# 8LVA three-phase synchronous motors

## User's manual

Version: **1.0 (2017-06-06)**
Model no.: **MAMOT7-ENG**

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# 1 General information

## 1.1 Manual history

| Version | Date | Comment | Author |
|---|---|---|---|
| 1.00 | 2017-06-06 | First edition | Docu 2 |

### Information:

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

## 1.2 About this user's manual

This user 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 operation and a long service life.

As a component of the machine, this manual is to 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.

### Information:

**This user's manual is not intended for end customers! It is the responsibility of the machine manufacturer or system provider to provide the safety guidelines relevant to end customers in the operating instructions for the end customer in the respective local language.**

## 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!** | Disregarding these safety guidelines and notices can be life-threatening. |
| **Warning!** | Disregarding these safety guidelines and notices can result in severe injury or substantial damage to property. |
| **Caution!** | Disregarding these safety guidelines and notices can result in injury or damage to property. |
| **Note:** | This information is important for preventing errors. |

### 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. The motors are only permitted to be used with servo drives that are operated on grounded, three-phase industrial power systems (TN, TT power system).

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 type plate and in the user's manual (e.g. connection and environmental 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**
> - **Managing 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 property damage caused by 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 property damage 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!**

**There is an immediate risk of fatal injury in case of contact with live parts.**

**If connections are connected or disconnected in the wrong order or under voltage, arcs can arise and persons and contacts can be damaged.**

**Even if the motor is not turning, the control and power connections can still carry voltage!**

- **Never touch the connectors when the power is on.**
- **Never disconnect or connect electrical connections to the motor and servo drive under voltage!**
- **Do not remain in the dangerous zone during operation; secure the danger zone from access by unauthorized persons.**
- **Always operate the motor with all of its safety features. You should also do this during short-term testing and trial operations!**
- **Keep all covers and switch cabinet doors closed during operation and for as long as the machine has not been disconnected from the mains.**
- **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 discharging time of an intermediate circuit, if present.**
- **Only connect the measuring instruments in the absence of current and voltage!**

### 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.**

- **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 safety precautions need to 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 stop switches 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 remain in a dangerous area during operation and secure it from access by unauthorized persons.**
- **Before working on the machine, secure it against unwanted movements. Any holding brake present is not suitable for this!**
- **Keep all covers and switch cabinet doors closed during operation and for as long as the machine has not been disconnected from the mains.**
- **Always operate the motor with all of its safety features. You should also do this during short-term 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 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 mishandling of 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 loss of power 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.

## Danger!

**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 remain in a dangerous area during operation and secure it from 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 downtime.**
- **Allow motor and gearbox to cool sufficiently before working on it. Because even after shutting down, there is still a risk of burning for a prolonged period of time.**
- **Always operate the motor or gearbox with all safety devices. You should also do this during short-term 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
- Applicable industrial 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. cable 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.

**The operator is obligated**

- to know and implement applicable industrial safety regulations
- to know and implement national, local and plant-specific regulations
- to conduct a risk assessment to identify hazards related to on-site working conditions
- to create documentation with safety guidelines for operation of the finished system (with motors, gears, servo drives, etc.)
- to periodically verify that his own operating instructions and manuals correspond to the current status of applicable regulations
- to clearly define and assign responsibilities for installation, operation, troubleshooting, maintenance and cleaning
- to ensure that relevant personnel have read and understood this user's manual
- to provide personnel with regular training and inform them of hazards
- to provide personnel with the necessary 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. These are persons who are familiar with the transport, mounting, installation, commissioning and operation of devices who also have the appropriate qualifications (e.g. IEC 60364). National accident prevention regulations must be observed.

The safety notices, information on connection conditions (type plate and documentation) and limit values specified in the technical data are to be read carefully before installation and commissioning and must always be observed.

### 1.3.8 Safety notices

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

“Hot surface” warning sticker

### 1.3.9 Protective equipment

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

# 1.4 8LVA - Compact servo technology

The 8LVA 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 8LVA series are designed to be highly dynamic and are distinguished by their outstanding intrinsic acceleration characteristics. Additional noteworthy features include low cogging and a high overload capability. These motors have IP54 protection standard but are also available with IP65 protection. They can optionally be equipped with a holding brake. Designed for use with ACOPOSmicro servo drives, these motors offer extremely high performance and are some of the most compact on the market. 8LVA servo 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. |

**Note:**

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

## 1.4.2 Type plate

The type plate clearly identifies each motor. The motor number ensures traceability.

**Note:**

- **The type plate must be visible at all times.**
- **The type plate is not permitted to be removed from the motor.**

### 1.4.2.1 Embedded parameter chip

All relevant mechanical and electrical information and data is contained 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 for the electronics is switched on, the motor is automatically identified. The motor transmits its nominal values and limit values to the servo drive. The drive then uses these to independently calculate the current limit values and current control parameters necessary for safe operation of the motor. The user only has to optimize the speed and position controllers. The integrated commissioning environment in B&R Automation Studio™ provides all necessary support.

Routine service work is also simplified in addition to commissioning, and motors can be exchanged without having to take extra time to set parameters.

# 2 Technical data

## 2.1 General description

The special construction of the surface allows them to be used in applications for the food and beverage industry. Depressions where liquid can collect were deliberately avoided.

- Ultra compact and highly dynamic
- High overload capability and low cogging
- Power range up to 1 kW for 80 VDC and 320 VDC DC bus voltage
- Self-locking connector system
- Robust, industrial-strength connector with optimal EMC shielding
- 300° swivel double angular built-in connector and single-cable solution (hybrid)
- Available with optional gearbox or direct attachment of gearbox (8LVB)

### 2.1.1 Cooling / Construction type (b)

8LVA servo motors are self-cooling and have a long, slim design. The motors must be installed on the cooling surface (flange).

Valid code: A

### 2.1.2 Sizes (c)

The 8LVA servo motor series is available in three different sizes (1, 2, 3). They have different dimensions (especially flange dimensions) and power ratings. These different sizes are indicated by a number represented by (**c**) in the model number. The larger the number, the larger the flange dimensions and power data for the respective motor.

| | Available sizes | | |
|---|---|---|---|
| **Cooling type** | **1** | **2** | **3** |
| A | Yes | Yes | Yes |

### 2.1.3 Lengths (d)

The 8LVA servo motor series is available in two different lengths. They have different power ratings with identical flange dimensions. These different lengths are indicated by a number represented by (**d**) in the model number.

| | Available sizes | | |
|---|---|---|---|
| **Length** | **1** | **2** | **3** |
| 2 | --- | Yes | --- |
| 3 | Yes | Yes | Yes |

## 2.2 Motor encoder systems

### General

Motors in the 8LV series are available with EnDat encoders as well as resolvers. The encoder system is listed as part of the model 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. A disadvantage is the low accuracy of 6-10 arcmin. Furthermore, no multi-turn variant with resolvers is possible.

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.

### 2.2.1 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.

### 2.2.2 Resolver

#### General information

RE-15-1-J04 resolvers are used in the motors.

#### Technical data

| | Encoder type / Order code (ee) |
|---|---|
| | R0 |
| Precision | 10 angular minutes |
| Vibration during operation<br>10 < f ≤ 500 Hz | ≤500 m/s² |
| Shock during operation<br>Duration 11 ms | ≤1,000 m/s² |

### 2.2.3 EnDat 2.2 encoder

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.

#### General information

Digital drive systems and position control loops require fast and highly secure transfer of data obtained from position measuring instruments. In addition, other data such as drive-specific characteristics, correction tables, etc. should also be available. To ensure a high level of system security, measuring instruments must be integrated in routines for detecting errors and be able to perform diagnostics.

The EnDat interface from HEIDENHAIN is a digital, bidirectional interface for measuring instruments. It is able to output position values from incremental and absolute measuring instruments and can also read and update information on the measuring instrument or store new data there. Because it relies on serial data transfer, only 4 signal lines are needed. Data is transferred synchronously to the clock signal defined by the subsequent electronics. The type of transfer used (e.g. for position values, parameters, diagnostics, etc.) is selected using mode commands sent to the measuring instrument by the subsequent electronics.

## EnDat 2.2 encoders - Technical data

| | Encoder type / Order code (ee) | | |
|---|---|---|---|
| | **B1** | **B8** | **B9** |
| Operating principle | Inductive | | |
| EnDat protocol | EnDat 2.2 | | |
| Single-turn / Multi-turn | M | S | M |
| Battery-backed | Yes | --- | |
| Revolutions | 65536 | 1 | 4096 |
| Resolution [bits single-turn / bits multi-turn] | 18/16 | 19/0 | 19/12 |
| Precision ["] | 120 | | |
| Switching frequency ≥ [kHz] | Digital pos. in the encoder | | |
| Vibration during operation - Stator Max [m/s2] | 300 | 400 | |
| Vibration during operation - Rotor Max [m/s2] | 300 | 600 | |
| Max. shock during operation [m/s2] | 1000 | 2000 | |
| Manufacturer's product ID | EBI 1135 | ECI 1119 FS | EQI 1131 FS |
| Manufacturer's website | www.heidenhain.de | | |

## 2.3 Motor options

Servo motors from the 8LV series are available in different variants depending on the customer's requirements:

- With various motor encoders
- With various nominal speeds
- Available with double angular built-in connector or single-cable solution (hybrid)
- With or without an oil seal
- With or without a holding brake
- Keyed or smooth shaft end

### 2.3.1 Motor encoder (ee)

Encoders are listed as part of the model number in the form of a 2-digit code (**ee**).

| | Code for order key (ee) / Availability of motor encoders | | | |
|---|---|---|---|---|
| **Size/Length** | **R0** | **B1** | **B8** | **B9** |
| 8LVx**13** | Yes | Yes | --- | --- |
| 8LVx**22** | Yes | Yes | Yes | Yes |
| 8LVx**23** | Yes | Yes | Yes | Yes |
| 8LVx**33** | Yes | Yes | Yes | Yes |

### 2.3.2 Nominal speed (nnn)

The nominal speed is listed as part of the model number in the form of a 3-digit code (**nnn**). This code represents the nominal speed divided by 100 at 80 VDC operation. It begins with zero. The code "030" corresponds to a speed of 3000 rpm.

| | Available nominal speeds $n_N$ [rpm] at 80 VDC operation | | | | |
|---|---|---|---|---|---|
| | **500** | **950** | **1500** | **2100** | **3000** |
| | Code for order key (nnn) | | | | |
| **Size/Length** | **005** | **A95** | **015** | **021** | **030** |
| 8LVA**13** | --- | --- | Yes | --- | Yes |
| 8LVA**22** | --- | --- | Yes | --- | Yes |
| 8LVA**23** | --- | Yes | Yes | --- | Yes |
| 8LVA**33** | Yes | --- | Yes | Yes | --- |

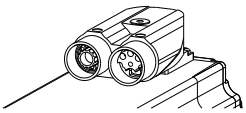
### 2.3.3 Connection, oil seal, holding brake and shaft end (ff)

For the corresponding code (**ff**) for the order key, see the following table:

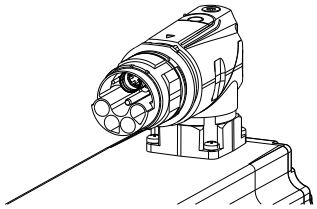
| **Code for order key (ff)** | **Available for size** | **Motor options** | | | |
|---|---|---|---|---|---|
| | | **Connection (300° stepless rotation)** | **Oil seal** | **Holding brake** | **Shaft end** |
| D0 | 1, 2, 3 | Double angular built-in connector | --- | --- | Smooth |
| D1 | 2, 3 | Double angular built-in connector | --- | --- | With key |
| D2 | 1, 2, 3 | Double angular built-in connector | --- | Yes | Smooth |
| D3 | 2, 3 | Double angular built-in connector | --- | Yes | With key |
| D6 | 1, 2, 3 | Double angular built-in connector | Yes | --- | Smooth |
| D7 | 2, 3 | Double angular built-in connector | Yes | --- | With key |
| D8 | 1, 2, 3 | Double angular built-in connector | Yes | Yes | Smooth |
| D9 | 2, 3 | Double angular built-in connector | Yes | Yes | With key |
| S0 | 2, 3 | Single-cable solution (hybrid) | --- | --- | Smooth |
| S1 | 2, 3 | Single-cable solution (hybrid) | --- | --- | With key |
| S2 | 2, 3 | Single-cable solution (hybrid) | --- | Yes | Smooth |
| S3 | 2, 3 | Single-cable solution (hybrid) | --- | Yes | With key |
| S6 | 2, 3 | Single-cable solution (hybrid) | Yes | --- | Smooth |
| S7 | 2, 3 | Single-cable solution (hybrid) | Yes | --- | With key |
| S8 | 2, 3 | Single-cable solution (hybrid) | Yes | Yes | Smooth |
| S9 | 2, 3 | Single-cable solution (hybrid) | Yes | Yes | With key |

### 2.3.4 Connection

In addition to the standard connection (double angular built-in connector), the single-cable solution (hybrid) is also available.



Double angular built-in connector



Single-cable solution

For information about possible combinations, see the previous table.

see "Motor options table" on page 14

### 2.3.5 Oil seal

The 8LV servo motors in sizes 2 and 3 are available with an optional Form A oil seal in accordance with DIN 3760. When equipped with an oil seal, the motors have IP65 protection in accordance with EN 60034-5.

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

### 2.3.6 Holding brake

Motors in the 8LV series can be delivered with a holding brake. It is used to hold the motor shaft when no power is applied to the motor.

**Operating principle**

The holding brake is controlled by the ACOPOS servo drive. It uses permanent magnets that are demagnetized when 24 VDC is applied to a magnet winding. This releases the brake.

This brake is designed as a holding brake and is not permitted to be used for operational braking! Under these conditions, the brake has a service life of approximately 5,000,000 switching cycles (opening and closing the brake is one cycle).

Loaded braking during an emergency stop is permitted but reduces its service life. The required brake holding torque is determined based on the actual load torque. It is recommended to take into account a safety factor of 2 for the load torque.

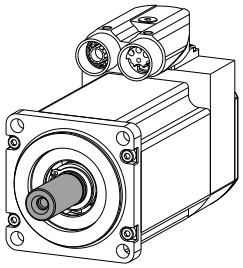
**Technical data for the standard holding brake**

| | Motor size | | |
|---|---|---|---|
| | **1** | **2** | **3** |
| Holding torque $M_{Br}$ [Nm] | 0.35 | 2.2 | 3.2 |
| Connected load $P_{On}$ [W] | 8 | 8.4 | 13.4 |
| Maximum speed nmax [rpm] | 6000 | 12000 | 12000 |
| Supply current $I_{On}$ [A] | 0.33 | 0.35 | 0.56 |
| Supply voltage $U_{On}$ [V] | 24 VDC +6% / -10% | 24 VDC +6% / -10% | 24 VDC +6% / -10% |
| Moment of inertia $J_{Br}$ [kgcm²] | 0.013 | 0.07 | 0.38 |
| Mass $m_{Br}$ [kg] | 0.1 | 0.16 | 0.29 |

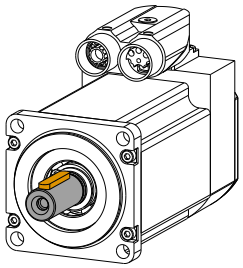
### 2.3.7 Design of the shaft end

All 8LV servo motor shafts comply with DIN 748. They can be delivered with a smooth shaft or a keyed shaft (depending on motor size).

**Smooth shaft end**
A smooth shaft end is used for a force-fit shaft-hub connection and guarantees a back-lash-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 for the servo motors in this series conform to keyway form N1 in accordance with 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 in accordance with 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.



## 2.4 8LVA - Order key

### Order key

| 8LV | b | c | d | . | ee | nnn | ff | gg | - | h |
|---|---|---|---|---|---|---|---|---|---|---|

**Cooling type/ construction** (see section "cooling types")

**A**...Self cooled

**Sizes** (See section "Sizes")
Valid values: **1,2,3**

**Lengths** (See section "Lengths")
Valid values: **2,3**

**Encoder system** (See section "Motor encoder systems")

**R0**...Resolver
**B1**...Endat 2.2 Multiturn, 16 - lines
**B8**...Endat 2.2 Singleturn (Size 2 and 3 only)
**B9**...Endat 2.2 Multiturn (Size 2 and 3 only)

**Nominal speed** (See section "Nominal speed")

**005**...500 rpm
**A95**...950 rpm
**015**...1500 rpm
**020**...2000 rpm (corresponds to 2100 rpm)
**030**...3000 rpm

**Motor options** (See section "Connection type, Oil seal, Holding brake, Shaft end")

Connection type:
**Df**...angled swivel connector
**Sf**...angled single-cable solution (hybrid)

Valid values: **D1, S0, S9**

**Special motor options**

**00**...No special motor options

**Motor version:** Valid value: **0** (value assigned automatically and cannot be chosen freely)

**Additional motor options or special motor options must be arranged with B&R**

### 2.4.1 Example order 1

A three-phase synchronous motor of type **8LVA22** 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 encoder.

The (ee) code for the encoder system is **B1**.

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

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

The model number for the required motor is therefore **8LVA22.B1030S300-0**.

### 2.4.2 Example order 2

A three-phase synchronous motor of type **8LVA33** with a nominal speed of 1500 rpm has been selected for an application.

The connection should use a double angled built-in 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 1500 rpm is **015**.

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

The model number for the required motor is therefore **8LVA33.R0015D600-0**.

# 2.5 General motor data

| General information | Cooling type A |
|---|---|
| CE certification | Yes |
| C-UR-US listed | Yes |
| UL file number | PRHZ2.E235396 |

| Electrical characteristics | |
|---|---|
| DC bus voltage on the ACOPOSmicro | 80VDC [1] |
| Conventional connection type (power connection / encoder connection) | ytec circular connector from Intercontec |
| Connection type - Single-cable solution (hybrid) | htec circular connector from Intercontec |

| Thermal characteristics | |
|---|---|
| Insulation class in accordance with EN 60034-1 | F |
| Methods of cooling in accordance with EN 60034-6 (IC code) | Self-cooling, no separate surface cooling (IC4A0A0) |
| Thermal motor protection in accordance with EN 60034-11 | Size 1: No, size 2 and 3: KTY 83-110<br>Maximum winding temperature 155°C (limited by the thermal motor protection in the ACOPOSmicro drive system to 110°C with EnDat feedback and 130°C with resolver feedback) |

| Mechanical characteristics | |
|---|---|
| Roller bearing, dynamic load ratings and nominal service life | Based on DIN ISO 281 |
| Shaft end in accordance with DIN 748 | Form E |
| Oil seal in accordance with DIN 3760 | Form A |
| Key and keyway in accordance with DIN 6885-1 | Form A keys, form N1 keyway |
| Balancing the shaft in accordance with ISO 1940/1, G6.3 | Half-key arrangement |
| Mounting flange | IEC 72-1 |
| Smooth rotation of shaft end, coaxial properties and mounting flange plane in accordance with DIN 42955 | Tolerance R |
| Coating<br>Color | Water-based coating<br>RAL 9005 flat |

| Operating conditions | |
|---|---|
| Rating class, operating mode in accordance with 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 the nominal current and stall current at installation elevations starting at 1000 m above sea level | 10% per 1000 m |
| Maximum installation elevation | 2000 m [3] |
| Max. flange temperature | 65°C |
| EN 60034-5 protection (IP code)<br>With optional oil seal | IP54 [4]<br>IP65 [4] [5] |
| Construction and mounting arrangement type in accordance with EN 60034-7 (IM code) | Horizontal (IM3001)<br>Vertical, motor hangs on the machine (IM3011)<br>Vertical, motor stands on the machine (IM3031) |

| Storage and transport conditions | |
|---|---|
| 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 |

## 2.5.1 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 n0 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. |

[1] Permitted DC bus voltage on the ACOPOS single-phase: 320 VDC
[2] Continuous operation at ambient temperatures ranging from +40°C to max. +50°C is possible, but this will result in a shorter service life.
[3] Requirements that go beyond this must be arranged with B&R.
[4] The protection ratings are only achieved if the power and signal connections are installed properly.
[4] The protection ratings are only achieved if the power and signal connections are installed properly.
[5] Only available for size 2 and 3!

| Term | Symbol | Unit | Description |
|---|---|---|---|
| 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/s² | Maximum acceleration of the motor without a load or brake. Value for the dynamics of the motor (corresponds to Mmax/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 | kgcm² | Moment of inertia for a motor without holding brake |
| Ground | m | kg | Mass of motor without holding brake |

## 2.5.2 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 |
|---|---|---|
| 8LVx1, 8LVx2, 8LVx3 | 250x250x6 | Aluminum |

# 2.6 8LVA standard motors

The 8LVA series includes a selection of sizes and options that represent preferred types (standard motors). These standard motors feature an unbeatable price/performance ratio and much faster delivery times. If necessary, these motors can be ready on short notice and dispatched using express delivery. The following standard motors are available:

- With high-precision inductive encoders or resolvers
- With oil seal only
- With or without holding brake[1)]
- With smooth shaft only

1) Motors with order code 8LVAcd.eennn**D0**gg-0 are not equipped with a holding brake. Order code 8LVAcd.eennn**D2**gg-0 is used for motors with a holding brake.

### Size 1, 2 and 3 - Technical data

| Model number | 8LVA13. B1030D000-0 | 8LVA13. B1030D200-0 | 8LVA23. B1030D000-0 | 8LVA23. B1030D200-0 | 8LVA33. B1021D000-0 | 8LVA33. B1021D200-0 |
|---|---|---|---|---|---|---|
| **Motor** | | | | | | |
| Nominal speed $n_N$ [rpm] | 3000 | | | | 2100 | |
| Number of pole pairs | 4 | | | | | |
| Nominal torque $M_n$ [Nm] | 0.32 | | 1.3 | | 2.45 | |
| Nominal power $P_N$ [W] | 101 | | 408 | | 539 | |
| Nominal current $I_N$ [A] | 1.4 | | 5.8 | | 7.3 | |
| Stall torque $M_0$ [Nm] | 0.36 | | 1.35 | | 2.6 | |
| Stall current $I_0$ [A] | 1.6 | | 6 | | 7.9 | |
| Maximum torque $M_{max}$ [Nm] | 1 | | 4 | | 7.2 | |
| Maximum current $I_{max}$ [A] | 5.2 | | 20.7 | | 26 | |
| Maximum speed $n_{max}$ [rpm] | 6600 | | | | | |
| Torque constant $K_T$ [Nm/A] | 0.23 | | | | 0.33 | |
| Voltage constant $K_E$ [V/1000 rpm] | 13.61 | | | | 19.9 | |
| Stator resistance $R_{2ph}$ [Ω] | 5.8 | | 0.83 | | 0.503 | |
| Stator inductance $L_{2ph}$ [mH] | 10.2 | | 2 | | | |
| Electrical time constant $t_{el}$ [ms] | 1.8 | | 2.4 | | 4 | |
| Thermal time constant $t_{therm}$ [min] | 15 | | 38 | | 34 | |
| Moment of inertia J [kgcm²] | 0.03 | | 0.26 | | 0.95 | |
| Mass without brake m [kg] | 0.6 | | 1.45 | | 2.45 | |
| **Holding brake** | | | | | | |
| Holding torque of the brake $M_{Br}$ [Nm] | 0.35 | | 2.2 | | 3.2 | |
| Brake mass [kg] | 0.1 | | 0.25 | | 0.57 | |
| Moment of inertia for the brake $J_{Br}$ [kgcm²] | 0.013 | | 0.12 | | 0.38 | |
| **Recommendations** | | | | | | |
| ACOPOS 8Vxxxx.xx... | 1010.50 | | 1090 | | | |
| ACOPOS P3 8EI... | 2X2M | | 8X8M | | | |
| ACOPOSmicro 80VD100Px.xxxx-01 | C000,C00X | C000, C00X | | | | |
| Cross section for B&R motor cables [mm²] | 0.75 | | | | | |
| Connector size | 1.0 | | | | | |
| **Options** | | | | | | |
| Connection type | Male connector | | | | | |
| Connection direction | Angled (swivel connector) | | | | | |
| Encoder | B1 2.2 Bat inductive 16-line 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).
**ACOPOS missing information:**The DC bus voltage must be reduced in order to operate this device with an ACOPOS drive (max. 325 VDC).
**ACOPOSmulti:**Operating this device with ACOPOSmulti inverter module is not possible due to the high DC bus voltage when powered from the mains.

**NOTE cable:** The suitable cables can be found in the catalog (Book 1) chapter ACOPOSmicro servo drive.

# 2.7 8LVA1/8LVA2 - Product overview

## Size 1 and 2

| Model number | 8LVA13. ee015ffgg-0 | 8LVA13. ee030ffgg-0 | 8LVA22. ee015ffgg-0 | 8LVA22. ee030ffgg-0 | 8LVA23. eeA95ffgg-0 | 8LVA23. ee015ffgg-0 | 8LVA23. ee030ffgg-0 |
|---|---|---|---|---|---|---|---|
| **Motor** | | | | | | | |
| Nominal speed $n_N$ [rpm] | 1500 | 3000 | 1500 | 3000 | 950 | 1500 | 3000 |
| Number of pole pairs | 4 | | | | | | |
| Nominal torque $M_n$ [Nm] | 0.34 | 0.32 | 0.67 | 0.65 | 1.33 | | 1.3 |
| Nominal power $P_N$ [W] | 53 | 101 | 105 | 204 | 132 | 209 | 408 |
| Nominal current $I_N$ [A] | 0.8 | 1.4 | 1.61 | 2.9 | 2.02 | 3.2 | 5.8 |
| Stall torque $M_0$ [Nm] | 0.36 | | 0.68 | | | 1.35 | |
| Stall current $I_0$ [A] | 0.9 | 1.6 | 1.64 | 3 | 2.05 | 3.25 | 6 |
| Maximum torque $M_{max}$ [Nm] | 1 | | 2 | | | 4 | |
| Maximum current $I_{max}$ [A] | 2.8 | 5.2 | 5.6 | 10.3 | 7.8 | 11.2 | 20.7 |
| Maximum speed $n_{max}$ [rpm] | 6600 | | | | | | |
| Torque constant $K_T$ [Nm/A] | 0.42 | 0.23 | 0.42 | 0.23 | 0.66 | 0.42 | 0.23 |
| Voltage constant $K_E$ [V/1000 rpm] | 25.13 | 13.61 | 25.13 | 13.61 | 39.79 | 25.13 | 13.61 |
| Stator resistance $R_{2ph}$ [Ω] | 17.4 | 5.8 | 6.02 | 2 | 6.36 | 2.6 | 0.83 |
| Stator inductance $L_{2ph}$ [mH] | 30.7 | 10.2 | 12.2 | 4.1 | 15.3 | 6.3 | 2 |
| Electrical time constant $t_{el}$ [ms] | 1.8 | | 2 | 2.1 | | 2.4 | |
| Thermal time constant $t_{therm}$ [min] | 15 | | 35 | | | 38 | |
| Moment of inertia J [kgcm²] | 0.03 | | 0.14 | | | 0.26 | |
| Mass without brake m [kg] | 0.6 | | 1.05 | | | 1.45 | |
| **Holding brake** | | | | | | | |
| Holding torque of the brake $M_{Br}$ [Nm] | 0.35 | | | | 2.2 | | |
| Brake mass [kg] | 0.1 | | 0.29 | | | 0.25 | |
| Moment of inertia for the brake $J_{Br}$ [kgcm²] | 0.013 | | | | 0.12 | | |
| **Recommendations** | | | | | | | |
| ACOPOS 8Vxxxx.xx... | 1010.50 | | | 1016.50 | 1010.50 | 1016.50 | 1090 |
| ACOPOS P3 8EI... | 2X2M | | | | 4X5M | | 8X8M |
| ACOPOSmicro 80VD100Px.xxxx-01 | C0XX | | | | | | |
| Cross section for B&R motor cables [mm²] | 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).
**ACOPOS missing information:**The DC bus voltage must be reduced in order to operate this device with an ACOPOS drive (max. 325 VDC).
**ACOPOSmulti:**Operating this device with ACOPOSmulti inverter module is not possible due to the high DC bus voltage when powered from the mains.

**NOTE cable:** The suitable cables can be found in the catalog (Book 1) chapter ACOPOSmicro servo drive.

# 2.8 8LVA3 - Product overview

## Size 3

| Model number | 8LVA33.ee005ffee-0 | 8LVA33.ee015ffgg-0 | 8LVA33.ee021ffgg-0 |
|---|---|---|---|
| **Motor** | | | |
| Nominal speed $n_N$ [rpm] | 500 | 1500 | 2100 |
| Number of pole pairs | | 4 | |
| Nominal torque $M_n$ [Nm] | 2.4 | 2.5 | 2.45 |
| Nominal power $P_N$ [W] | 126 | 393 | 539 |
| Nominal current $I_N$ [A] | 2 | 6 | 7.3 |
| Stall torque $M_0$ [Nm] | | 2.6 | |
| Stall current $I_0$ [A] | 2.2 | 6.3 | 7.9 |
| Maximum torque $M_{max}$ [Nm] | | 7.2 | |
| Maximum current $I_{max}$ [A] | 7.6 | 20.4 | 26 |
| Maximum speed $n_{max}$ [rpm] | | 6600 | |
| Torque constant $K_T$ [Nm/A] | 1.18 | 0.42 | 0.33 |
| Voltage constant $K_E$ [V/1000 rpm] | 71.21 | 25.13 | 19.9 |
| Stator resistance $R_{2ph}$ [Ω] | 6.24 | 0.808 | 0.503 |
| Stator inductance $L_{2ph}$ [mH] | 24.12 | 3.3 | 2 |
| Electrical time constant $t_{el}$ [ms] | 3.9 | 4.1 | 4 |
| Thermal time constant $t_{therm}$ [min] | | 34 | |
| Moment of inertia J [kgcm²] | | 0.95 | |
| Mass without brake m [kg] | | 2.45 | |
| **Holding brake** | | | |
| Holding torque of the brake $M_{Br}$ [Nm] | 2.2 | 3.2 | |
| Brake mass [kg] | | 0.57 | |
| Moment of inertia for the brake $J_{Br}$ [kgcm²] | 0.12 | 0.38 | |
| **Recommendations** | | | |
| ACOPOS 8Vxxxx.xx... | 1016.50 | 1090 | |
| ACOPOS P3 8EI... | 4X5M | 8X8M | |
| ACOPOSmicro 80VD100Px.xxxx-01 | | C0XX | |
| Cross section for B&R motor cables [mm²] | | 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).
**ACOPOS missing information:**The DC bus voltage must be reduced in order to operate this device with an ACOPOS drive (max. 325 VDC).
**ACOPOSmulti:**Operating this device with ACOPOSmulti inverter module is not possible due to the high DC bus voltage when powered from the mains.

**NOTE cable:** The suitable cables can be found in the catalog (Book 1) chapter ACOPOSmicro servo drive.

# 2.9 8LVA1 - Technical data

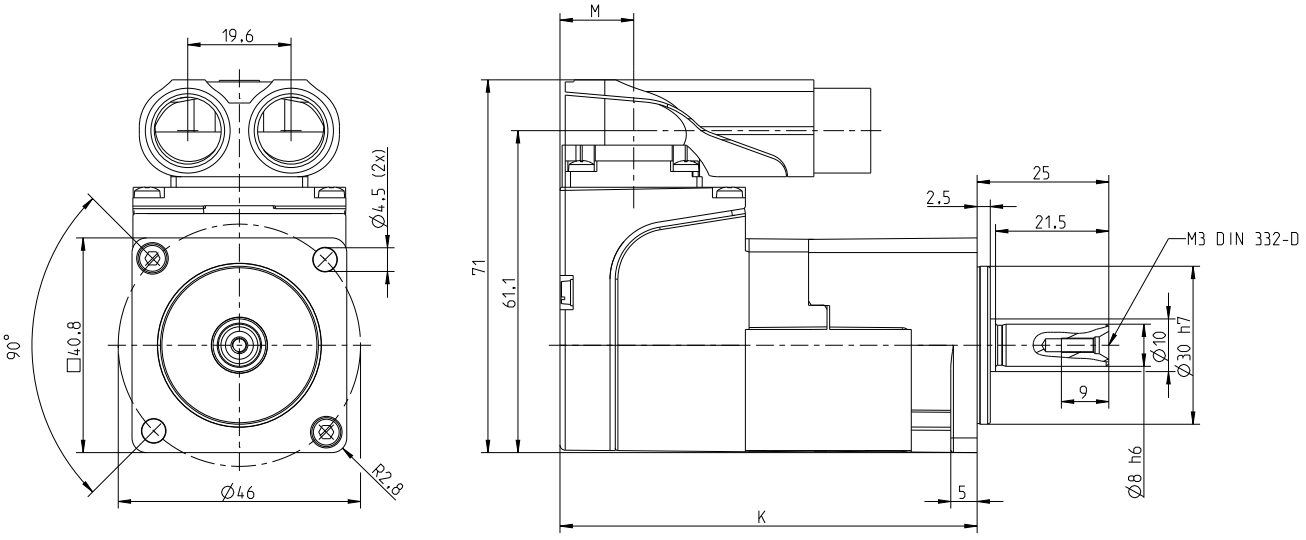
## Size 1

| Model number | 8LVA13.ee015ffgg-0 | 8LVA13.ee030ffgg-0 |
|---|---|---|
| **Motor** | | |
| Nominal speed $n_N$ [rpm] | 1500 | 3000 |
| Number of pole pairs | 4 | |
| Nominal torque $M_n$ [Nm] | 0.34 | 0.32 |
| Nominal power $P_N$ [W] | 53 | 101 |
| Nominal current $I_N$ [A] | 0.8 | 1.4 |
| Stall torque $M_0$ [Nm] | 0.36 | |
| Stall current $I_0$ [A] | 0.9 | 1.6 |
| Maximum torque $M_{max}$ [Nm] | 1 | |
| Maximum current $I_{max}$ [A] | 2.8 | 5.2 |
| Maximum speed $n_{max}$ [rpm] | 6600 | |
| Torque constant $K_T$ [Nm/A] | 0.42 | 0.23 |
| Voltage constant $K_E$ [V/1000 rpm] | 25.13 | 13.61 |
| Stator resistance $R_{2ph}$ [Ω] | 17.4 | 5.8 |
| Stator inductance $L_{2ph}$ [mH] | 30.7 | 10.2 |
| Electrical time constant $t_{el}$ [ms] | 1.8 | |
| Thermal time constant $t_{therm}$ [min] | 15 | |
| Moment of inertia J [kgcm²] | 0.03 | |
| Mass without brake m [kg] | 0.6 | |
| **Holding brake** | | |
| Holding torque of the brake $M_{Br}$ [Nm] | 0.35 | |
| Brake mass [kg] | 0.1 | |
| Moment of inertia for the brake $J_{Br}$ [kgcm²] | 0.013 | |
| **Recommendations** | | |
| ACOPOS 8Vxxxx.xx... | 1010.50 | |
| ACOPOS P3 8EI... | 2X2M | |
| ACOPOSmicro 80VD100Px.xxxx-01 | C0XX | |
| Cross section for B&R motor cables [mm²] | 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).
**ACOPOS missing information:**The DC bus voltage must be reduced in order to operate this device with an ACOPOS drive (max. 325 VDC).
**ACOPOSmulti:**Operating this device with ACOPOSmulti inverter module is not possible due to the high DC bus voltage when powered from the mains.

**NOTE cable:** The suitable cables can be found in the catalog (Book 1) chapter ACOPOSmicro servo drive.

## 2.9.1 8LVA13 - Dimensions

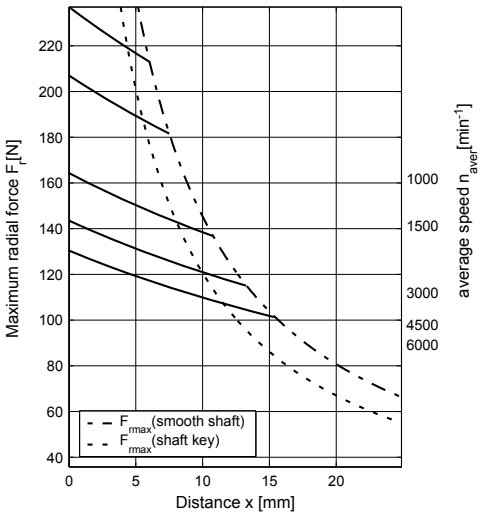



**Double angular built-in connector**

| EnDat/Resolver feedback | | | Extension of K depending on motor option |
|---|---|---|---|
| | K | M | Holding brake |
| **Encoder assignments** | **R0, B1** | **R0, B1** | |
| 8LVA13 | 79.5 | 14 | 28 |

## 2.9.2 Maximum shaft load

The values in the diagram below are based on a mechanical service life of the bearings of 20,000 operating hours.




maximum allowed axial force: $F_{amax}$ = 22 N

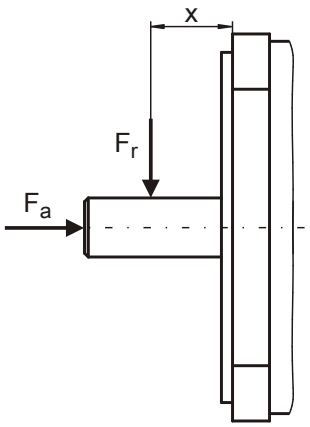
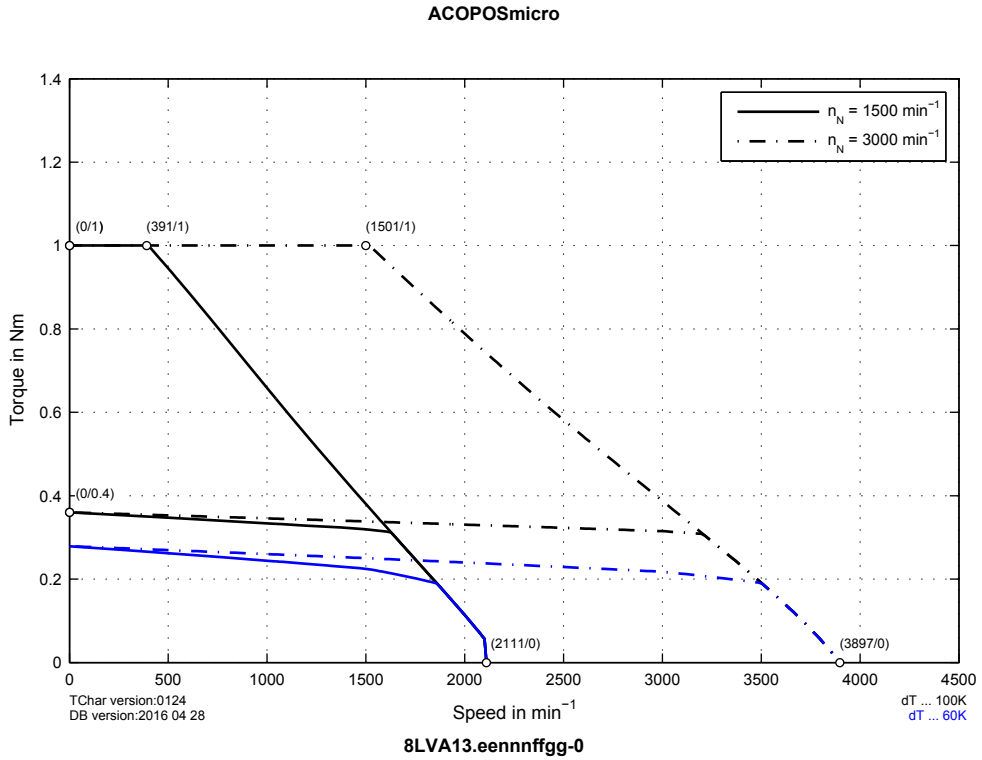


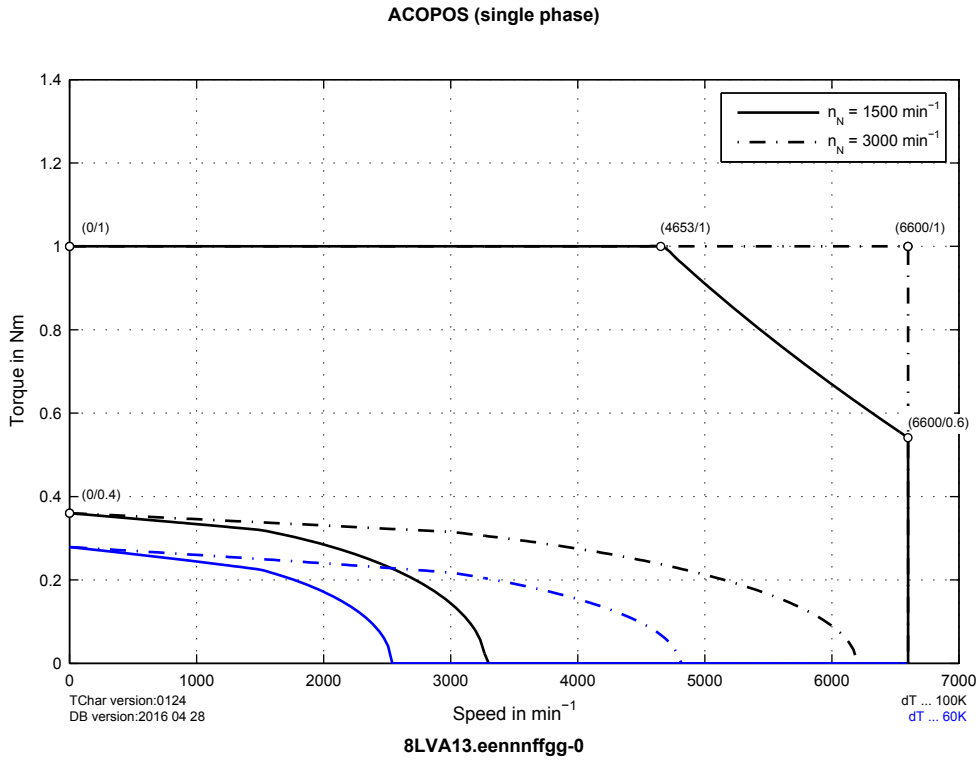

Figure 1: Definition of shaft load

$F_r$..... Radial force
$F_a$..... Axial force
x..... Distance between the motor flange and the point where radial force $F_r$ is applied

## 2.9.3 Speed-Torque characteristic curve at 80 VDC DC bus voltage



## 2.9.4 Speed-Torque characteristic curve at 325 VDC DC bus voltage



# 2.10 8LVA2 - Technical data

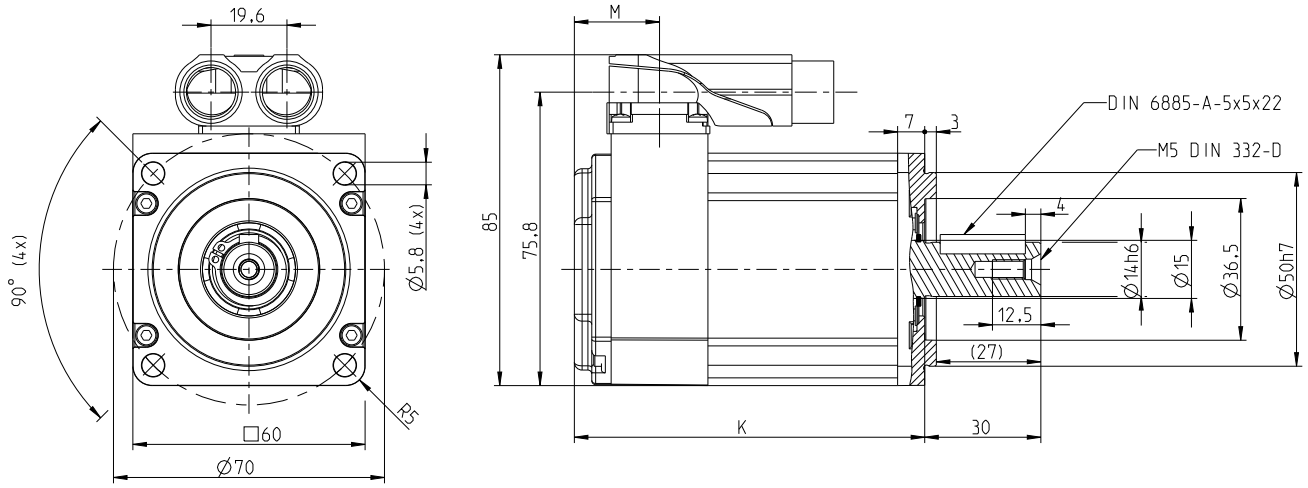
### Size 2

| Model number | 8LVA22.ee015ffgg-0 | 8LVA22.ee030ffgg-0 | 8LVA23.eeA95ffgg-0 | 8LVA23.ee015ffgg-0 | 8LVA23.ee030ffgg-0 |
|---|---|---|---|---|---|
| **Motor** | | | | | |
| Nominal speed $n_N$ [rpm] | 1500 | 3000 | 950 | 1500 | 3000 |
| Number of pole pairs | 4 | | | | |
| Nominal torque $M_n$ [Nm] | 0.67 | 0.65 | 1.33 | | 1.3 |
| Nominal power $P_N$ [W] | 105 | 204 | 132 | 209 | 408 |
| Nominal current $I_N$ [A] | 1.61 | 2.9 | 2.02 | 3.2 | 5.8 |
| Stall torque $M_0$ [Nm] | 0.68 | | 1.35 | | |
| Stall current $I_0$ [A] | 1.64 | 3 | 2.05 | 3.25 | 6 |
| Maximum torque $M_{max}$ [Nm] | 2 | | 4 | | |
| Maximum current $I_{max}$ [A] | 5.6 | 10.3 | 7.8 | 11.2 | 20.7 |
| Maximum speed $n_{max}$ [rpm] | 6600 | | | | |
| Torque constant $K_T$ [Nm/A] | 0.42 | 0.23 | 0.66 | 0.42 | 0.23 |
| Voltage constant $K_E$ [V/1000 rpm] | 25.13 | 13.61 | 39.79 | 25.13 | 13.61 |
| Stator resistance $R_{2ph}$ [Ω] | 6.02 | 2 | 6.36 | 2.6 | 0.83 |
| Stator inductance $L_{2ph}$ [mH] | 12.2 | 4.1 | 15.3 | 6.3 | 2 |
| Electrical time constant $t_{el}$ [ms] | 2 | 2.1 | | 2.4 | |
| Thermal time constant $t_{therm}$ [min] | 35 | | | 38 | |
| Moment of inertia J [kgcm²] | 0.14 | | | 0.26 | |
| Mass without brake m [kg] | 1.05 | | | 1.45 | |
| **Holding brake** | | | | | |
| Holding torque of the brake $M_{Br}$ [Nm] | 2.2 | | | | |
| Brake mass [kg] | 0.29 | | | 0.25 | |
| Moment of inertia for the brake $J_{Br}$ [kgcm²] | 0.12 | | | | |
| **Recommendations** | | | | | |
| ACOPOS 8Vxxxx.xx... | 1010.50 | 1016.50 | 1010.50 | 1016.50 | 1090 |
| ACOPOS P3 8EI... | 2X2M | | 4X5M | | 8X8M |
| ACOPOSmicro 80VD100Px.xxxx-01 | C0XX | | | | |
| Cross section for B&R motor cables [mm²] | 0.75 | | | | |
| Connector size | 1.0 | | | | |

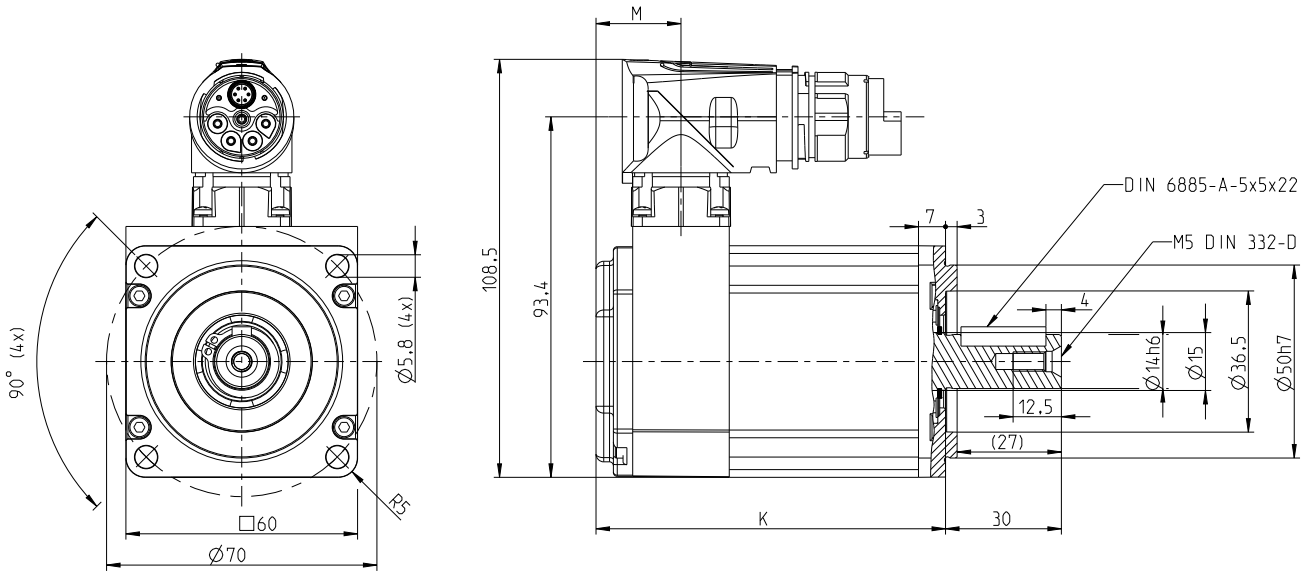
**Servo drive:** The recommended servo drive / inverter module is designed for 1.1x the stall current. If more than double the amount is needed during the acceleration phase, the next larger servo drive should be selected. This recommendation is only a guideline; detailed inspection of the corresponding speed/torque characteristic curve can result in deviations of the servo drive size (larger or smaller).
**ACOPOS missing information:**The DC bus voltage must be reduced in order to operate this device with an ACOPOS drive (max. 325 VDC).
**ACOPOSmulti:**Operating this device with ACOPOSmulti inverter module is not possible due to the high DC bus voltage when powered from the mains.

**NOTE cable:** The suitable cables can be found in the catalog (Book 1) chapter ACOPOSmicro servo drive.

## 2.10.1 8LVA2x - Dimensions




**Double angular built-in connector**



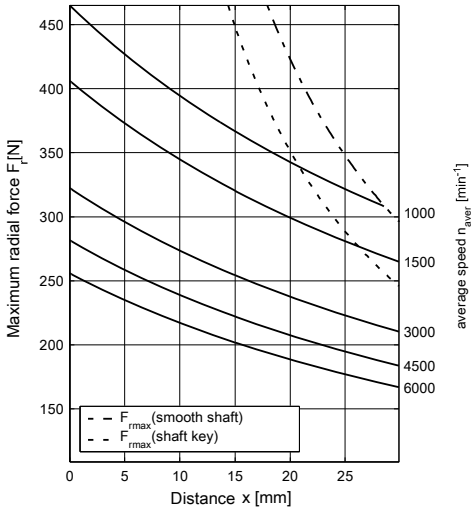

**Single-cable solution**

| EnDat/Resolver feedback | | | | | Extension of K depending on motor option | |
|---|---|---|---|---|---|---|
| | K | K | M | M | Holding brake | Oil seal |
| **Encoder assignments** | **R0, B1** | **B8, B9** | **R0, B1** | **B8, B9** | | |
| 8LVA22 | 85.5 | 90.5 | 17 | 22 | 33 | 7 |
| 8LVA23 | 106 | 111 | 17 | 22 | 33 | 7 |

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

## 2.10.2 Maximum shaft load

The values in the diagram below are based on a mechanical service life of the bearings of 20,000 operating hours.




maximum allowed axial force: $F_{amax}$ = 42 N

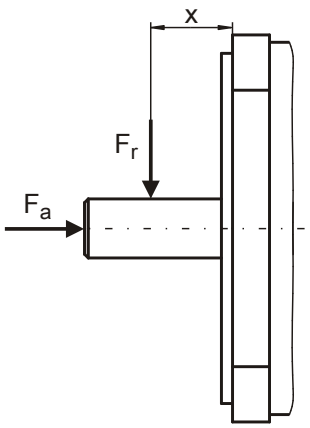
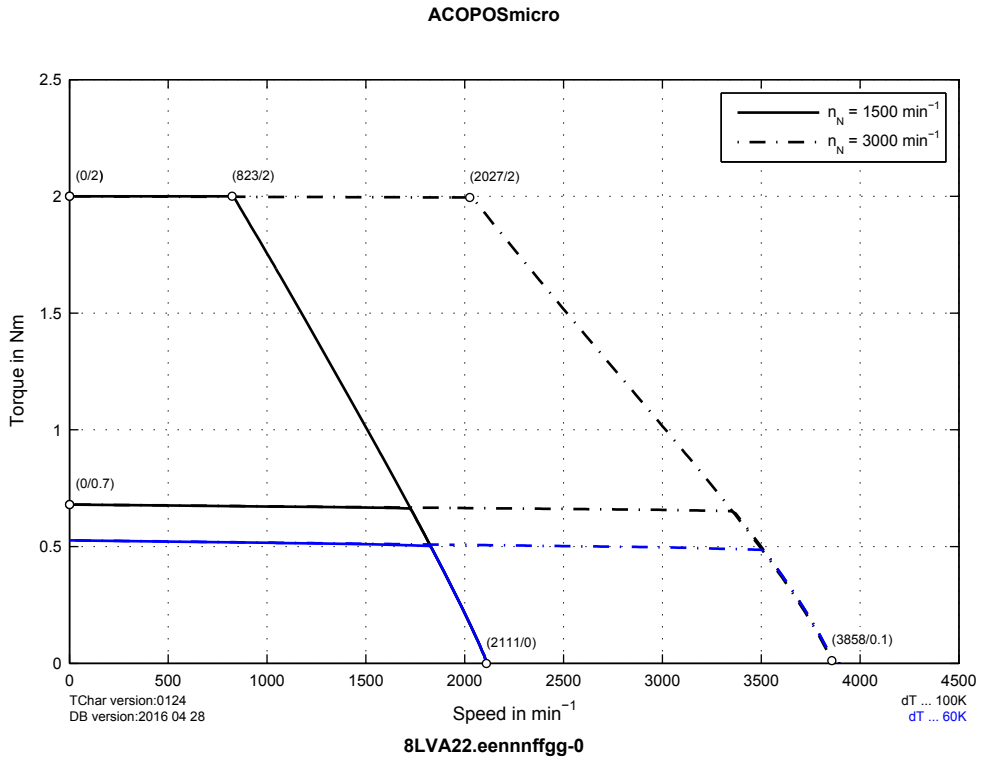
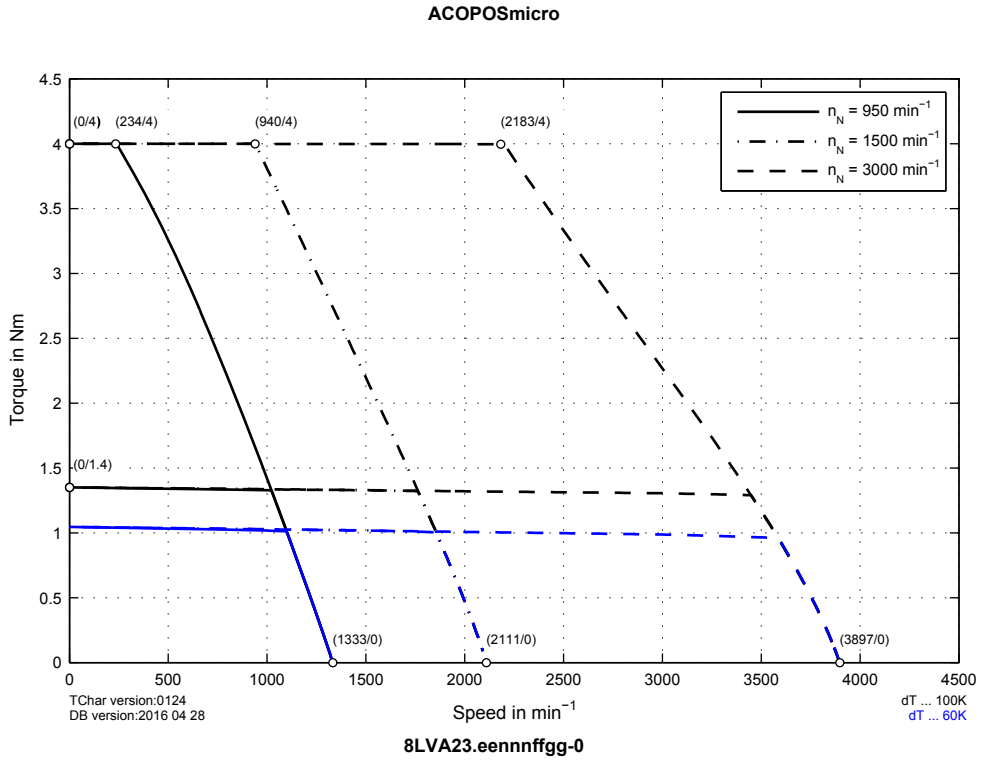



Figure 2: Definition of shaft load

$F_r$..... Radial force
$F_a$..... Axial force
x..... Distance between the motor flange and the point where radial force $F_r$ is applied

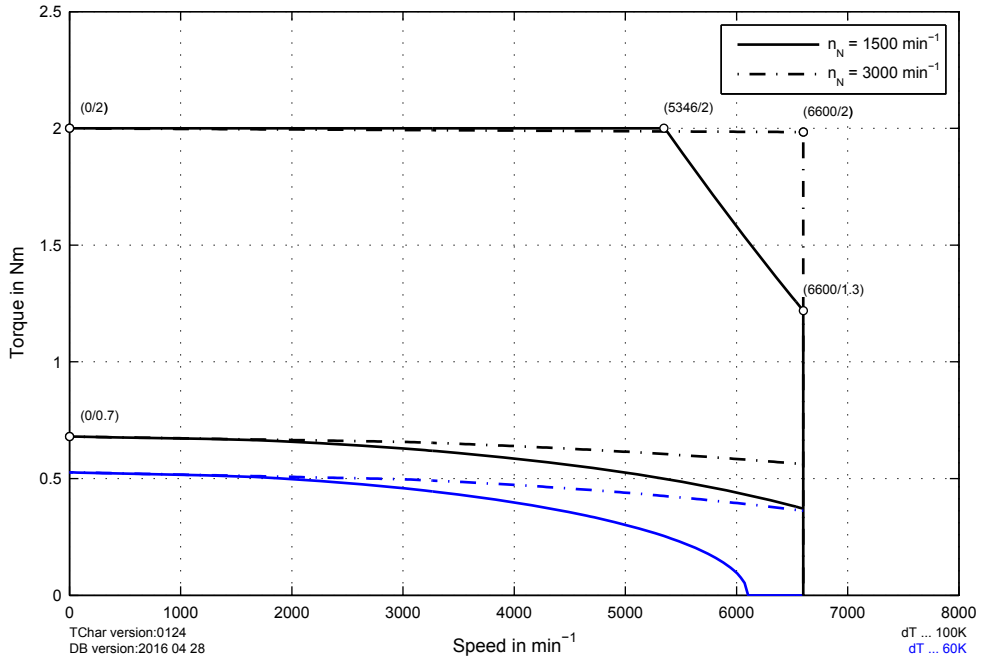
## 2.10.3 Speed-Torque characteristic curve at 80 VDC DC bus voltage



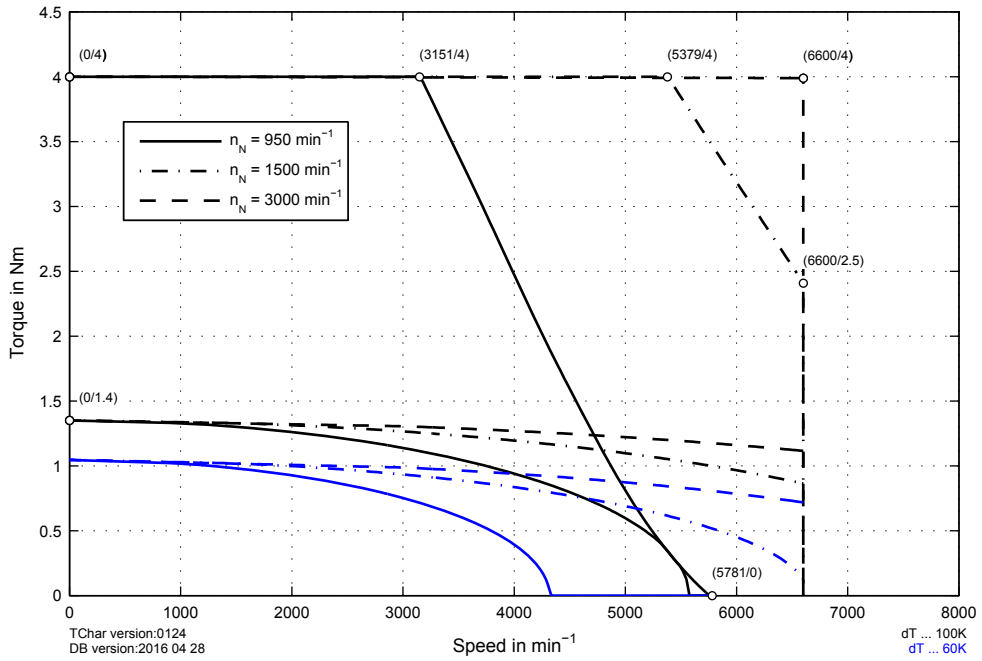
## 2.10.4 Speed-Torque characteristic curve at 325 VDC DC bus voltage

**ACOPOS (single phase)**




**8LVA22.eennnffgg-0**

**ACOPOS (single phase)**




**8LVA23.eennnffgg-0**

# 2.11 8LVA3 - Technical data

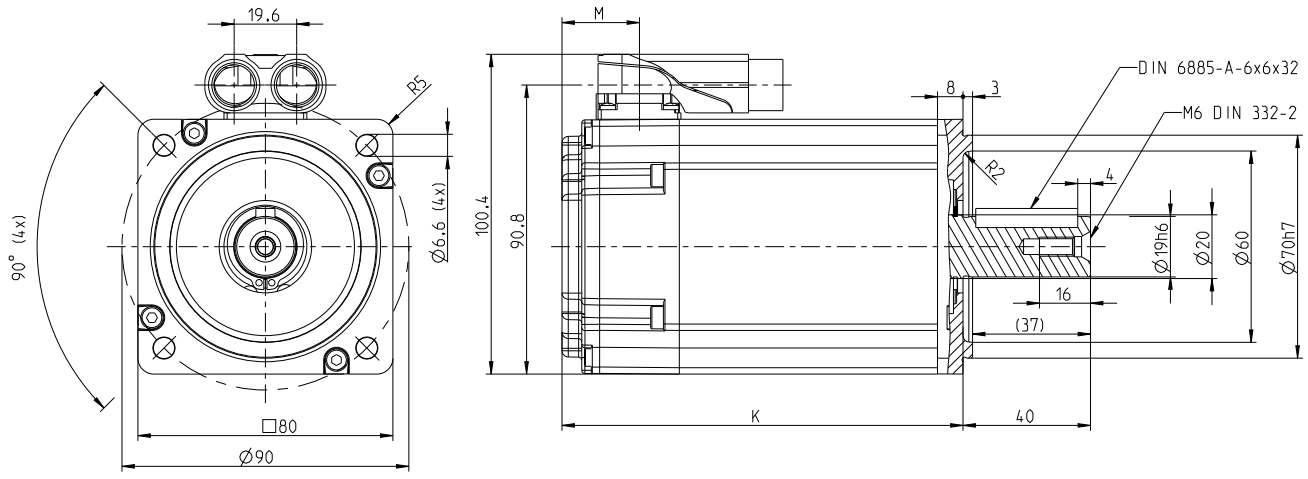
### Size 3

| Model number | 8LVA33.ee005ffee-0 | 8LVA33.ee015ffgg-0 | 8LVA33.ee021ffgg-0 |
|---|---|---|---|
| **Motor** | | | |
| Nominal speed $n_N$ [rpm] | 500 | 1500 | 2100 |
| Number of pole pairs | | 4 | |
| Nominal torque $M_n$ [Nm] | 2.4 | 2.5 | 2.45 |
| Nominal power $P_N$ [W] | 126 | 393 | 539 |
| Nominal current $I_N$ [A] | 2 | 6 | 7.3 |
| Stall torque $M_0$ [Nm] | | 2.6 | |
| Stall current $I_0$ [A] | 2.2 | 6.3 | 7.9 |
| Maximum torque $M_{max}$ [Nm] | | 7.2 | |
| Maximum current $I_{max}$ [A] | 7.6 | 20.4 | 26 |
| Maximum speed $n_{max}$ [rpm] | | 6600 | |
| Torque constant $K_T$ [Nm/A] | 1.18 | 0.42 | 0.33 |
| Voltage constant $K_E$ [V/1000 rpm] | 71.21 | 25.13 | 19.9 |
| Stator resistance $R_{2ph}$ [Ω] | 6.24 | 0.808 | 0.503 |
| Stator inductance $L_{2ph}$ [mH] | 24.12 | 3.3 | 2 |
| Electrical time constant $t_{el}$ [ms] | 3.9 | 4.1 | 4 |
| Thermal time constant $t_{therm}$ [min] | | 34 | |
| Moment of inertia J [kgcm²] | | 0.95 | |
| Mass without brake m [kg] | | 2.45 | |
| **Holding brake** | | | |
| Holding torque of the brake $M_{Br}$ [Nm] | 2.2 | 3.2 | |
| Brake mass [kg] | | 0.57 | |
| Moment of inertia for the brake $J_{Br}$ [kgcm²] | 0.12 | 0.38 | |
| **Recommendations** | | | |
| ACOPOS 8Vxxxx.xx... | 1016.50 | 1090 | |
| ACOPOS P3 8EI... | 4X5M | 8X8M | |
| ACOPOSmicro 80VD100Px.xxxx-01 | | C0XX | |
| Cross section for B&R motor cables [mm²] | | 0.75 | |
| Connector size | | 1.0 | |

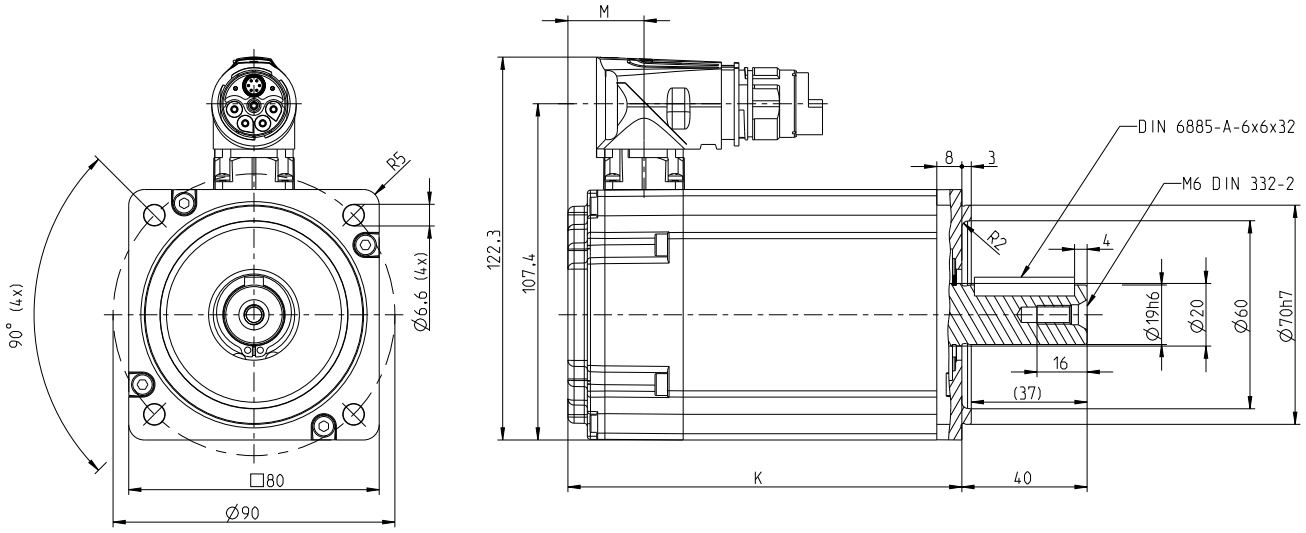
**Servo drive:** The recommended servo drive / inverter module is designed for 1.1x the stall current. If more than double the amount is needed during the acceleration phase, the next larger servo drive should be selected. This recommendation is only a guideline; detailed inspection of the corresponding speed/torque characteristic curve can result in deviations of the servo drive size (larger or smaller).
**ACOPOS missing information:**The DC bus voltage must be reduced in order to operate this device with an ACOPOS drive (max. 325 VDC).
**ACOPOSmulti:**Operating this device with ACOPOSmulti inverter module is not possible due to the high DC bus voltage when powered from the mains.

**NOTE cable:** The suitable cables can be found in the catalog (Book 1) chapter ACOPOSmicro servo drive.

## 2.11.1 8LVA33 - Dimensions




**Double angular built-in connector**



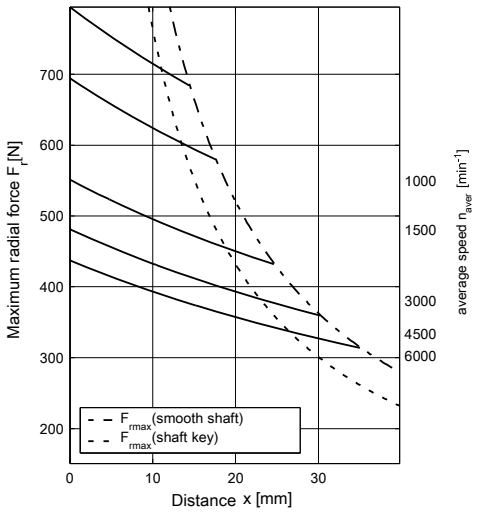

**Single-cable solution**

| EnDat/Resolver feedback | | | | | Extension of K depending on motor option | |
|---|---|---|---|---|---|---|
| **Model number** | **K** | **K** | **M** | **M** | **Holding brake** | **Oil seal** |
| **Encoder assignments** | **R0, B1** | **B8, B9** | **R0, B1** | **B8, B9** | | |
| 8LVA33 | 119 | 126 | 17.5 | 24.5 | 36 | 5 |

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

## 2.11.2 Maximum shaft load

The values in the diagram below are based on a mechanical service life of the bearings of 20,000 operating hours.




maximum allowed axial force: $F_{amax}$ = 75 N

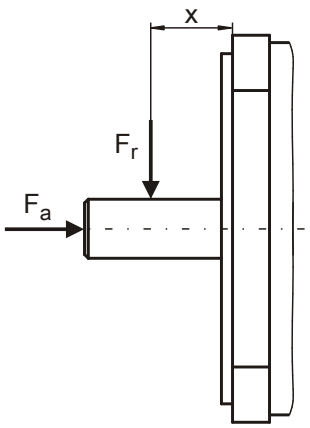
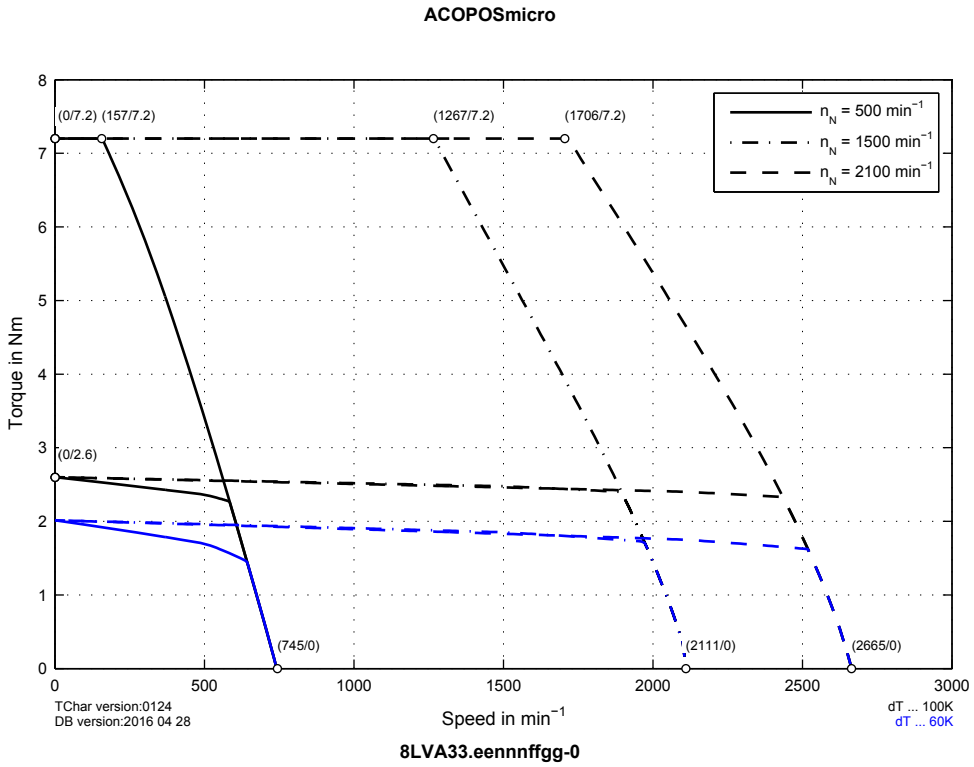


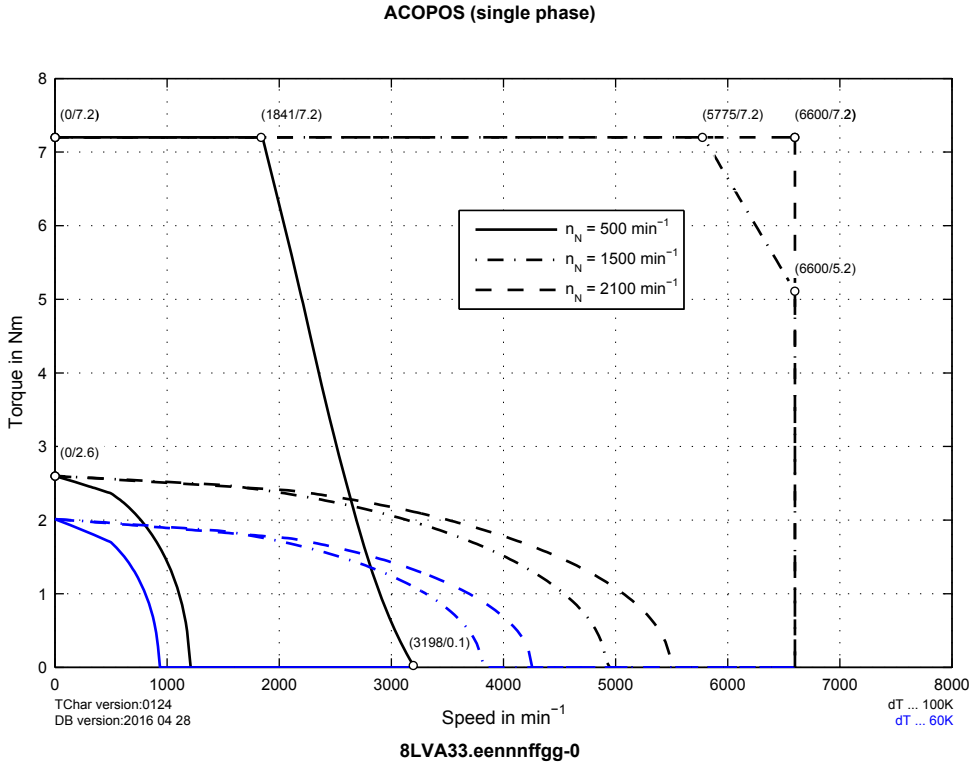

Figure 3: Definition of shaft load

$F_r$..... Radial force
$F_a$..... Axial force
x..... Distance between the motor flange and the point where radial force $F_r$ is applied

## 2.11.3 Speed-Torque characteristic curve at 80 VDC DC bus voltage




## 2.11.4 Speed-Torque characteristic curve at 325 VDC DC bus voltage



# 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.

### Danger!

**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 mounted on the shaft end.**

## 3.1 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 equipment can result in serious injury and/or material damage.**

- **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.**

**Environmental conditions for transport**

- Dry; dust-, frost- and vibration-free
- Room temperature between -20°C and +60°C
- Max. relative humidity 90%, (non-condensing)
- Well ventilated and free from drafts
- The air in the room must be free of aggressive or hazardous gases.

## 3.2 Storage

### Warning!

**Damage caused by loss of material properties.**

**Long storage or storage under improper conditions means that certain materials age prematurely, lose their properties and can be damaged. Damaged components can result in further property damage.**

**Recommendations for the prevention of damage caused by storage:**

- **Reduce the storage time to the minimum and do not exceed the max. storage time of 2 years.**
- **Turn the motor shaft at least once every 6 months by hand or at low speed (max. 50 rpm). During this run-in period, bearing noises can occur, these are completely normal and 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 for protection against dust.**
- **Check the seals for damage when the goods are issued or before using them.**

**Storage conditions**

- Dry; dust-, frost- and vibration-free
- Room temperature between -20°C and +60°C
- Max. relative humidity 90%, (non-condensing)
- Well ventilated and free from drafts
- The air in the room must be free of aggressive or hazardous gases.

# 4 Installation conditions

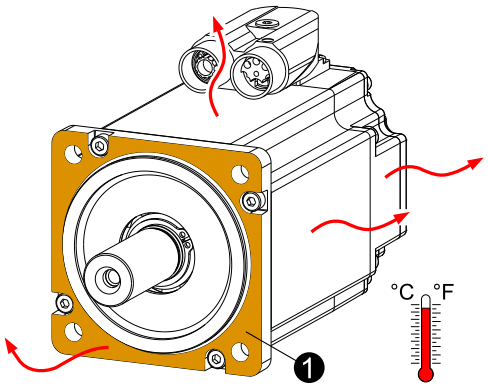
Before every commissioning procedure, the motor must be checked by qualified personnel. The check must include the proper condition in terms of mounting and installation, the installation conditions and safe operation.

| Operating conditions | |
|---|---|
| Rating class, operating mode in accordance with 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 the nominal current and stall current at installation elevations starting at 1000 m above sea level | 10% per 1000 m |
| Maximum installation elevation | 2000 m [3] |
| Max. flange temperature | 65°C |
| EN 60034-5 protection (IP code)<br>With optional oil seal | IP54 [4]<br>IP65 [4] [5] |
| Construction and mounting arrangement type in accordance with EN 60034-7 (IM code) | Horizontal (IM3001)<br>Vertical, motor hangs on the machine (IM3011)<br>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.




Ensure that

- the opposite side to the mounting flange is not thermally insulated and sufficient heat can be released from the motor.
- unobstructed air circulation with sufficient cooling air motor housing.
- the specified maximum values of the motor temperature are not exceeded.

Note that

- the power or heat of the motors is dissipated via the motor flange and surface of the motor housing.
- the motor can become warm due to external heat sources.

[2] Continuous operation at ambient temperatures ranging from +40°C to max. +50°C is possible, but this will result in a shorter service life.
[3] Requirements that go beyond this must be arranged with B&R.
[4] The protection ratings are only achieved if the power and signal connections are installed properly.
[4] The protection ratings are only achieved if the power and signal connections are installed properly.
[5] Only available for size 2 and 3!

## Warning!

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

**If the maximum permissible operating temperature is exceeded, an arising 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 $\mathbf{F_r}$ and $\mathbf{F_a}$ 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.

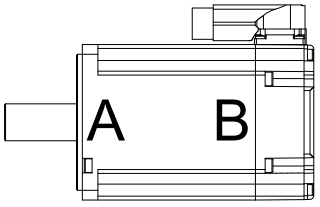
**8LVA1 (with/without holding brake)**
**8LVB2 (with holding brake)**

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 $F_a$).

**8LVA2 (without holding brake)**
**8LVA3 (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 $F_a$

Information regarding determination of permissible values for $F_r$ and $F_a$ can be taken from the motor data for the respective three-phase synchronous motors (see section "Radial force diagram"). Permissible values are based on a bearing lifespan of 20,000 h (bearing lifespan calculation based on DIN ISO 281).

### 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

Assembly is only permitted to be carried out in a voltage-free condition and only by qualified personnel[2)]. Before installation, voltage to the control cabinet must be switched off and prevented from being switched on again.

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

### Danger!

**Personal injury and damage to property caused by unauthorized conversions!**

**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 property damage and injuries cannot be excluded.**

**Therefore, unauthorized conversions are 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 property damage caused by 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 property damage 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) The definition of "qualified personnel" can be found in section "Safety" of chapter "General information".

## Danger!

**Risk of injury due to electric shock!**

**There is an immediate risk of fatal injury in case of contact with live parts.**

**If connections are connected or disconnected in the wrong order or under voltage, arcs can arise and persons and contacts can be damaged.**

**Even if the motor is not turning, the control and power connections can still carry voltage!**

- **Never touch the connectors when the power is on.**
- **Never disconnect or connect electrical connections to the motor and servo drive under voltage!**
- **Do not remain in the dangerous zone during operation; secure the danger zone from access by unauthorized persons.**
- **Always operate the motor with all of its safety features. You should also do this during short-term testing and trial operations!**
- **Keep all covers and switch cabinet doors closed during operation and for as long as the machine has not been disconnected from the mains.**
- **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 discharging time of an intermediate circuit, if present.**
- **Only connect the measuring instruments in the absence of current and voltage!**

**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.**

- **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 safety precautions need to 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 stop switches 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 remain in a dangerous area during operation and secure it from access by unauthorized persons.**
- **Before working on the machine, secure it against unwanted movements. Any holding brake present is not suitable for this!**
- **Keep all covers and switch cabinet doors closed during operation and for as long as the machine has not been disconnected from the mains.**
- **Always operate the motor with all of its safety features. You should also do this during short-term 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 equipment can result in serious injury and/or material damage.**

- **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.**

## Danger!

**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 mishandling of 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 loss of power 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.

## Danger!

**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 remain in a dangerous area during operation and secure it from 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 downtime.**
- **Allow motor and gearbox to cool sufficiently before working on it. Because even after shutting down, there is still a risk of burning for a prolonged period of time.**
- **Always operate the motor or gearbox with all safety devices. You should also do this during short-term 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 bearings can be damaged by excessive axial forces (e.g. by impacting or pressing) on the shaft.**

- **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 bearing!

**Lifting and transporting**

The weight of attachment elements (gear wheels, 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 (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 tensioning 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.

### Danger!

**Personal injury and property damage 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 property damage 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.**
- **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.

### 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 conductor must be connected via the power connection or motor plug.

### Danger!

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

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

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

### Danger!

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

**Connecting the motor directly to the mains leads to severe personal injury and property damage.**

- **The is only permitted to be used with servo drives that are operated on grounded, three-phase industrial power systems (TN, TT power mains).**

### Danger!

**Risk of injury due to electric shock!**

**There is an immediate risk of fatal injury in case of contact with live parts.**

**If connections are connected or disconnected in the wrong order or under voltage, arcs can arise and persons and contacts can be damaged.**

**Even if the motor is not turning, the control and power connections can still carry voltage!**

- **Never touch the connectors when the power is on.**
- **Never disconnect or connect electrical connections to the motor and servo drive under voltage!**
- **Do not remain in the dangerous zone during operation; secure the danger zone from access by unauthorized persons.**
- **Always operate the motor with all of its safety features. You should also do this during short-term testing and trial operations!**
- **Keep all covers and switch cabinet doors closed during operation and for as long as the machine has not been disconnected from the mains.**
- **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 discharging time of an intermediate circuit, if present.**
- **Only connect the measuring instruments in the absence of current and voltage!**

## Danger!

**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 remain in a dangerous area during operation and secure it from 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 downtime.**
- **Allow motor and gearbox to cool sufficiently before working on it. Because even after shutting down, there is still a risk of burning for a prolonged period of time.**
- **Always operate the motor or gearbox with all safety devices. You should also do this during short-term testing and trial operations!**

### 5.5.1 Cables and connectors

#### 5.5.1.1 Cables from other manufacturers

## Note:

**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 in accordance with EN 60034-25.**
- **Without documented evidence, no claim for warranty is possible for winding damage resulting from voltage rise on the winding.**

#### 5.5.1.2 Connectors from other manufacturers

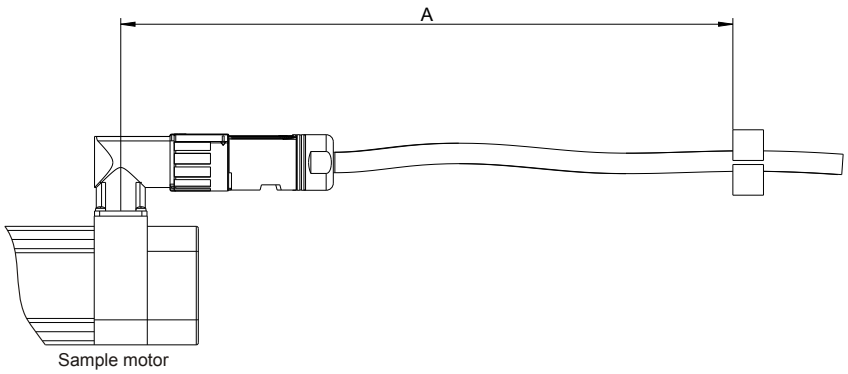
## Caution!

**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 support



- Cable support: 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!

## Note:

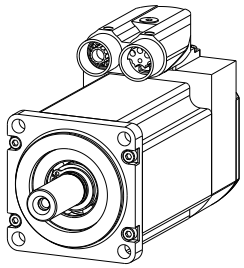
**For additional technical data and order data for the cables, see the current user's manual for the ACOPOS system being used. These are available in the Downloads section of the B&R website www.br-automation.com.**

#### 5.5.1.4 Cable bend radius

For the exact cable bend radius values, see the corresponding cable specifications.

### 5.5.2 Connection sequence

**Double angular built-in connector**



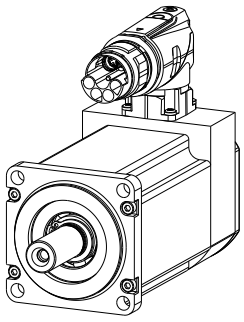
**Connecting**

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 Ensure proper connections

## Caution!

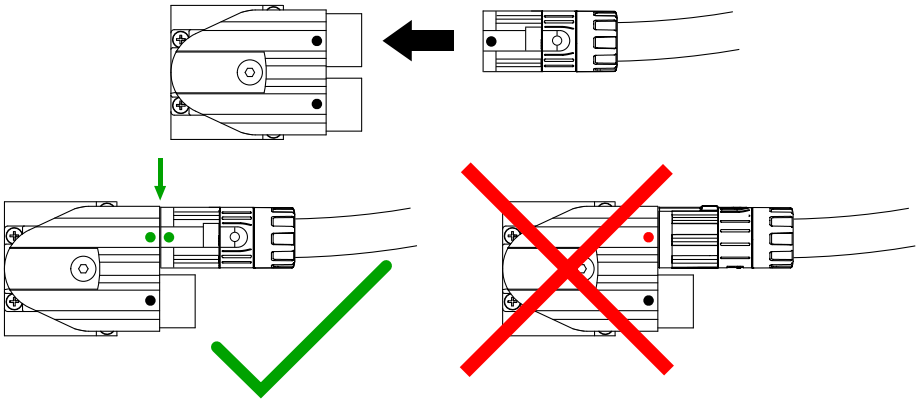
**Damage due to improper connector installation!**

**Misalignment and subsequent pulling can cause disturbances and damage to the motor!**

- **Ensure that connectors are installed and connected properly.**

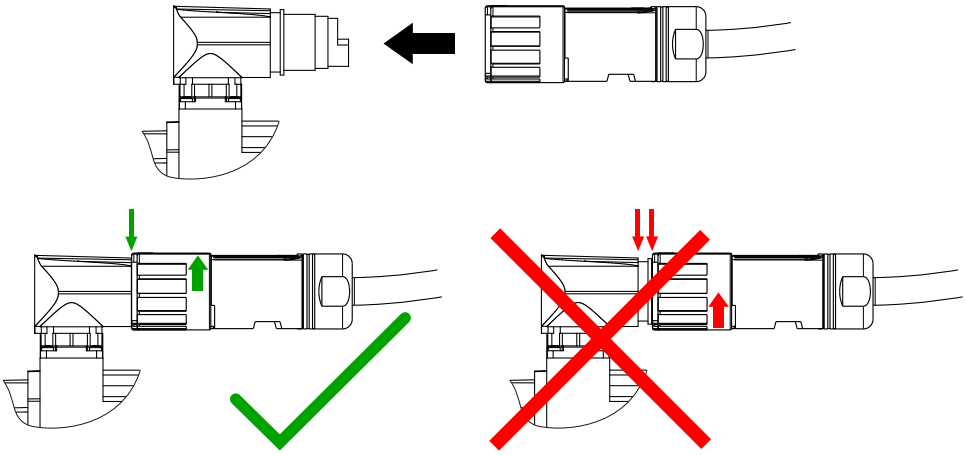
#### 5.5.3.1 Double angular built-in connector

The double angular built-in connector is equipped with a self-locking quick-release fastener. During installation, make sure that the connectors are fully connected and locked.



#### 5.5.3.2 Single-cable solution (hybrid)

The single-cable solution (hybrid) is equipped with a quick-release fastener. During installation, make sure that the connectors are tightly connected and locked.



## Caution!

**Damage due to improper connector installation!**

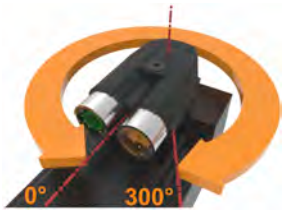
**If the connector is not fully connected to the motor connection with the single-cable solution (hybrid), contact problems and subsequent operating failures will result.**

- **Completely connect the connector to the motor connection without a gap and then lock the connector.**

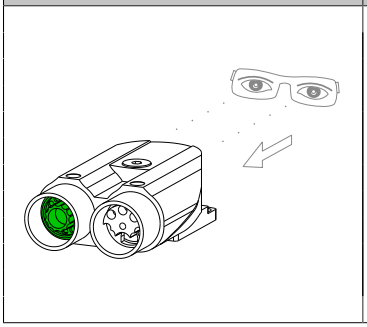
## 5.5.4 Connection type

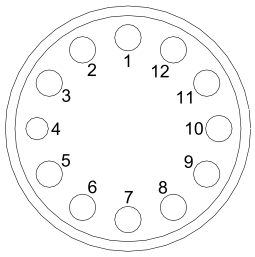
### 5.5.4.1 Double angular built-in connector

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



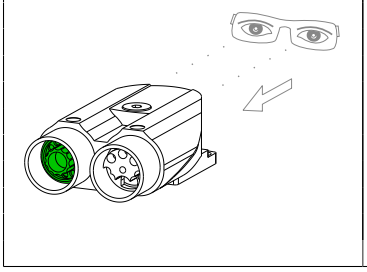

#### 5.5.4.1.1 Resolver connection - Pinout

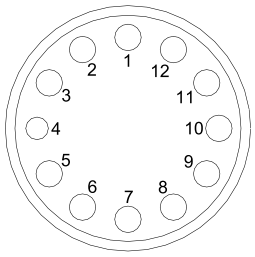





| Pin | Description | Function |
|---|---|---|
| 1 | --- | --- |
| 2 | --- | --- |
| 3 | --- | --- |
| 4 | --- | --- |
| 5 | --- | --- |
| 6 | R1 | Reference signal inverted |
| 7 | --- | --- |
| 8 | S4 | Sinus output signal |
| 9 | S2 | Sinus output signal inverted |
| 10 | S3 | Cosine output signal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

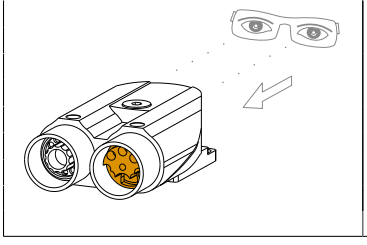
#### 5.5.4.1.2 EnDat 2.2 connection - Pinout

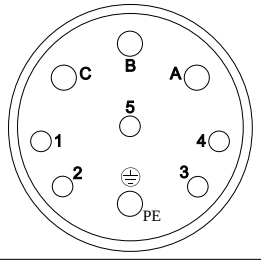





| Pin | Description | Function |
|---|---|---|
| 1 | +5 V output / 0.25 A | +5 V encoder power supply |
| 2 | D | Data output |
| 3 | D\ | Data output inverted |
| 4 | T | Clock input |
| 5 | T\ | Clock input inverted |
| 6 | Sense COM | Battery 0 V |
| 7 | COM (1, 3-9, 11, 13-15) | 0 V encoder power supply |
| 8 | --- | --- |
| 9 | --- | --- |
| 10 | --- | --- |
| 11 | --- | --- |
| 12 | Sense +5 V | Battery +5 V |

#### 5.5.4.1.3 Pinout power connection.





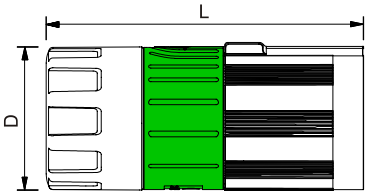

| Pin | Description | Function |
|---|---|---|
| A | U | Motor connection U |
| B | V | Motor connection V |
| C | W | Motor connection W |
| PE | PE | Grounding |
| 1 | T+ | Temperature + |
| 2 | T- | Temperature - |
| 3 | B+ | Brake + |
| 4 | B- | Brake - |
| | | |
| | | |

#### 5.5.4.1.4 ytec connector - Dimensions

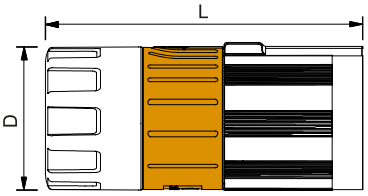
The ytec connectors made by Intercontec, compatible with the **double angular built-in connector**, have the same dimensions and can be distinguished by the colors green and orange. The connection to the motor is made without tools.

| ytec Connectors | Color | L | D |
|---|---|---|---|
| Encoder connectors | Green | 42 mm | 18.7 mm |
| Power connectors | Orange | 42 mm | 18.7 mm |

**Encoder connectors**




**Power connectors**



### 5.5.4.2 Single-cable solution (hybrid)

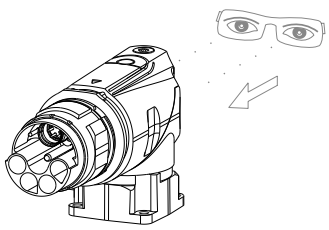
- 300° swivel connector
- Encoder and power conductor in one cable
- Quick-release self-locking connector system
- Robust industrial connectors with optimal EMC shielding
- Robust metal housing

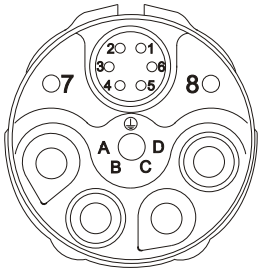
## Note:

**The following conditions must be met by the drives in order to operate a motor with a hybrid connector.**

- **For ACOPOSmulti: The cable cover must be designed for operation with a hybrid cable (cable cutout present, delivered 2015 or later)**
- **For ACOPOSmulti with SafeMOTION: The configured operating system version (NC version) must be set to V2.48.0 or later; the Safety Release must be V1.9 or later.**
- **For all drives: The configured operating system version (NC version) must be set to V2.42.2 or later.**

#### 5.5.4.2.1 Single-cable solution (hybrid) - Pinout



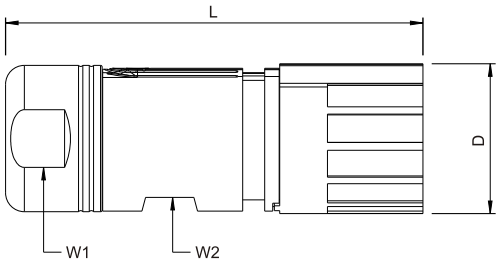



| Pin | Signal |
|---|---|
| A | Motor connection U |
| B | Motor connection V |
| C | Motor connection W |
| D | --- |
| 7 | Brake - |
| 8 | Brake + |
| PE | Grounding |
| 1 | Up |
| 2 | Ground |
| 3 | Data |
| 4 | Data inverted |
| 5 | Clock input |
| 6 | Clock input inverted |

#### 5.5.4.2.2 htec connector - Dimensions

The htec connector from Intercontec can be connected without tools.

**htec connector**




| htec connector | Length (1) | Diameter (D) | W1 | W2 |
|---|---|---|---|---|
| Encoder connectors | 77.8 mm | 27.9 mm | 25 mm | 24 mm |

# 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. servo drive) as well as the finished machine.

## 6.2 Safety

Commissioning is only permitted to be carried out by qualified personnel[1)].

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

### Danger!

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

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

**Electronic devices are never completely 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 property damage caused by 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 property damage 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.

[1)] The definition of "qualified personnel" can be found in section "Safety" of chapter "General information".

## Danger!

**Risk of injury due to electric shock!**

**There is an immediate risk of fatal injury in case of contact with live parts.**

**If connections are connected or disconnected in the wrong order or under voltage, arcs can arise and persons and contacts can be damaged.**

**Even if the motor is not turning, the control and power connections can still carry voltage!**

- **Never touch the connectors when the power is on.**
- **Never disconnect or connect electrical connections to the motor and servo drive under voltage!**
- **Do not remain in the dangerous zone during operation; secure the danger zone from access by unauthorized persons.**
- **Always operate the motor with all of its safety features. You should also do this during short-term testing and trial operations!**
- **Keep all covers and switch cabinet doors closed during operation and for as long as the machine has not been disconnected from the mains.**
- **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.**
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- **Only connect the measuring instruments in the absence of current and voltage!**

**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.**

- **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 safety precautions need to 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 stop switches 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 remain in a dangerous area during operation and secure it from access by unauthorized persons.**
- **Before working on the machine, secure it against unwanted movements. Any holding brake present is not suitable for this!**
- **Keep all covers and switch cabinet doors closed during operation and for as long as the machine has not been disconnected from the mains.**
- **Always operate the motor with all of its safety features. You should also do this during short-term 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 equipment can result in serious injury and/or material damage.**

- **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.**

## Danger!

**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 mishandling of 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 loss of power 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.

## Danger!

**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 remain in a dangerous area during operation and secure it from 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 downtime.**
- **Allow motor and gearbox to cool sufficiently before working on it. Because even after shutting down, there is still a risk of burning for a prolonged period of time.**
- **Always operate the motor or gearbox with all safety devices. You should also do this during short-term testing and trial operations!**

### 6.2.2 Reversing operation

## Danger!

**Personal injury and damage to property due to shaft breakage!**

**The shaft key can become dislodged during heavy reversing operation. In extreme cases, this can cause the shaft end to break, which can lead to severe damage!**

- **It is therefore preferable to use a smooth shaft during heavy reversing operation.**

### 6.2.3 Freely rotating motors

With freely rotating motors, remove any existing shaft keys (or mounting screws or other mounting elements) before operation or implement measures to prevent their ejection. Any shaft protection sleeve present, such as used for transport and storage, is not appropriate protection and must also be removed.

## Danger!

**Personal injury and damage to property due to ejected elements!**

**With freely rotating motors, an existing shaft key (or mounting screws or other mounting elements) can be ejected and cause personal injury and damage to property.**

- **Remove or secure shaft keys (or mounting screws or other assembly elements) before operation (even during short-term testing and trial operations!).**
- **Any shaft protection sleeve present, such as used for transport and storage, is not appropriate protection and must also be removed.**

### 6.2.4 Holding brake

The motors can be equipped with an optional holding brake. It is only used to hold the motor shaft in place when no power is applied to the motor.

The maximum motor torque far exceeds the holding torque of the brake.

## Danger!

**Personal injury and damage to property due to non-intended use of the holding brake!**

**If the holding brake is used differently than intended, functional failures and accidents involving personal injury or damage to property are possible.**

- **Do not use the holding brake for braking under normal operating conditions! It is not intended for normal braking.**
- **Do not use the holding brake to protect personnel! The holding brake does not provide protection for personnel!**
- **Do not use the holding brake to hold loads! They do not ensure a securing function (e.g. against lowering in the case of lifted loads).**
- **Do not load motors with holding brakes axially either during assembly or during operation. It is especially important to prevent axial forces in the direction of the B flange since these forces can cause the brake to fail!**

## Note:

**Loaded braking during an emergency stop is permitted but reduces its service life.**

For further information about the holding brake, see chapter "Technical data".

## 6.3 Verification

### 6.3.1 To verify before commissioning

Before commissioning, ensure that

- the drive is undamaged and the motor is not in the danger zone of other equipment.
- the motor is properly aligned and attached.
- the screws are correctly tightened.
- unused connecting threads on the bearing shield of the flange are closed.
- all components attached to the output shaft are secured against unintentional release.
- shaft keys and other mounting elements were removed on freely rotating motors. They can be ejected due to centrifugal force.
- all the necessary protective equipment (mechanical, thermal, electrical) is installed.
- the motor connections are made properly.
- the protective ground conductor system is designed properly and verified.
- the wires do not touch the motor surface.
- the drive is free (release the brake, if necessary).
- the emergency stop functions have been checked.
- the fan (if present) is connected properly and its functionality checked.

## Danger!

**Personal injury and property damage 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 property damage 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.**
- **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

During commissioning, check that

- the functionality of all motor attachments (protective equipment, encoder, brake, cooling, etc.) has been verified.
- the operating conditions (see chapter "Installation conditions") are observed.
- the brake (if present) is released.
- all electrical attachments and connections are properly designed and secured.
- all protective measures 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 have been installed and set up in accordance with the manufacturer's specifications.
- Measures are in place to ensure that the maximum permissible speed $n_{max}$ of the motor cannot 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 specialized personnel immediately.

## 6.4 Faults during operation

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

| Disturbance | Possible error source | Correction |
|---|---|---|
| Motor will not start | Controller enable missing | Activate controller enable |
| | Controller error, encoder error | Read error log on inverter/controller, correct error |
| | Power supply not present | Check connection and power supply |
| | Rotating field | Check phase sequence, replace connection line if necessary |
| | Brake will not release | Check triggering, connections and power supply |
| | Brake defective | If necessary, contact B&R. |
| Runs noisily | Insufficient shielding in connection lines | Check shielding connection and grounding |
| | Controller parameters too high | Optimize controller parameters |
| Vibrations | Coupling element or machine not properly balanced | Adjust balance |
| | Power transmission system misaligned | Realign power transmission system |
| | Mounting screws loose | Check and tighten screw connections |
| Noise during operation | 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 type plate |
| | Insufficient heat dissipation | Ensure sufficient heat dissipation. |
| | Brake not releasing sufficiently, causing friction | 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 type plate)
- Type and extent of fault
- Circumstances under which the fault occurred
- Application data (cycle of torque, speed and forces over time, environmental 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 degree of pollution present, carry out periodic cleaning in order to ensure the removal of heat loss, among other things.

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

Assembly is only permitted to be carried out in a voltage-free condition and only by qualified personnel[2)]. Before installation, voltage to the control cabinet must be switched off and prevented from being switched on again.

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

### Danger!

**Personal injury and damage to property caused by unauthorized conversions!**

**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 property damage and injuries cannot be excluded.**

**Therefore, unauthorized conversions are 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 property damage caused by 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 property damage 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) The definition of "qualified personnel" can be found in section "Safety" of chapter "General information".

## Danger!

**Risk of injury due to electric shock!**

**There is an immediate risk of fatal injury in case of contact with live parts.**

**If connections are connected or disconnected in the wrong order or under voltage, arcs can arise and persons and contacts can be damaged.**

**Even if the motor is not turning, the control and power connections can still carry voltage!**

- **Never touch the connectors when the power is on.**
- **Never disconnect or connect electrical connections to the motor and servo drive under voltage!**
- **Do not remain in the dangerous zone during operation; secure the danger zone from access by unauthorized persons.**
- **Always operate the motor with all of its safety features. You should also do this during short-term testing and trial operations!**
- **Keep all covers and switch cabinet doors closed during operation and for as long as the machine has not been disconnected from the mains.**
- **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 discharging time of an intermediate circuit, if present.**
- **Only connect the measuring instruments in the absence of current and voltage!**

**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.**

- **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 safety precautions need to 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 stop switches 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 remain in a dangerous area during operation and secure it from access by unauthorized persons.**
- **Before working on the machine, secure it against unwanted movements. Any holding brake present is not suitable for this!**
- **Keep all covers and switch cabinet doors closed during operation and for as long as the machine has not been disconnected from the mains.**
- **Always operate the motor with all of its safety features. You should also do this during short-term 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 equipment can result in serious injury and/or material damage.**

- **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.**

## Danger!

**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 mishandling of 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 loss of power 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.

## Danger!

**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 remain in a dangerous area during operation and secure it from 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 downtime.**
- **Allow motor and gearbox to cool sufficiently before working on it. Because even after shutting down, there is still a risk of burning for a prolonged period of time.**
- **Always operate the motor or gearbox with all safety devices. You should also do this during short-term testing and trial operations!**

## 7.2 Motor bearing and holding brake

**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).

**Holding brake**

Over time, exposure to moisture and contamination can reduce the braking torque. The application should therefore check the braking torque from time to time using the brake test function with the safety factor required for the application.

If the brake is no longer achieving the necessary torque, a refresh cycle can help it achieve the necessary torque again.

- The brake test function in the ACOPOS servo drive used must be enabled.
- During a refresh cycle, the motor is allowed to turn one revolution at a speed of 50 rpm with the brake engaged. This cleans the brake pads and generally helps the brake to once again achieve the torque it needs.
- After the refresh cycle, the brake should be tested again.
- If the brake is still not achieving the necessary torque after 5 refresh cycles, the motor must be replaced.

Replace the motor when the brake no longer reaches its required torque.

If necessary, contact B&R. Repairs to the motor and brake are only permitted to be carried out by B&R!

## Note:

**The motors can be equipped with an optional holding brake. It is used to hold the motor shaft when no power is applied to the motor. The maximum motor torque far exceeds the holding torque of the brake.**

## Danger!

**Personal injury and damage to property due to non-intended use of the holding brake!**

**If the holding brake is used differently than intended, functional failures and accidents involving personal injury or damage to property are possible.**

- **Do not use the holding brake for braking under normal operating conditions! It is not intended for normal braking.**
- **Do not use the holding brake to protect personnel! The holding brake does not provide protection for personnel!**
- **Do not use the holding brake to hold loads! They do not ensure a securing function (e.g. against lowering in the case of lifted loads).**
- **Do not load motors with holding brakes axially either during assembly or during operation. It is especially important to prevent axial forces in the direction of the B flange since these forces can cause the brake to fail!**

## Note:

**Loaded braking during an emergency stop is permitted but reduces its service life.**

## 7.3 Oil seal

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

## Note:

**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.**

# 8 Disposal

**Separation of materials**

It is necessary to separate different materials so the device can undergo an environmentally friendly recycling process. Disposal must comply with applicable legal regulations.

| Component | Disposal | Note |
|---|---|---|
| Motors | Electronic recycling | A magnetized rotor must never be transported or delivered outside the stator! |
| Gearbox (without oil) | Metal waste | |
| Waste oil (gearbox) | Special waste | |
| 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.

**Danger!**

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

**The motors must not be separated into individual parts.**

**A magnetized rotor must never be transported or delivered outside the stator!**

- **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 property damage.**