

8LWA three-phase synchronous motors

User's manual

Version: **1.02 (February 2021)**
Order no.: **MA8LWA-ENG**

Translation of the original documentation

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1 General information

1.1 Manual history

Version	Date	Notes
1.02	February 2021	General revision
1.01	April 2020	Corrected heading (speed-torque characteristic curve: from "80 VDC" to "325 VDC").
1.00	March 2020	First edition for motor version V0

Information:

B&R makes every effort to keep user's manuals as current as possible. New versions are available in electronic form on the B&R website (www.br-automation.com). Check regularly to determine if you have the latest version.

1.2 About this user's manual

This user's manual describes the product, informs you how to use it and warns of possible dangers.

The personnel responsible for installation, operation, fault rectification, maintenance and cleaning must read and understand this manual before starting any work. The machine documentation must also be taken into account; the product described here is a component of this. This, along with observing all specifications and safety guidelines, will ensure safe functionality and a long service life.

As a component of the machine, this manual must be made freely accessible and stored in the immediate vicinity of the machine.

In addition to the information in this manual, local accident prevention regulations and national industrial safety regulations apply.

This document is not intended for end customers! The safety guidelines required for end customers must be incorporated into the operating instructions for end customers in the respective national language by the machine manufacturer or system provider.

1.3 Safety

This chapter provides you with safety-related information about working with the product.

Safety guidelines relevant to certain phases of the product's service life have been documented in the relevant chapters in this manual.

1.3.1 Organization of safety notices

Safety notices in this manual are organized as follows:

Safety notice	Description
Danger!	Failure to observe these safety guidelines and notices can result in death.
Warning!	Failure to observe these safety guidelines and notices can result in severe injury or substantial damage to property.
Caution!	Failure to observe these safety guidelines and notices can result in injury or damage to property.
Note:	These instructions are important for avoiding malfunctions.

1.3.2 Intended use

B&R motors and gear motors are components designed for installation in electrical systems or machines. They were designed, developed and manufactured for general industrial use. They are intended to be operated in covered rooms and under normal climatic conditions, which is usually the case in modern production halls. When used in residential areas, commercial areas or small businesses, additional filtering measures are required or must be provided by the user. Only operate the motor with B&R drive systems.

Use in accordance with the intended purpose is prohibited until:

- It has been determined that the machine complies with the provisions of EC Directive 2006/42/EC (Machinery Directive) and EMC Directive 2014/30/EU.
- All values specified on the nameplate and in the user's manual (e.g. connection and ambient conditions) have been observed.

1.3.3 Reasonably foreseeable misuse

Use of this product in areas with fatal risks or dangers is prohibited!

Danger!

Severe personal injury and damage to property due to failure!

When used without ensuring exceptionally high safety measures, death, injury, severe physical impairments or other serious losses are possible.

Do not use the product in the following areas, as well as other areas associated with fatal risks or dangers:

- Explosive areas
- Monitoring nuclear reactions in nuclear power plants
- Flight control systems and air traffic control
- Controlling mass transport systems
- Medical life support systems
- Controlling weapons systems

In special cases – use in non-commercial installations – with additional requirements (e.g. protection of children's fingers), these requirements must be satisfied during setup on the system side.

1.3.4 General sources of danger

Tampering of protection or safety devices

Protective and/or safety devices protect you and other persons from dangerous voltage, rotating or moving elements and hot surfaces.

Danger!

Personal injury and damage to property due to tampering of protective equipment!

If protective or safety devices are removed or put out of operation, there is no longer any personal protection and serious personal injury and damage to property can occur.

- Do not remove any safety devices.
- Do not put any safety devices out of operation.
- Always use all safety devices during short-term test and trial operations!

Dangerous voltage

To operate the motors, dangerous voltage must be applied to certain parts.

Danger!

Risk of injury due to electric shock!

If live parts are touched, there is immediate danger of fatal electric shock.

If connections are connected or disconnected in the incorrect order or when the power is switched on, electric arcs can occur and persons and contacts can be damaged.

Even if the motor is not rotating or is running as a generator driven externally, the control and power connections can still carry voltage!

- Never touch connections when the power is switched on.
- Never disconnect or connect electrical connections to the motor and servo drive when the power is switched on!
- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Always operate the motor with all safety equipment. Do this even during short testing and trial operations!
- Keep all covers and control cabinet doors closed during operation and as long as the machine is not disconnected from the power system.
- Before working on motors, gearboxes or servo drives or in the danger zone of your machine, disconnect them completely from the power system and secure them against being switched on again by other persons or automatic systems.
- Note the discharge time of any existing DC bus.
- Only connect measuring instruments when the power is switched off!

Danger due to electromagnetic fields

Electromagnetic fields are generated by the operation of electrical power engineering equipment such as transformers, drives and motors.

Danger!

Danger to health due to electromagnetic fields!

The functionality of a heart pacemaker can be impaired by electromagnetic fields to such an extent that the wearer experiences harm to his or her health, possibly with a fatal outcome.

- Observe relevant national health and safety regulations.
- Persons with pacemakers are not allowed to be in endangered areas.
- Warn staff by providing information, warnings and safety identification.
- Secure the danger zone by means of barriers.
- Reduce electromagnetic fields at their source (using shielding, for example).

Dangerous motion

By rotating and positioning motions of the motors, machine elements are moved or driven and loads conveyed.

After switching on the machine, movements of the motor shaft must always be expected! For this reason, higher-level protective measures must be put in place to ensure that personnel and machines are protected. This type of protection can be achieved, for example, by using stable mechanical protective equipment such as protective covers, protective fences, protective gates or photoelectric sensors.

In the immediate vicinity of the machine, provide sufficient and easily accessible emergency switching-off devices to stop the machine as quickly as possible in the event of an accident.

Danger!

Danger of injury due to rotating or moving elements and loads!

By rotating or moving elements, body parts can be drawn in or severed or subjected to impacts.

- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Before working on the machine, secure it against unwanted movements. A holding brake is not suitable for this!
- Keep all covers and control cabinet doors closed during operation and as long as the machine is not disconnected from the power system.
- Always operate the motor with all safety equipment. Do this even during short testing and trial operations!
- Motors can be started automatically via remote control! If appropriate, a corresponding warning symbol must be applied, and protective measures must be implemented to prevent entry into the high-risk area.

Warning!

Danger of injury due to incorrect control or a defect.

Improper control of motors or a defect can result in injuries and unintended and hazardous movements of motors.

Such incorrect behavior can be triggered by:

- Incorrect installation or faults when handling components
- Improper or incomplete wiring
- Defective devices (servo drive, motor, position encoder, cables, brake)
- Incorrect control (e.g. caused by software error)

Risk due to hot surfaces

Due to the power dissipation from the motor and friction in the gearbox, these components as well as their environment can reach a temperature of more than 100°C.

The resulting heat is released to the environment via the housing and the flange.

Warning!

Risk of burns due to hot surfaces!

Touching hot surfaces (e.g. motor and gearbox housings, as well as connected components), can lead to very severe burns due to the very high temperature of these parts.

- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Never touch the motor or gearbox housing as well as adjacent surfaces during nominal load operation.
- Be aware of hot surfaces also during standstill.
- Allow the motor and gearbox to cool down sufficiently before working on them; there remains the risk of burns for a long period of time after they are switched off.
- Always operate the motor or gearbox with all safety devices. Do this even during short testing and trial operations!

1.3.5 Provisions and safety guidelines

To ensure proper commissioning and safe operation, be sure to observe the following:

- General safety regulations
- The applicable work safety regulations
- National accident prevention regulations (e.g. VBG 4) for working with high-voltage systems

- National, local and plant-specific regulations for your end product
- Relevant regulations for electrical installations (e.g. wire cross section, fuses, protective conductor connection). The values provided in chapter "Technical data" must also be taken into account here.

The operator is solely responsible for these and all other regulations applicable at the place of use.

1.3.6 Responsibilities of the operator

The operator is the person who uses the motor for commercial purposes or who provides it for use by a 3rd party while carrying legal product responsibility for the protection of the user, personnel or other 3rd parties.

Obligations of the operator

- Applicable industrial safety regulations must be observed.
- National, local and plant-specific regulations must be observed.
- A risk assessment must identify hazards that can arise due to on-site working conditions.
- Documentation including safety guidelines must be prepared for operating the finished system (with motors, gearboxes, servo drives, etc.).
- Whether the applicable operating instructions and manuals correspond to current rules and standards must be checked regularly.
- Responsibilities for installation, operation, fault correction, maintenance and cleaning must be clearly regulated and defined.
- It must be ensured that responsible personnel have read and understood this user's manual.
- Personnel must receive training on a regular basis and be informed of hazards.
- Personnel must be provided with the required protective equipment.

1.3.7 Qualified personnel

All tasks such as the transport, installation, commissioning and servicing of devices are only permitted to be carried out by qualified personnel. Qualified personnel are those familiar with the transport, mounting, installation, commissioning and operation of devices who also have the appropriate qualifications to perform these tasks (e.g. IEC 60364). National accident prevention regulations must be observed.

The safety guidelines, information about connection conditions (nameplate and documentation) and limit values specified in the technical data must be read carefully before installation and commissioning and must be strictly observed.

1.3.8 Safety notices

A "hot surface" warning label is provided with the product. Attach it to the assembled product so that it is visible at all times.



"Hot surface" warning label

1.3.9 Protective equipment

Always wear suitable safety clothing and equipment for your personal protection.

1.4 8LWA - Compact servo technology



The 8LWA motor series is the perfect choice when it comes to installing servo motors in extremely tight spaces. Equipped with either a resolver or digital EnDat 2.2 interface, these motors can meet the absolute highest demands. With their low moment of inertia, motors in the 8LWA series are designed to be highly dynamic and distinguished by their outstanding intrinsic acceleration characteristics. Additional noteworthy features include low cogging and a high overload capability. By default, these motors have IP64 protection but are also available with IP65 protection. They can optionally be equipped with a holding brake. Designed for use with ACOPOS P3 servo drives, these motors offer extremely high performance and are some of the most compact on the market. 8LWA motors are recommended for a wide range of applications and provide an optimal price/performance ratio in the power range up to 1 kW.

1.4.1 Standards and guidelines

The motors are intended for use in commercial plants and subject to the following standards and guidelines:

Standards

EN 60034- 1	Rotating electrical machines - measurement and operating behavior
EN 60034- 5	Degrees of protection provided by the integral design of rotating electrical machines
EN 60034- 6	Rotating electrical machines - Cooling types
EN 60034- 7	Rotating electrical machines - Classification of types of construction, mounting arrangements
EN 60034- 11	Rotating electrical machines - Thermal protection

Guidelines

Low Voltage Directive 2014/35/EU	The motors correspond to the low voltage directive (conformity).
EMC Directive 2014/30/EU	To operate the motor in accordance with its intended use, it must comply with the protection requirements of the EMC directive. Proper installation (e.g. spatial separation of signal lines and power cables, shielded lines and cables) is the responsibility of the plant installer and system provider. If operating with a power converter, then the EMC guidelines of the power converter, encoder and brake manufacturers must be observed.
RoHS Directive 2011/65/EU	The motors in this series comply with the RoHS Directive (2011/65/EU) for the assessment of electrical and electronic products with respect to the restriction of hazardous substances.

Advice:

National, local and plant-specific regulations must also be taken into account!

1.4.2 Nameplate

The nameplate clearly identifies each motor. The serial number ensures traceability.

The nameplate adhesive label on the motor housing contains the following information:

1	Order code	
2	11-digit serial number	
3	Serial number as a barcode (Code 128)	
4	CE marking	
5	Technical data	
	I _n Rated current	
	M _n Rated torque	
	n _n Rated speed	
	IP protection class	
	I ₀ Continuous stall current	
	M ₀ continuous stall torque	
6	Manufacturer	
7	UL-recognized component mark	
9	Insulation class	
10	Production period (week/year)	
11	Revision	

The nameplate clearly identifies each motor. The serial number ensures traceability.

Advice:

The nameplate should be visible at all times in installed state.

1.4.2.1 Embedded parameter chip

All relevant mechanical and electrical information and data is stored in the EnDat encoder used for B&R motors. This means that the user does not have to configure settings on the servo drive. As soon as the encoder is connected to the servo drive and the power supply to the electronics is switched on, the motor is automatically identified. The motor sends its nominal parameters and limit parameters to the servo drive. The drive then automatically determines the current limits and current control parameters required for optimal control of the motor. The only things that the user has to optimize are the speed and position controllers. Support for this is provided by the integrated commissioning environment of B&R Automation Studio™.

In addition to assistance during commissioning, routine service work is also simplified, and motors can be replaced without having to take extra time to set parameters.

2 Technical data

2.1 General description

8LWA servo motors have a particularly high torque density. A new internal design helps the 8LWA, paired with an ACOPOS P3 servo drive, achieve 25% higher torque than comparable motors.

Can be used at elevations up to 4,000 meters.

The power, encoder signal and brake signal are all transferred over a single hybrid cable.

2.2 8LWA - Order key

8LW b c d . ee nnn ff gg - h

Cooling / Construction type

A ... Self-cooling

see "Cooling / Construction type (b)" on page 14

Size

Valid values: **1, 2, 3** see "Sizes (c)" on page 14

Length

Valid values: **2, 3** see "Length (d)" on page 14

Motor encoder system

Resolver: **R0**

Inductive EnDat encoders: **B8, B9, Z8, Z9**

see "Motor encoder systems" on page 15

Nominal speed

030 ... 3000 rpm

045 ... 4500 rpm

see "Nominal speed (nnn)" on page 16

Motor options

Dx ... Built-in double angular connector (swivel)

Sx ... Single-cable solution (hybrid), angled (swivel)

Ux ... Single-cable solution (hybrid), straight

x0 ... Smooth shaft

x1 ... Keyed shaft

x2 ... Smooth shaft, holding brake

x3 ... Keyed shaft, holding brake

x6 ... Smooth shaft, oil seal

x7 ... Keyed shaft, oil seal

x8 ... Smooth shaft, holding brake, oil seal

x9 ... Keyed shaft, holding brake, oil seal

see "8LWA - Motor options (ff)" on page 17

Special motor options

00 ... No special motor options

Motor version

0 ... Version 0 (The motor version is specified as code (h) in the order number. Motor version 0 is currently valid.)

Advice:

Order keys only provide information about possible combinations in exceptional cases. Information about possible combinations is available in the CAD configurator (cad.br-automation.com).

2.2.1 Example order 1

A three-phase synchronous motor of type **8LWA22** with a nominal speed of 3000 rpm has been selected for an application.

The connection should use a single-cable solution (hybrid). The motor should be equipped with a holding brake, a keyed shaft and an EnDat single-turn encoder.

The (ee) code for the encoder system is **B8**.

The (nnn) code for a nominal speed of 3000 rpm is **030**.

The (ff) code for the other options is **S3**.

The order number for the necessary motor is therefore **8LWA22.B8030S300-0**.

2.2.2 Example order 2

A three-phase synchronous motor of type **8LWA33** with a nominal speed of 4500 rpm has been selected for an application.

The connection should be designed as a built-in double angular connector. The motor should be equipped without a holding brake, with a smooth shaft end and resolver encoder. The motor should also be equipped with a oil seal.

The code (ee) for the encoder system is **R0**.

The code (nnn) for a nominal speed of 4500 rpm is **045**.

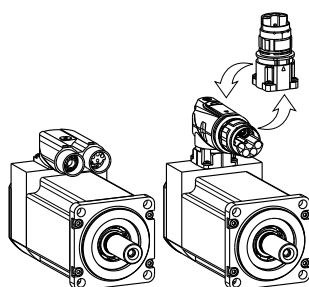
The (ff) code for the other options is **D6**.

The order number for the necessary motor is therefore **8LWA33.R0045D600-0**.

2.3 Cooling / Construction type (b)

8LW b c d . ee nnn ff gg - h

see "Order key" on page 12



8LW motors are only available with self-cooling type **A** (8LWA).

These motors have a long, slender form and must be attached to the machine using the mounting flange, which also serves as a cooling surface.

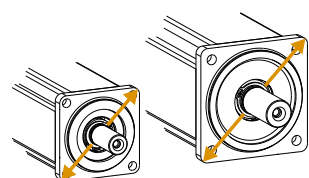
The cooling type is identified by a character (**b**) in the order number.

Cooling type (b)		Connection technology (see motor options)
8LWA	Self-cooling	Built-in double angular connector
		Single-cable solution (hybrid) - Angled
		Single-cable solution (hybrid) - Straight

2.4 Sizes (c)

8LW b c d . ee nnn ff gg - h

see "Order key" on page 12



8LWA servo motors are available in various sizes (1, 2, 3). These differ in dimensions (especially flange dimensions) and power data.

The sizes are distinguished by a character (**c**) in the order number. The larger this number, the larger the flange dimensions and power data of the respective motor.

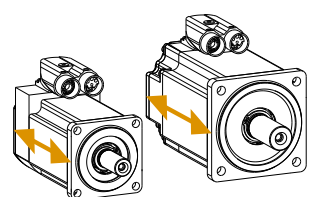
Availability

	Available sizes (c)		
	8LWA1	8LWA2	8LWA3
8LWA	Yes	Yes	Yes

2.5 Length (d)

8LW b c d . ee nnn ff gg - h

see "Order key" on page 12



8LWA servo motors are available in various lengths. These differ in the power data with identical flange dimensions.

The lengths are distinguished by a number (**d**) in the order number. The larger this number, the longer the respective motor.

Availability

	Available lengths (d)	
	8LWAx2	8LWAx3
8LWA1	---	Yes
8LWA2	Yes	Yes
8LWA3	---	Yes

2.6 Motor encoder systems

8LW b c d . ee nnn ff gg - h

see "Order key" on page 12

The motors are available with EnDat encoders as well as resolvers. The encoder system is specified as part of the order number in the form of a 2-digit code (**ee**).

Analog and digital transfer

A resolver is an analog encoder system. Resolvers are particularly robust against vibrations and high operating temperatures. Their disadvantage is the low precision of 6-10 arcminutes. There is still no multi-turn variant with resolvers.

Digital encoders use a serial transfer protocol. This protocol is called EnDat. The EnDat protocol is a developed standard that incorporates the advantages of absolute and incremental position measurement and also offers a read/write parameter memory in the encoder. The embedded parameter chip is stored by B&R in this encoder memory. This data and the B&R ACOPOS systems form a plug-and-play drive solution. Absolute positioning can be used within a revolution with the single-turn variants. A homing procedure is not required because of the absolute position measurement. For applications where the motor covers several revolutions for positioning, a multi-turn encoder that can save up to 65535 revolutions can be used. A solution with a single-turn encoder variant with a homing procedure is also possible.

2.6.1 EnDat 2.2

For the advanced, fully digital EnDat 2.2 protocol, the positions are generated directly in the encoder and communicated serially with the drive system. This transfer is very robust in relation to disturbances and is even certified for safety applications.

2.6.2 General safety encoder

Safety-related position measurement systems

In machine and system manufacturing, the topic of safety is becoming more and more important. This is mirrored in legislation and stricter safety criteria in national and international standards. Most importantly, stricter requirements serve to protect personnel, but they also increasingly serve to protect property and the environment. The goal of functional safety is to minimize or eliminate dangerous situations that can occur in machines and systems either with or without operational errors. This is generally achieved by implementing redundant systems. Moving axes in safety applications require position information in order to be able to carry out their corresponding safety functions. Different system configurations can be implemented to get independent position values. One possibility is using two measuring instruments per axis. To keep costs down, the aim is often to create a solution with only one position measuring instrument. Until now, analog measuring instruments with sine/cosine signals were used for this purpose. The encoder manufacturer Heidenhain – as the first manufacturer with the purely serial EnDat 2.2 protocol for safety position measurement systems – offers a serial single-encoder solution per IEC 61 508 SIL 2. All the advantages of serial data transfer – such as cost optimization, diagnostics possibilities, automatic commissioning and high-speed generation of position values – can now benefit safety applications as well.

100% inspection during production and additional measures during final testing ensure errors have not occurred related to shaft and coupling connections on rotary encoders when using motors with safety encoders (per EN ISO 13849-2).

2.6.3 Information: SafeMOTION

For information about the area of application and procedure for setting up the various safety functions, please refer to the SafeMOTION user's manual (MAACPMSAFEMC-ENG) in the Downloads section of the B&R website www.br-automation.com.

2.6.4 Technical data

2.6.4.1 Resolver

Technical data	Resolver / Order code (ee)	
	R0	
Type	RE-15-1-J04	
Precision	10 angular minutes	
Vibration during operation 10 < f ≤ 500 Hz	≤500 m/s ²	
Shock during operation Duration 11 ms	≤1000 m/s ²	

Availability	Available resolvers / Order code (ee)	
	R0	
8LWA1	Yes	
8LWA2	Yes	
8LWA3	Yes	

2.6.4.2 EnDat 2.2 encoder

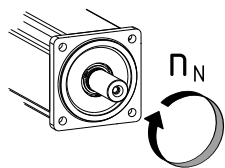
Technical data	Encoder type / Order code (ee)			
	B8	Z8	B9	Z9
Operating principle	Inductive			
EnDat protocol	2.2			
Functional safety ¹⁾	---	Yes	---	Yes
Single-turn/Multi-turn	S		M	
Battery-backed	---			
Revolutions	1		4096	
Resolution [bits single-turn / bits multi-turn]	19/0		19/12	
Precision ["]	±120			
Cutoff frequency ≥ [kHz]	Digital pos. in the encoder			
Stator - Vibration during operation Max. [m/s2]	400			
Rotor - Vibration during operation Max. [m/s2]	600			
Max. shock during operation [m/s2]	2000			
Manufacturer's product ID	ECI 1119 FS EnDat22		EQI 1131 FS EnDat22	

Availability	Available encoders / Order code (ee)			
	B8	Z8	B9	Z9
8LWA1	Yes	Yes	Yes	Yes
8LWA2	Yes	Yes	Yes	Yes
8LWA3	Yes	Yes	Yes	Yes

2.7 Nominal speed (nnn)

8LW b c d . ee nnn ff gg - h

see "Order key" on page 12



8LWA servo motors are available with various nominal speeds.

The nominal speed is specified as part of the order number in the form of a 3-digit code (nnn).

	Order code (nnn)	
	030	045
Nominal speed n_N [rpm]	3000	4500

Availability

	Available nominal speeds n_N [rpm]	
	3000	4500
8LWA1	---	Yes
8LWA2	Yes	Yes
8LWA3	Yes	Yes

¹⁾ See appendix B "Safety level overview for ACOPOS product family safety functions" of the SafeMOTION user's manual (MAACPM SAFEMC-ENG), which is available in the Downloads section of the B&R website.

2.8 8LWA - Motor options (ff)

8LW b c d . ee nnn ff gg - h

see "Order key" on page 12

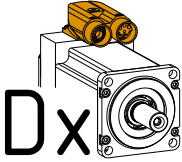
Order code motor options (ff)

See the following table for the corresponding code (ff) in the order key.

The first position in the code (ff) defines the connection direction with options **Dx**, **Sx** and **Ux**. The second position (e.g. x1, x2, x3) defines all other motor options according to the table.

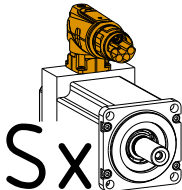
Built-in double angular connector (swivel)

Encoder and power cable: Separated with their own connections

Connection direction	Motor option			Availability			Order code (ff)
	Oil seal	Holding brake	Shaft end	8LWA1	8LWA2	8LWA3	
	---	---	Smooth shaft	Yes	Yes	Yes	D0
	---	---	Keyed shaft	---	Yes	Yes	D1
	---	(⚡)	Smooth shaft	Yes	Yes	Yes	D2
	---		Keyed shaft	---	Yes	Yes	D3
	Yes	---	Smooth shaft	Yes	Yes	Yes	D6
	Yes	---	Keyed shaft	---	Yes	Yes	D7
	Yes	(⚡)	Smooth shaft	Yes	Yes	Yes	D8
	Yes		Keyed shaft	---	Yes	Yes	D9

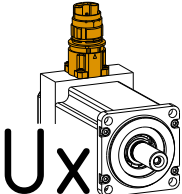
Single-cable solution (hybrid), angled (swivel)

Encoder and power cable: Combined in one cable

Connection direction	Motor option			Availability			Order code (ff)
	Oil seal	Holding brake	Shaft end	8LWA1	8LWA2	8LWA3	
	---	---	Smooth shaft	Yes	Yes	Yes	S0
	---	---	Keyed shaft	---	Yes	Yes	S1
	---	(⚡)	Smooth shaft	Yes	Yes	Yes	S2
	---		Keyed shaft	---	Yes	Yes	S3
	Yes	---	Smooth shaft	Yes	Yes	Yes	S6
	Yes	---	Keyed shaft	---	Yes	Yes	S7
	Yes	(⚡)	Smooth shaft	Yes	Yes	Yes	S8
	Yes		Keyed shaft	---	Yes	Yes	S9

Single-cable solution (hybrid) - Straight

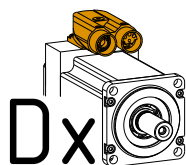
Encoder and power cable: Combined in one cable

Connection direction	Motor option			Availability			Order code (ff)
	Oil seal	Holding brake	Shaft end	8LWA1	8LWA2	8LWA3	
	---	---	Smooth shaft	Yes	Yes	Yes	U0
	---	---	Keyed shaft	---	Yes	Yes	U1
	---	(⚡)	Smooth shaft	Yes	Yes	Yes	U2
	---		Keyed shaft	---	Yes	Yes	U3
	Yes	---	Smooth shaft	Yes	Yes	Yes	U6
	Yes	---	Keyed shaft	---	Yes	Yes	U7
	Yes	(⚡)	Smooth shaft	Yes	Yes	Yes	U8
	Yes		Keyed shaft	---	Yes	Yes	U9

2.8.1 8LWA - Connection direction (ff)

Power and encoder connections

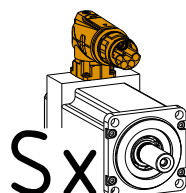
8LWA servo motors are available with 3 different connection options.



Built-in double angular connector

Connection direction: Angled (swivel¹⁾)

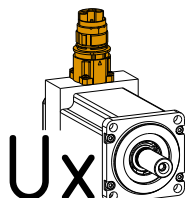
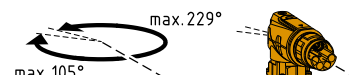
Encoder and power cable: Separated with their own connections



Single-cable solution (hybrid)

Connection direction: Angled (swivel¹⁾)

Encoder and power cable: Combined in one cable



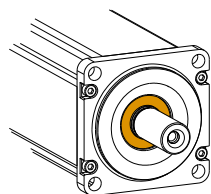
Single-cable solution (hybrid)

Connection direction: Straight

Encoder and power cable: Combined in one cable

1) Check the angle specifications and the feasibility with regard to requirements using the CAD configurator (cad.br-automation.com).

2.8.2 8LWA - Oil seal (ff)



8LWA servo motors are available with a form A oil seal per DIN 3760.

With an oil seal, the motors have IP65 protection per EN 60034-5.

Servicing

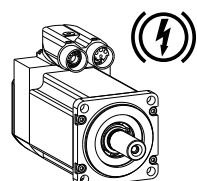
To maintain functionality of the oil seal, it must be lubricated regularly with oil. An oil seal that is not lubricated will harden due to increased frictional heat and will eventually provide only dust protection.

Advice:

Proper lubrication of the oil seal must be ensured throughout the entire service life of the motor.

For this reason, mounting a gearbox on motors with an oil seal is not permitted!

2.8.3 8LWA - Holding brake (ff)



8LWA motors are available with a standard holding brake. It is installed directly behind the A-side flange on the motor and used to hold the motor shaft when the power to the servo motor is switched off.

Technical data

	8LWA1	8LWA2	8LWA3
Holding torque M_{Br} [Nm]	0.35	2.2	4.0
Connected load P_{On} [W]	8	8.2	13.4
Maximum speed n_{max} [rpm]	6000	12000	10000

	8LWA1	8LWA2	8LWA3
Supply current I_{On} [A]	0.33	0.35	0.56
Supply voltage U_{On} [VDC]	24 (+6% / -10%)		
Moment of inertia J_{Br} [kgcm ²]	0.013	0.12	0.38
Weight m_{Br} [kg]	0.1	0.19	0.29

Operating principle

The holding brake is a permanent magnet brake and can be controlled by the B&R drive system. Based on principle, this type of holding brake exhibits a minimal amount of backlash. Voltage (see the technical data) is required to release the brake.

The brake is designed as a holding brake. It not permitted to be used for operational braking! Under these conditions, the brake has a service life of approximately 5,000,000 cycles (opening and closing the brake is one cycle). Loaded braking during an emergency stop is permitted but reduces its service life.

Information:

The required brake holding torque is determined based on the actual load torque. It is recommended by the brake manufacturer to take into account a safety factor of 2.

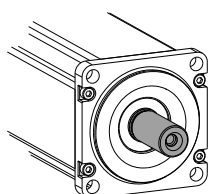
Warning!

The holding brake is not intended for normal braking. The holding brake does not provide protection for personnel. The maximum motor torque far exceeds the holding torque for the brake.

2.8.4 8LWA - Shaft end (ff)

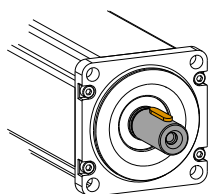
All 8LWA servo motors have shaft ends per DIN 748.

Variants



Smooth shaft end

A smooth shaft end is used for a force-fit shaft-hub connection and guarantees a backlash-free connection between the shaft and hub as well as a high degree of operating smoothness. The end of the shaft has a threaded center hole.



Keyed shaft end

A keyed shaft end is used for a form-fit torque transfer with low demands on the shaft-hub connection and for handling torque in a constant direction.

The keyways conform to keyway form N1 per DIN 6885-1. Form A keyed shafts that conform to DIN 6885-1 are used. Balancing motors with keyways is done using the shaft and fitment key convention per DIN ISO 8821.

The end of the shaft has a threaded center hole that can be used to mount machine actuators with shaft end cover plates.

Caution!

Shaft breakage due to heavy reverse operation.

The shaft key can become dislodged during heavy reverse operation. In extreme cases, the shaft could brake!

- Preferably use smooth shaft ends with clamping elements.

Caution!

Motor damage due to imbalance.

If motors with a keyed shaft end are operated without the shaft key, this can result in imbalances and subsequently motor damage.

- In these cases, use a smooth shaft end.

Warning!

Personal injury and damage to property due to ejected elements!

With freely rotating motors, ejected elements can cause personal injury and damage to property.

- **The following safety precautions also apply during short testing and trial operations!**
- **Secure the keys.**
- **Secure or remove mounting screws or other mounting elements.**
- **A shaft protection sleeve for transport and storage must also be removed.**

2.9 General motor data

General information	8LWA
CE certification	Yes
C-UR-US listed	Yes
UL file number	PRHZ2.E235396
Electrical characteristics	8LWA
DC bus voltage on the ACOPOS P3	325 VDC ¹⁾
Conventional connection type (power connection / encoder connection)	ytec circular connector
Connection type - Single-cable solution (hybrid)	htec circular connector
Support	8LWA
Automation Studio	V4.4.6 and higher
Motion system	
mapp Motion	Version 5.08.0 and higher
ACP10	Version 5.04.0 and higher
Thermal properties	8LWA
Insulation class per EN 60034-1	F
Methods of cooling per EN 60034-6 (IC code)	Self-cooling, free circulation surface cooling (IC4A0A0)
Thermal motor protection per EN 60034-11	Size 1: No Size 2 and 3: AM-LPTC1000F Maximum winding temperature 145°C (limited to 130°C by the thermal motor protection in the ACOPOS P3 drive system)
Mechanical properties	8LWA
Roller bearing, dynamic load rating and nominal service life	Based on DIN ISO 281
Shaft end per DIN 748	Form E
Oil seal per DIN 3760	Form A
Key and keyway per DIN 6885-1	Form A keys, form N1 keyway
Shaft balancing per ISO 1940/1, G6.3	Shaft and fitment key convention
Mounting flange	IEC 72-1
Radial runout, concentricity and axial runout of mounting flange per DIN 42955	Tolerance R
Coating	Water-based coating
Color	RAL 9005 flat
Operating conditions	8LWA
Rating class, operating mode per EN 60034-1	S1 - Continuous operation
Ambient temperature during operation	-15°C to +40°C
Maximum ambient temperature during operation	+50°C ²⁾
Relative humidity during operation	5 to 95%, non-condensing
Reduction of the nominal current and stall current at temperatures above 40°C	5% per 5°C
Reduction of rated and stall current at installation elevations	5% per 1000 m
Starting at 1000 m above sea level	
Maximum installation elevation	4000 m ³⁾
Max. flange temperature	65°C
Degree of protection per EN 60034-5 (IP code) ⁴⁾	
- Without oil seal	IP64
- With oil seal	IP65
Type of construction and mounting arrangement per EN 60034-7 (IM code)	Horizontal (IM3001) Vertical, motor attached to the machine (IM 3011) ⁵⁾ Vertical, motor stands on the machine (IM3031)
Storage and transport conditions	8LWA
Storage temperature	-20 to +60°C
Relative humidity during storage	Max. 90%, non-condensing
Transport temperature	-20 to +60°C
Relative humidity during transport	Max. 90%, non-condensing

¹⁾ Permissible DC bus voltage on the ACOPOS P3, single-phase: 325 VDC

²⁾ Continuous operation at an ambient temperature of +40°C to max. +50°C is possible, but this results in premature aging.

³⁾ Requirements that go beyond this must be arranged with B&R.

⁴⁾ The degrees of protection are only achieved if the power and signal connections are fully installed.

⁵⁾ With the IM 3011 type of construction and mounting arrangement (vertical, motor attached to the machine), there is a risk of production fluids or oils penetrating the motor on the flange side. Motors or motor-gearbox combinations that should be used with this mounting arrangement must therefore have at least IP65 protection on the flange side.

2.9.1 Formula symbols

Term	Symbol	Unit	Description
Nominal speed	n_N	rpm	Nominal speed of the motor
Nominal torque	M_N	Nm	The nominal torque is output by the motor ($n = n_N$) when the nominal current is being drawn. This is possible for any length of time if the environmental conditions are correct.
Nominal power	P_N	kW	The nominal power is output by the motor when $n = n_N$. This is possible for any length of time if the environmental conditions are correct.
Nominal current	I_N	A	The nominal current is the RMS value for the phase current (current in the motor supply line) when generating the nominal torque at the nominal speed. This is possible for any length of time if the environmental conditions are correct.
Stall torque	M_0	Nm	The stall torque is output by the motor at the speed n_0 and when the stall current is being applied. This is possible for any length of time if the environmental conditions are correct. Speed n_0 must be high enough so that the winding temperature in all windings is uniform and steady ($n_0 = 50$ rpm for B&R motors). The continuous torque is reduced when the motor is at a complete standstill.
Stall current	I_0	A	The stall current is the RMS value of the phase current (current in the motor supply line) for the generation of the stall torque at the speed n_0 . This is possible for any length of time if the environmental conditions are correct. Speed n_0 must be high enough so that the winding temperature in all windings is uniform and steady ($n_0 = 50$ rpm for B&R motors).
Peak torque	M_{\max}	Nm	The peak torque is briefly output by the motor when the peak current is being drawn.
Peak current	I_{\max}	A	The peak current is the RMS value of the phase current (current in the motor supply line) for generating the peak torque. This is only permitted to be drawn for a short time. The peak current is determined by the magnetic circuit. Exceeding this value for a short time can cause irreversible demagnetization of the magnet material.
Max. angular acceleration	a	rad/s ²	Maximum acceleration of the motor without a load or brake. Value for the dynamics of the motor (corresponds to M_{\max}/J).
Maximum speed	n_{\max}	rpm	Maximum motor speed. This is a mechanical condition (centrifugal force, bearing wear).
Average speed	n_{Avg}	rpm	Average speed for one cycle
Torque constant	K_t	Nm/A	The torque constant determines the torque generated by the motor with 1 A RMS phase current. This value applies at a motor temperature of 20°C. If the temperature increases, the torque constant is reduced (typically down to 10%). If the current increases, the torque constant is reduced (typically starting at twice the value of the nominal current).
Voltage constant	K_E	V/1000 rpm	The voltage constant specifies the RMS value (phase-phase) of the reverse voltage induced by the motor at a speed of 1000 rpm (EMF). This value applies at a motor temperature of 20°C. When the temperature increases, the voltage constant is reduced (usually down to 5%). If the current increases, the voltage constant is reduced (typically starting at twice the value of the nominal current).
Stator resistance	R_{2ph}	Ohm	Resistance measured in ohms between two motor connections (phase-phase) at 20°C winding temperature. On B&R motors, the windings use a star connection.
Stator inductance	L_{2ph}	mH	Winding inductance measured between two motor connections. Stator inductance depends on the rotor position.
Electrical time constant	t_{el}	ms	Corresponds to 1/5 of the time needed for the stator current to stabilize in constant operating conditions.
Thermal time constant	t_{therm}	min.	Corresponds to 1/5 of the time needed for the motor temperature to stabilize in constant operating conditions.
Moment of inertia	J	kgcm ²	Moment of inertia for a motor without holding brake
Ground	m	kg	Mass of motor without holding brake

2.9.2 Power dissipation

Power from the motors is dissipated via the motor flange and surface of the motor. The following factors are important to ensure optimal heat dissipation:

- Thermally open installation
- Free convection

The motor data specified for the nominal operating point apply to a motor installed in a thermally open system. The dimensions of the flange plates used for measurement can be found in the following table.

Generally speaking: the larger the flange, the better the heat dissipation.

Size	Dimensions [mm]	Material
8Lxx1, 8Lxx2, 8Lxx3	250x250x6	Aluminum

2.10 8LWA13 - Technical data

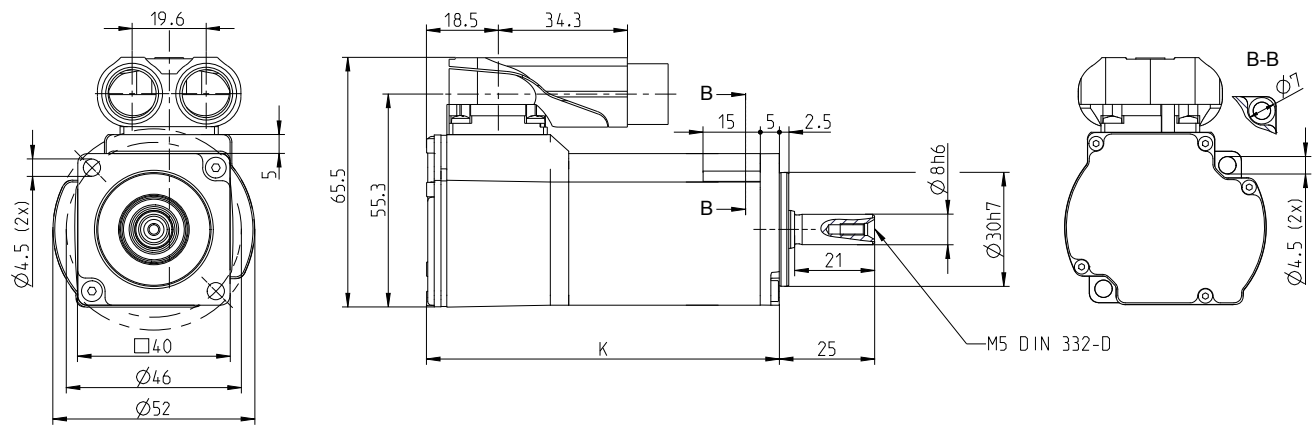
2.10.1 8LWA13 - Technical data

Model number	8LWA13.ee045ffgg-0
Motor	
Nominal speed n_N [rpm]	4500
Number of pole pairs	4
Nominal torque M_N [Nm]	0.315
Nominal power P_N [W]	148
Nominal current I_N [A]	0.573
Stall torque M_0 [Nm]	0.36
Stall current I_0 [A]	0.655
Maximum torque M_{max} [Nm]	1
Maximum current I_{max} [A]	2.35
Maximum speed n_{max} [rpm]	6600
Torque constant K_T [Nm/A]	0.55
Voltage constant K_E [V/1000 rpm]	33.52
Stator resistance R_{2ph} [Ω]	44.47
Stator inductance L_{2ph} [mH]	45.6
Electrical time constant t_{el} [ms]	1
Thermal time constant t_{therm} [min]	13
Moment of inertia J [kgcm ²]	0.03
Weight without brake m [kg]	1.1
Holding brake	
Holding torque of brake M_{Br} [Nm]	0
Mass of brake [kg]	0
Moment of inertia of brake J_{Br} [kgcm ²]	0
Recommendations	
ACOPOS P3 8Elxxxx...	1X6M
Cross section for B&R motor cables [mm ²]	0.75
Connector size	1.0

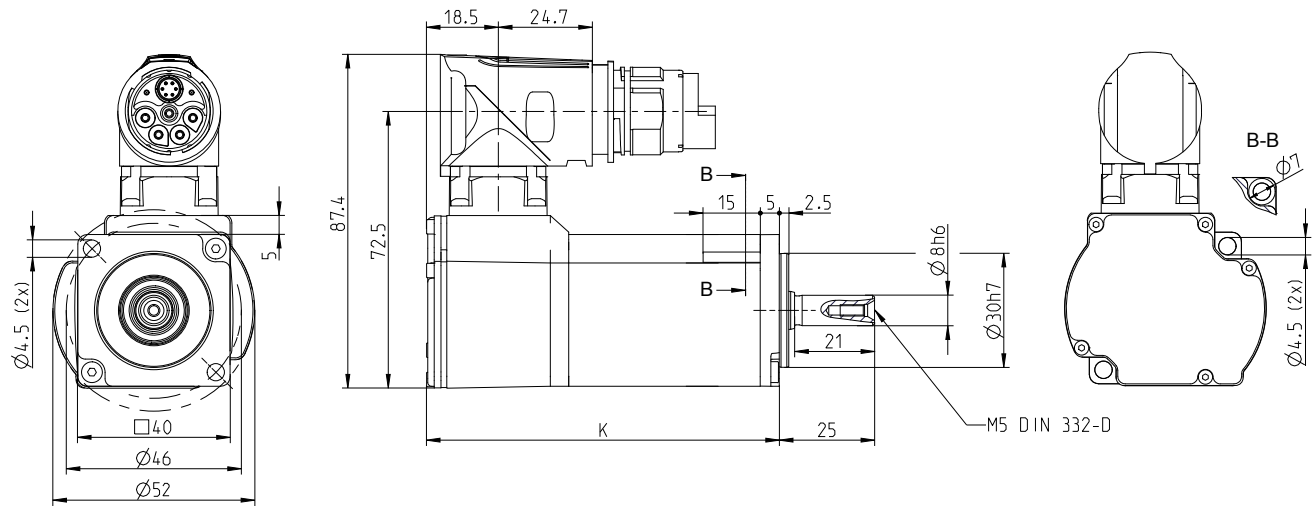
Servo drive: The recommended servo drive / inverter module is designed for 1.1x the stall current. If more than double the amount is needed during the acceleration phase, the next larger servo drive should be selected. This recommendation is only a guideline; detailed inspection of the corresponding speed/torque characteristic curve can result in deviations of the servo drive size (larger or smaller).

ACOPOSmulti: Operating this device with ACOPOSmulti inverter module is not possible due to the high DC bus voltage when powered from the mains.

2.10.1.1 8LWA13 - Dimensions



Built-in double angular connector

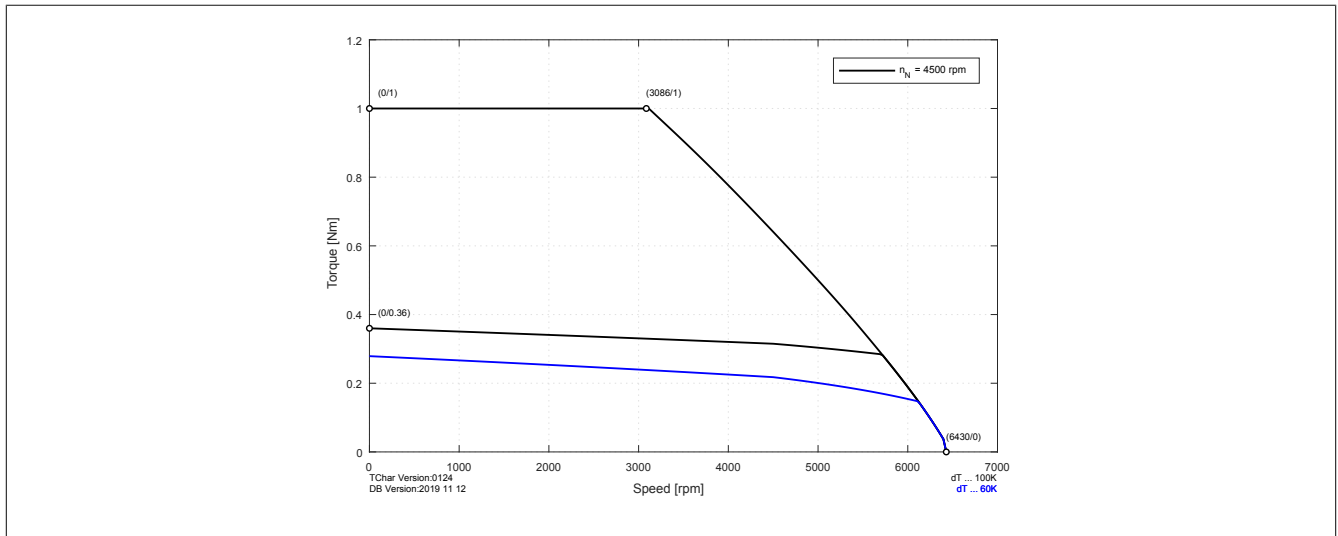


Single-cable solution

EnDat/Resolver feedback		
	K (without holding brake)	K (with holding brake)
Encoder assignments	R0, B8/Z8, B9/Z9	
8LWA13	97	120

2.10.1.2 Speed-Torque characteristic curve at 325 VDC DC bus voltage

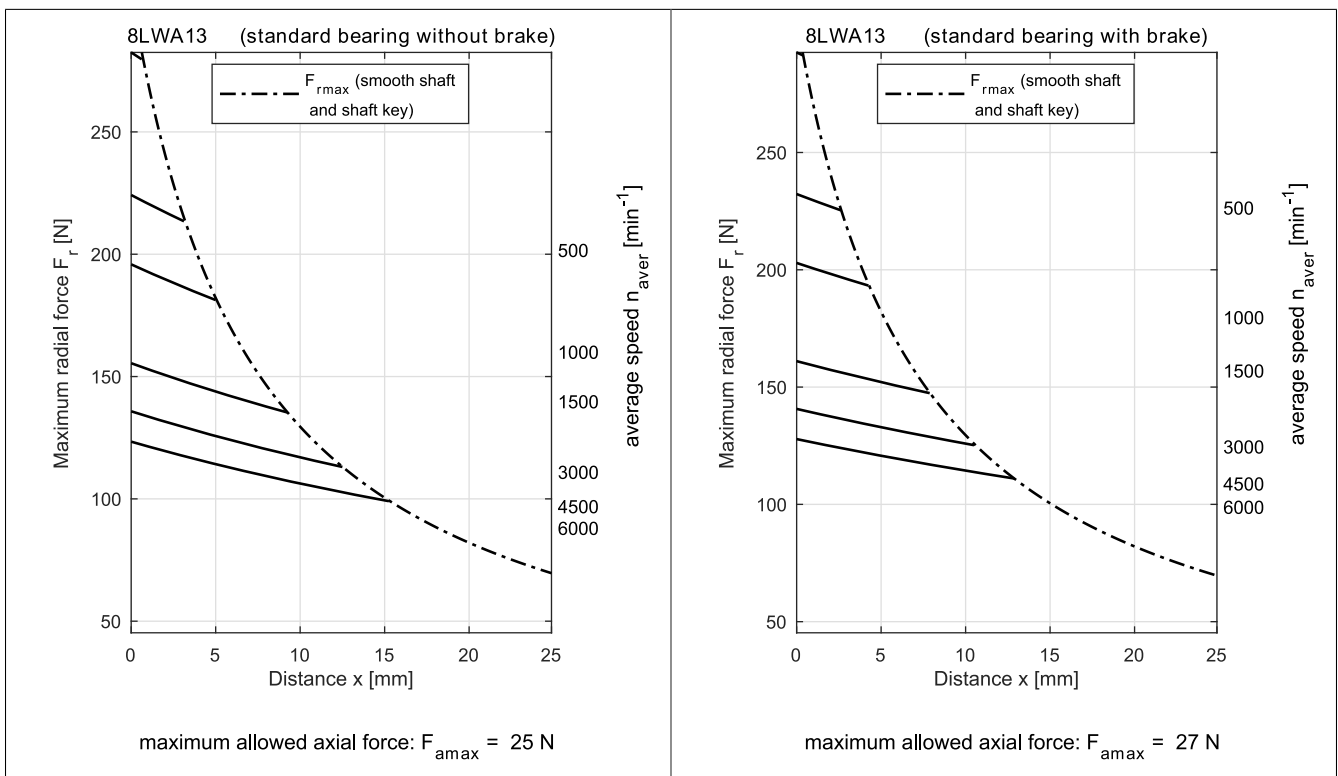
8LWA13.eennnffgg-0



2.10.1.3 Maximum shaft load

Note the information in section "Load due to radial and axial force" on page 36 of chapter "Installation conditions".

2.10.1.3.1 8LWA13 - Standard bearing



2.11 8LWA2 - Technical data

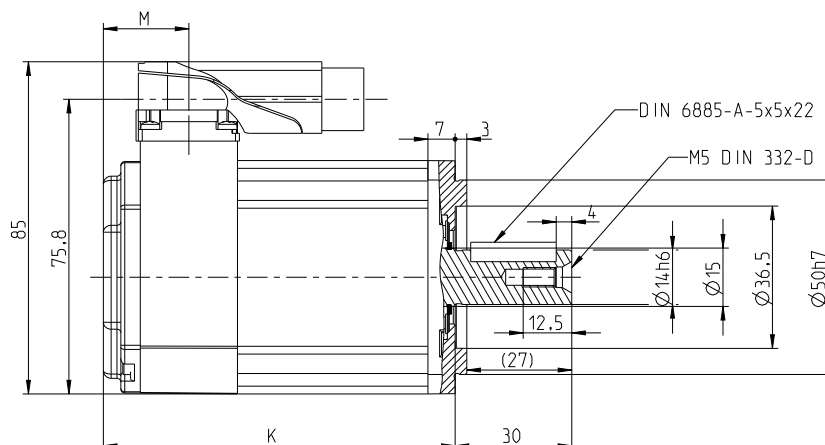
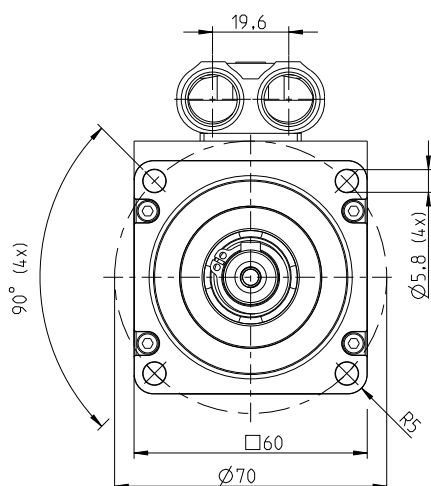
2.11.1 8LWA2 - Technical data

Model number	8LWA22.ee030ffgg-0	8LWA22.ee045ffgg-0	8LWA23.ee030ffgg-0	8LWA23.ee045ffgg-0
Motor				
Nominal speed n_N [rpm]	3000	4500	3000	4500
Number of pole pairs	4			
Nominal torque M_N [Nm]	0.76	0.741	1.43	1.38
Nominal power P_N [W]	239	349	449	650
Nominal current I_N [A]	0.91	1.345	1.72	2.509
Stall torque M_0 [Nm]	0.775		1.5	
Stall current I_0 [A]	0.923	1.409	1.79	2.727
Maximum torque M_{max} [Nm]	2		4	
Maximum current I_{max} [A]	3.1	4.7	6.2	9.3
Maximum speed n_{max} [rpm]	6600			
Torque constant K_T [Nm/A]	0.84	0.55	0.84	0.55
Voltage constant K_E [V/1000 rpm]	50.27	33.52	50.27	33.52
Stator resistance R_{2ph} [Ω]	27.1	12.5	10.5	4.25
Stator inductance L_{2ph} [mH]	60.3	27.1	29.9	11.8
Electrical time constant t_{el} [ms]	2.2		2.8	
Thermal time constant t_{therm} [min]	35		38	
Moment of inertia J [kgcm ²]	0.14		0.26	
Weight without brake m [kg]	1.1		1.5	
Holding brake				
Holding torque of brake M_{Br} [Nm]	0			
Mass of brake [kg]	0.3		0	0.3
Moment of inertia of brake J_{Br} [kgcm ²]	2.2	0.12	0	0.12
Recommendations				
ACOPOS 8Vxxx.xx...	-		1016.50	-
ACOPOSmicro 80VD100Px.xxx-01	-		C00X	-
ACOPOS P3 8Elxxx...	1X6M		8X8M	4X5M
Cross section for B&R motor cables [mm ²]	0.75			
Connector size	1.0			
Options				
Connection type	-		Single-cable solution	-
Connection direction	-		Angled (swivel)	-
Encoder	-		B9 2.2 inductive multi-turn	-
Shaft end	-		Smooth shaft	-

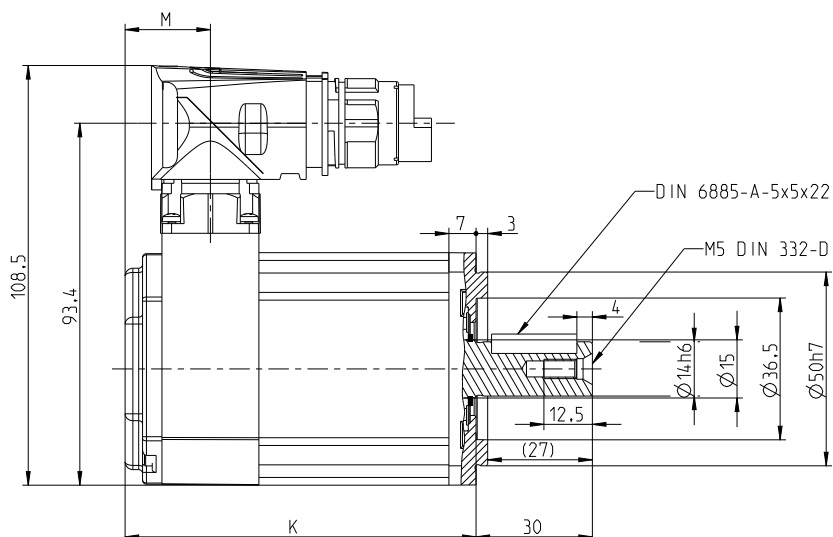
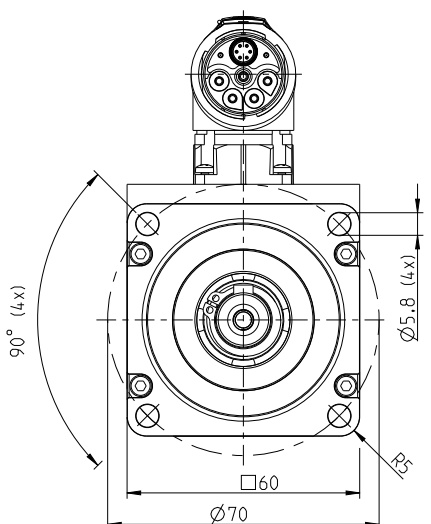
Servo drive: The recommended servo drive / inverter module is designed for 1.1x the stall current. If more than double the amount is needed during the acceleration phase, the next larger servo drive should be selected. This recommendation is only a guideline; detailed inspection of the corresponding speed/torque characteristic curve can result in deviations of the servo drive size (larger or smaller).

ACOPOSmulti: Operating this device with ACOPOSmulti inverter module is not possible due to the high DC bus voltage when powered from the mains.

2.11.1.1 8LWA2 - Dimensions



Built-in double angular connector



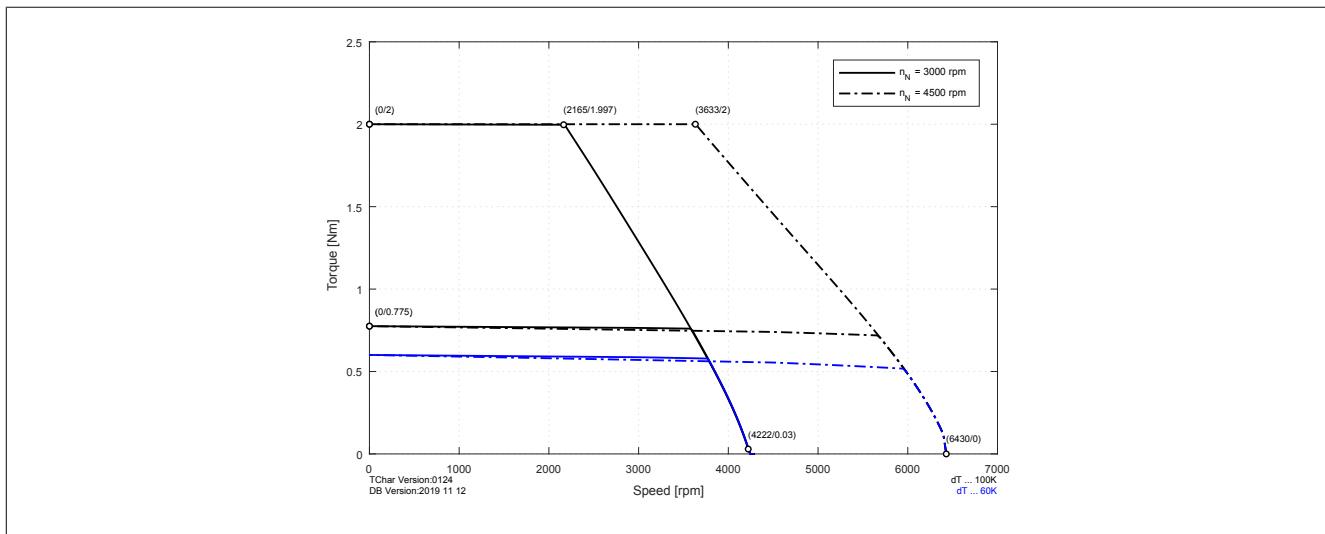
Single-cable solution

EnDat/Resolver feedback				Extension of K and M depending on motor option		
Encoder assignments	K	K	M	M	Holding brake	Oil seal
	R0	B8/Z8, B9/Z9	R0	B8/Z8, B9/Z9		
8LWA22	85.5	90.5	17	22	33	7
8LWA23	106	111	17	22	33	7

IMPORTANT: Dimensions K and M depend on the length of the encoder cover.

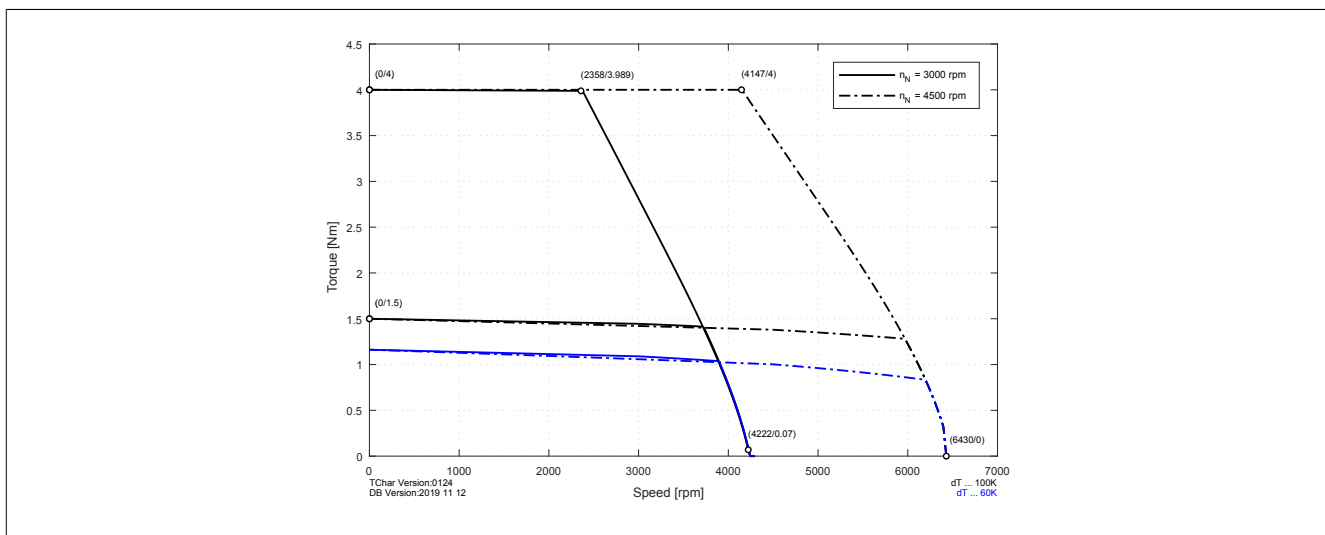
2.11.1.2 Speed-Torque characteristic curve at 325 VDC DC bus voltage

8LWA22.eennnffgg-0



2.11.1.3 Speed-Torque characteristic curve at 325 VDC DC bus voltage

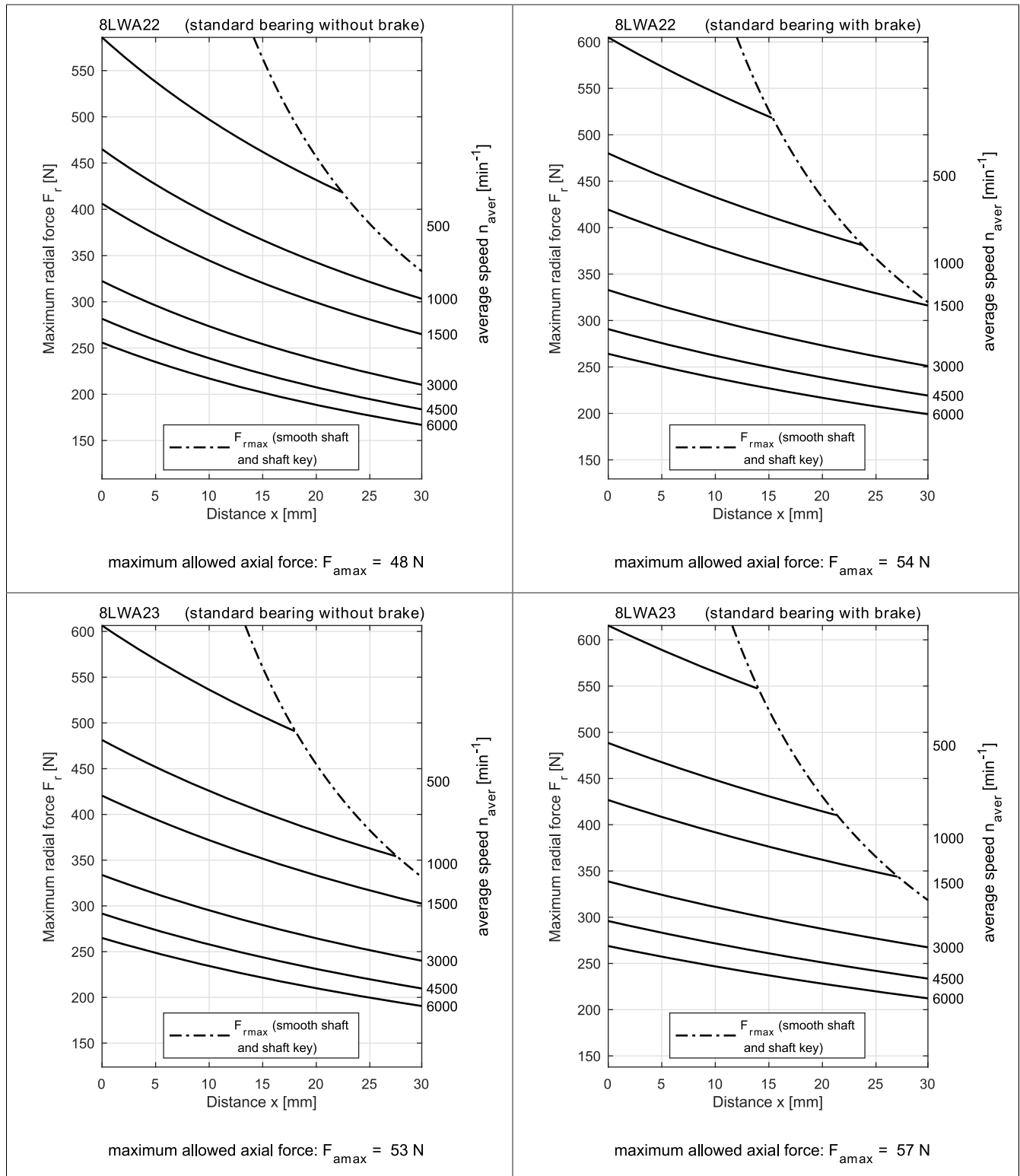
8LWA23.eennnffgg-0



2.11.1.4 Maximum shaft load

Note the information in section "Load due to radial and axial force" on page 36 of chapter "Installation conditions".

2.11.1.4.1 8LWA2 - Standard bearing



2.12 8LWA33 - Technical data

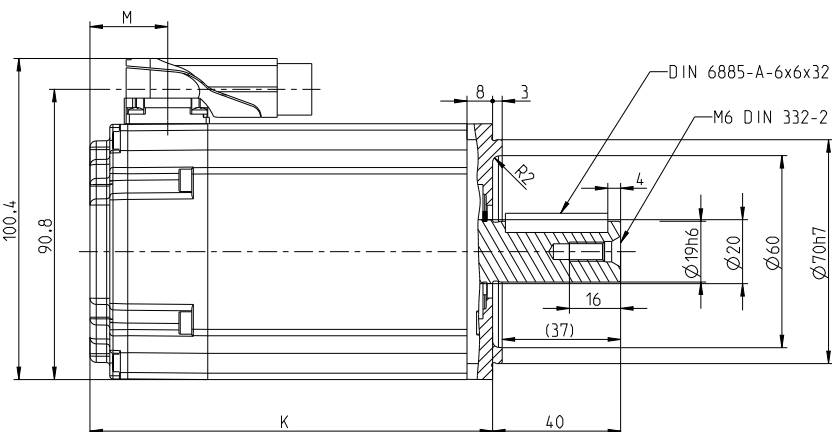
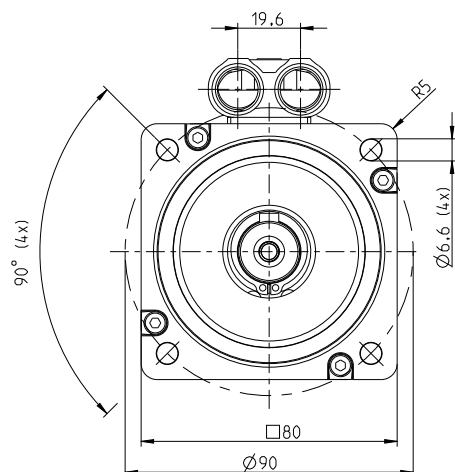
2.12.1 8LWA33 - Technical data

Model number	8LWA33.ee030ffgg-0	8LWA33.ee045ffgg-0
Motor		
Nominal speed n_N [rpm]	3000	4500
Number of pole pairs	4	
Nominal torque M_N [Nm]	2.64	2.44
Nominal power P_N [W]	829	1150
Nominal current I_N [A]	3.18	4.436
Stall torque M_0 [Nm]	2.95	
Stall current I_0 [A]	3.512	5.364
Maximum torque M_{max} [Nm]	7.2	
Maximum current I_{max} [A]	10.3	15.5
Maximum speed n_{max} [rpm]	6600	
Torque constant K_T [Nm/A]	0.84	0.55
Voltage constant K_E [V/1000 rpm]	50.27	33.52
Stator resistance R_{2ph} [Ω]	2.7	1.3
Stator inductance L_{2ph} [mH]	8.6	4.1
Electrical time constant t_{el} [ms]	3.2	
Thermal time constant t_{therm} [min]	34	
Moment of inertia J [kgcm ²]	0.95	
Weight without brake m [kg]	2.6	
Holding brake		
Holding torque of brake M_{Br} [Nm]	0	
Mass of brake [kg]	0.55	
Moment of inertia of brake J_{Br} [kgcm ²]	0.38	
Recommendations		
ACOPOS P3 8Elxxxx...	4X5M	8X8M
Cross section for B&R motor cables [mm ²]	0.75	
Connector size	1.0	

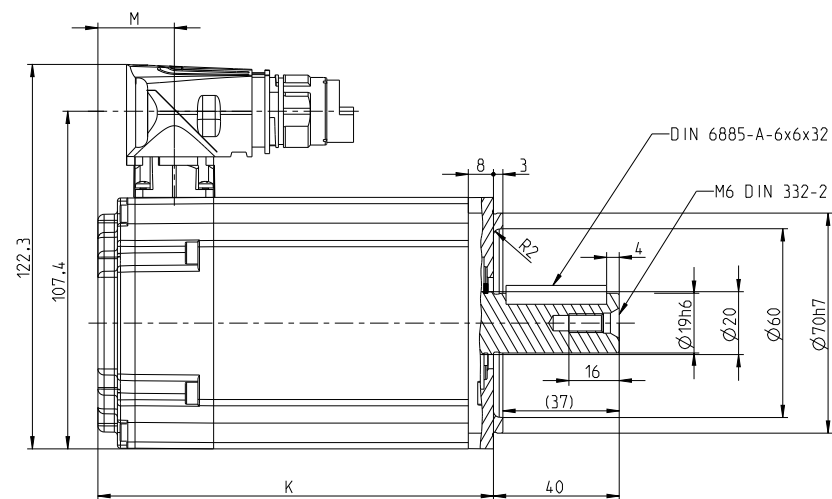
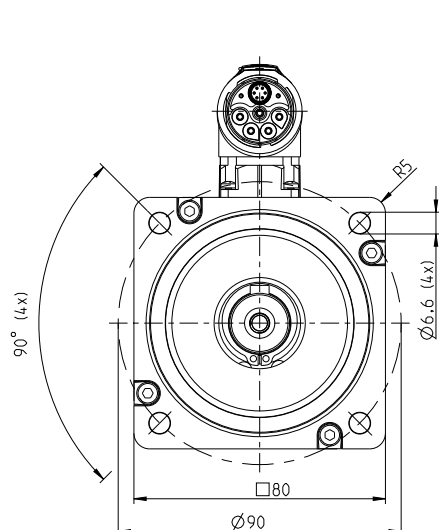
Servo drive: The recommended servo drive / inverter module is designed for 1.1x the stall current. If more than double the amount is needed during the acceleration phase, the next larger servo drive should be selected. This recommendation is only a guideline; detailed inspection of the corresponding speed/torque characteristic curve can result in deviations of the servo drive size (larger or smaller).

ACOPOSmulti: Operating this device with ACOPOSmulti inverter module is not possible due to the high DC bus voltage when powered from the mains.

2.12.1.1 8LWA33 - Dimensions



Built-in double angular connector



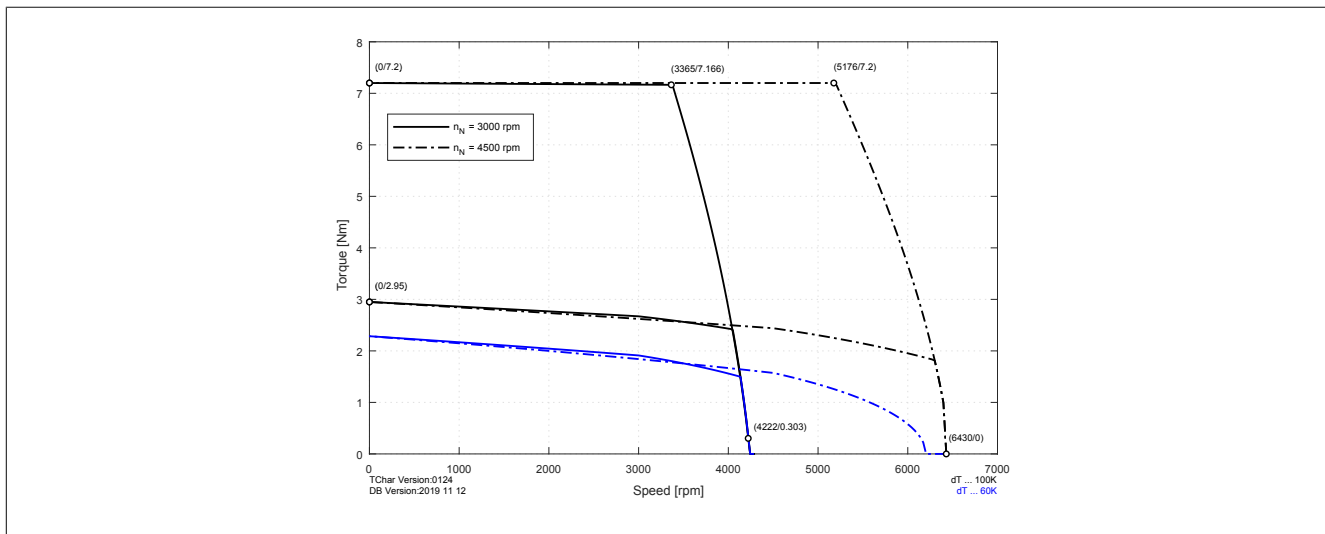
Single-cable solution

EnDat/Resolver feedback					Extension of K depending on motor option	
Order number	K	K	M	M	Holding brake	Oil seal
Encoder assignments	R0	B8/Z8, B9/Z9	R0	B8/Z8, B9/Z9		
8LWA33	119	126	17.5	24.5	36	5

IMPORTANT: Dimensions K and M depend on the length of the encoder cover.

2.12.1.2 Speed-Torque characteristic curve at 325 VDC DC bus voltage

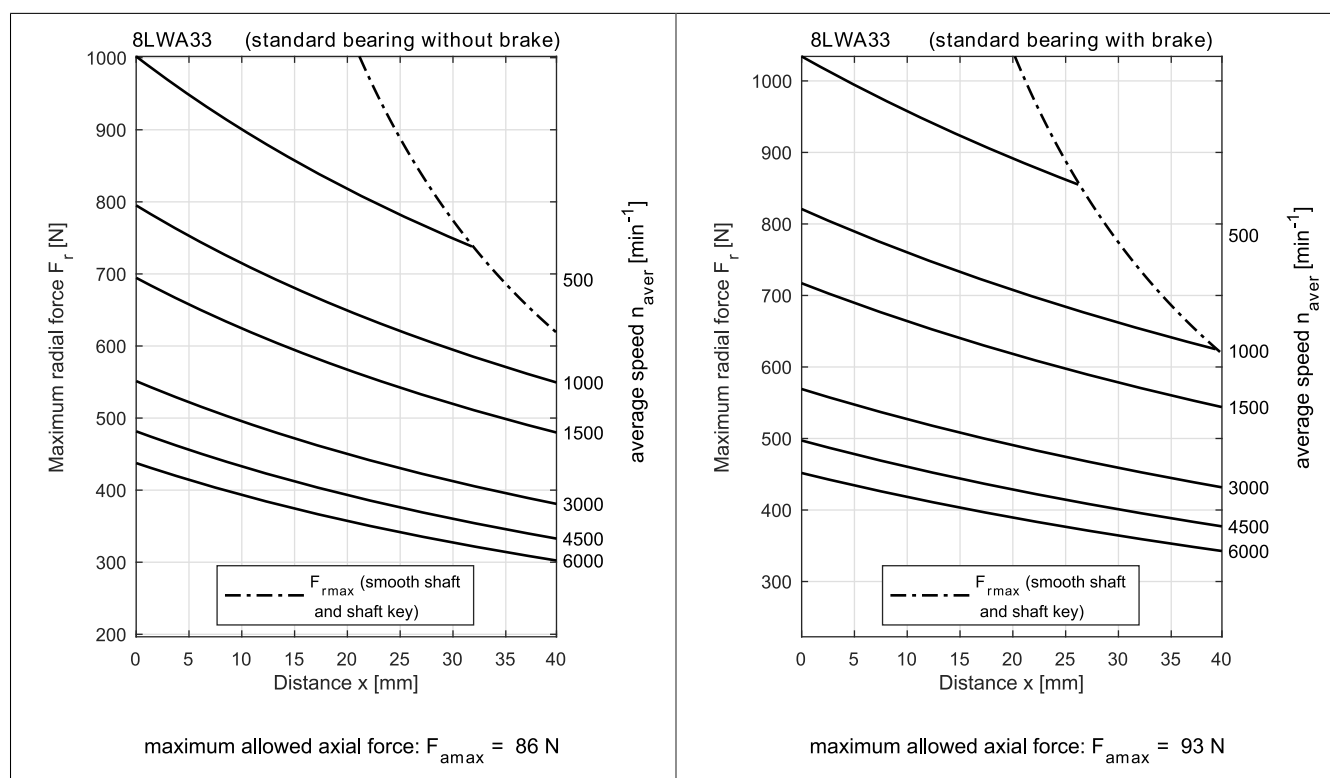
8LWA33.eennnffgg-0



2.12.1.3 Maximum shaft load

Note the information in section "Load due to radial and axial force" on page 36 of chapter "Installation conditions".

2.12.1.3.1 8LWA33 - Standard bearing



3 Transport and storage

During transport and storage, the product must be protected against undue stress (mechanical loads, temperature, moisture, corrosive atmospheres, etc.).

If necessary, also protect existing electrostatically sensitive components such as the encoders in motors against electrostatic discharge (ESD).

Never use attachment parts (cable connection, terminal boxes, fans, etc.) for securing during transport or as supporting surfaces.

Transport and storage conditions

- The room must be dry, dust-free and free of vibrations.
- The room must be well ventilated and free from drafts.
- The air in the room is not permitted to contain aggressive or hazardous gases.

Storage and transport conditions	8LWA
Storage temperature	-20 to +60°C
Relative humidity during storage	Max. 90%, non-condensing
Transport temperature	-20 to +60°C
Relative humidity during transport	Max. 90%, non-condensing

Radial or axial forces on the shaft

Caution!

Damage to property due to excessive radial or axial forces on the shaft.

Excessive radial or axial forces on the shaft can damage the bearing and impair the effect of any holding brake present to such an extent that the braking effect is non-existent or reduced. Similarly, encoder errors or damage to the gearbox can occur as a result.

- Transport and store the product only in its original packaging and lying on the housing.
- Avoid pressure and impact on the shaft end and housing.
- Do not use the shaft for securing during transport.
- Transport and lift heavy output shaft components separately and not installed on the shaft end.

Transport

Check product deliveries immediately for transport damage and report any damage immediately to the carrier. In the event of damage, discontinue use where applicable.

Danger!

Danger of injury due to loads!

Suspended loads can lead to personal injury or death if they fall down. Heavy loads can tilt and trap people or severely injure them.

Failure to comply with instructions, guidelines and regulations or use of unsuitable or damaged tools and devices can result in serious injury and/or damage to property.

- Motors should only be lifted without any additional load from other products (e.g. gears, pulleys, couplings, etc.).
- If motors have eye bolts, only lift the motors using the eye bolts.
- Only use permitted lifting, transport and aids with sufficient lifting capacity.
- Never stand in the danger zone or under suspended loads.
- Secure the product against dropping and tilting.
- Wear safety shoes, protective clothing and a safety helmet.
- Comply with the national and local regulations.

Storage**Caution!**

Damage caused by degraded material properties.

Storage for long periods of time or storage under improper conditions can cause certain materials to age prematurely, to have degraded properties and to become damaged. Damaged components can then result in further damage to property.

Recommendations to avoid damage during storage:

- **Reduce the storage time to a minimum and do not exceed the maximum storage time of 2 years.**
- **Rotate the motor shaft a few turns at least every 6 months either by hand or at a low speed (max. 50 rpm). Bearing noise can occur during the run-in phase, which is perfectly normal and is not a sign of bearing damage.**
- **Apply a preservative coating to unprotected components such as the shaft end.**
- **Avoid contact corrosion.**
- **Use the original packaging.**
- **Use covers to protect against dust.**
- **Check the seals for damage when the item is issued or prior to use.**

4 Installation conditions

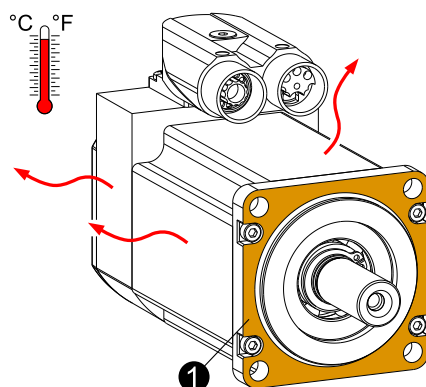
Before every commissioning procedure, the motor must be checked by qualified personnel. The check must include the proper condition in terms of mounting and installation, the installation conditions and safe operation.

Operating conditions	8LWA
Rating class, operating mode per EN 60034-1	S1 - Continuous operation
Ambient temperature during operation	-15°C to +40°C
Maximum ambient temperature during operation	+50°C ²⁾
Relative humidity during operation	5 to 95%, non-condensing
Reduction of the nominal current and stall current at temperatures above 40°C	5% per 5°C
Reduction of rated and stall current at installation elevations	5% per 1000 m
Starting at 1000 m above sea level	
Maximum installation elevation	4000 m ³⁾
Max. flange temperature	65°C
Degree of protection per EN 60034-5 (IP code) ⁴⁾	
- Without oil seal	IP64
- With oil seal	IP65
Type of construction and mounting arrangement per EN 60034-7 (IM code)	Horizontal (IM3001) Vertical, motor attached to the machine (IM 3011) ⁵⁾ Vertical, motor stands on the machine (IM3031)

4.1 Flange installation and cooling

Ensure unobstructed air circulation and cooling so that no heat accumulation can build up on the motor.

Attach the motor with the **motor flange** (1), which also serves as a **cooling surface**, directly on the machine.



The following points must be observed:

- The opposite side of the mounting flange is not permitted to be thermally insulated. Heat from the motor must be allowed to dissipate sufficiently.
- Air circulation must not be impeded. There must be sufficient cooling air on the motor housing.
- Exceeding the specified maximum values for motor temperature is not permitted.

It is important to note the following:

- Power or heat from the motors is dissipated via the mounting flange and surface of the motor housing.
- The motor can heat up due to external heat sources.

²⁾ Continuous operation at an ambient temperature of +40°C to max. +50°C is possible, but this results in premature aging.

³⁾ Requirements that go beyond this must be arranged with B&R.

⁴⁾ The degrees of protection are only achieved if the power and signal connections are fully installed.

⁵⁾ With the IM 3011 type of construction and mounting arrangement (vertical, motor attached to the machine), there is a risk of production fluids or oils penetrating the motor on the flange side. Motors or motor-gearbox combinations that should be used with this mounting arrangement must therefore have at least IP65 protection on the flange side.

Caution!

Personal injury and damage to property due to failure or overheating of the drive.

If the maximum permissible operating temperature is exceeded, a drive defect with consequential damage is very probable.

The cause of a defect could insufficient lubrication due to overheating, for example.

- **For safety reasons, switch off the machine if the maximum permissible temperature is exceeded.**
- **Ensure unobstructed air circulation and cooling so that no heat accumulation can build up in the drive or machine.**

4.2 Load due to radial and axial force

Radial and axial forces (F_r , F_a) applied to the shaft end during operation and installation must observe the conditions listed below.

Simultaneously **loading the shaft** end with the maximum values of F_r and F_a is not permitted! Contact B&R if this occurs.

Radial force

Radial force F_r on the shaft end is a function of the loads during installation (e.g. belt tension on pulleys) and operation (e.g. load torque on the pinion). The maximum radial force F_r depends on the shaft end type, bearing type, average speed, the position where the radial force is applied and the desired service life of the bearings.

Axial force, shift in shaft position caused by axial force

Axial force F_a on the shaft end is a function of the loads during installation (e.g. stress caused by mounting) and operation (e.g. thrust caused by slanted tooth pinions). The maximum axial force F_a depends on the bearing type and the desired lifespan of the bearings.

8LxA1 (with/without holding brake)

8LxA2 (with holding brake)

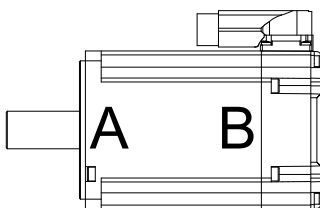
The **fixed bearing** is secured on the **B flange** with a retaining ring. The floating bearing is preloaded on the A flange with a spring in the direction of the B flange. Axial forces in the direction of the A flange can cause the spring bias to be overcome, which shifts the shaft by the amount of axial backlash in the bearing (approx. 0.1 - 0.2 mm). This shift can cause problems on motors with holding brakes or all motors with inductive encoder systems. As a result, no axial force in excess of the calculated values is permitted in the direction of the A flange when using these motor (see "Determining permissible values of F_r and F_a ").

8LxA2 (without holding brake)

8LxA3 (with/without holding brake)

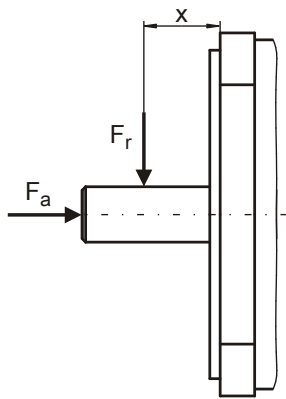
The **fixed bearing** is secured on the **A flange** with a retaining ring. The floating bearing is preloaded on the B flange with a spring in the direction of the A flange. Axial forces in the direction of the B flange can cause the spring bias to be overcome, which shifts the shaft by the amount of axial backlash in the bearing (approx. 0.1 - 0.2 mm). This shift can cause problems on motors with holding brakes or all motors with inductive encoder systems. As a result, no axial force in excess of the calculated values is permitted in the direction of the B flange when using these motor (see "Determining permissible values of F_r and F_a ").

A and B flange position



Determining permissible values of F_r and F_a

For information about determining permissible values of F_r and F_a , see the motor data for the respective servo motors (section "Technical data", "Permissible shaft load"). Permissible values are based on a bearing lifespan of 20,000 h (bearing lifespan calculation based on DIN ISO 281).



F_r Radial force

F_a Axial force

x Distance between the motor flange and the point where radial force F_r is applied.

Figure 1: Definition of shaft load

Overdetermined bearing

Avoid an overdetermined bearing when attaching drive elements onto the output shaft! The necessarily occurring tolerances cause additional forces on the output shaft bearing. This can damage or significantly reduce the service life of the bearing!

5 Installation and connection

5.1 Before installation

Read this user's manual completely before performing any work activities.

In addition, take into account the technical documentation for all other machine components as well as the finished machine.

5.2 Safety

Work on motors and their wiring is only permitted to be carried out by qualified personnel ²⁾ without voltage applied. The control cabinet must first be disconnected from the power supply and secured against being switched on again.

Only use appropriate equipment and tools. Protect yourself with safety equipment.

Warning!

Personal injury and damage to property due to unauthorized modifications!

As a result of unauthorized modifications to the product, the performance and limit values can be negatively affected and dangers can arise. Due to this, severe damage to property and injuries cannot be excluded.

Unauthorized modifications are therefore prohibited!

- Do not carry out any unauthorized modifications or alterations to the product.
- If necessary, contact B&R.

5.2.1 General sources of danger

Tampering of protection or safety devices

Protective and/or safety devices protect you and other persons from dangerous voltage, rotating or moving elements and hot surfaces.

Danger!

Personal injury and damage to property due to tampering of protective equipment!

If protective or safety devices are removed or put out of operation, there is no longer any personal protection and serious personal injury and damage to property can occur.

- Do not remove any safety devices.
- Do not put any safety devices out of operation.
- Always use all safety devices during short-term test and trial operations!

Dangerous voltage

To operate the motors, dangerous voltage must be applied to certain parts.

²⁾ see "Qualified personnel" on page 8

Danger!

Risk of injury due to electric shock!

If live parts are touched, there is immediate danger of fatal electric shock.

If connections are connected or disconnected in the incorrect order or when the power is switched on, electric arcs can occur and persons and contacts can be damaged.

Even if the motor is not rotating or is running as a generator driven externally, the control and power connections can still carry voltage!

- Never touch connections when the power is switched on.
- Never disconnect or connect electrical connections to the motor and servo drive when the power is switched on!
- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Always operate the motor with all safety equipment. Do this even during short testing and trial operations!
- Keep all covers and control cabinet doors closed during operation and as long as the machine is not disconnected from the power system.
- Before working on motors, gearboxes or servo drives or in the danger zone of your machine, disconnect them completely from the power system and secure them against being switched on again by other persons or automatic systems.
- Note the discharge time of any existing DC bus.
- Only connect measuring instruments when the power is switched off!

Danger due to electromagnetic fields

Electromagnetic fields are generated by the operation of electrical power engineering equipment such as transformers, drives and motors.

Danger!

Danger to health due to electromagnetic fields!

The functionality of a heart pacemaker can be impaired by electromagnetic fields to such an extent that the wearer experiences harm to his or her health, possibly with a fatal outcome.

- Observe relevant national health and safety regulations.
- Persons with pacemakers are not allowed to be in endangered areas.
- Warn staff by providing information, warnings and safety identification.
- Secure the danger zone by means of barriers.
- Reduce electromagnetic fields at their source (using shielding, for example).

Dangerous motion

By rotating and positioning motions of the motors, machine elements are moved or driven and loads conveyed.

After switching on the machine, movements of the motor shaft must always be expected! For this reason, higher-level protective measures must be put in place to ensure that personnel and machines are protected. This type of protection can be achieved, for example, by using stable mechanical protective equipment such as protective covers, protective fences, protective gates or photoelectric sensors.

In the immediate vicinity of the machine, provide sufficient and easily accessible emergency switching-off devices to stop the machine as quickly as possible in the event of an accident.

Danger!

Danger of injury due to rotating or moving elements and loads!

By rotating or moving elements, body parts can be drawn in or severed or subjected to impacts.

- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Before working on the machine, secure it against unwanted movements. A holding brake is not suitable for this!
- Keep all covers and control cabinet doors closed during operation and as long as the machine is not disconnected from the power system.
- Always operate the motor with all safety equipment. Do this even during short testing and trial operations!
- Motors can be started automatically via remote control! If appropriate, a corresponding warning symbol must be applied, and protective measures must be implemented to prevent entry into the high-risk area.

Danger!

Danger of injury due to loads!

Suspended loads can lead to personal injury or death if they fall down. Heavy loads can tilt and trap people or severely injure them.

Failure to comply with instructions, guidelines and regulations or use of unsuitable or damaged tools and devices can result in serious injury and/or damage to property.

- Motors should only be lifted without any additional load from other products (e.g. connection elements).
- Only use permitted lifting, transport and aids with sufficient lifting capacity.
- Never stand in the danger zone or under suspended loads.
- Secure the product against dropping and tilting.
- Wear safety shoes, protective clothing and a safety helmet.
- Comply with the national and local regulations.

Warning!

Danger of injury due to incorrect control or a defect.

Improper control of motors or a defect can result in injuries and unintended and hazardous movements of motors.

Such incorrect behavior can be triggered by:

- Incorrect installation or faults when handling components
- Improper or incomplete wiring
- Defective devices (servo drive, motor, position encoder, cables, brake)
- Incorrect control (e.g. caused by software error)

Risk due to hot surfaces

Due to the power dissipation from the motor and friction in the gearbox, these components as well as their environment can reach a temperature of more than 100°C.

The resulting heat is released to the environment via the housing and the flange.

Warning!

Risk of burns due to hot surfaces!

Touching hot surfaces (e.g. motor and gearbox housings, as well as connected components), can lead to very severe burns due to the very high temperature of these parts.

- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Never touch the motor or gearbox housing as well as adjacent surfaces during nominal load operation.
- Be aware of hot surfaces also during standstill.
- Allow the motor and gearbox to cool down sufficiently before working on them; there remains the risk of burns for a long period of time after they are switched off.
- Always operate the motor or gearbox with all safety devices. Do this even during short testing and trial operations!

5.2.2 Noise emissions

Take into account the health of personnel in proximity to the machine.

Warning!

Hearing damage due to noise levels.

During operation, the motor can exceed the permissible workplace noise level and also cause hearing damage.

- Implement suitable noise reduction measures (e.g. housings, covers or other sound-insulating measures).
- Take into account applicable industrial safety regulations.

5.3 Shaft end and bearing

The motor shaft is supported on both sides with grease-lubricated grooved ball bearings. Protect the motor from damage due to excessive radial and axial forces!

Under all circumstances, avoid the following loads on the front shaft end or the rear motor housing cover:

- Excessive pressure
- Impacts
- Hammer blows

Warning!

Damage due to excessive axial forces!

The motor bearings can be damaged or the service life reduced by excessive axial forces (e.g. by impacting or pressing) on the shaft. Damage to the encoder or any installed options (holding brake, gearbox) is also possible.

- Do not hit the motor or output shaft with a hammer. The impact of a hammer certainly exceeds the permissible values.
- In addition, avoid impact and excessive pressure on the motor and output shaft.

Overdetermined bearing

Avoid an overdetermined bearing when attaching drive elements onto the output shaft! The necessarily occurring tolerances cause additional forces on the output shaft bearing. This can damage or significantly reduce the service life of the bearings!

Lifting and transporting

The weight of attachment elements (toothed gears, pulleys, couplings, etc.) can have a harmful effect on the bearing during lifting and transportation from the motor. Take into account these radial and axial loads during these operations!

Installing and removing attachment elements

Always install and remove the attachment elements (toothed gears, pulleys, couplings, etc.) at the shaft end without any axial load on the motor bearings and all other parts installed in the motor. For this, use suitable clamping sets, pressure sleeves, other clamping elements, retractors, etc. The centering hole on the face side of the shaft end can be used for this work.

Pay attention to balanced connection elements or corresponding assembly.

Secure the attachments against unintended loosening after installation and before operation.

5.4 Installing in the system

Before working on motors, gearboxes or servo drives or in the danger zone of your machine, disconnect them completely from the power system and secure them against being switched on again by other persons or automatic systems.

Inspection

Before installation, inspect the components to determine whether they are suitable and undamaged.

Warning!

Personal injury and damage to property due to damaged or unsuitable machine components!

Operating a machine with damaged or unsuitable components is a safety risk and can lead to failures. Severe damage to property and injuries cannot be excluded.

- **Never operate a machine with a damaged motor or gearbox or any other damaged component.**
- **Never install a damaged component in a machine.**
- **Do not use motors or gearboxes that have already been overloaded during operation.**
- **Before installation, ensure that the motor or gearbox is suitable for the machine.**
- **It is better not to carry out short-term test and trial operations with damaged or inappropriate machine components.**
- **Label damaged or non-operational components in a readily visible location and clearly.**

Cleaning

Clean anti-corrosive agents and dirt off the output shaft and flange of the motor as well as the opposite side of the shaft and flange on the machine.

Caution!

Damage to property caused by improper cleaning.

Contact with cleaning agents can damage oil seals, sealing lips and gaskets.

- **Only use suitable and material-friendly cleaning agents.**
- **Ensure that oil seals, sealing lips and gaskets do not come into contact with cleaning agents.**

Installation with the mounting flange

Attach the motor with the mounting flange, which also serves as a cooling surface, directly to the machine.

For this, the motor must be screwed to the machine via the flange.

Apply tightening torque in accordance with the standard when tightening the screws and use a screw locking mechanism.

5.5 Connecting and disconnecting the motor

Observe the following safety guidelines and instructions when connecting and disconnecting the motor:

The protective ground conductor must be connected via the power connection or motor connector.

Danger!

Personal injury and damage to property due to missing ground potential!

If there is no proper ground potential on the motor housing or servo drive, fault currents can lead to serious personal injury and damage to property.

- **Properly (also during short-term test and trial operation!) connect the motor housing and the servo drive to the ground potential (PE rail).**

Danger!

Personal injury and damage to property due to direct mains connection!

Connecting the motor directly to the mains results in severe personal injury and damage to property.

- Only operate the motor with B&R drive systems.

Danger!

Risk of injury due to electric shock!

If live parts are touched, there is immediate danger of fatal electric shock.

If connections are connected or disconnected in the incorrect order or when the power is switched on, electric arcs can occur and persons and contacts can be damaged.

Even if the motor is not rotating or is running as a generator driven externally, the control and power connections can still carry voltage!

- Never touch connections when the power is switched on.
- Never disconnect or connect electrical connections to the motor and servo drive when the power is switched on!
- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Always operate the motor with all safety equipment. Do this even during short testing and trial operations!
- Keep all covers and control cabinet doors closed during operation and as long as the machine is not disconnected from the power system.
- Before working on motors, gearboxes or servo drives or in the danger zone of your machine, disconnect them completely from the power system and secure them against being switched on again by other persons or automatic systems.
- Note the discharge time of any existing DC bus.
- Only connect measuring instruments when the power is switched off!

Warning!

Risk of burns due to hot surfaces!

Touching hot surfaces (e.g. motor and gearbox housings, as well as connected components), can lead to very severe burns due to the very high temperature of these parts.

- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Never touch the motor or gearbox housing as well as adjacent surfaces during nominal load operation.
- Be aware of hot surfaces also during standstill.
- Allow the motor and gearbox to cool down sufficiently before working on them; there remains the risk of burns for a long period of time after they are switched off.
- Always operate the motor or gearbox with all safety devices. Do this even during short testing and trial operations!

5.5.1 Cables and connectors

Information:

To find the technical data and order data for the cables, see the current user's manual for the B&R drive system being used.

They are available in the Downloads section of the B&R website (www.br-automation.com).

5.5.1.1 Cables from other manufacturers

Caution!

Damage caused by voltage rise!

Cables from other manufacturers can have a negative effect on voltage rise on the winding. The winding can become damaged as a result of voltage rise.

- If non-B&R cables are used, you must provide documented evidence of conformity with voltage class A per EN 60034-25.
- If this evidence has not been provided, there is no claim to warranty due to winding damage that can be attributed to a rise in voltage on the winding.

5.5.1.2 Connectors from other manufacturers

Advice:

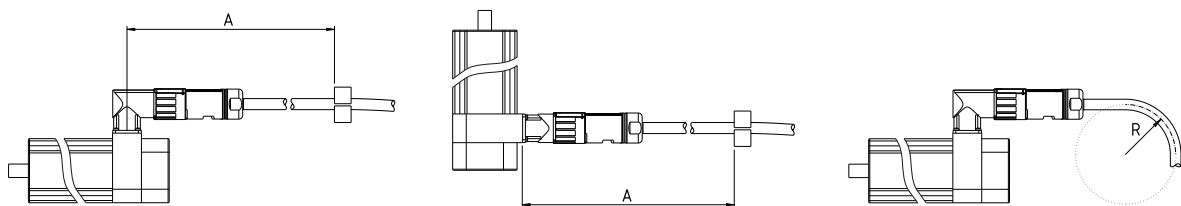
Disturbances caused by electrical or electromagnetic effects!

When using connectors from other manufacturers, EMC faults cannot be excluded.

- Use B&R connectors to ensure compliance with the EMC limit values of the connection.
- Ensure proper assembly and that cable shields are connected correctly.

5.5.1.3 Cable clamp and bend radius

To ensure that cables and connectors are not exposed to harmful loads, the cable clamp (**A**) and minimum bend radius (**R**) must be observed during installation.



Cable clamp (A)

- A = Max. 300 mm along longitudinal axis of connector
- The connection must be free of force and torque.
- Movement relative to the connector is not permitted!
- Tensile stress on cables and connectors is not permitted!

Bend radius (R)

- For the minimum radius values, see the current technical data sheet for the cable.

5.5.2 Connection sequence

When connecting or disconnecting the servo motor, the following safety guidelines and orders must be observed.

Danger!

Risk of injury due to electric shock!

If live parts are touched, there is immediate danger of fatal electric shock.

If connections are connected or disconnected in the incorrect order or when the power is switched on, electric arcs can occur and persons and contacts can be damaged.

Even if the motor is not rotating or is running as a generator driven externally, the control and power connections can still carry voltage!

- Never touch connections when the power is switched on.
- Never disconnect or connect electrical connections to the motor and servo drive when the power is switched on!
- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Always operate the motor with all safety equipment. Do this even during short testing and trial operations!
- Keep all covers and control cabinet doors closed during operation and as long as the machine is not disconnected from the power system.
- Before working on motors, gearboxes or servo drives or in the danger zone of your machine, disconnect them completely from the power system and secure them against being switched on again by other persons or automatic systems.
- Note the discharge time of any existing DC bus.
- Only connect measuring instruments when the power is switched off!

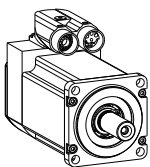
Danger!

After switching off the servo drive, wait for the DC bus to discharge for at least five minutes. To avoid a hazard, the current voltage on the DC bus must be measured between -DC1 and +DC1 and less than 42 VDC before starting work with a suitable measuring instrument. An unlit operating LED does not indicate that the device is de-energized!

Caution!

The temperature sensor on the motor is sensitive to electrostatic discharge (ESD). For this reason, the attachment cables on the drive system side (ACOPOS) must first be completely assembled and connected. Only then are the connectors permitted to be connected to the motor in the order described.

Double angular built-in connector



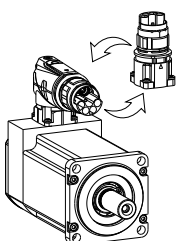
Connecting

1. Connect the orange power connector.
2. Connect the green encoder connector.

Disconnecting

1. Disconnect the green encoder connector.
2. Disconnect the orange power connector.

Single-cable solution (hybrid)



Connecting

1. Connect the connector to the motor.

Disconnecting

1. Disconnect the connector to the motor.

5.5.3 Connecting connectors properly

The connectors for the power and encoder connection of B&R motors are available as [speedtec system](#)¹ and itec system. The systems differ in the type of locking mechanism.

- 1) The speedtec system on the motor side is backward compatible with wiring with a screw terminal. Existing wiring with screw terminals can therefore continue to be used when replacing motors. For the proper connection, see "Screw terminal (for motors with speedtec connection)" on page 50.

Caution!

Damage due to improperly connected connectors!

Incorrectly connected connectors can result in disturbances and damage to the motor and encoder!

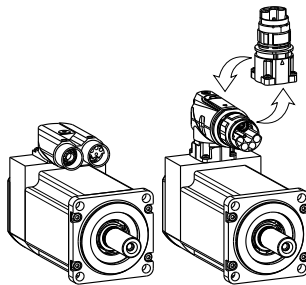
- **Always connect or disconnect the connector straight in/out, without force and without tools.**
- **It is important to ensure that connectors are fully connected and locked.**

5.5.3.1 System overview

The available connectors have different locking systems and are therefore operated in different ways.

The built-in double angular connector is designed as a [ytec system](#).

The connector locks automatically when connected.



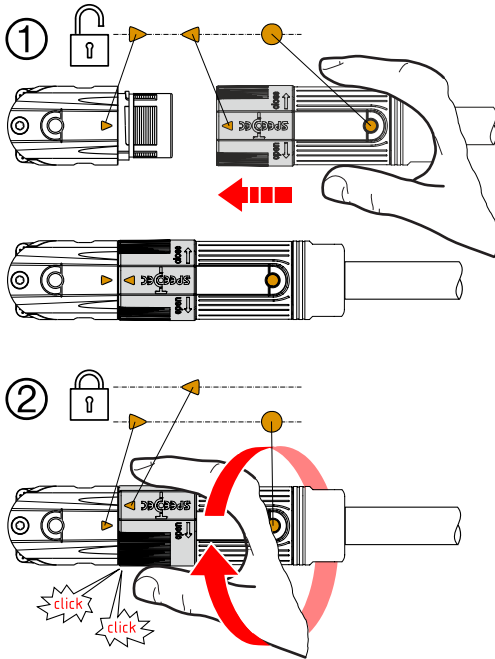
The single-cable solution (hybrid) is designed as a [speedtec system](#).

The connector must be locked manually when connected.

5.5.3.2 speedtec system

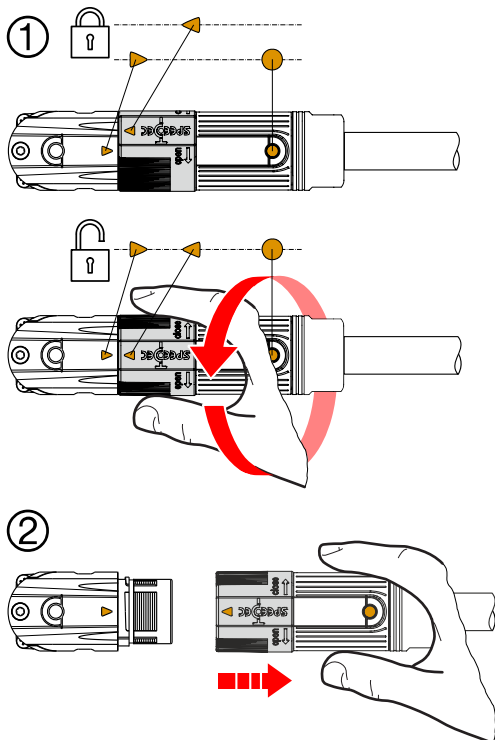
The speedtec system is equipped with a tool-free quick-release fastener and an internal thread, making it compatible with built-in connectors that use a screw terminal.

Connecting and locking



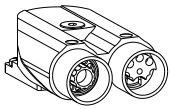
1. Align the ►◄• markings with each other. Push the connector straight and tightly onto the built-in connector.
2. Tighten the locking ring clockwise (direction of arrow "close"). The interlocking device must be turned until at least 2 "click" sounds can be heard. To ensure correct locking, the ►◄• markings must also be **offset** from each other (see step 2 in the figure on the left).

Unlocking and disconnecting the connector



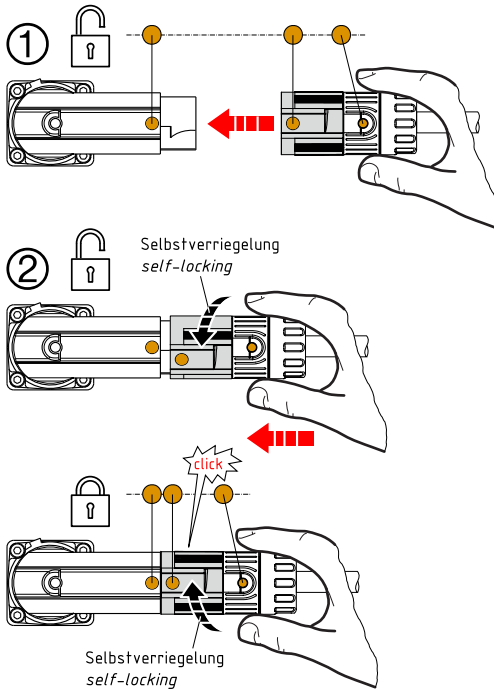
1. Turn the locking ring counterclockwise (direction of arrow "open") until the ►◄• markings are aligned with each other.
2. Disconnect the connector straight out and without force from the built-in connector. It is only permitted to pull the connector during removal, not the cable.

5.5.3.3 ytec system



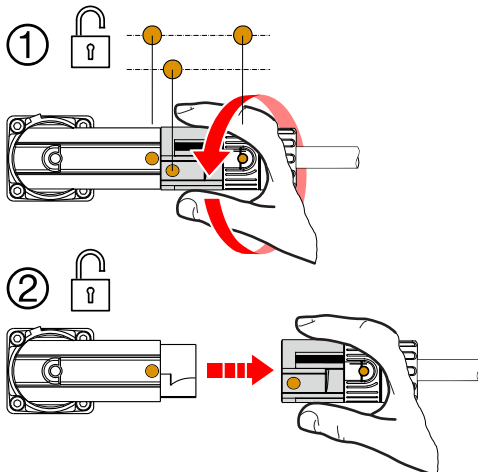
The tool-free self-locking ytec system twists the frontmost ring of the connector during connection and returns it to the middle position after it has been locked.

Connecting and locking



1. Align the ••• markings with each other.
Push the connector straight and without gaps.
2. While pushing, the front ring of the connector turns counterclockwise and jumps back to the middle position after locking. Correct locking is indicated by the middle position of the front ring and a "click" sound.

Unlocking and disconnecting the connector



1. Turn the front ring of the connector one eighth of a turn counterclockwise and hold it in this position.
2. Disconnect the connector straight out and without force.
It is only permitted to pull the connector during removal, not the cable.

5.5.3.4 Screw terminal (for motors with speedtec connection)

The screw terminal is used when an existing motor with a screw terminal is replaced by a new motor (of the same series with a backward compatible speedtec connection). The existing wiring with screw terminals can therefore continue to be used.

The connection is made without tools; it is important to ensure installation without tilting.

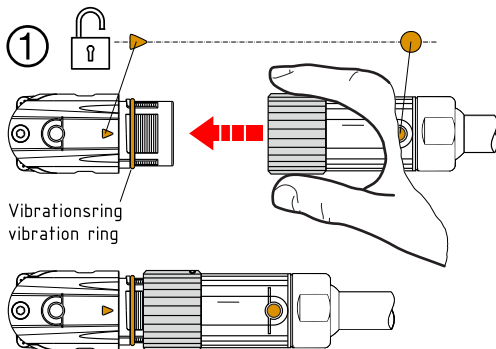
Vibration ring

If strong vibrations (>4-6 g) are expected during operation, the screw terminal must be secured with a vibration ring. This prevents the screw connection from coming loose. The vibration ring does not provide a sealing function.

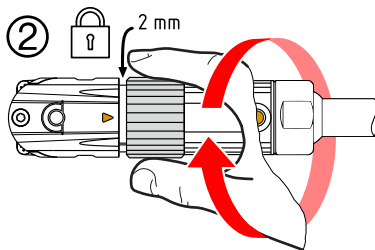
Installation is performed without tools by sliding onto the built-in connector on the motor side. The corresponding nut for the vibration ring is located just after the fine thread.

Order number for the vibration ring:	Content of delivery:	
8PX000.00-1	Vibration ring, size 1, 50 pieces	(for motors with speedtec connection)
8PX001.00-1	Vibration ring, size 1.5, 10 pieces	(for motors with speedtec connection)

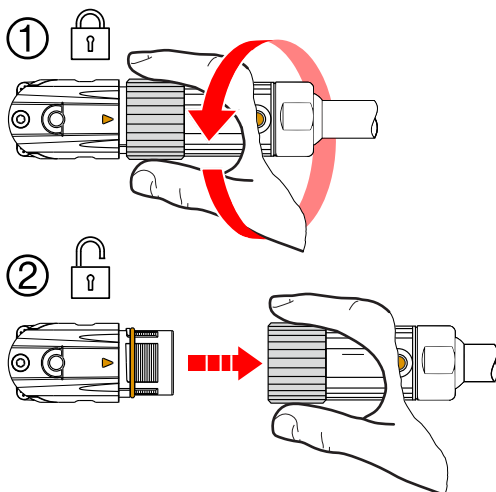
Connecting and locking



1. Fit a vibration ring if necessary.
Align the ►• markings with each other.
Push the connector straight onto the built-in connector.
2. Turn the locking ring clockwise and tighten it until the end stop.
The gap between the connector and the built-in connector should be approx. 2 mm.



Unlocking and disconnecting the connector

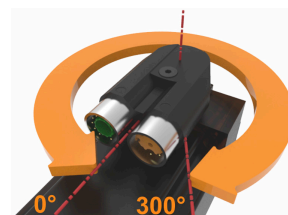


1. Turn the locking ring counterclockwise until it is completely detached from the thread of the built-in connector.
2. Disconnect the connector straight out and without force from the built-in connector.
It is only permitted to pull the connector during removal, not the cable.

5.5.4 Connection type

5.5.4.1 Double angular built-in connector

- 300° swivel double angular built-in connector
- Quick-release self-locking connector system
- Robust industrial connectors with optimal EMC shielding
- Robust metal housing



5.5.4.1.1 Resolver connection - Pinout

		Pin	Description	Function
		1	---	---
		2	---	---
		3	---	---
		4	---	---
		5	---	---
		6	R1	Reference signal inverted
		7	---	---
		8	S4	Sinus output signal
		9	S2	Sinus output signal inverted
		10	S3	Cosine output signal inverted
		11	S1	Cosine output signal inverted
		12	R2	Reference signal

5.5.4.1.2 EnDat 2.2 connection - Pinout

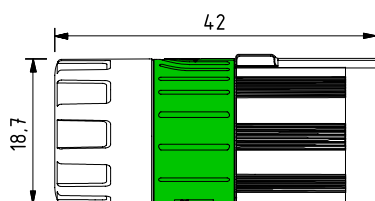
		Pin	Description	Function
		1	U+	Encoder supply +12.5 V
		2	D	Data output
		3	D\	Data output inverted
		4	T	Clock input
		5	T\	Clock input inverted
		6	COM (12)	Battery supply 0 V
		7	COM (1)	Encoder supply 0 V
		8	---	---
		9	---	---
		10	---	---
		11	---	---
		12	VBATT	Battery supply

5.5.4.1.3 Pinout power connection.

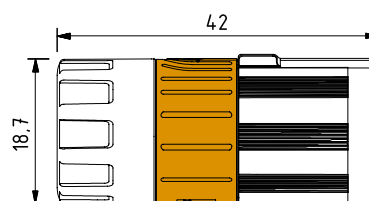
		Pin	Description	Function
		A	U	Motor connection U
		B	V	Motor connection V
		C	W	Motor connection W
		PE	PE	Grounding
		1	T+	Temperature +
		2	T-	Temperature -
		3	B+	Brake +
		4	B-	Brake -

5.5.4.1.4 ytec connector - Dimensions

The ytec connectors, compatible with the **built-in double angular connector**, have the same dimensions and can be distinguished by the colors green and orange. The connection to the motor is made without tools.



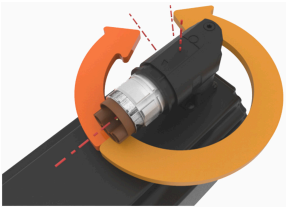
Encoder connector (green)



Power connector (orange)

5.5.4.2 Single-cable solution (hybrid) - (speedtec system)

- 300° swivel speedtec connection
- Encoder and power cable: Combined in one cable
- Quick-release self-locking connector system
- Robust industrial connectors with optimal EMC shielding
- Robust metal housing



Advice:

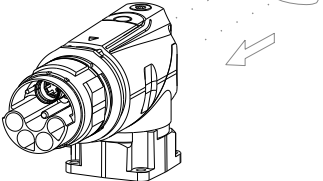
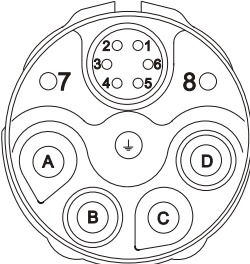
In the case of motors with the single-cable solution (hybrid), the temperature signal is not transmitted via two separate lines in the motor cable as before. Instead, it is transmitted digitally via the encoder interface.

The following conditions must be met by the drives in order to operate a motor with a single-cable solution (hybrid).

- For ACOPOS P3 with SafeMOTION: The configured operating system version (NC version) must be set to V5.04.0 or later; the Safety Release must be version 1.9 or later.
- For all drives: The configured operating system version (NC version) must be set to version 5.04.0 or later.

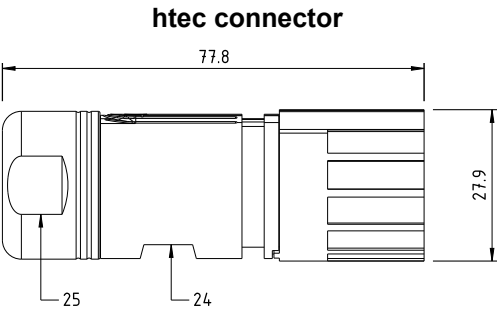
If the conditions listed above are not met, temperature evaluation on the drive will not work.

5.5.4.2.1 Single-cable solution (hybrid) - Pinout

		Pin	Signal
		A	Motor connection U
		B	Motor connection V
		C	Motor connection W
		D	---
		7	Brake -
		8	Brake +
		PE	Grounding
		1	Encoder connection
		2	Ground
		3	Data
		4	Data inverted
		5	Clock input
		6	Clock input inverted

5.5.4.2.2 htec connector - Dimensions

The htec connector can be connected without tools.



6 Commissioning and operation

6.1 Before commissioning and operation

Read this user's manual completely before starting any commissioning activities or operation.

In addition, take into account the technical documentation for all other machine components (e.g. the B&R drive system) as well as the finished machine.

6.2 Safety

Commissioning is only permitted to be carried out by qualified personnel²⁾.

Only use appropriate equipment and tools. Protect yourself with safety equipment.

Caution!

Severe personal injury and damage to property due to failure of the servo drive!

If the servo drive fails, an uncontrolled motor can cause damage.

Electronic devices are generally not failsafe!

- **Ensure that the motor is brought into a safe state if the servo drive fails.**

6.2.1 General sources of danger

Tampering of protection or safety devices

Protective and/or safety devices protect you and other persons from dangerous voltage, rotating or moving elements and hot surfaces.

Danger!

Personal injury and damage to property due to tampering of protective equipment!

If protective or safety devices are removed or put out of operation, there is no longer any personal protection and serious personal injury and damage to property can occur.

- **Do not remove any safety devices.**
- **Do not put any safety devices out of operation.**
- **Always use all safety devices during short-term test and trial operations!**

Dangerous voltage

To operate the motors, dangerous voltage must be applied to certain parts.

²⁾ see "Qualified personnel" on page 8

Danger!

Risk of injury due to electric shock!

If live parts are touched, there is immediate danger of fatal electric shock.

If connections are connected or disconnected in the incorrect order or when the power is switched on, electric arcs can occur and persons and contacts can be damaged.

Even if the motor is not rotating or is running as a generator driven externally, the control and power connections can still carry voltage!

- Never touch connections when the power is switched on.
- Never disconnect or connect electrical connections to the motor and servo drive when the power is switched on!
- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Always operate the motor with all safety equipment. Do this even during short testing and trial operations!
- Keep all covers and control cabinet doors closed during operation and as long as the machine is not disconnected from the power system.
- Before working on motors, gearboxes or servo drives or in the danger zone of your machine, disconnect them completely from the power system and secure them against being switched on again by other persons or automatic systems.
- Note the discharge time of any existing DC bus.
- Only connect measuring instruments when the power is switched off!

Danger due to electromagnetic fields

Electromagnetic fields are generated by the operation of electrical power engineering equipment such as transformers, drives and motors.

Danger!

Danger to health due to electromagnetic fields!

The functionality of a heart pacemaker can be impaired by electromagnetic fields to such an extent that the wearer experiences harm to his or her health, possibly with a fatal outcome.

- Observe relevant national health and safety regulations.
- Persons with pacemakers are not allowed to be in endangered areas.
- Warn staff by providing information, warnings and safety identification.
- Secure the danger zone by means of barriers.
- Reduce electromagnetic fields at their source (using shielding, for example).

Dangerous motion

By rotating and positioning motions of the motors, machine elements are moved or driven and loads conveyed.

After switching on the machine, movements of the motor shaft must always be expected! For this reason, higher-level protective measures must be put in place to ensure that personnel and machines are protected. This type of protection can be achieved, for example, by using stable mechanical protective equipment such as protective covers, protective fences, protective gates or photoelectric sensors.

In the immediate vicinity of the machine, provide sufficient and easily accessible emergency switching-off devices to stop the machine as quickly as possible in the event of an accident.

Danger!

Danger of injury due to rotating or moving elements and loads!

By rotating or moving elements, body parts can be drawn in or severed or subjected to impacts.

- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Before working on the machine, secure it against unwanted movements. A holding brake is not suitable for this!
- Keep all covers and control cabinet doors closed during operation and as long as the machine is not disconnected from the power system.
- Always operate the motor with all safety equipment. Do this even during short testing and trial operations!
- Motors can be started automatically via remote control! If appropriate, a corresponding warning symbol must be applied, and protective measures must be implemented to prevent entry into the high-risk area.

Danger!

Danger of injury due to loads!

Suspended loads can lead to personal injury or death if they fall down. Heavy loads can tilt and trap people or severely injure them.

Failure to comply with instructions, guidelines and regulations or use of unsuitable or damaged tools and devices can result in serious injury and/or damage to property.

- Motors should only be lifted without any additional load from other products (e.g. connection elements).
- Only use permitted lifting, transport and aids with sufficient lifting capacity.
- Never stand in the danger zone or under suspended loads.
- Secure the product against dropping and tilting.
- Wear safety shoes, protective clothing and a safety helmet.
- Comply with the national and local regulations.

Warning!

Danger of injury due to incorrect control or a defect.

Improper control of motors or a defect can result in injuries and unintended and hazardous movements of motors.

Such incorrect behavior can be triggered by:

- Incorrect installation or faults when handling components
- Improper or incomplete wiring
- Defective devices (servo drive, motor, position encoder, cables, brake)
- Incorrect control (e.g. caused by software error)

Risk due to hot surfaces

Due to the power dissipation from the motor and friction in the gearbox, these components as well as their environment can reach a temperature of more than 100°C.

The resulting heat is released to the environment via the housing and the flange.

Warning!

Risk of burns due to hot surfaces!

Touching hot surfaces (e.g. motor and gearbox housings, as well as connected components), can lead to very severe burns due to the very high temperature of these parts.

- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Never touch the motor or gearbox housing as well as adjacent surfaces during nominal load operation.
- Be aware of hot surfaces also during standstill.
- Allow the motor and gearbox to cool down sufficiently before working on them; there remains the risk of burns for a long period of time after they are switched off.
- Always operate the motor or gearbox with all safety devices. Do this even during short testing and trial operations!

6.2.2 Freely rotating motors

With freely rotating motors, measures must be taken to prevent the key (if present) from being ejected. Measures must be taken to prevent mounting screws or other mounting elements from being ejected or removed prior to operation. A shaft protection sleeve for transport and storage is not appropriate protection and must also be removed.

Warning!

Personal injury and damage to property due to ejected elements!

With freely rotating motors, ejected elements can cause personal injury and damage to property.

- The following safety precautions also apply during short testing and trial operations!
- Secure the keys.
- Secure or remove mounting screws or other mounting elements.
- A shaft protection sleeve for transport and storage must also be removed.

6.3 Verification

6.3.1 To verify before commissioning

The following must be ensured before commissioning:

- The drive is not permitted to be damaged.
- The motor must be properly aligned and secured and is not permitted to be within the danger zone of other equipment.
- The screw connections must be tightened correctly.
- Any unused connection threads on the flanged end shield must be sealed.
- All components attached to the output shaft must be secured against unintentional release.
- Motors that have a keyed shaft end are not permitted to be operated without a key. The resulting imbalance can result in motor damage.
- For freely rotating motors, keys must be secured against ejection and mounting screws; other mounting elements must be secured or removed.
- All the necessary protective equipment (mechanical, thermal, electrical) must be installed.
- All motor connections must be properly made.
- The protective ground conductor must be installed properly and verified.
- The wires are not permitted to touch the motor surface.
- The drive must be free (release brake).
- The emergency switch-off functions must be checked.
- A holding brake must be functional if available.
- If a fan is present, it must be properly connected and functional.
- If a liquid cooling system is present, it must be properly connected, functional and leak-proof.

Warning!

Personal injury and damage to property due to damaged or unsuitable machine components!

Operating a machine with damaged or unsuitable components is a safety risk and can lead to failures. Severe damage to property and injuries cannot be excluded.

- **Never operate a machine with a damaged motor or gearbox or any other damaged component.**
- **Never install a damaged component in a machine.**
- **Do not use motors or gearboxes that have already been overloaded during operation.**
- **Before installation, ensure that the motor or gearbox is suitable for the machine.**
- **It is better not to carry out short-term test and trial operations with damaged or inappropriate machine components.**
- **Label damaged or non-operational components in a readily visible location and clearly.**

6.3.2 To verify during commissioning

The following must be ensured during commissioning:

- The functionality of all the motor's components and assemblies (protective equipment, encoder, brake, cooling, gearbox, etc.) must have been verified.
- The operating conditions (see chapter "Installation conditions") must be observed.
- A holding brake, if present, must be released when the motor is rotating.
- If a liquid cooling system is present, it must be functional and leak-proof.
- All electrical attachments and connections must be properly designed and secured.
- All protective measures must have been implemented in order to prevent contact with voltage-carrying components, hot surfaces and rotating or moving parts and assemblies. Also check whether these protective measures are working properly.
- All output elements must be installed and set up in accordance with the manufacturer's specifications.
- The max. permissible speed n_{\max} of the motor must be limited and is not permitted to be exceeded. The maximum permissible speed n_q is the maximum speed that is permissible for short-time duty.

6.3.3 During operation

During operation, be aware of the following signs that can indicate a malfunction:

- Unusual noises
- Unusual vibrations
- Unusual odors
- Smoke generation
- Unusual temperature development
- Increased power consumption
- Lubricant outlet
- The monitoring or safety device responds

If possible, switch off the machine as soon as possible in order to avoid damage or accidents. Always ensure the safety of other persons as well as your own safety during shutdowns and causal investigation!

In the case of shutdowns, please inform the responsible qualified personnel immediately.

6.4 Faults during operation

In the following table, you can find possible causes of error broken down by malfunction as well as information about how to fix them.

Fault	Possible cause	Fix
Motor will not start	Controller enable missing	Activate controller enable
	Controller error, encoder error	Read error listing on inverter/controller, correct error Check the connector to ensure it is connected correctly (see chapter "Installation and connection", section "Ensure proper connections")
	Power supply not present	Check connection and power supply Check the connector to ensure it is connected correctly (see chapter "Installation and connection", section "Ensure proper connections")
	Rotating field	Check phase sequence, replace connection line if necessary
	Brake will not release (optional equipment may be available)	Check triggering, connections and power supply
Runs noisily	Brake defective (optional equipment may be available)	If necessary, contact B&R.
	Insufficient shielding in connection lines	Check shielding connection and grounding
Vibrations	Controller parameters too high	Optimize controller parameters
	Coupling element or machine not properly balanced	Adjust balance
	Power transmission system misaligned	Realign power transmission system
Noise during operation	Mounting screws loose	Check and tighten screw connections
	Foreign bodies in the motor	If necessary, contact B&R.
	Bearing damage	If necessary, contact B&R.
The motor becomes too warm - the temperature monitoring responds	Power transmission system overloaded	Check motor load and compare with data on nameplate
	Insufficient heat dissipation	Ensure sufficient heat dissipation.
	Brake will not release sufficiently - Grinding brake (optional equipment may be available)	If necessary, contact B&R.
Current consumption too high - motor torque too low	Rest angle is incorrect	Check rest angle and adjust as needed

If necessary, contact B&R.

For this, the following information should be provided:

- Order description and serial number (see nameplate)
- Type and extent of fault
- Circumstances under which the fault occurred
- Application data (cycle of torque, speed and forces over time, ambient conditions)

7 Inspection and maintenance

Various operating conditions (e.g. operating mode, temperature, speed, load, mounting orientation), can have a significant impact on the service life of lubricants, seals and bearings.

Depending on the pollution degree, clean regularly on site to ensure heat is being dissipated properly, for example.

The following tasks are the responsibility of the operator:

- A maintenance plan and the documentation of inspections and maintenance work is created.
- Motors and cooling air-supplying construction are checked for dirt, moisture and leaks.
- Motors and cooling air-supplying construction are cleaned.
- Checking cables and connectors for damage.
- All safety devices are tested for safe operation.

7.1 Safety

Work on motors and their wiring is only permitted to be carried out by qualified personnel ²⁾ without voltage applied. The control cabinet must first be disconnected from the power supply and secured against being switched on again.

Only use appropriate equipment and tools. Protect yourself with safety equipment.

Warning!

Personal injury and damage to property due to unauthorized modifications!

As a result of unauthorized modifications to the product, the performance and limit values can be negatively affected and dangers can arise. Due to this, severe damage to property and injuries cannot be excluded.

Unauthorized modifications are therefore prohibited!

- Do not carry out any unauthorized modifications or alterations to the product.
- If necessary, contact B&R.

7.1.1 General sources of danger

Tampering of protection or safety devices

Protective and/or safety devices protect you and other persons from dangerous voltage, rotating or moving elements and hot surfaces.

Danger!

Personal injury and damage to property due to tampering of protective equipment!

If protective or safety devices are removed or put out of operation, there is no longer any personal protection and serious personal injury and damage to property can occur.

- Do not remove any safety devices.
- Do not put any safety devices out of operation.
- Always use all safety devices during short-term test and trial operations!

Dangerous voltage

To operate the motors, dangerous voltage must be applied to certain parts.

²⁾ see "Qualified personnel" on page 8

Danger!

Risk of injury due to electric shock!

If live parts are touched, there is immediate danger of fatal electric shock.

If connections are connected or disconnected in the incorrect order or when the power is switched on, electric arcs can occur and persons and contacts can be damaged.

Even if the motor is not rotating or is running as a generator driven externally, the control and power connections can still carry voltage!

- Never touch connections when the power is switched on.
- Never disconnect or connect electrical connections to the motor and servo drive when the power is switched on!
- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Always operate the motor with all safety equipment. Do this even during short testing and trial operations!
- Keep all covers and control cabinet doors closed during operation and as long as the machine is not disconnected from the power system.
- Before working on motors, gearboxes or servo drives or in the danger zone of your machine, disconnect them completely from the power system and secure them against being switched on again by other persons or automatic systems.
- Note the discharge time of any existing DC bus.
- Only connect measuring instruments when the power is switched off!

Danger due to electromagnetic fields

Electromagnetic fields are generated by the operation of electrical power engineering equipment such as transformers, drives and motors.

Danger!

Danger to health due to electromagnetic fields!

The functionality of a heart pacemaker can be impaired by electromagnetic fields to such an extent that the wearer experiences harm to his or her health, possibly with a fatal outcome.

- Observe relevant national health and safety regulations.
- Persons with pacemakers are not allowed to be in endangered areas.
- Warn staff by providing information, warnings and safety identification.
- Secure the danger zone by means of barriers.
- Reduce electromagnetic fields at their source (using shielding, for example).

Dangerous motion

By rotating and positioning motions of the motors, machine elements are moved or driven and loads conveyed.

After switching on the machine, movements of the motor shaft must always be expected! For this reason, higher-level protective measures must be put in place to ensure that personnel and machines are protected. This type of protection can be achieved, for example, by using stable mechanical protective equipment such as protective covers, protective fences, protective gates or photoelectric sensors.

In the immediate vicinity of the machine, provide sufficient and easily accessible emergency switching-off devices to stop the machine as quickly as possible in the event of an accident.

Danger!

Danger of injury due to rotating or moving elements and loads!

By rotating or moving elements, body parts can be drawn in or severed or subjected to impacts.

- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Before working on the machine, secure it against unwanted movements. A holding brake is not suitable for this!
- Keep all covers and control cabinet doors closed during operation and as long as the machine is not disconnected from the power system.
- Always operate the motor with all safety equipment. Do this even during short testing and trial operations!
- Motors can be started automatically via remote control! If appropriate, a corresponding warning symbol must be applied, and protective measures must be implemented to prevent entry into the high-risk area.

Danger!

Danger of injury due to loads!

Suspended loads can lead to personal injury or death if they fall down. Heavy loads can tilt and trap people or severely injure them.

Failure to comply with instructions, guidelines and regulations or use of unsuitable or damaged tools and devices can result in serious injury and/or damage to property.

- Motors should only be lifted without any additional load from other products (e.g. connection elements).
- Only use permitted lifting, transport and aids with sufficient lifting capacity.
- Never stand in the danger zone or under suspended loads.
- Secure the product against dropping and tilting.
- Wear safety shoes, protective clothing and a safety helmet.
- Comply with the national and local regulations.

Warning!

Danger of injury due to incorrect control or a defect.

Improper control of motors or a defect can result in injuries and unintended and hazardous movements of motors.

Such incorrect behavior can be triggered by:

- Incorrect installation or faults when handling components
- Improper or incomplete wiring
- Defective devices (servo drive, motor, position encoder, cables, brake)
- Incorrect control (e.g. caused by software error)

Risk due to hot surfaces

Due to the power dissipation from the motor and friction in the gearbox, these components as well as their environment can reach a temperature of more than 100°C.

The resulting heat is released to the environment via the housing and the flange.

Warning!

Risk of burns due to hot surfaces!

Touching hot surfaces (e.g. motor and gearbox housings, as well as connected components), can lead to very severe burns due to the very high temperature of these parts.

- Do not stay in the danger zone during operation and secure it against access by unauthorized persons.
- Never touch the motor or gearbox housing as well as adjacent surfaces during nominal load operation.
- Be aware of hot surfaces also during standstill.
- Allow the motor and gearbox to cool down sufficiently before working on them; there remains the risk of burns for a long period of time after they are switched off.
- Always operate the motor or gearbox with all safety devices. Do this even during short testing and trial operations!

7.2 Motor bearing

Motor bearing

In the case of trouble-free operation, we recommend changing the motor bearing after approx. 20,000 operating hours as a general maintenance guideline (calculated bearing mission time L_{h10} : 20,000 operating hours).

7.3 Oil seal

Motors can optionally be equipped with an oil seal (form A per DIN 3760). The motors thus satisfy the requirements for IP65 protection per EN 60034-5.

Advice:

Gearbox mounting is not permitted as a result, however, since maintenance of the oil seal is impeded by the gearbox.

- Ensure sufficient lubrication of the oil seal throughout the entire service life of the motor.

7.4 Cleaning

Clean the motors regularly to ensure good heat dissipation.

Information:

- During cleaning work, hold the drive cable/connector in place.
- Remove fibers and foreign matter from the motor housing by hand without damaging the motor surface or shaft end.
- Use a cloth moistened with water to remove dust and dirt from the motor housing (excluding the shaft end).

Caution!

- Cleaning is only permitted to be carried out by qualified personnel.
- Before starting cleaning work, make sure that the motor is switched off, disconnected from power, stopped and cooled down.
- Compressed air tools, high-pressure cleaners, wire brushes, scrapers, etc. are not suitable for cleaning the motor and cables.

8 Disposal

Separation of materials

To ensure that devices can be recycled in an environmentally friendly manner, it is necessary to separate out the different materials. Disposal must be carried out in accordance with applicable legal regulations.

Component	Disposal	Note
Motors	Electronic recycling	A magnetized rotor is not permitted to be transported or delivered outside the stator under any circumstances!
Gearbox (without oil)	Metal waste	
Waste oil (gearbox)	Special waste	
Coolant	Special waste	For liquid-cooled motors only. Consists of water / oil with additives.
Modules, cables	Electronic recycling	
Batteries	Special waste	Danger of fire: Do not store batteries together with conductive materials during disposal.
Cardboard/Paper packaging	Paper/Cardboard recycling	

8.1 Safety

8.1.1 Protective equipment

Always wear suitable safety clothing and equipment for your personal protection.

8.1.2 Rotor with rare earth magnets

In B&R motors, rotors are installed with rare earth magnets with high magnetic energy densities.

Warning!

Personal injury and damage to property due to rare earth magnets!

The motors are not permitted to be disassembled into individual parts.

A magnetized rotor is not permitted to be transported or delivered outside the stator under any circumstances!

- Due to the surrounding magnetic fields, the functionality of a pacemaker can be impaired in such a way that it can lead to bodily harm or even death of the carrier.
- The surrounding magnetic fields can affect or destroy electronic and mechanical measuring instruments.
- The strong magnetic attractive force can lead to uncontrolled movements of the magnet or the attraction of other objects. Personal injury due to impacts or trapping is possible. If magnets are splintered during collision, personal injury cannot be ruled out.
- In potentially explosive atmospheres, a spark generated by magnets can lead to serious explosions and cause personal injury and damage to property.

Publishing information

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