of inertia of rotor 1)	J_{rot}	kg*m²	0.00025	0.000273
Rated speed - 100K	$n_{N\ 100K}$	1/min	4,000	
Rated torque - 100K 1)	$M_{N\ 100K}$	Nm	3.79	
Rated current - 100K	$I_{N\ 100K}$	A	4.69	
Rated power - 100K 1)	$P_{N\ 100K}$	kW	1.59	
Maximum torque 20 °C (cold) 1)	$M_{max\ 20°C}$	Nm	22.6	
Maximum torque 100K (warm) 1)	$M_{max\ 100K}$	Nm	20.8	
Maximum current	$I_{max(eff)}$	A	29.6	
Maximum speed (electrical)	$n_{max\ el}$	1/min	6,000	
Maximum speed (mechanical)	$n_{max\ mech}$	1/min	6,000	
Number of pole pairs	p		5	
Torque constant at 20 °C 1)	K_m	Nm/A	0.94	
Voltage constant at 20 °C 1)	K_E	V/1000 min^{-1}	56.1	
Winding resistance at 20 °C	R_{12}	Ohm	1.27	
Winding inductance	L_{12_min}	mH	7.9	
Leakage capacitance of the component	C_{ab}	nF	1.5	
Thermal time constant of winding	T_{th_W}	s	34.0	
Thermal time constant of motor	T_{th_M}	min	16.0	
Mass	m_{mot}	kg	5.9	7.0
Holding brake				
Holding torque	M_4	Nm	0	7.20
Rated voltage	U_N	V	0	24
Rated current	I_N	A	0	0.60
Maximum connection time	t_1	ms	0	30
Maximum disconnection time	t_2	ms	0	120
1) For tolerance details refer to ➦chapter 6.4 “Tolerances”				

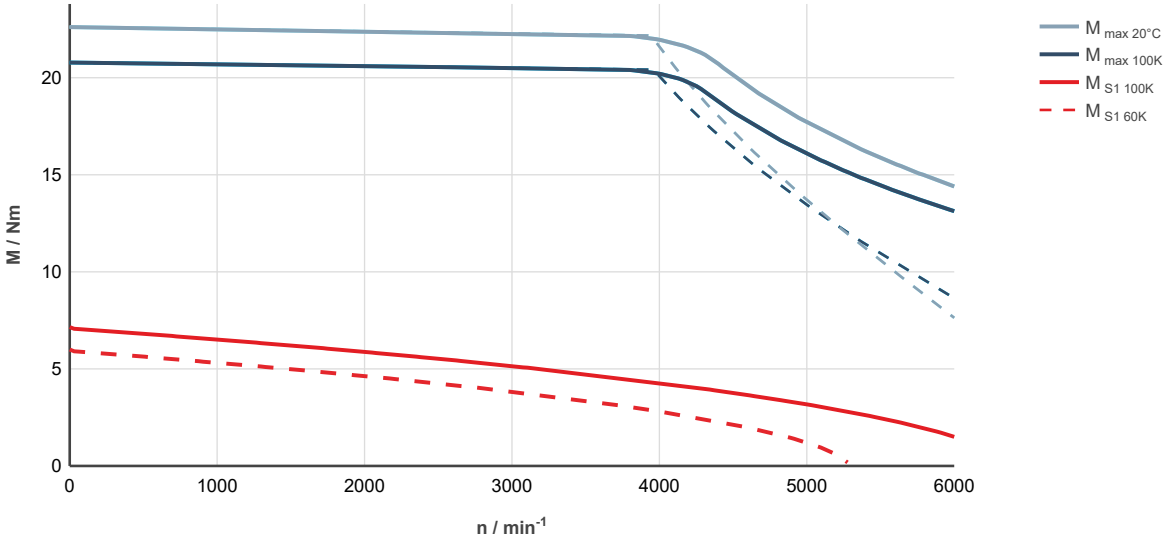


Fig. 23: MS2S05-C0BTN-___0-____-__, ctrlX DRIVE, uncontrolled supply 3 × AC 400 V

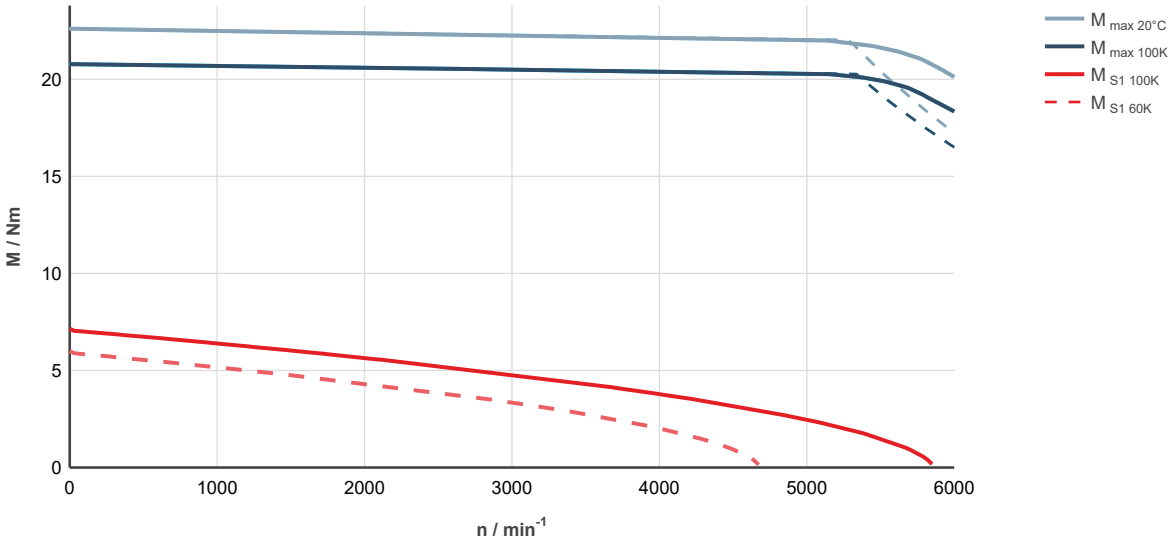
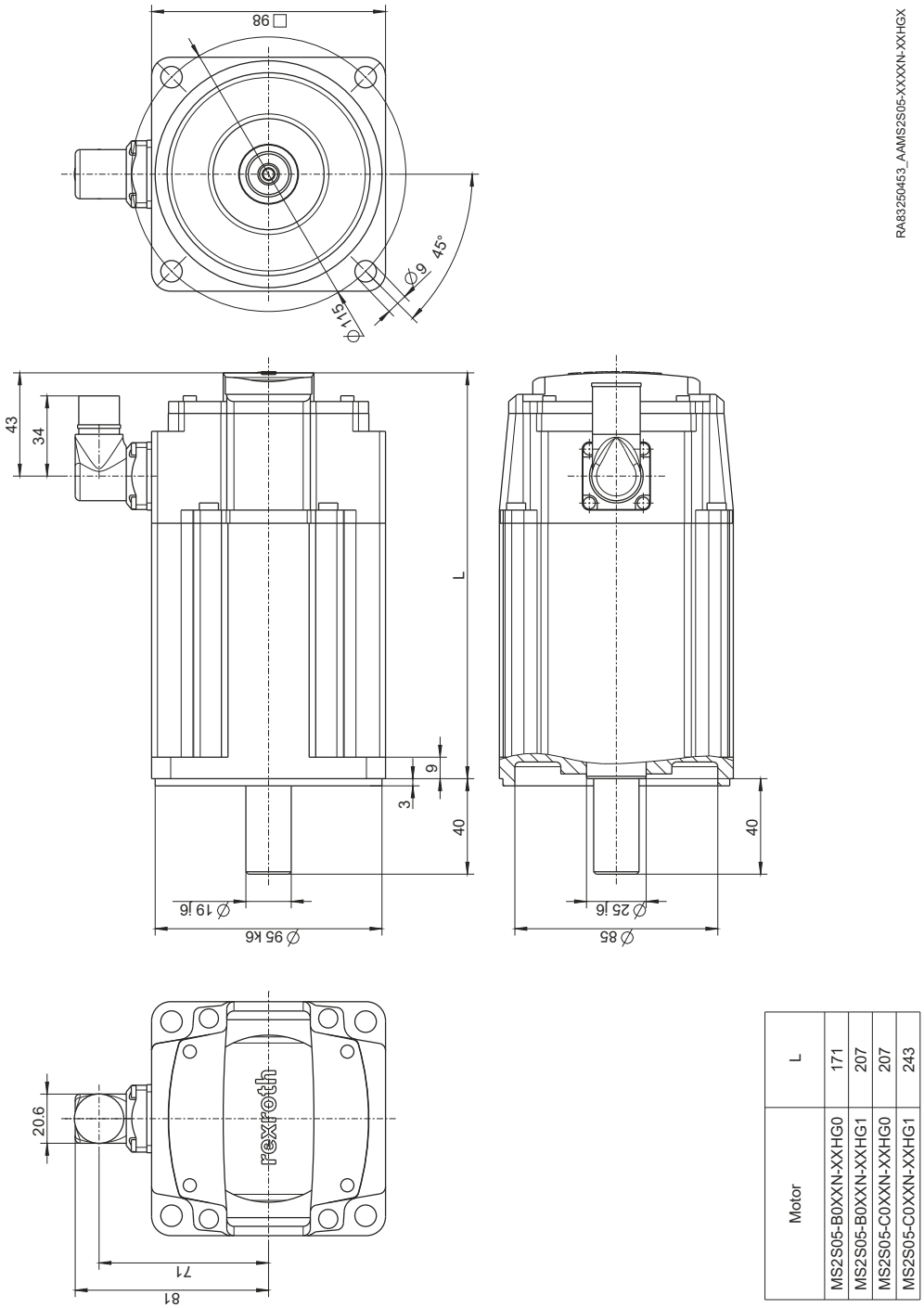


Fig. 24: MS2S05-C0BTN-___0-____-__, ctrlX DRIVE, controlled supply 3 x AC 400 ... 480 V

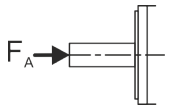
7.3.2 MS2S05 Self-cooling specifications



Motor	L
MS2S05-B0XXN-XXHG0	171
MS2S05-B0XXN-XXHG1	207
MS2S05-C0XXN-XXHG0	207
MS2S05-C0XXN-XXHG1	243

Fig. 25: RA83250453_AAMS2S05-XXXXN-XXHGX_-90G

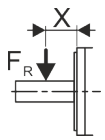
7.3.3 MS2S05 Axial force



Axial forces F_A are permissible without limitation up to 40 N. Higher axial forces only after a detailed dimensioning by your distribution partner at Bosch Rexroth. For evaluation purposes, please specify the following information:

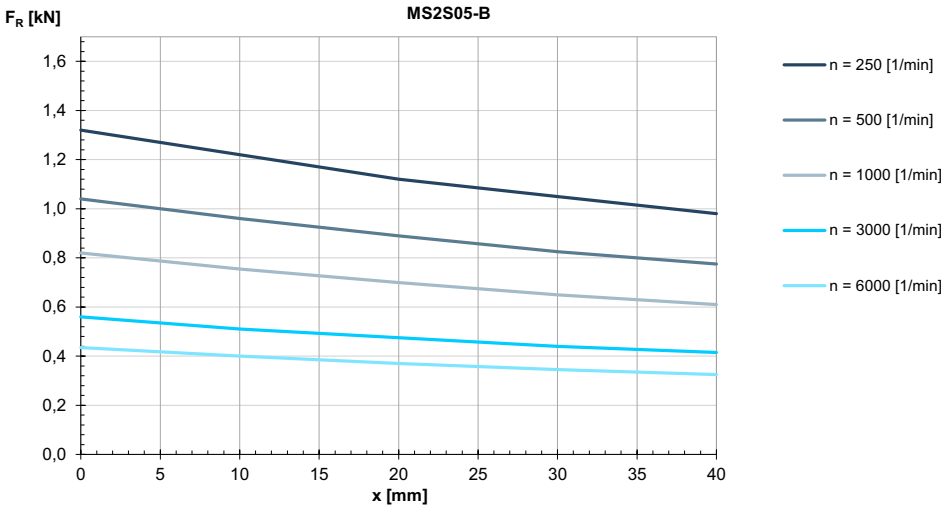
- Axial and radial force with force application point
- Installation position (horizontal, vertical with the shaft end pointing to the top or bottom)
- Mean speed

7.3.4 MS2S05 Radial force

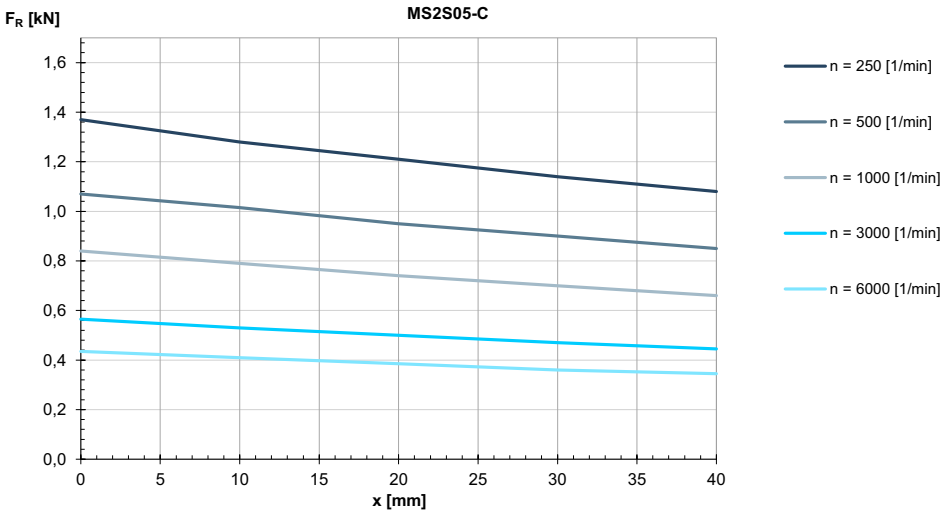


The permissible radial force F_R is specified in distance x from the shaft shoulder, depending on the mean speed in the following diagram.

Radial force in distance x from the shaft shoulder at a nominal bearing service life of Lh10 = 20.000 h



Radial force in distance x from the shaft shoulder at a nominal bearing service life of Lh10 = 20.000 h



8 Electrical connection

8.1 Circuit diagram

8.1.1 Single cable connection for MS2S with encoder (digital "I") and optional brake

Circuit diagram

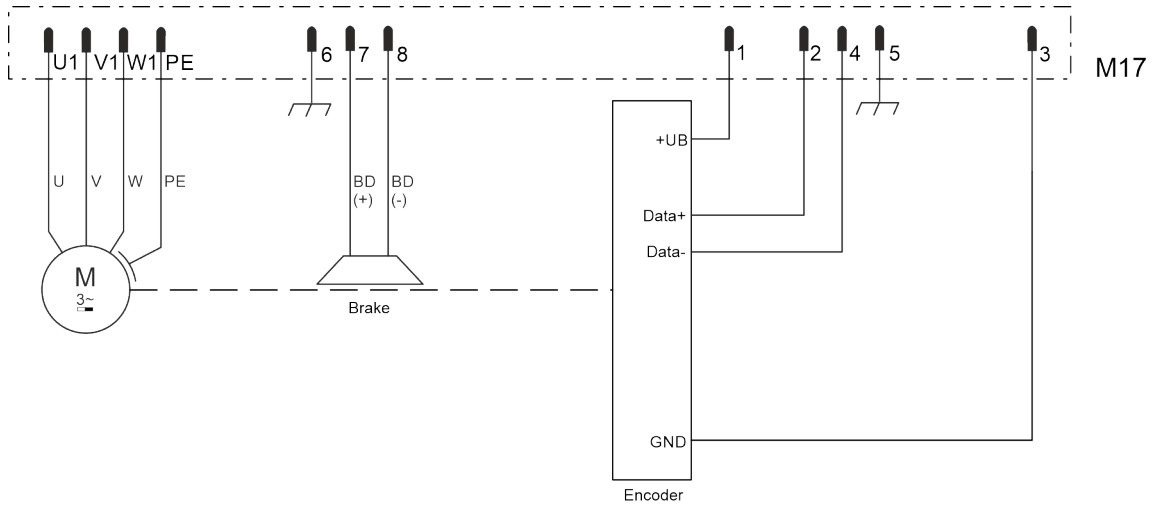


Fig. 26: Circuit diagram MS2S

8.2 M17 single cable connector, rotatable (SpeedTec)

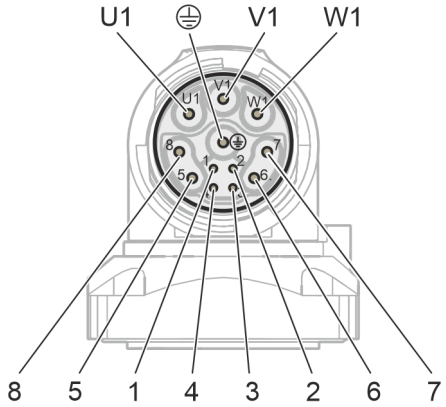


Fig. 27: Cable view of single cable connection M17

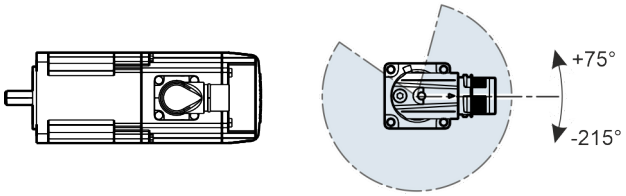
Designation	Function	
	with brake	without brake
U1	A1	A1
V1	A2	A2
W1	A3	A3
⏚	PE	PE
1	+UB	+UB
2	Data+	Data+
3	GND	GND
4	Data-	Data-
5	Shld_Enc	Shld_Enc
6	Shld_BD	Shld_BD
7	BD(+)	n.c.
8	BD(-)	n.c.

Adjustment range

The output direction of the single cable connector M17 is adjustable. The device connectors can be manually rotated of a plug connector has been installed. Do not use any tools (e.g. pliers or screwdrivers) to turn the device connector to avoid damage.

Change the output direction a maximum of ten times and do not exceed the specified adjustment torques and the angle of rotation.

The theoretical setting range is shown below.

Adjustment range single cable connector SpeedTec M17	
	
Adjustment torque	4 ... 9 Nm

Connect plug-in connector of ready-made hybrid cable.

1. Check the power wire cross-section of the ready-made hybrid cable (RHB2). Laying type, rated current I0_100K

2. Insert plug-in connector and lock the SpeedTec locking by turning clockwise.
3. Secure the hybrid cable against vibrations.
   ➥ Motor is ready for operation from an electrical engineering point of view.

8.3 Shielding concept

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

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

8.4 Ready-made connection cables

Preassembled power cables, encoder cables and hybrid cables can be provided for the motors. Motors with single cable technology are connected using a hybrid cable. The hybrid cable combines the functionality of power and encoder cable.

Die maximum cable length is 40 meters. The maximum cable length can be limited in case of certain motor control unit combinations. Please refer to the documentation about the control unit.

Please contact your sales partner in case of questions about available connection cables.

9 Ambient conditions

9.1 Ambient conditions during operation

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

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

Table 17: Ambient conditions

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

9.1.1 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 MS2S motors:

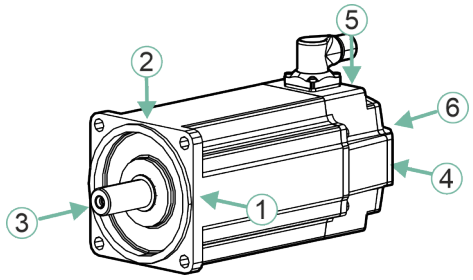


Fig. 28: Vibration load on measuring points

Table 18: Permissible vibration load for MS2S motors

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

The specified values must not be exceeded.

9.2 Derating in case of deviating ambient conditions

Reduce high performance data:

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

   We have:

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

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

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.

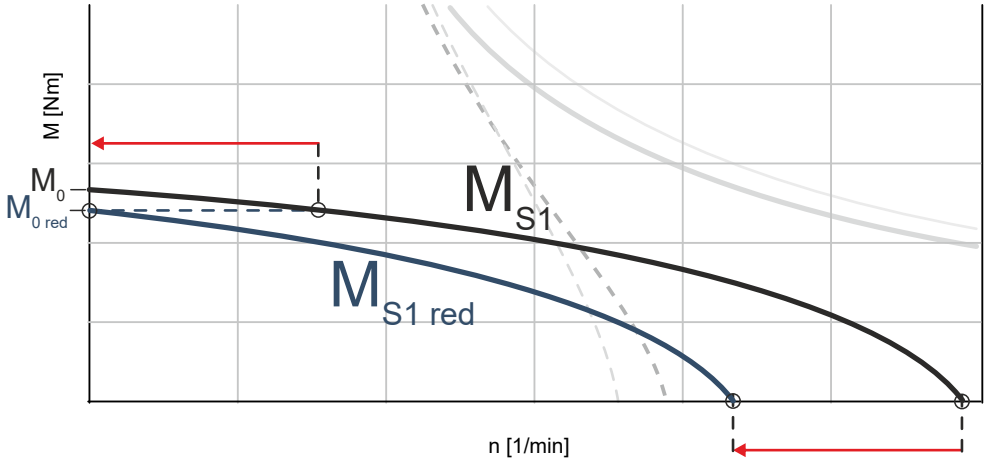


Fig. 29: Determine S1-characteristic curve $M_{S1\ red}$ with derating factor f_{TH}

Table 19: 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 20: Derating factors for self-cooling 100K

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

9.3 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.

Please observe the following classification limitations:

Table 21: Classification limitation (DIN EN IEC 60721-3-2)

Transport	
Ambient temperature	-25 ... +70 °C
Relative humidity	5 ... 75 %
Shock load	➦ Chapter 9.5 “Shock load during transport und storage ” on page 64

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).

9.3.1 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 (ESD).
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.
– Never walk under hanging loads.
– Never lift the motor on the shaft.
– Use suitable protective equipment and protective clothing during transport, and wear safety shoes.

- 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.
- Avoid increased transport vibrations.
- Remove any existing transport locks prior to commissioning and keep them.

9.4 Storage

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

Please observe the following classification limitations:

Table 22: Classification limitation (DIN EN IEC 60721-3-1)

Bearing	
Ambient temperature	-25 ... +55 °C
Relative air humidity	5 ... 75 %

Bearing	
Absolute air humidity	1 ... 29 g/m³
Direct solar radiation	Not permitted
Shock load	➦Chapter 9.5 “Shock load during transport und storage ” on page 64

NOTICE

Damage due to moisture and humidity!

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

Additional measures have to taken upon commissioning to ensure smooth functioning – irrespective of the storage time which may be longer than the warranty period of our products. Warranty extension is not a consequence.

Table 23: Measures before commissioning motors that have been stored over a prolonged period of time

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

9.5 Shock load during transport und storage

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

Table 24: Permissible shock load for MS2S motors

Frame size	Maximum allowed shock load (11 ms)	
	Axial	radial
MS2S03, -04, -05	100 m/s²	1000 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.

10 Service repair, maintenance and spare parts

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

MS2S may only be repaired in the manufacturer´s works or in a workshop authorized by Rexroth.

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 **20,000** operating hours. Shorter replacement intervals may be necessary; cf. checks during operation . We recommend regular visual inspections on shaft sealing rings. Depending on operating conditions, signs of wear may appear after 5,000 operating hours. If necessary, replace the shaft sealing rings.

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

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

Preparing information

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

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

11 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.

Significant motor 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. 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 of the rotor or secondary part must be demagnetized before disposal to avoid injuries or damage.

The demagnetization is reached via special thermal treatment. The handling duration is influenced by the rotor frame size. The rotor or the secondary part has to remain in the oven for a minimum of 30 minutes, starting at the time, the magnetic surface has reached 300 °C. If the magnets are surrounded by a bandage or a cover plate, it is recommended to remove it before heating in the oven to expose the magnets.

If demagnetization is successful, the magnets can be separated from the rotor or secondary part after cooling without applying force.

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 Appendix

12.1 CE conformity

Declarations of conformity confirming the design and compliance with the valid EN standards and directives are available for MS2S motors. If required, the declarations of conformity can be requested from the responsible sales office.

The CE mark is attached to the type label of the motors.

12.2 UL / CSA

The UL/CSA conformity of MS2S motors can be found on the type plate of the motors.

The list of MS2S motors is available under UL file number E335445 ➦www.ul.com.

12.3 China RoHS 2

The China RoHS 2 conformity can be found on the type plate of the motors. Information about listing:➦www.boschrexroth.com.cn/zh/cn/home_2/china_rohs2

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