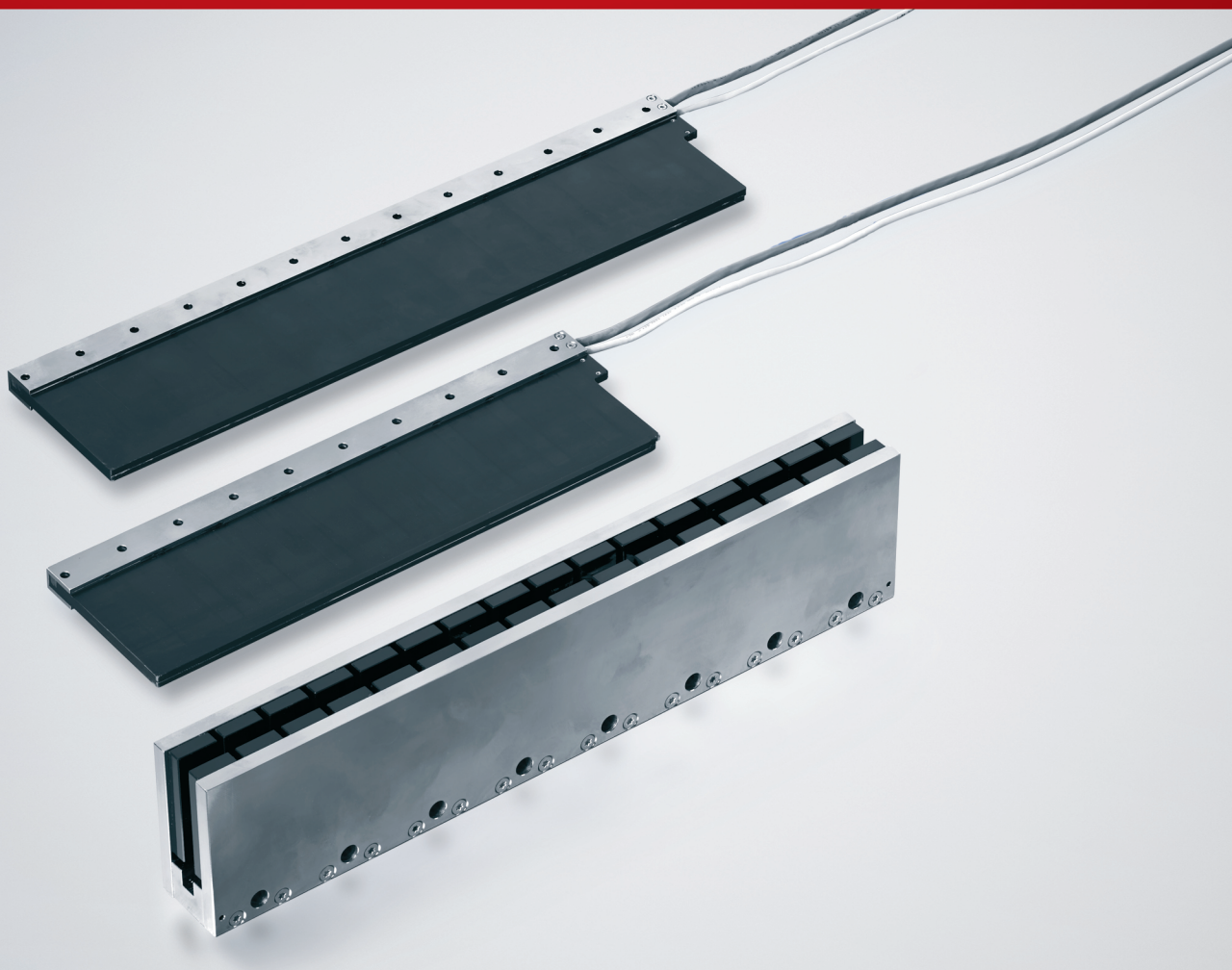
BECKHOFF New Automation Technology

Operation Manual | EN

AL3800

Ironless linear servomotors



6/24/2021 | Version: 3.6

Documented motors – AL38xx

Linear servomotor	Speed (max.)	Peak force for 3 sec.	Continuous force with air cooling	Peak current with air cooling
AL3803-0000-000x	2.7 m/s	F_P = 700 N	F_{ca} = 141 N	I_{ca} = 5.6 A
AL3803-0001-000x	6.6 m/s	F_P = 700 N	F_{ca} = 141 N	I_{ca} = 13.9 A
AL3806-0000-000x	2.7 m/s	F_P = 1400 N	F_{ca} = 282 N	I_{ca} = 11.3 A
AL3806-0001-000x	6.6 m/s	F_P = 1400 N	F_{ca} = 282 N	I_{ca} = 28.0 A
AL3809-0000-000x	2.7 m/s	F_P = 2100 N	F_{ca} = 423 N	I_{ca} = 16.9 A
AL3809-0001-000x	6.6 m/s	F_P = 2100 N	F_{ca} = 423 N	I_{ca} = 42.0 A
AL3812-0000-000x	2.7 m/s	F_P = 2800 N	F_{ca} = 564 N	I_{ca} = 22.6 A
AL3812-0001-000x	6.6 m/s	F_P = 2800 N	F_{ca} = 564 N	I_{ca} = 56.0 A
AL3818-0000-000x	2.7 m/s	F_P = 4200 N	F_{ca} = 846 N	I_{ca} = 34.0 A

Table of content

1 Foreword

1.1 Notes on the documentation

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.
It is essential that the documentation and the following notes and explanations are followed when installing and commissioning the components.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.
We reserve the right to revise and change the documentation at any time and without prior announcement.
No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

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1.2 Documentation issue status

Origin of the document

This documentation was originally written in German. All other languages are derived from the German original.

Product features

Only the product features specified in the current user documentation are valid. Further information given on the product pages of the Beckhoff homepage, in emails or in other publications is not authoritative.

Issue	Comment
3.6	**Chapter update:** Connection of motors with flying wires **8.2;** NTC Specification **8.5.2**
3.5	**Chapter update:** Disposal **4.4**
3.4	**Chapter update:** EC declaration of conformity **2.1**; Technical drawing AL38xx **10.2.1**
3.3	**Chapter update:** 1.0 Foreword; 3.0 Safety
3.2	**Chapter update:** 8.2
3.1	**Chapter update:** 10.2
3.0	Complete revision
2.1	Version February 2005

1.3 Intended use

The ironless linear servomotors of the series AL38xx are cogging-free and therefore particularly suitable as drives for axes with low mass or high demands on synchronism, e.g. in machines in the semiconductor industry.

The thermal protection contact incorporated in the motor windings must be analyzed and monitored.

⚠ WARNING	
	Caution - Risk of injury! Electronic equipment is not fail-safe. The machine manufacturer is responsible for ensuring that the connected motors and the machine are brought into a safe state in the event of a fault in the drive system.

The linear servomotors from the AL38xx series are exclusively installed as components into electrical systems or machines and may only be put into operation as integrated components of the system or machine.
The motors may **only** be operated under the ambient conditions defined in this documentation.

2 Guidelines and Standards

⚠ CAUTION

Danger for persons, the environment or equipment

Linear servomotors from the AL38xx series are **not** products within the meaning of the EC machinery directive. Operation of the linear servomotors in machines or systems is only permitted once the machine or system manufacturers has provided evidence of CE conformity of the complete machine or system.

2.1 EC declaration of conformity

Provision of EU Declaration of Conformity:

Beckhoff Automation GmbH & Co. KG will be glad to provide you with EU declarations of conformity and manufacturer's declarations for all products upon request to info@beckhoff.com.

3 Safety

3.1 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

Description of symbols

In this documentation the following symbols are used with an accompanying safety instruction or note. The safety instructions must be read carefully and followed without fail!

⚠ DANGER

Serious risk of injury!

Failure to follow the safety instructions associated with this symbol directly endangers the life and health of persons.

⚠ WARNING

Risk of injury!

Failure to follow the safety instructions associated with this symbol endangers the life and health of persons.

⚠ CAUTION

Personal injuries!

Failure to follow the safety instructions associated with this symbol can lead to injuries to persons.

NOTE

Damage to the environment or devices

Failure to follow the instructions associated with this symbol can lead to damage to the environment or equipment.

Tip or pointer

This symbol indicates information that contributes to better understanding.

UL pointer

This symbol indicates important information about the UL-compliant.

3.2 Special safety instructions for the AL38xx

The safety instructions are designed to avert danger and must be followed during installation, commissioning, production, troubleshooting, maintenance and trial or test assemblies.

The linear servomotors from the AL3xxx series are not capable of running independently and are always installed into a machine or system. After installation the additional documentation and safety instructions provided by the machine manufacturer must be read and followed.

⚠ WARNING

Serious risk of injury through high electrical voltage!

- Negligent, improper handling of the linear servomotor and bypassing of the safety devices can lead to personal injury or death through electric shock.
- It must be ensured that the protective conductor has been firmly connected.
- The machine manufacturer must prepare a hazard analysis for the machine, and must take appropriate measures to ensure that unexpected movements cannot lead to injury to persons or to objects.
- Power leads may be live, even if the motor is not running. Never undo the electrical connections to the motor when it is live. Under unfavorable conditions arcing may occur, resulting in injury and damage to contacts.
- Disconnect the linear servomotor from the servo drive and secure it against reconnection before working on electrical parts with a voltage > 50 V.
- The DC link voltage of the servo drive may exceed 890 V_{DC}. Wait until the DC link capacitors are discharged before touching live terminals. The voltage measured between the DC+ and DC- terminals (X02) must have dropped to below 50 V_{DC}.

⚠ WARNING

Serious risk of injury through hot surfaces!

- The surface temperature may exceed 50 °C, resulting in a risk of burns.
- Avoid touching the housing during or shortly after operation.
- Leave the linear servomotor to cool down for at least 15 minutes after it is switched off.
- Use a thermometer to check whether the surface has cooled down sufficiently.

NOTE

Danger to the environment or devices

- Carefully read this manual before using the linear servomotor thoroughly, paying particular attention to the safety instructions. In the event of any uncertainties please notify your sales office immediately and refrain from working on the linear servomotor.
- Only well trained, qualified electricians with sound knowledge of drive equipment may work on the device.
- Adhere without fail to the climatic conditions for the installation. Further information can be found in the chapter Technical data and Mechanical installation.
- If a linear servomotor is installed in a machine it must not be commissioned until proof of compliance of the machine with the latest version of the EC Machinery Directive has been provided. This includes all relevant harmonized standards and regulations required for implementation of this Directive in national legislation.

NOTE

Damage to the device due to inappropriate treatment

Treat the components of the linear servomotor with care, both in the packed and unpacked state. The magnet yokes are particularly sensitive. Never let the magnet yokes fall on the floor.

NOTE

Damage to the magnets at higher temperatures

The magnets should never be exposed to temperatures above 70° C. They can become demagnetized at higher temperatures.

⚠ CAUTION

Magnetic attractive forces can lead to damage

- The magnetic plates exercise a powerful attractive force on any soft-magnetic materials such as iron. These forces are more than the hand can manage. They can cause serious injuries.
- Do not bring any soft-magnetic objects closer than 10 cm to the magnetic side of the magnetic plates.
- During assembly, the magnet yokes may be subject to mutual attractive forces. The magnets of the magnet yokes may be damaged by the end plate of an adjacent magnet yoke.

⚠ WARNING

Damage due to power failure

The linear servomotor is driven by a servo drive. It is possible for a power failure, or for some other serious fault, to cause the motor to start up automatically. Provide mechanical safety equipment that will protect the motor and your machine from being damaged in such circumstances.

4 Handling

4.1 Transport

Climate category:	2K3 according to EN 60721
Transport temperature:	-25 °C - +70 °C, max. fluctuation 20 K/hour
Transport humidity:	relative humidity 5% - 95%, non-condensing

The linear servomotor may only be transported by qualified personnel and in the manufacturer's original packaging.

If the packaging is damaged, check the motor for visible damage. Inform the transport company and, if necessary, the manufacturer.

4.2 Storage

Climate category:	2K3 according to EN 60721
Storage temperature:	-25 °C - +70 °C, max. fluctuation 20 K/hour
Air humidity:	relative humidity 5% - 95%, non-condensing
Storage time:	without limitation

Store only in the manufacturer’s original packaging

4.3 Maintenance / Cleaning

- Maintenance and cleaning only by qualified personnel.
- Opening the motor invalidates the warranty.
- Clean the housing with isopropanol or similar.

NOTE

Destruction of the linear servomotor

Never immerse or spray the linear servomotor.

Proper functioning of the bearings and buffers, and guidance of the movable lines, must all be tested.

4.4 Disposal

In accordance with the WEEE 2012/19/EU Directives we take old devices and accessories back for professional disposal, provided the transport costs are taken over by the sender.

Send the devices with the note “For disposal” to:

Beckhoff Automation GmbH & Co. KG
Huelshorstweg 20
D-33415 Verl

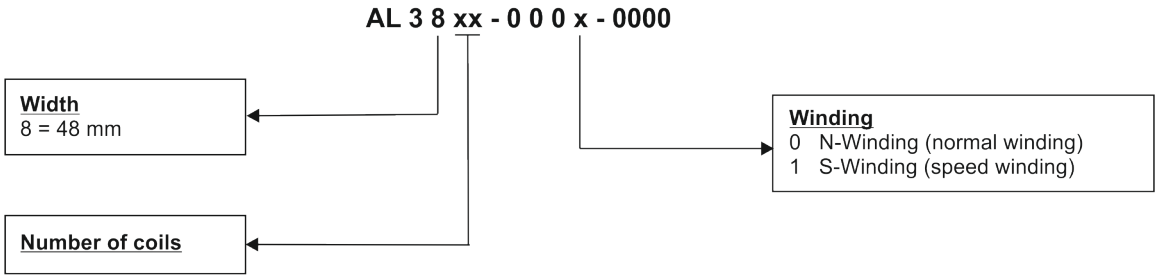
5 Product identification

5.1 AL38xx scope of delivery

Please check that the delivery includes the following items:

- Motor from the AL3800 series
- Name plate

5.2 AL38xx type key



6 Technical description

6.1 Design of the motors

The linear servomotors from the AL38xx series are ironless three-phase motors for high-quality servo applications. In conjunction with our digital servo drive, they are particularly suitable for positioning tasks in the semiconductor industry with demanding requirements in terms of synchronism and precision.

The motors from the AL38xx series are intended to be operated exclusively by the digital servo drive with speed and torque control.

The linear servomotors have permanent magnets in the secondary section. This advanced neodymium magnetic material makes a significant contribution to the motors' exceptional dynamic properties. A three-phase coil unit supplied by the servo drive is housed in the coil unit. The motor has no brushes; the commutation being implemented electronically in the servo drive.

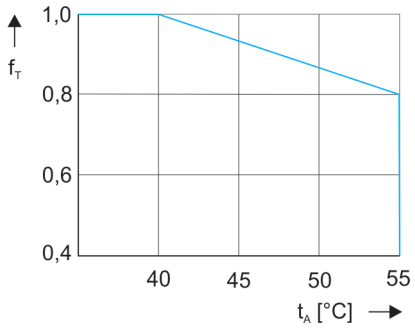
Furthermore, a feedback system is necessary for operation. The suitable feedback system must be selected on the basis of the application requirements. Dynamics, speed, contamination levels, resolution and the servo drive employed must be considered

6.2 General technical data

Technical data	AL38xx
Climate category	3K3 according to EN 60721
Ambient temperature (at rated values)	+5 - +40 °C for installation altitudes up to 1000 m amsl
Permissible humidity (at rated values)	95% relative humidity, non-condensing
Installation altitude (currents and torques)	For installation altitudes above 1000 m amsl and 40 °C

6.2.1 Power derating

Ambient temperature



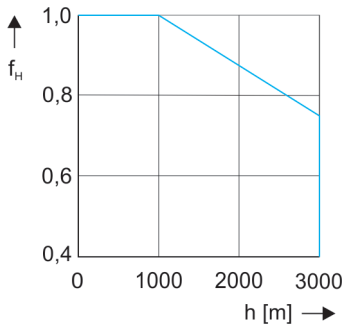
f_T = Temperature utilisation factor

t_A = Ambient temperature in °C

Calculation of the power data when exceeding the specified temperature limit > 40 °C:

$\mathbf{F_{CA\_red} = F_{CA} \times f_T}$

Installation altitude



f_H = Altitude utilisation factor

h = Altitude in metres

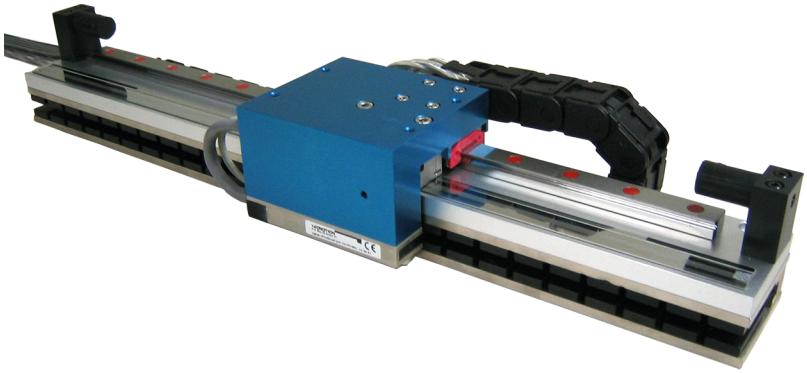
Calculation of the power data when exceeding the specified installation altitude > 1000 m:

$\mathbf{F_{CA\_red} = F_{CA} \times f_H}$

Ambient temperature and installation altitude

Calculation of the power data when exceeding the specified limits:
Ambient temperature > 40 °C and installation altitude > 1000 m
$\mathbf{F_{CA\_red} = F_{CA} \times f_T \times f_H}$

6.3 Standard features



The ironless linear servomotors of the AL38xx series from Beckhoff are not self-contained systems. It includes various components such as a coil unit and magnet yokes and must be integrated into a complete machine concept or a complete working unit. The size and shape of the carrier frame, the design of the carriage, the type of rail and type of bearings, and the kind of buffer used depend on the application. The carrier frame and the carriage must be designed such that an air gap is created between the coil unit and the magnet yoke.

6.3.1 Coil unit, primary part (N/S)

The N-type (normal winding) represents the preferred type. The S-type (speed winding) has a higher maximum speed and current consumption. The dimensions of the N- and S-types are identical.

6.3.2 Magnet yoke, secondary part

The magnet yokes are available in different lengths.

6.4 Additional equipment

You require further components for the proper installation of your linear servomotor.

These are not included in the scope of delivery.

6.4.1 Screws and locating pins

The screws and locating pins are needed to position and fasten the coil unit to the carriage, and also the magnet yoke to the carrier frame.

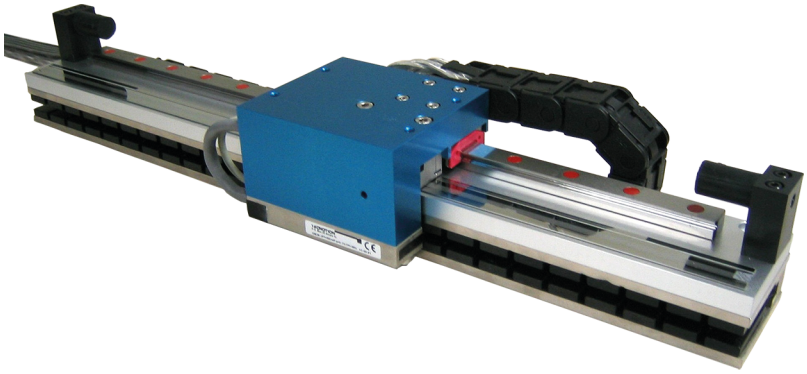
Attribute	AL38xx
Screws for magnet yokes (stainless)	M6 x 50, EN ISO 4762
Screws for coil unit (steel); Length depends on the thickness of the carriage	M5, EN ISO 4762
Locating pins (stainless)	3h8, EN ISO 8734

6.4.2 Servo drive and feedback system

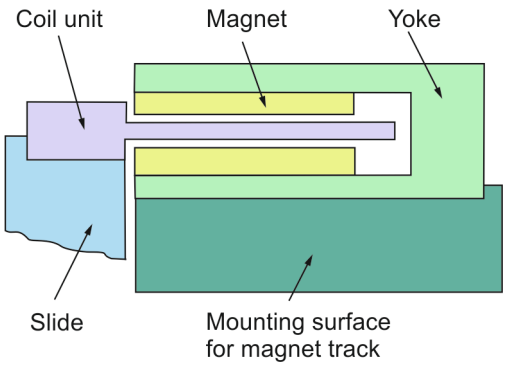
The following components are required for the construction of a complete linear axis and its operation:

- Servo drive, e.g.: AX5xxx from Beckhoff Automation GmbH & Co. KG.
- Graduated rule and linear displacement transducer
- Cables, plugs and guides
- Mechanical support / machine bed

7 Mechanical installation



7.1 Specification of the mounting surfaces



The mounting surfaces for the magnet yokes and the coil unit must be extremely even, in order to prevent bending forces.

- Evenness of the mounting surface for the coil unit: ≤ 0.1 mm
- Evenness of the mounting surface for the magnet yokes: ≤ 0.1 mm

The path of the magnet yokes (also referred to as magnetic track) and the coil unit must be aligned with each other. In order to achieve contactless movement, the mounting surfaces of the coil unit and the magnetic track must be parallel.

- Parallelism of the mounting surface of the coil unit relative to the magnetic track: ≤ 0.05 mm

7.2 Installation sequence

⚠ WARNING

Damage due to uncontrolled magnetic attractive forces

The sequence specified in this introduction for the installation must be followed. Deviation from the sequence may result in dangerous situations and damage through magnetic forces.

Complete the installation of the machine bed, before installing the linear motor components. Mount and align the rails and the graduated rule on the machine bed. Fit the bearings, buffers and required cables on the carriage. Make sure the carriage moves properly.

Installation order:

1. Mount the magnet yokes on the support frame of the machine.
2. Mount the coil unit on the carriage.
3. Connect the cables to the coil unit.

7.3 Mounting the magnet yokes

NOTE

Damage due to contamination

The mounting surface must always be free from contamination. Particles with a size of more than 0.1 mm can result in incorrect configuration and damage to your linear motor.

Start the assembly with yoke 1. Align yoke with 3 mm alignment pins or a milling reference. Mount the magnet yokes on the support frames. Observe the maximum tightening torque

An axis reference for the magnetic yokes is achieved as follows:

- Alignment pins in the center yoke (for short distances)
- Alignment pins along the entire path (for longer distances)
- Milling reference along the entire path (inside radius < 0.2 mm) for longer distances

The other magnet yokes can then be mounted, whereby the mutual attractive force of the magnet yokes can be controlled and utilized for the mechanical contact.

7.4 Assembling the coil unit

NOTE

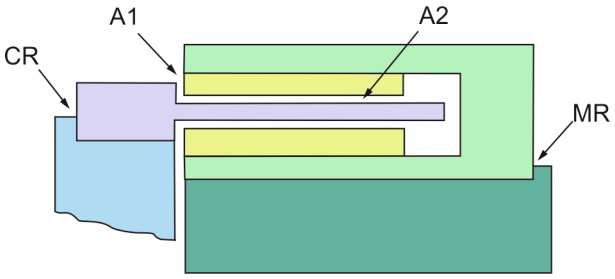
Damage due to contamination

The mounting surface must always be free from contamination. Particles with a size of more than 0.1 mm can result in incorrect configuration and damage to the linear motor.

Mounting of the coil unit on the clean mounting surface of the carriage is not hindered by attractive forces!

An axis reference for the coil unit (CR) is achieved as follows:

- Two alignment pins next to the first and last bolt of the coil unit
- Milling reference along the entire path (inside radius < 0.2 mm)



Procedure:

1. Insert the coil unit in the magnet yoke and position it on the mounting surface
2. Align the coil unit with the axis reference
3. Secure the coil unit with bolts
4. Observe the specified tightening torque!

The exact air gap dimensions (A1 and A2) can only be achieved, if the references and measurements mentioned above are adhered to.

NOTE

Damage caused by vibration

For applications that are subject to vibrations, the bolts must be secured (e.g. with clamping rings or thread locking compound)

Thermal protection

If the linear motor is operated continuously at its rated output, thermal compound should be used, in order to optimize the thermal contact between the coil unit and the mounting surface.

7.5 Dismantling sequence

⚠ WARNING

Damage due to uncontrolled magnetic attractive forces

The specified installation sequence must be followed! Deviation from the sequence may result in dangerous situations due to magnetic attractive forces.

The correct dismantling sequence is as follows:

1. Disconnect the cables from the coil unit.
2. Remove the coil unit from the carriage.
3. Remove the magnet yokes from the support frame of the machine.

8 Electrical installation

8.1 Important notes

⚠ DANGER

Serious risk of injury through electric shock!

- Only staff qualified and trained in electrical engineering are allowed to wire up the motor.
- Check the assignment of the servo drive and servomotor. Compare the rated voltage and the rated current of the devices.
- Always make sure that the motors are de-energized during assembly and wiring, i.e. no voltage may be switched on for any piece of equipment which is to be connected. Ensure that the control cabinet remains turned off (barrier, warning signs etc.). The individual voltages will only be turned on again during commissioning.
- Never undo the electrical connections to the motor when it is live. Control and power leads may be live, even if the motor is not running.

NOTE

Smooth operation

- Ensure that there the servo drive and the motor are earthed properly. See below for further information regarding EMC shielding and earthing. Earth the mounting plate and motor housing. Information about the connection method can be found in the chapter entitled Connection of motors with preassembled cables
- Use only cables approved by Beckhoff for the operation of the AL38xx.
- Route the power and encoder cables as separately as possible from one another (separation > 20 cm). This will improve the immunity of the system to electromagnetic interference.
- Lay all cables with an adequate cross-sectional area according to EN 60204. The recommended cross-section can be found in the technical data.
- Wiring:

  ⇨ Connect the feedback cable

  ⇨ Connect the motor cables

  ⇨ Shielding at both ends (shield terminal or EMC plug)

NOTE

HF interference

- The ground symbol  , which you will find in the wiring diagrams, indicates that you must provide an electrical connection, with as large a surface area as possible, between the unit indicated and the mounting plate in the control cabinet. This connection is to suppress HF interference and must not be confused with the PE (protective earth) symbol (protective measure according to EN 60204).

8.2 Connection of motors with flying wires

If motors with flying wires are ordered, a plug can be assembled as required. The assignment of the signals to the wires is given in the tables below.

Performance

Wire	Signal
Black	U
Red	V
White	W
Green	PE
Braid	shield

Temperature contact

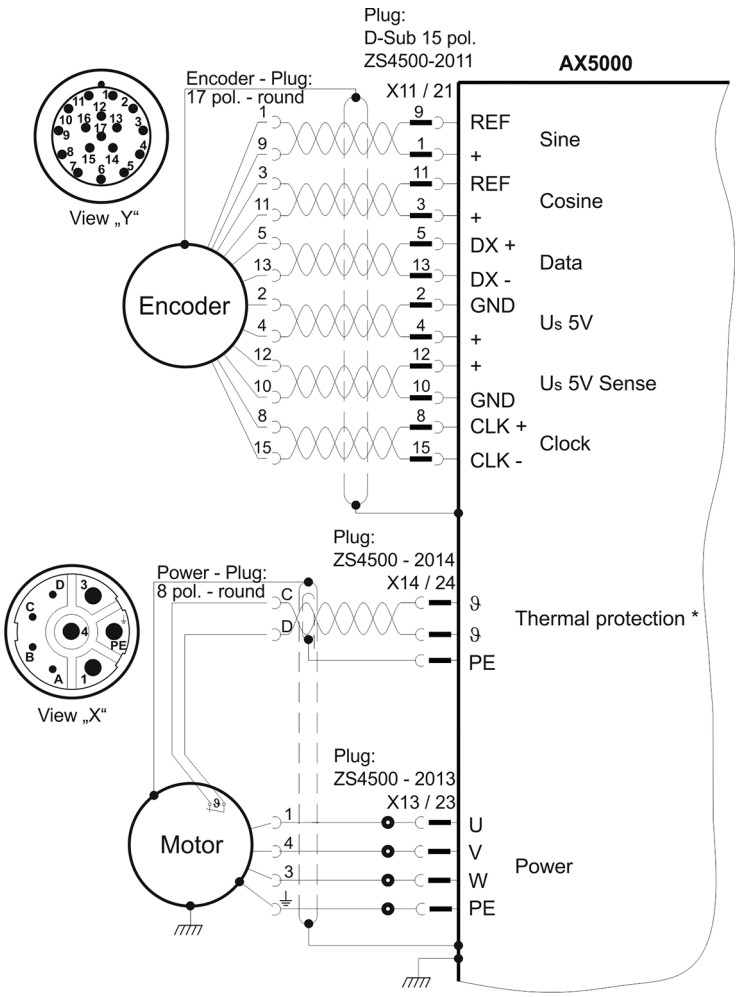
Wire	Signal
White	PTC
Green	NTC
Brown	PTC
Yellow	NTC
Braid	shield

8.3 Connection of motors with preassembled cables

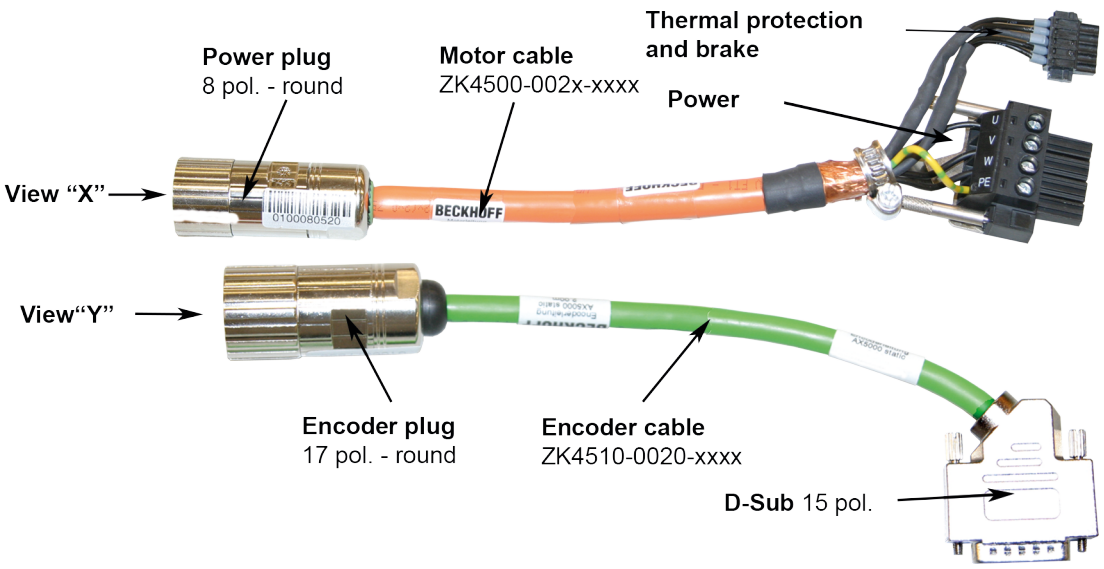
Beckhoff offers preassembled motor and feedback cables for safe, faster and flawless installation of the motors. Beckhoff cables have been tested with regard to the materials, shielding and connectors used. They ensure proper functioning and compliance with statutory regulations such as EMC, UL etc. The use of other cables may lead to unexpected interference and invalidate the warranty.

- Carry out the wiring in accordance with the valid standards and regulations.
- Only use our preassembled shielded cables for the power and feedback connections. Incorrectly installed shielding inevitably leads to EMC interference.
- Cables that move during the operation of the linear servomotor are always to be regarded as wearing parts. It is advisable to install these with the help of a plug connector between the moved cable and the motor cable of the coil unit such that simple replacement is ensured. The minimum bending radius of the respective cable is to be taken from the corresponding data sheets.
- Detailed specifications of the cables can be found on our homepage under Download→ Documentation→ Drive Technology→ Cables.

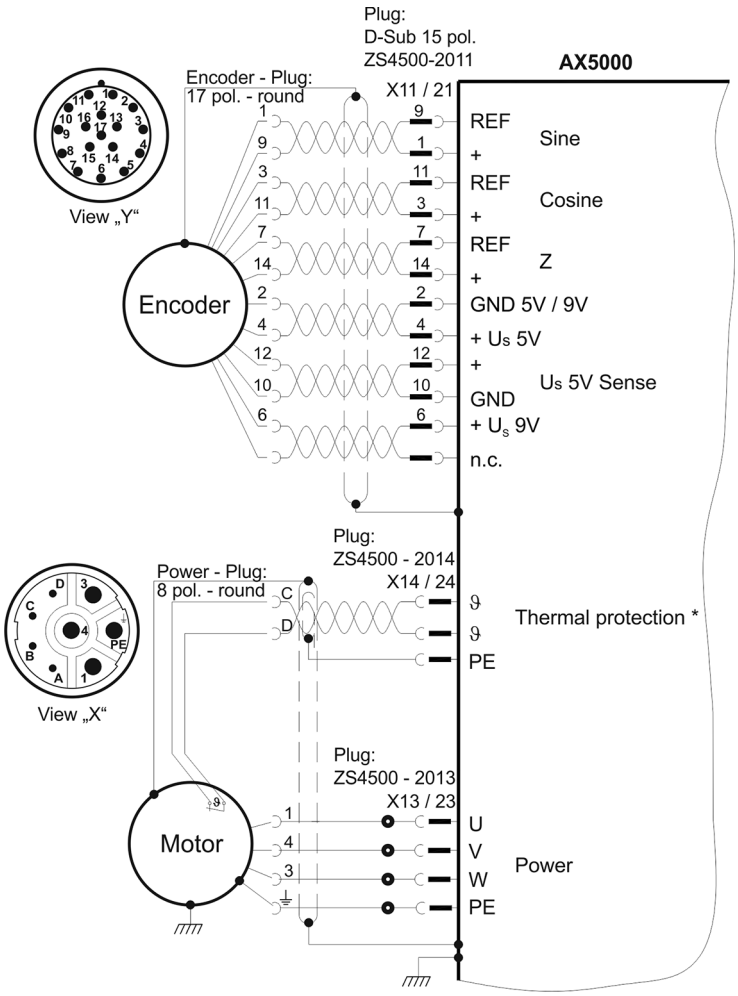
8.3.1 AX5000 connection diagram for AL38xx and absolute value encoder



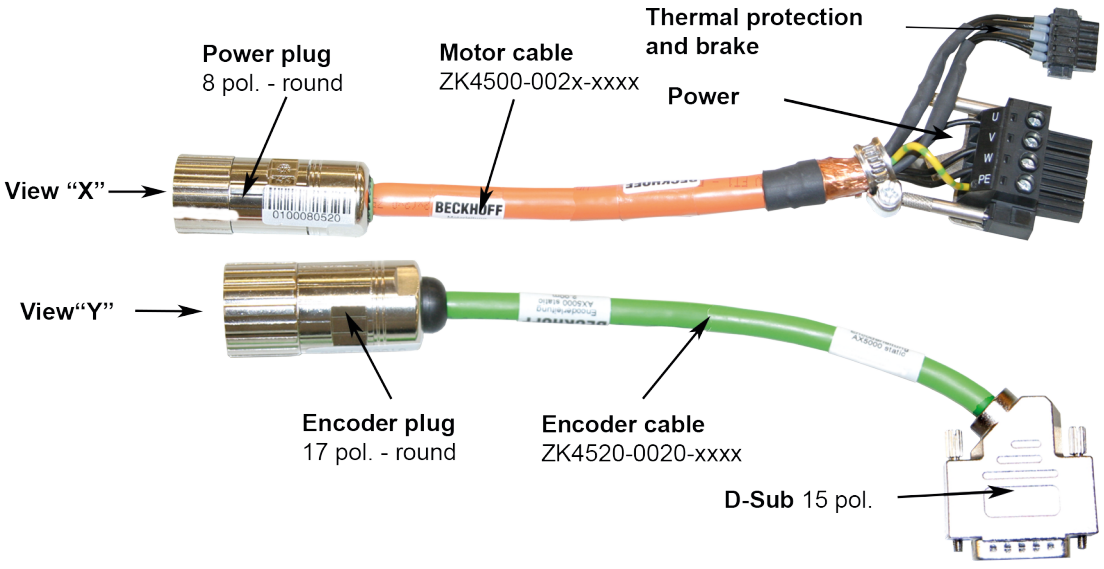
* If no ConnectorBox is used, the ZK4540-0020-xxxx thermal protection contact cable is additionally required. This is to be connected to X14 / 24.



8.3.2 AX5000 connection diagram for AL38xx and Sin/Cos encoder with zero pulse



* If no ConnectorBox is used, the ZK4540-0020-xxxx thermal protection contact cable is additionally required. This is to be connected to X14 / 24.



8.4 Calculation of the brake resistor

During the braking procedure of the linear axis, energy is fed back into the servo drive. During the design the regenerative power must be calculated in order to select a brake resistor if necessary.

To do this the peak and continuous power must be calculated.

$P_{max} = 0.9 * (m * V^2) / (2\ t_b)$

$P_{rated} = P_{max} * t_b / t_z$

P_{max} = maximum power of the brake resistor in Watts (W)

P_{rated} = continuous power of the brake resistor in Watts (W)

M = moved mass (carriage + load) in kg

V = carriage velocity in m/s

t_b = braking time in seconds

t_z = cycle time in seconds

8.5 Temperature sensor

The coil unit is equipped with two temperature sensors, a PTC-1k and a NTC. The temperature sensors are used to monitor the temperature in the coil unit. The temperature cable contains four wires.

8.5.1 PTC specification

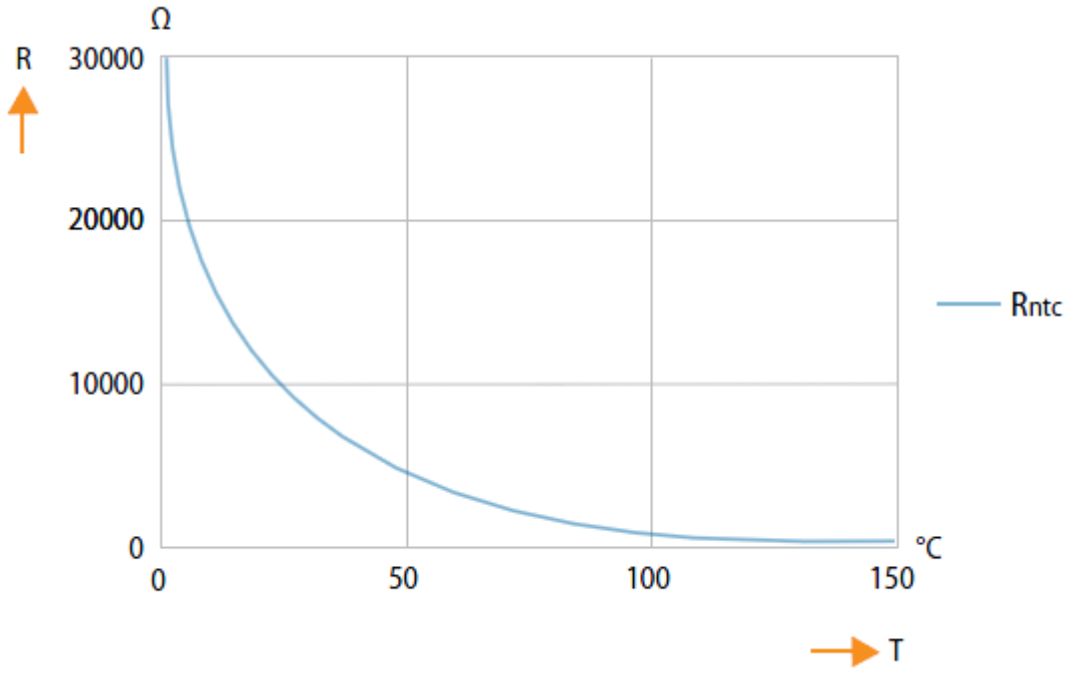
The PTC-1k sensor exhibits a sharp rise in temperature when the temperature is close to a certain critical value, and therefore operates as a digital indicator. A gradual temperature signal can, however, not be generated from this PTC.

At room temperature, the PTC has an electrical resistance of around 65 ohms. As the temperature rises up to a critical temperature, the resistance exhibits an almost linear rise up to 1000 ohms. Above this temperature, the resistance rises exponentially. The switching resistance is therefore 1000 ohms. The servo drive will immediately disconnect the power supply if this resistance is exceeded. This makes it possible to guard against overheating the motor. The thermal protection contact cable must therefore be properly connected to the servo drive.

Temperature	Resistance
Up to 20° C below the critical temperature	< 250 Ω
Up to 5° C below the critical temperature	< 550 Ω
Switching resistance	**> 1000 Ω**
Above the critical temperature	> 1330 Ω

8.5.2 NTC Specification

The NTC sensor is used for temperature monitoring in the coil unit.



Specifications of the NTC sensor	
Tolerance $\Delta R_R / \Delta R_R$	5 %
Max. Power	60 mW

T (°C)	0	10	20	30	40	50	60	70	80	90	100	110	120	130
R_{NTC} (Ω)	32650	19900	12490	8057	5327	3603	2488	1752	1258	918	680	511	389	301

8.6 Polarity test

NOTE

Protection of the linear servomotor

Before the test, make sure that the linear motor system has suitable electrical and mechanical protection.

Ensure that the count direction of the feedback matches the traversing direction of the motor. If this is the case, the motor is connected correctly. If this is not the case, two phases (phases 1 and 3) of the motor cable can be swapped, in order to correct the traversing direction.

All linear servomotors from Beckhoff are wired and connected in exactly the same way, so that a single test is sufficient in order to determine the polarity of a motor/graduated rule combination. If more than one axis is being constructed in a similar way, the polarity will be identical.

9 Commissioning

9.1 Important notes

⚠ CAUTION

Serious risk of injury!

- Only specialist personnel with extensive knowledge in the areas of electrical engineering / drive technology are allowed to install and commission the equipment.
- Check that all live connection points are protected against accidental contact.
- Never undo the electrical connections to the motor when it is live.
- The surface temperature of the motor can exceed 70 °C in operation. Check (measure) the temperature of the motor. Wait until the motor has cooled down below 40 °C before touching it.
- Make sure that, even if the drive starts to move unintentionally, no danger can result for personnel or machinery.

9.2 General commissioning

The procedure for commissioning is described as an example. A different method may be appropriate or necessary, depending on the application of the equipment.

Once you have made sure that that the linear servomotor system of your application is properly mounted, both mechanically and electrically, you can put your linear servomotor system into operation.

9.2.1 Parameterization

Depending on the components used (motor type, feedback system, servo drive) the following specific parameters must be configured:

- the presence and switching mode of the limit switches (normally open / normally closed),
- the presence of an electromechanical brake,
- the type and interface,
- the motor type,
- the maximum continuous current,
- the maximum peak current,
- the switching resistance of the temperature sensor,
- safety settings,
- parameterization of the error reactions: tripping of the limit switches, switching off, overcurrent, overspeed and emergency stop,
- commutation detection,
- parameters for the current controller (*current loop*),
- parameters for the speed controller (*speed loop*),
- parameters for the position controller (*position loop*),

9.2.2 Commissioning

- Check that the drive elements (carriage, magnetic plate, coil unit) are tightly fastened and correctly adjusted.
- Can the carriage move unhindered over the entire motor track without touching the magnet yoke?
- Are the mechanical end-stops, limit switches and buffers properly dimensioned, and are they configured correctly?
- Is the thermal protection contact cable connected?
- Does the combination of the motor and the graduated rule have the correct polarity?
- Check the wiring and connections to the motor and the servo drive. Check that the earthing is correct.
- Test the function of the holding brake, if used.
- Check whether the carriage of the motor can be moved freely (vent the brake beforehand if there is one). Listen out for grinding noises.
- Check that all the required measures against accidental contact with live and moving parts have been carried out.
- Carry out any further tests which are specifically required for your system.
- Now commission the drive according to the commissioning instructions for the servo drive.
- In multi-axis systems, individually commission each drive unit (servo drive/motor(s)).
- Is the track free from foreign bodies?
- Are cables correctly guided?

9.2.3 Optimizing the control settings

Generally speaking, settings made to the current controller do not affect the motor performance. A wide range is also available for adequate possible settings. The settings of the current control depend only on the application parameters of the servo drive and of the motor.

Due to its sensitivity to oscillations, to noise and to delays, the speed control only has limited use as a factor for servo drive power. Please take the time to adjust this controller correctly before the position controller is optimized. In this respect, be sure to also read the instructions in the manuals for the servo drive employed.

Adjustment of the controller

The position controller can only be adjusted correctly if the speed controller has been adjusted correctly beforehand.

9.3 Troubleshooting

The following table is to be seen as a “First Aid” box. There can be a large number of different reasons for a fault, depending on the particular conditions in your system. The fault causes described below are mostly those which directly influence the motor. Peculiarities which show up in the control behavior can usually be traced back to an error in the parameterization of the servo drives.

Information about this can be found in the documentation for the servo drives and the commissioning software.

Error	Possible cause	Measures to remove the cause of the fault
Motor does not move	• Servo drive not enabled • Break in setpoint lead • Motor phases in wrong sequence • Brake not released • Drive is mechanically blocked	• Apply ENABLE signal • Check setpoint lead • Correct the phase sequence • Check brake control • Check mechanism
Motor runs away	• Motor phases in wrong sequence	• Correct the phase sequence
Motor oscillates	• Break in the shielding of the feedback cable • Amplification to high	• Replace the feedback cable • Use the motor default values
Error message: brake	• Short-circuit in the supply voltage lead to the motor holding brake • Voltage too low • Faulty motor holding brake	• Eliminate short-circuit • Increase the voltage • Replace the motor brake
Error message: output stage fault	• Motor cable has short circuit or earth leakage • Motor has short circuit or earth leakage	• Replace motor cable • Replace motor
Error message: feedback	• Connector is not properly plugged in • Break in cable, cable crushed or similar • Internal error	• Check the plug connector • Check cables • Read out the error messages
Brake does not grip	• Required holding torque too high • Brake faulty	• Check the design • Replace the motor brake

For multi-axis systems there may be further hidden reasons for faults.

10 Technical data

10.1 Term definitions

Winding type
The winding type describes the structure of the windings. Depending on the coil unit this can be the N-type or the S-type, which differ in their electrical values. The N-type (normal) represents the standard. The S-type (speed) is characterized by a higher max. speed and a higher current consumption.

Peak force Fp (N)
The peak force specifies the maximum force of the motor. It cannot be constantly generated.

Peak current (IPa)
The peak current is the maximum permissible current.

Continuous force with air cooling (Fca)
The air-cooled motor can apply the force continuously, without water cooling. The value is specified for a motor with an aluminum cooling surface (thermal resistance 0.05K/W) at 20 °C.

Continuous power loss (Pca)
The continuous power dissipation is the max. power dissipation of the motor. It can be used for the calculation of the cooling systems.

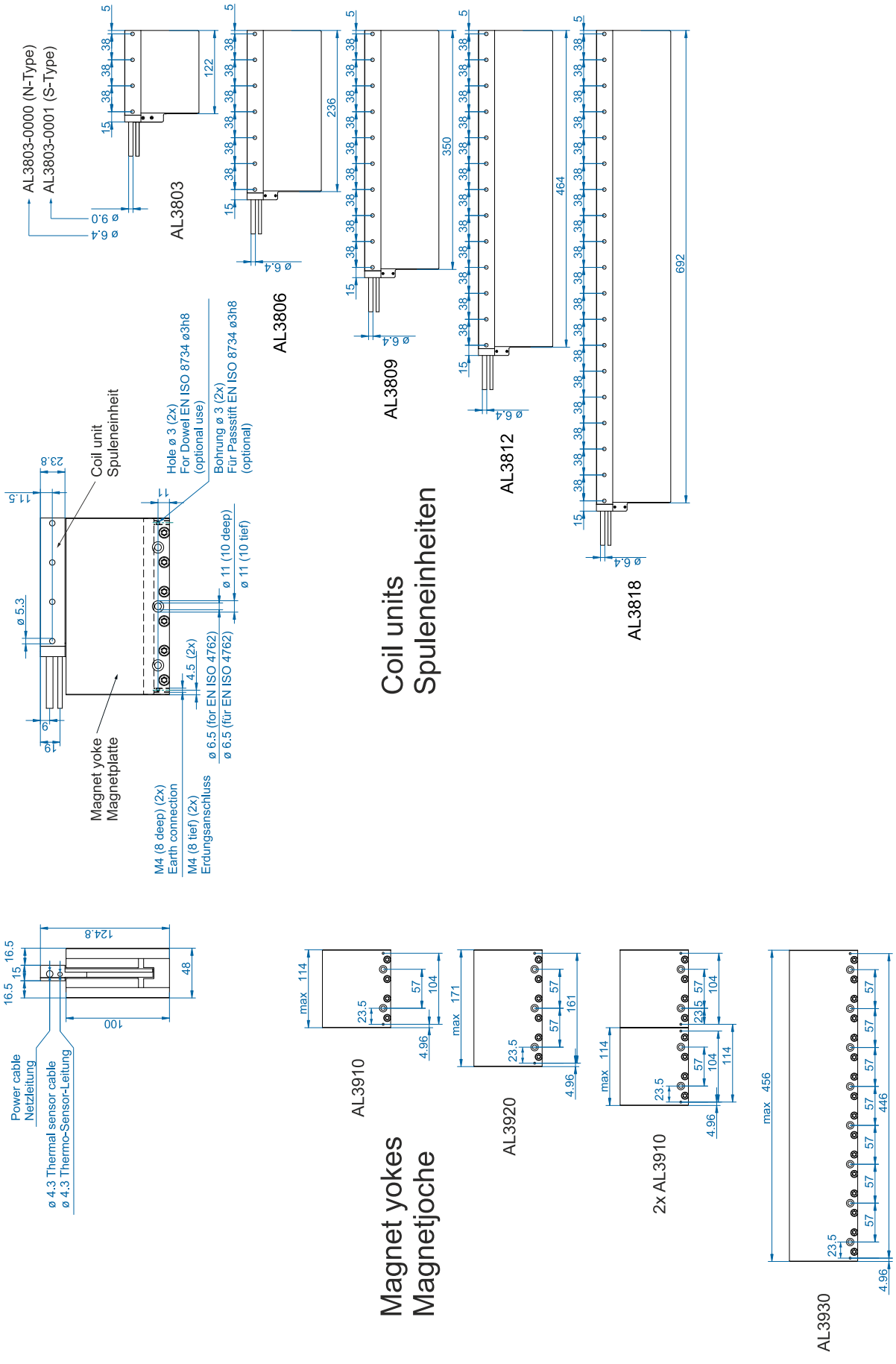
Power constant (Kf)
The power constant specifies how much force in Newtons the motor generates with 1A effective sine current. The following applies: F=I x Kf (up to I = 2 x I0)

Pole spacing
The pole spacing is the period in which the magnetic field (north/south) of the magnetic plate repeats itself.

10.2 AL38xx

Technical data	AL3803	AL3806	AL3809	AL3812	AL3818
Winding type	N / S	N / S	N / S	N / S	N / -
Velocity (max.)	2.7 m/s (N) 6.6 m/s (S)	2.7 m/s (N) 6.6 m/s (S)	2.7 m/s (N) 6.6 m/s (S)	2.7 m/s (N) 6.6 m/s (S)	2.7 m/s (N)
Motor configuration	3-phase synchronous linear motors (230 V AC)				
Peak force 3 s (FP)	700 N	1400 N	2100 N	2800 N	4200 N
Peak current (IPa)	5.6 A (N), 13.9 A (S)	11.3 A (N), 28 A (S)	16.9 A (N), 42 A (S)	22.6 A (N), 56 A (S)	34 A (N)
Continuous force with air cooling (Fca)	141 N	282 N	423 N	564 N	846 N
Continuous current (Ica)	1.14 A (N) 2.8 A (S)	2.27 A (N), 5.6 A (S)	3.4 A (N), 8.4 A (S)	4.5 A (N), 11.2 A (S)	6.8 A (N)
Continuous power loss (Pca)	82 W	165 W	247 N	330 W	494 W
Power constant (Kf)	124 N/A (N), 50.3 N/A (S)				124 N/A (N)
Motor constant (Km)	323 N²/W	647 N²/W	970 N²/W	1293 N²/W	1940 N²/W
Pole spacing	57 mm				
Winding resistance Ph-Ph (Rf)	31.6 Ω (N), 5.2 Ω (S)	15.8 Ω (N), 2.58 Ω (S)	10.6 Ω (N), 1.72 Ω (S)	8 Ω (N), 1.3 Ω (S)	5.2 Ω (N)
Winding inductance Ph-Ph (Lf)	56 mH (N), 9.2 mH (S	28 mH (N), 4.6 mH (S)	18 mH (N), 3 mH (S)	14 mH (N), 2.4 mH (S)	9.4 mH (N)
Thermal resistance (Rth)	1.04 °C/W	0.52 °C/W	0.35 °C/W	0.26 °C/W	0.17 °C/W
Magnetic attractive force (Fa)	0 N				
Weight of the coil unit (Mp)	0.55 kg	0.95 kg	1.35 kg	1.75 kg	2.55 kg
Temperature sensor	PTC 1 kΩ				
Suitable servo drive	AX5x03 (N) AX5x06 (S)	AX5x06 (N), AX5112 (S)	AX5112 (N), AX5125 (S)	AX5112 (N), AX5125 (S)	AX5118 (N)
cable length not assembled	1 m				
Minimum static bending radius	4 x cable diameter				
Power cable outside diameter	6.40 mm				
Power cable configuration	4 x 0.82 mm²				
Sensor cable outside diameter	4.3 mm				
Sensor cable configuration	4 x 0.14 mm²				

10.2.1 Technical drawing AL38xx



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Beckhoff Headquarters

Beckhoff Automation GmbH & Co. KG

Huelshorstweg 20
33415 Verl
Germany

Phone:	+49(0)5246/963-0
Fax:	+49(0)5246/963-198
e-mail:	info@beckhoff.com

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Fax:	+49(0)5246/963-479
e-mail:	service@beckhoff.com

More Information:
www.beckhoff.com

Beckhoff Automation GmbH & Co. KG
Hülshorstweg 20
33415 Verl
Germany
Phone: +49 5246 9630
info@beckhoff.com
www.beckhoff.com