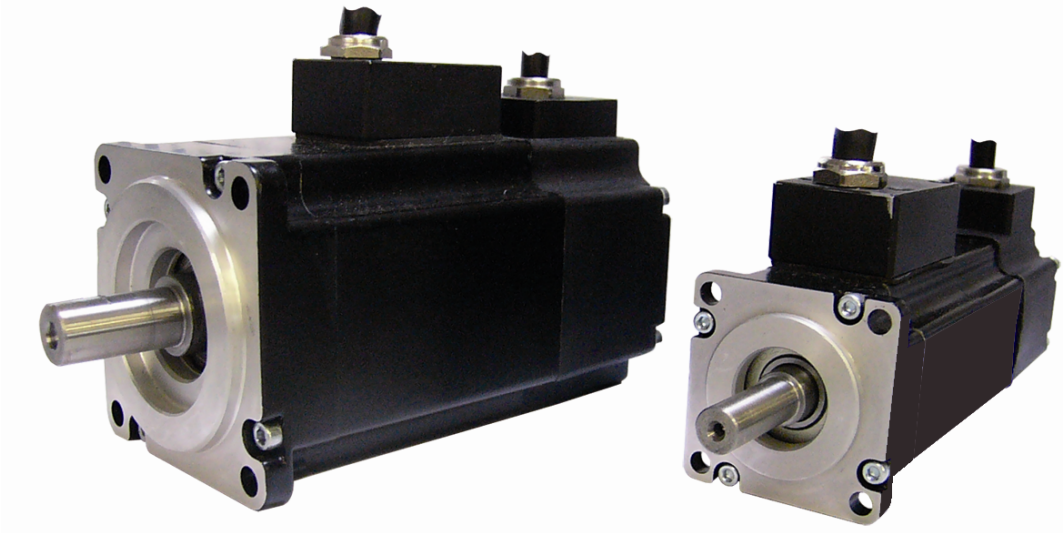


Documentation

Synchronous Servomotor AM3100

Version: 1.4
Date: 2012-04-20

BECKHOFF

Documented motors

AM3100	Standstill torque	Stand-still current	Rated speed	Rated supply voltage	Rotor moment of inertia		Weight	
					without brake	with brake	without brake	with brake
AM3111-030x	0,21 Nm	3,22 A	3000 min^{-1}	24 V DC	0,026 $Kgcm^2$	0,034 $Kgcm^2$	0,40 Kg	0,48 Kg
AM3112-040x	0,34 Nm	3,40 A	3500 min^{-1}	48 V DC	0,046 $Kgcm^2$	0,054 $Kgcm^2$	0,54 Kg	0,62 Kg
AM3121-020x	0,69 Nm	4,60 A	2000 min^{-1}	48 V DC	0,15 $Kgcm^2$	0,20 $Kgcm^2$	0,85 Kg	1,03 Kg

Chapter Page

Table of contents – AM3100

1 Foreword

1.1 Notes on the documentation

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards. It is essential that the following notes and explanations are followed when installing and commissioning these components. The "General safety instructions" and "Special safety instructions for AM3100" sections are also essential.

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.

 **CAUTION**	**Danger for persons, the environment or equipment** The motors are operated in the drive system in conjunction with Beckhoff servo motor EtherCAT terminals. Please observe the entire documentation which consists of: – AM3100 documentation (this manual) – Complete documentation (online and paper) for Beckhoff servo drives available at www.beckhoff.com. – Complete machine documentation (provided by the machine manufacturer)

1.2 Disclaimer

This documentation has been prepared with care. The products described are, however, constantly under development.
For this reason, the documentation may not always have been fully checked for consistency with the performance data, standards or other characteristics described.
If it should contain technical or editorial errors, we reserve the right to make changes at any time and without notice.
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.

1.3 Brands

Beckhoff®, TwinCAT®, EtherCAT®, Safety over EtherCAT®, TwinSAFE® and XFC® are registered and licensed brand names of Beckhoff Automation GmbH.
The use by third parties of other brand names or trademarks contained in this documentation may lead to an infringement of the rights of the respective trademark owner.

1.4 Patents

The TwinCAT technology is patent protected, in particular by the following applications and patents:
EP0851348, US6167425 with the corresponding applications and registrations in various other countries.

1.5 Copyright

1.6 Documentation issue status

Issue	Comment
1.4	**Chapter update:** Documented motors; 8.2.2; 8.2.3; 10.2
1.3	**Chapter update:** 8.2.1; 8.2.2 **New chapter**: 8.2.3
1.2	**Chapter update:** 8.2.1; 8.2.2
1.1	**Chapter update:**

Issue	Comment
	8.2.2
1.0	First issue

1.7 Appropriate use

Synchronous servomotors of the AM3100 series are designed as drives for handling equipment, textile machines, machine tools, packaging machines and similar machines with demanding requirements in terms of dynamics. The motors of the AM3000 and AM3500 series are **exclusively** intended for speed- and/or torque-controlled operation via digital servo motor ETHERCAT terminal - EL7201" from Beckhoff.

 **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 servomotors from the AM3100 series are exclusively designed for installation as components in electrical systems or machines and may only be operated 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** Servomotors of the AM3100 series are **not** classified as products within the meaning of the EC Machinery Directive. Operation of the 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

We,

Beckhoff Automation GmbH
Eiserstr. 5
33415 Verl
Germany

hereby declare, under our sole responsibility, that the product range

motor series AM3100
(types AM3111, AM3112 and AM3121

complies with following relevant regulations:

– EC Directive 2004/108/EC
  Electromagnetic compatibility

– EC Directive 2006/95/EC
  Electrical equipment designed for use within certain voltage limits

Used standards:
EN 60034-1, EN 60034-2, EN 60034-5, EN 60034-6, EN 60034-7

Attachment of the CE marking:	2011
Issued by:	Management
	H. Beckhoff
	Verl, 25.05.2011

3 Safety

3.1 General safety instructions

3.1.1 Personnel qualification

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

3.1.2 Description of safety symbols

The following safety symbols and associated safety instructions are used in this document. These safety instructions must be read and followed.

 DANGER	**Serious risk of injury!** **Failure** to follow the safety instructions associated with this symbol directly endangers the life and health of persons.
 WARNING	**Caution – 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.
Attention	**Damage to the environment or devices!** **Failure** to follow the safety instructions associated with this symbol can lead to damage to the environment or equipment.
 Note	**Tip or pointer** This symbol indicates information that contributes to better understanding.
	**UL note** This symbol indicates important information regarding UL certification.

3.2 Special safety instructions for AM3100

The safety instructions are designed to avert danger and must be followed during installation, commissioning, production, troubleshooting, maintenance and trial or test assemblies.
The servomotors of the AM3100 series are not designed for stand-alone operation and are always installed in 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!** • Never open the servomotor when it is live. Opening the device would invalidate any warranty and liability claims against Beckhoff Automation GmbH. • Negligent, improper handling of the servomotor and bypassing of the safety devices can lead to personal injury or death through electric shock. • Ensure that the protective conductor is connected properly. • The machine manufacturer must prepare a hazard analysis for the machine, and must take appropriate measures to ensure that unexpected movements can not lead to injury to persons or to material damage. • 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 unfavourable conditions arcing may occur, resulting in injury and damage to contacts. • Disconnect the servomotor from the servo terminal and secure it against reconnection.

 **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 servomotor to cool down for at least 15 minutes after it is switched off and use a thermometer to check whether the surface has cooled down sufficiently.

Attention	**Danger for persons, the environment or equipment** • Carefully read this manual before using the 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 servomotor. • Only well trained, qualified electricians with sound knowledge of drive equipment may work on the device. • During installation it is essential to ensure that the specified ventilation clearances and climatic conditions are adhered to. Further information can be found in the "Technical data" and "Mechanical installation" sections. • If a 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 harmonised standards and regulations required for implementation of this Directive in national legislation.

4 Handling

4.1 Transport

- Climate category: 2K3 according to EN 50178
- Transport temperature: -25 °C - +70 °C, max. fluctuation 20 K/hour
- Transport humidity: relative humidity 5% - 95%, non-condensing
- The servomotor may only be transported by qualified personnel and in the manufacturer's original recyclable packaging.
- Avoid hard impacts, particularly at the shaft end.
- If the packaging is damaged, check the motor for visible damage. Inform the transport company and, if necessary, the manufacturer.

4.2 Packaging

- Cardboard packaging with Instapak® foam cushion.
- You can return the plastic portion to the supplier (see Disposal)

Motor type	Carton	Max. stacking height
AM3100	X	10

4.3 Storage

- Climate category 2K3 according to EN50178
- Storage temperature: -80 °C - +55 °C, max. fluctuation 20 K/hour
- Air humidity: relative humidity 5% - 95%, non-condensing
- Max. stacking height: see table Packaging
- Storage time: without limitation
- Store only in the manufacturer’s original recyclable packaging

4.4 Maintenance / Cleaning

- Maintenance and cleaning only by qualified personnel.
- The ball bearings have a grease filling with a service life of 20,000 hours under normal operating conditions. The bearings should be replaced after 20,000 hours of operation under rated conditions.
- Check the motor for bearing noise every 2,500 operating hours or once per year. If any noises are heard, stop the operation of the motor. The bearings must be replaced.
- Opening the motor invalidates the warranty.
- Clean the housing with isopropanol or similar.

Attention	**Destruction of the servomotor** Never immerse or spray the servomotor.

4.5 Disposal

- In accordance with the WEEE 2002/96/EC Directives we take old devices and accessories back for professional disposal, provided the transport costs are taken over by the sender. Please send the devices to:

  Beckhoff Automation GmbH
  Eiserstrasse 5
  33415 Verl

  Germany

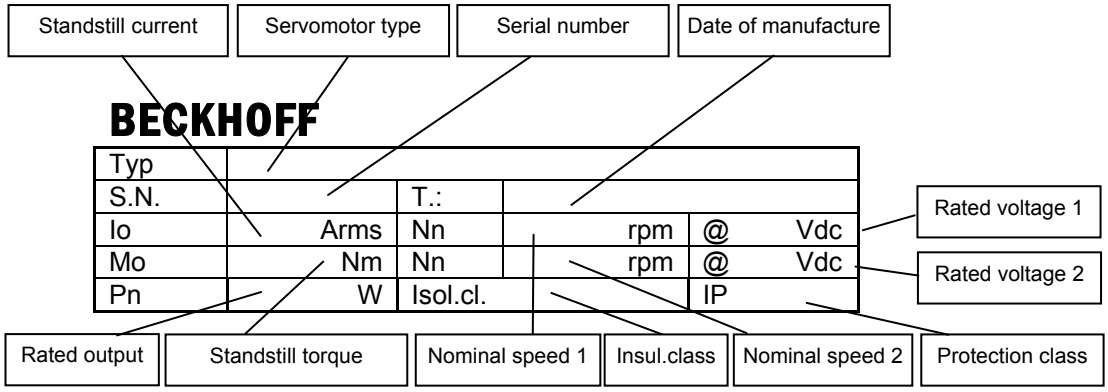
5 Product identification

5.1 Scope of supply

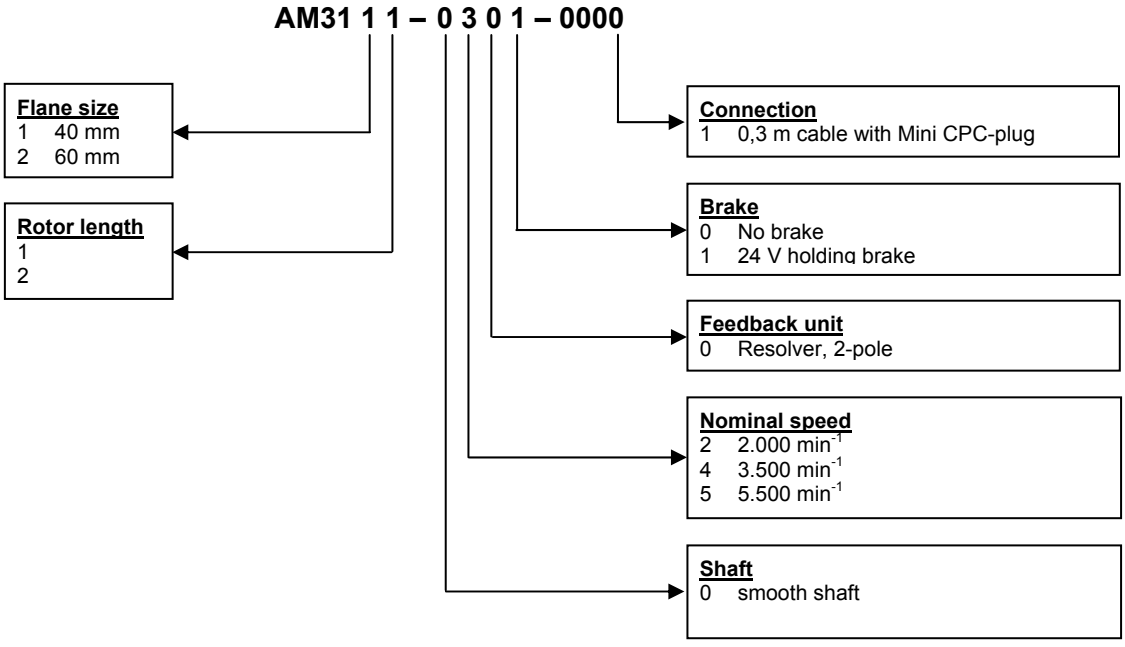
Please check that the delivery includes the following items:

- Motor from the AM3100 series
- Motor package leaflet (short info)

5.2 Nameplate



5.3 Type key



6 Technical description

6.1 Design of the motors

The synchronous servomotors of the AM3100 series are brushless three-phase motors for demanding servo-applications. In conjunction with our digital servo terminal they are particularly suitable for positioning tasks in industrial robots, machine tools, actuators etc. with demanding requirements in terms of dynamics and stability.

The servomotors are equipped with permanent magnets in the rotor. This advanced neodymium magnetic material makes a significant contribution to the motors' exceptional dynamic properties. A three-phase winding is housed in the stator, and this is powered by the servo drive. The motor has no brushes, the commutation being implemented electronically in the servo drive.

The motors normally have an integrated resolver to provide feedback. Beckhoff servo drives analyse the resolver position of the rotor and supply the motors with sine currents.

The motors are available with or without built-in holding brake which is free from backlash. The brake cannot be retrofitted.

The motors have a matt black coating (similar to RAL 9005). The finish is not resistant against solvents (e.g. trichlorethylene, thinners or similar).

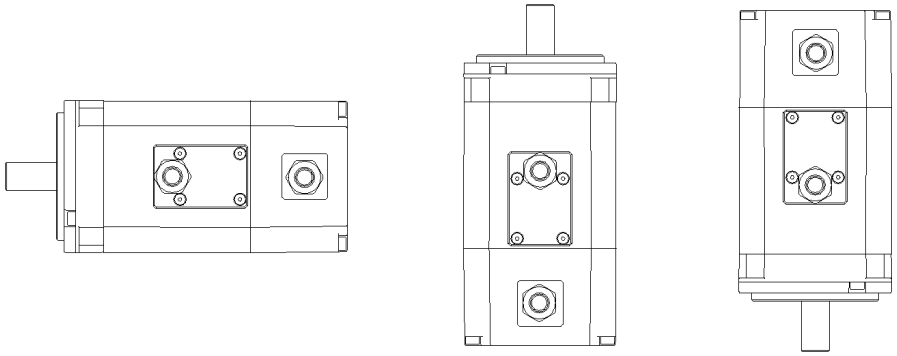
6.2 General technical data

Climate category	2K3 according to EN 50178
Ambient temperature (at rated values)	0 - +40 °C for site altitudes up to 1000 m amsl It is vital to consult our applications department for ambient temperatures above 40 °C and encapsulated installation of the motors.
Permissible humidity (at rated values)	95% relative humidity, non-condensing
Power derating (currents and torques)	For site altitudes above 1000 m amsl and 40 °C 6% at 2000 m amsl 17% at 3000m amsl 30% at 4000m amsl 55% at 5000m amsl No derating for site altitudes above 1000 m amsl with temperature reduction of 10K / 1000m
Ball bearing service life	=20,000 operating hours
Technical data	→ see Section 10
Storage and transport data	→ see Section 4

6.3 Standard features

6.3.1 Style

The basic style for the AM3100 synchronous servomotors is IM B5 according to DIN EN 60034-7.



IM B 5 (B5) IM V 3 (V3) IM V 1 (V)

6.3.2 Shaft end, A-side

Power transmission is made through the cylindrical shaft end A, fit **h7** according to EN 50347. The bearings are designed for a service life of 20,000 hours.

Radial force
If the motors drive via pinions or toothed belts, then high radial forces will occur. The permissible values at the shaft end, depending on the speed, may be read from the diagrams in the Section 10.

Axial force
Axial forces arise when assembling pinions or pulleys on the shaft and using angular gearheads, for example. The permissible maximum values can be found in the technical data.

Coupling
Double-coned collets, possibly in association with metal bellows couplings, have proven themselves as excellent, zero backlash coupling elements.

6.3.3 Flange

Flange dimensions according to IEC standard, fit **h7** accuracy according to DIN 42955
Tolerance class: **N**

6.3.4 Protection class

Standard version (body), except “V3”	IP65
Standard shaft bushing	IP40

6.3.5 Insulation material class

The motors conform to insulation material class F according to IEC 60085.

6.3.6 Vibration class

The motors are made to vibration class A according to DIN EN 60034-14. For a speed range of 600-3600 rpm and a shaft centre height between 56-132 mm, this means that the actual value of the permitted vibration severity is 1.6 mm/s.

Speed [rpm]	Max. rel. vibration displacement [µm]	Max. run-out [µm]
<= 1800	1,9	8
> 1800	1,9	8

6.3.7 Connection technology

The motors are fitted with straight connectors at the cable ends for the power supply and the feedback signals.

The mating connectors are not included in the scope of supply. We can supply preassembled feedback and power cables. Information regarding the cable materials can be found in Section 8.2.

6.3.8 Feedback unit

Standard	Resolver	Two-pole, hollow shaft

Note	**Motor length** The motor length depends on the built-in feedback unit, among other factors. Retrofitting is not possible.

6.3.9 Holding brake

WARNING	**Serious risk of injury!** The holding brake is not personal safety. If the brake is released then the rotor can be moved without a remanent torque!

The AM3100 motors are optionally available with an in-built holding brake. When the brake is de-energised it blocks the rotor. **The holding brakes are designed as standstill brakes** and are not suited for repeated operational braking.

The holding brakes can be controlled directly by the servo terminal (no personal safety!).

Note	**Motor length** The motor length depends on the built-in holding brake, among other factors. It is not possible to fit one at a later date.

6.4 Options

Holding brake
The holding brake is integrated in the motor. It increases the motor length.

6.5 Selection criteria

The three-phase servomotors are designed for operation with servo terminals.
Both units together form a speed or torque control loop.

The main selection criteria are:

- **Standstill torque** **M0 [Nm]**
- **Rated speed at rated supply voltage** **nn [min-1]**
- **Moment of inertia of motor and load** **J [kgcm²]**
- **Effective torque (calculated)** **Mrms [Nm]**

The static load **and** the dynamic load (acceleration/braking) must be taken into account in the calculation of the required motors and servo drives. Formulas and calculation example are available from our applications department on request.

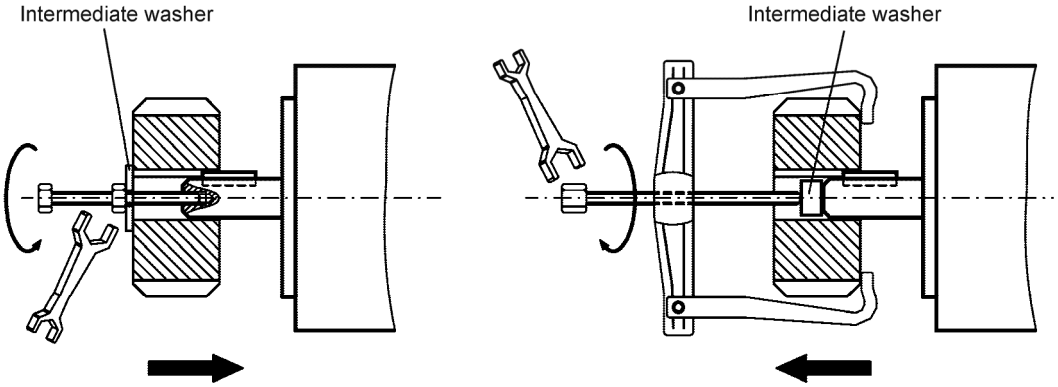
7 Mechanical installation

7.1 Important notes

Attention

Destruction of the motors

- Protect the motors from unacceptable stresses. Take care, especially during transport and handling, that components are not bent and that insulation clearances are not altered.
- The site must be free of conductive and aggressive material. For V3-mounting (shaft end upwards), make sure that no liquids can enter the bearings. If an encapsulated assembly is required, please consult our applications department beforehand.
- Ensure unhindered ventilation of the motors and observe the permissible ambient and flange temperatures. For ambient temperatures above 40 °C please consult our applications department beforehand.
- Servomotors are precision devices. The flange and shaft are especially vulnerable during storage and assembly. It is important to use the locking thread which is provided to tighten up couplings, gear wheels or pulleys and warm up the drive components, where possible. Blows or the use of force will lead to damage to the ball bearings and the shaft.



- Wherever possible, use only backlash-free, frictionally-locking collets or couplings. Ensure correct alignment of the couplings. A displacement will cause unacceptable vibration and the destruction of the ball bearings and the coupling.
- For toothed belts, it is vital to observe the permissible radial forces. An excessive radial load on the shaft will significantly shorten the life of the motor.
- Avoid axial loads on the motor shaft, as far as possible. Axial loading significantly shortens the life of the motor.
- In any case, avoid creating a mechanically constrained motor shaft mounting by using a rigid coupling with additional external bearings (e.g. in a gearbox).
- Take note of the no. of motor poles and the no. of resolver poles and ensure that the correct setting is made in the used servo drives. An incorrect setting can lead to the destruction of the motor, especially with small motors.
- Check compliance the permitted radial and axial loads F_R and F_A. When using a toothed belt drive, the **minimum** permitted diameter of the pinion follows from the equation: $d_{\min} \geq \frac{M_0}{F_R} x2$

8 Electrical installation

8.1 Important notes

 **WARNING**	**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 terminal and the motor. Compare the rated voltage and the rated current of the devices. • Always make sure that the motors are de-energised 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.
Attention	**Smooth operation** • Ensure that there the servo terninal and the motor are earthed properly. See below for further information regarding EMC shielding and earthing. Earth the mounting plate and motor housing. Further details of connection types can be found in Section 8.2 • Route the power and control cables as separately as possible from one another (separation > 20 cm). This will improve the immunity of the system to electromagnetic interference. If a motor power cable is used which includes integral brake control leads, then these brake control leads must be shielded. The shielding must be connected at both ends (see below). • Wiring: Connect the resolver Connect the motor cables Connect shields to shield terminals or EMC connectors at both ends Connect the motor holding brake
 **Attention**	**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). Follow the instructions in the circuit diagrams in Sections 8.3 to 8.6

8.2 Connection of motors with pre-assembled 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.
- Connect up the shielding according to the wiring diagrams in sections 8.2.3 Incorrectly installed shielding inevitably leads to EMC interference.

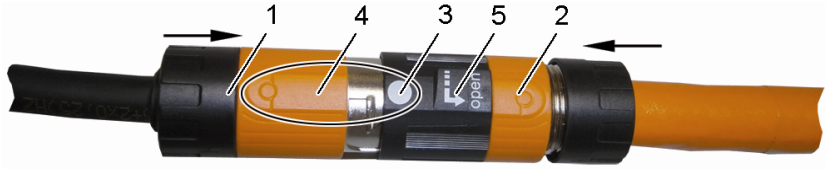
All available cable types are listed below. Should you require additional information please contact our support.

8.2.1 Cables

Motor cable with signal line

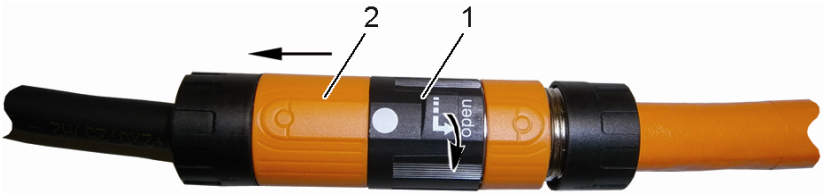
Connecting the plug connection:

Align the two plug connector (1) and (2) such that the white marking point (3) and the area (4) line up. Push the two plug connectors together in the direction of the arrow. Ensure that the black locking ring (5) can turn freely. Press the two plug connectors together until the locking point is reached.



To disconnect the plug connection:

Hold the plug connector (2), turn the black locking ring (1) downwards in the direction of the arrow and hold it in this position. Now pull the plug connector (2) apart to the left in the direction of the arrow.



Specification	**4x0,75 + (2x0,5)**
General data	
Weight	120,0 kg / km
Min. bending radius	36 mm (fixed installation), 88 mm (dynamic)
Overall diameter	8,8 mm +/-0,4 mm
Max. velocity	300 m/min
Max. acceleration	50 m/s²
Max. no. of cycles	10 Millionen
Max. horizontal length	50 m
Max. vertical length	5 m
Max. tensile load	10 N/mm²
Operating temperature	-20 to +60° C
Standards and features	
UL AWM listed	80°C - 300V
CSA AWM listed	80°C - 300V

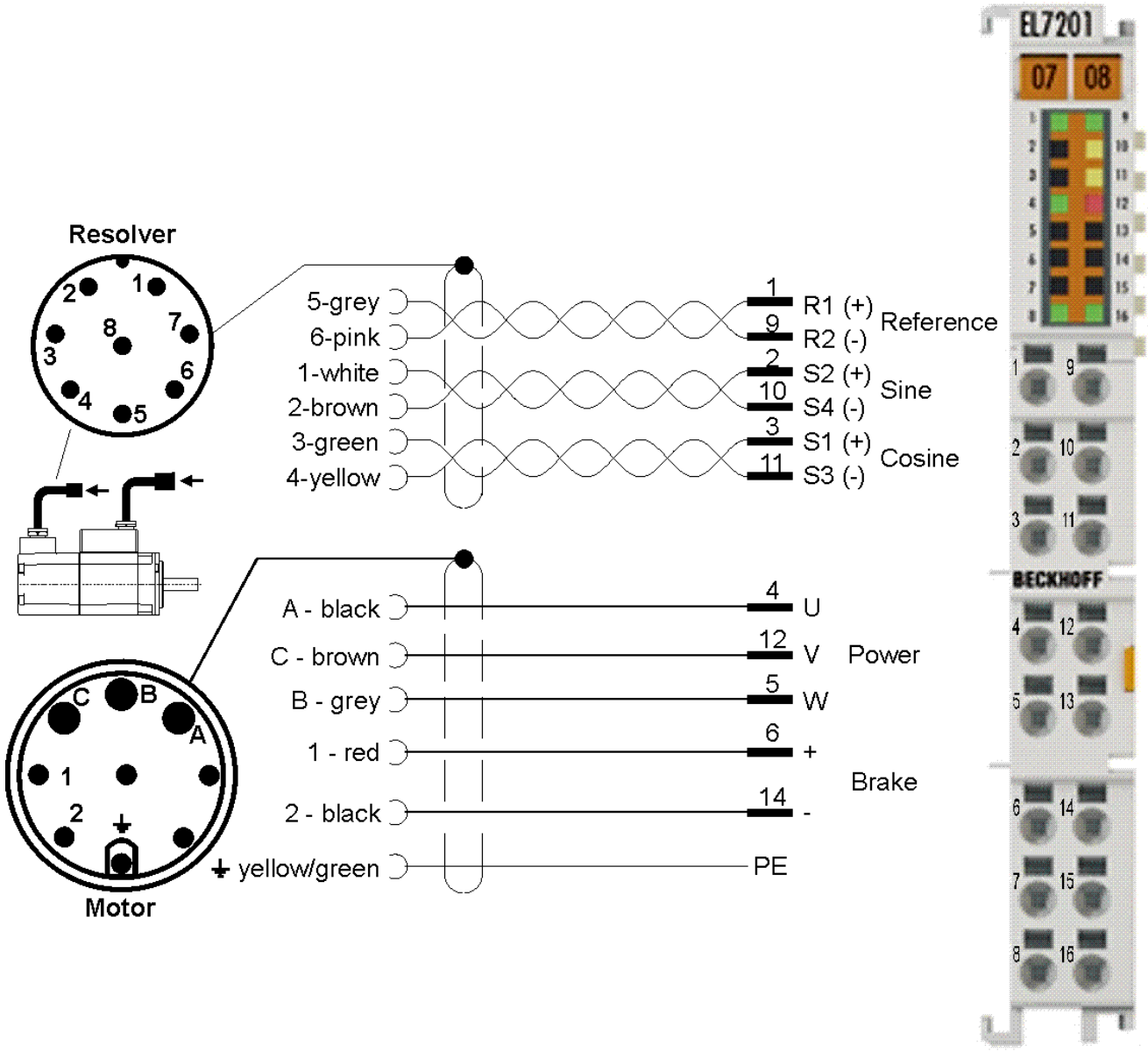
Flame resistance	DIN EN 50265-2-1
Oil resistance	UL 1581
Silicone-free	yes
CFC-free	yes
Halogen-free	yes
Sheath	
Material	TMPU halogen free according to UL AWM & CSA AWM
Shielding	tinned copper braid
Separator	Polyester strap
Colour	Ral 2003 orange
Power leads	4 x 0,75mm²
Conductor material	blank copper Cl.5 DIN EN 60228; VDE 0295; IEC 60228)
Insulation	TEO Flexene® polymer compound. according to UL AWM & CSA AWM
Colour code	black (1-3) + green yellow
Signal leads	2 x 0,50 mm²
Conductor material	blank copper Cl.5 DIN EN 60228; VDE 0295; IEC 60228)
Insulation	TEO Flexene® polymer compound. according to UL AWM & CSA AWM
Structure	
Shielding per pair	
Separator	Polyester foil
Colour code for signal pairs	1 pair
1st pair	Black and red
Electrical specifications	
Test conditions	20 °C
Test voltage - power leads (conductor/conductor - conductor/shielding) Test voltage - signal leads (conductor/conductor - conductor/shielding) Requirement	1,0 KV eff. 5 min 0,5 KV eff. 1min
Operating voltage	< 300 V
Conductor resistance	IEC 60228 Cl.5
Insulation resistance	>20 MOhm xKm
Capacitance	
Power	max. 100 pF / m
Signals	max. 120 pF / m

Resolver cable

Specification	Resolver cable **3x(2x0.25)**
General data	
Weight	77,0 kg / km
Min. bending radius	33 mm (fixed installation), 50 mm (dynamic)
Overall diameter	6,6 mm +/-0,4 mm
Max. velocity	240 m/min
Max. acceleration	30 m/s²
Max. no. of cycles	10 million
Max. horizontal length	20 m

Max. vertical length	5 m
Max. tensile load	20 N/mm²
Operating temperature	-20 to +60° C
Standards and features	
UL AWM listed	80°C - 300V
CSA AWM listed	80°C - 300V
Flame resistance	DIN EN 50265-2-1
Oil resistance	UL 1581
Silicone-free	yes
CFC-free	yes
Halogen-free	yes
Sheath	
Material	TMPU halogen free according to UL AWM & CSA AWM
Shielding	tinned copper braid
Separator	Polyester strap
Colour	Ral 6018 green
Signal leads	6 x 0,25 mm²
Conductor material	blank copper Cl.5 DIN EN 60228; VDE 0295; IEC 60228)
Insulation	TEO Flexene® polymer compound according to UL AWM & CSA AWM
Structure	Pair-wise twisted
Separator	Polyester foil
Colour code for signal pairs	3 pairs
1st pair	Brown and white
2nd pair	Green and yellow
3rd pair	Pink and gray
Electrical specifications	
Test conditions	20 °C
Test voltage (conductor/conductor - conductor/shielding) Requirement	0,5 Kv eff. 1min
Operating voltage	< 30V
Conductor resistance	< 77,8 Ohm IEC 60228 Cl.5
Insulation resistance	>200MOhm xKm
Capacitance	max. 120 pF / m

8.2.2 EL7201 connection diagram for AM3100 motors with resolver



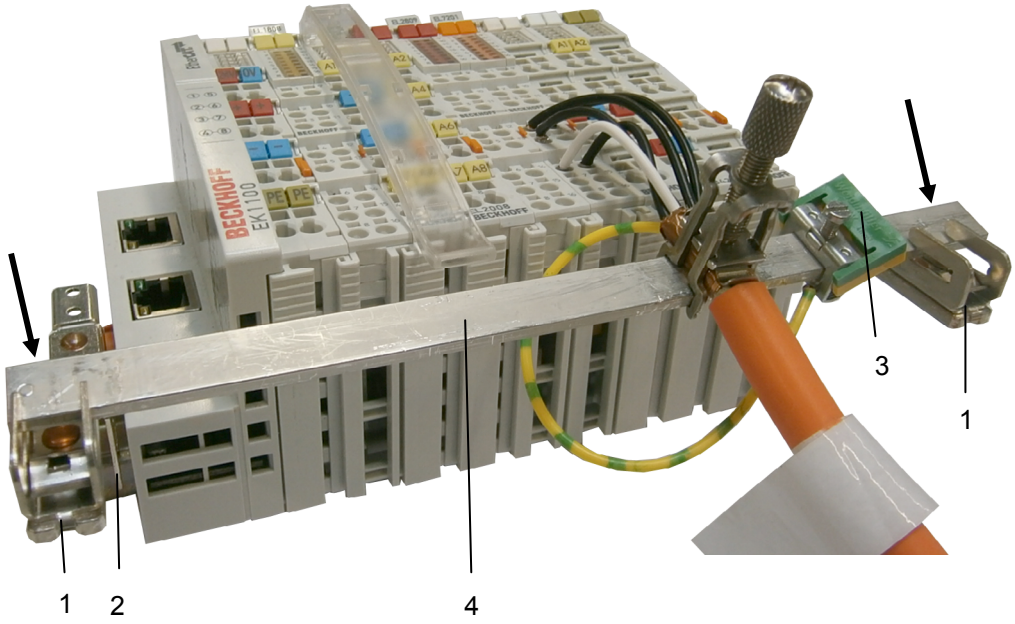
Motor cable: ZK4704-0411-2xxx

Resolver cable: ZK4724-0410-2xxx

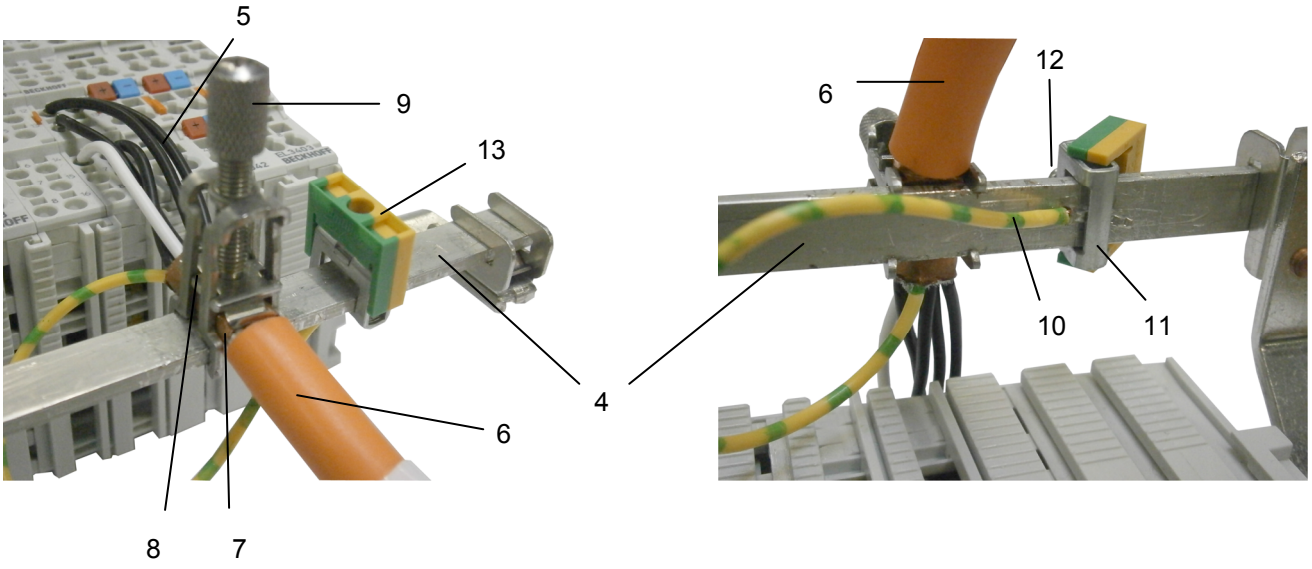
8.2.3 Shielding concept

Together with the shield busbar, the prefabricated cables from Beckhoff offer optimum protection against electromagnetic interference.

Connection of the motor cable to the shield busbar
Fasten the shield busbar supports (1) to the DIN rail (2). The DIN rail (2) must be in contact with the metallic rear wall of the control cabinet over a wide area. Push the PE clip over the shield busbar (4) and press the shield busbar (4) into the receptacles of the shield busbar supports (1).



Connect the cores (5) of the motor cable (6) and then fasten the copper-sheathed end (7) of the motor cable (6) to the shield busbar (4) using the shield clamp (8). Tighten the screw (9) to the stop.
Secure the PE core (10) of the motor cable (6) under the PE clip (11) and securely tighten the screw (12) of the PE clip. Move the indicator bracket (13) into the vertical position and lock it.



Connection of the feedback cable
The shield of the feedback cable is connected via the metallic plug fastener when screwing the feedback plug onto the AM3100.

9 Commissioning

9.1 Important notes

 **WARNING**	**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. • The surface temperature of the motor can exceed 100 °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 Guide for 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.

- Check the assembly and orientation of the motor.
- Check the drive components (coupling, gear unit, pulley) for the correct seating and setting (observe the permissible radial and axial forces).
- Check the wiring and connections to the motor and the servo terminal. Check that the earthing is correct.
- Test the function of the holding brake, if used. (apply 24 V, the brake must be released).
- Check whether the rotor of the motor revolves freely (release the brake, if necessary). 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 terminal.

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 behaviour can usually be traced back to an error in the parameterisation of the servo drive. The documentation for the servo terminal provides information on these matters.

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

Our applications department can give you further help with your problems.

Fault	Possible cause	Measures to remove the cause of the fault
Motor doesn't rotate	• Servo terminal not enabled • Break in setpoint lead • Motor phases in wrong sequence • Brake not released • Drive is mechanically blocked	• Supply 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 feedback cable • Use motor default values
Error message: brake	• Short-circuit in the supply voltage lead to the motor holding brake • Faulty motor holding brake	• Remove the short circuit • Replace motor
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	• Check connector • Check cables
Brake does not grip	• Required holding torque too high • Brake faulty	• Check the dimensioning • Replace motor

10 Technical data

All data valid for 40 °C ambient temperature and 100 K overtemperature of the winding.
The data can have a tolerance of +/- 10%.

10.1 Term definitions

Standstill torque M_0 [Nm]
The standstill torque can be maintained indefinitely at a speed n<100 rpm and rated ambient conditions.

Rated torque M_n [Nm]
The rated torque is produced when the motor is drawing the rated current at the rated speed.
The rated torque can be produced indefinitely at the rated speed in continuous operation (S1).

Standstill current I_{0rms} [A]
The standstill current is the effective sinusoidal current which the motor draws at n<100 rpm to produce the standstill torque.

Peak current (pulse current) I_{0max} [A]
The peak current (effective sinusoidal value) is approximately equivalent to 4-times the rated standstill current.
The peak current of the servo drive used must be smaller.

Torque constant K_{Trms} [Nm/A]
The torque constant defines how much torque in Nm is produced by the motor with 1A r.m.s. current. The relationship is $M=I \times K_T$ (up to $I = 2 \times I_0$)

Voltage constant K_{Erms} [mVmin]
The voltage constant defines the induced motor EMF, as an effective sinusoidal value between two terminals, per 1000 rpm.

Rotor moment of inertia J [kgcm²]
The constant J is a measure of the acceleration capability of the motor. For instance, at I_0 the acceleration time t_b from 0 to 3000 rpm is given as:

$$t_b\,[S] = \frac{3000\ x\ 2\pi}{M_0\ x\ 60s}\ x\ \frac{m^2}{10^4\ cm^2}\ x\ J$$

with M_0 in Nm and J in $kgcm^2$

Thermal time constant t_{TH} [min]
The constant t_{TH} defines the time for the cold motor, under a load of I_0 to heat up to an overtemperature of 0.63 x 100 Kelvin.
This temperature rise happens in a much shorter time when the motor is loaded with the peak current.

Release delay time t_{BRH} [ms] / Application delay time t_{BRL} [ms] of the brake
These constants define the response times of the holding brake when operated with the rated voltage from the servo drive.

10.2 Electrical and mechanical data

Technical Data		Symbol [Unit]	AM 3111	AM 3112	AM 3121
Electrical data					
	Standstill torque *	M_0 [Nm]	0,21	0,34	0,69
	Standstill current	I_{orms} [A]	3,22	3,40	4,60
	Max. mechanical speed	N_{max} [min^{-1}]	6000	6000	6000
	Max. rated mains voltage	U_N [VDC]	48	48	48
U_N = 24V	**Rated speed**	**N_n [min^{-1}]**	**3000**	**–**	**–**
	Rated torque *	M_n [Nm]	0,16	–	–
	Rated output	P_n [kW]	50	–	–
U_N = 48V	**Rated speed**	**N_n [min^{-1}]**	**5500**	**3500**	**2000**
	Rated torque *	M_n [Nm]	0,09	0,28	0,65
	Rated output	P_n [kW]	50	100	140
	Peak current	I_{0max} [A]	10,6	11,2	15,2
	Peak torque	M_{0max} [Nm]	0,48	0,96	1,95
	Torque constant	K_{Trms} [Nm/A]	0,050	0,094	0,141
	Voltage constant	K_{Erms} [mVmin]	3,0	5,7	8,5
	Winding resistance Ph-PH	R_{25} [Ω]	0,92	1,00	0,81
	Winding inductance Ph-Ph	L [mH]	0,70	1,42	1,9

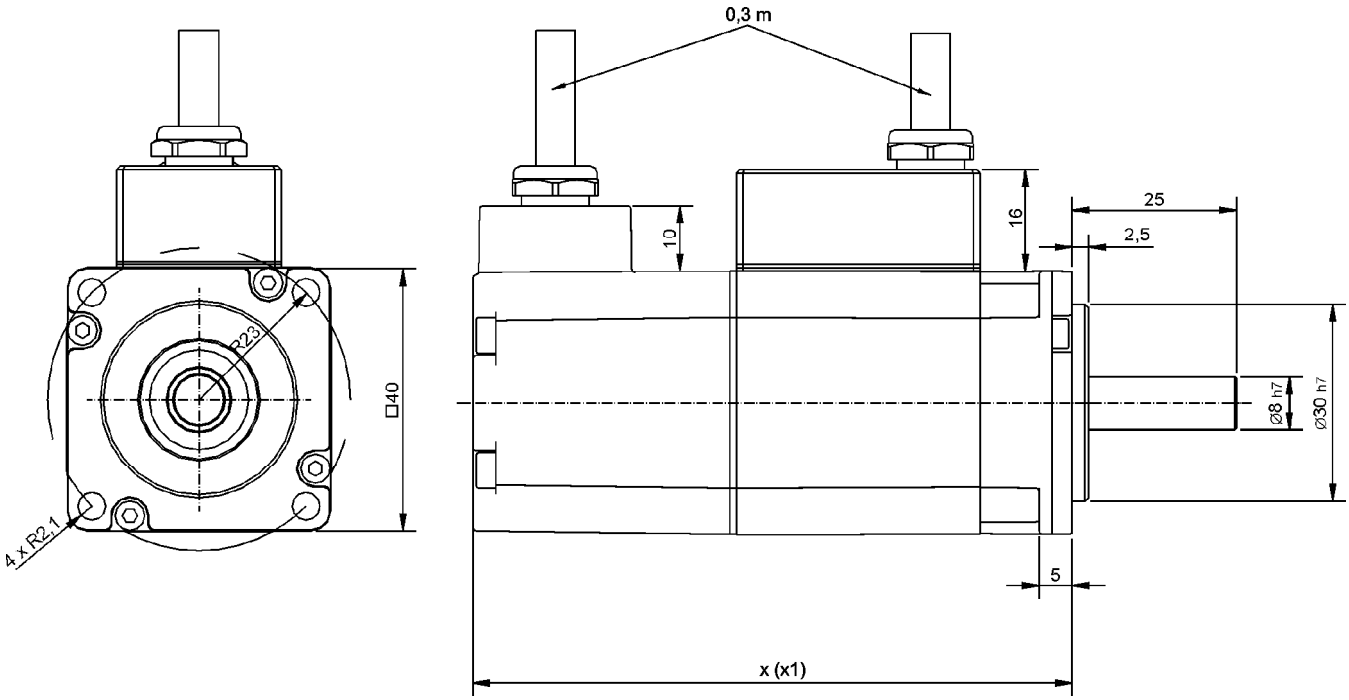
* reference flange aluminium 250 mm x 250 mm x 6 mm

Mechanical data	Symbol [Unit]	AM 3111	AM 3112	AM 3121
Rotor moment of inertia	J [$kgcm^2$]	0,026	0,046	0,15
Pole number		8	8	8
Static friction torque	M_R [Nm]	0,0048	0,0096	0,0195
Thermal time constant	t_{TH} [min]	20	20	30
Weight, standard	G [kg]	0,40	0,54	0,85
Permitted radial force at shaft end	see chapter	10.3.1	10.4.1	10.5.1
Permitted axial force	see chapter	10.3.1	10.4.1	10.5.1

Data for optional brake

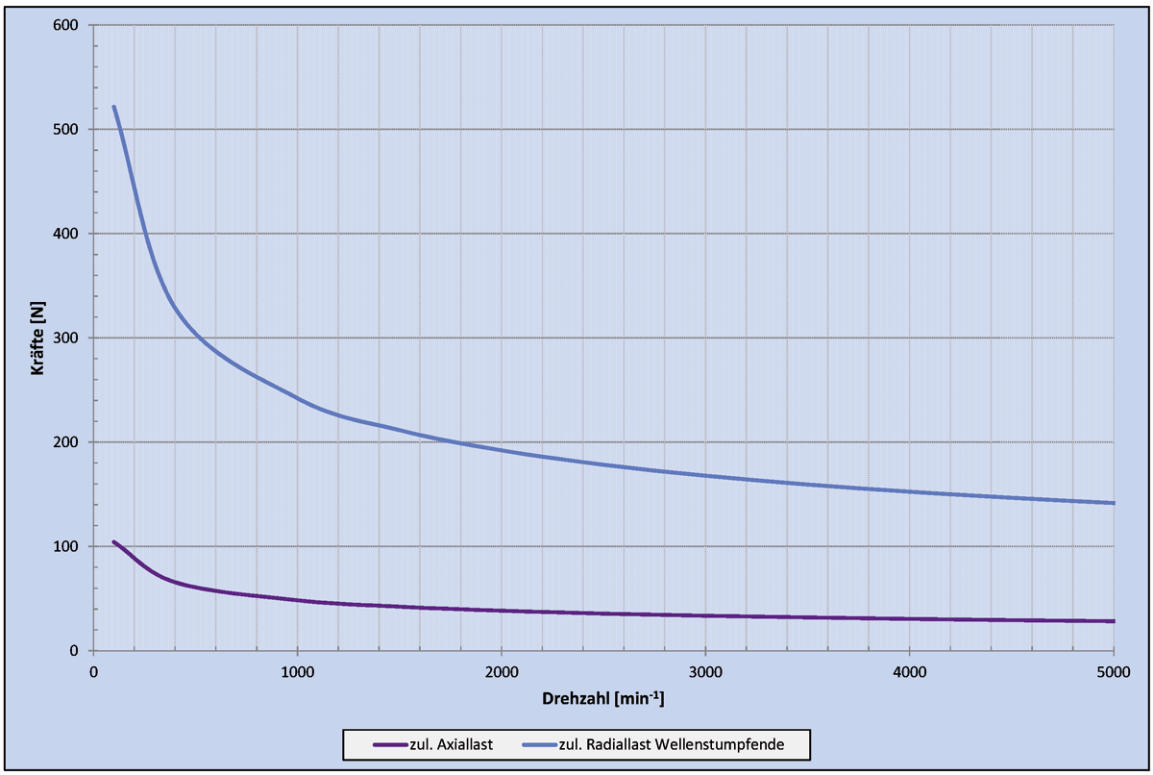
Data	Symbol [Unit]	AM3111	AM3112	AM3121
Holding torque	MB_R [Nm]	0,4	0,4	2
Supply voltage	U_{BR} [VDC]	24 +6% -10%	24 +6% -10%	24 +6% -10%
Electrical power	P_{BR} [W]	8	8	11
Current	I_{ON} [A]	0,34	0,34	0,46
Release delay time	t_{BRH} [ms]	10	10	25
Application delay time	t_{BRL} [ms]	6	6	6
Moment of inertia	J_{BR} [$kgcm^2$]	0,008	0,008	0,05
Weight, standard	G [kg]	0,08	0,08	0,184
Typical backlash	[° mech.]	0	0	0

10.3 Dimensional drawing AM3111



Motor type	Resolver	
	x - without brake	x1 - with brake
AM3111	91	122

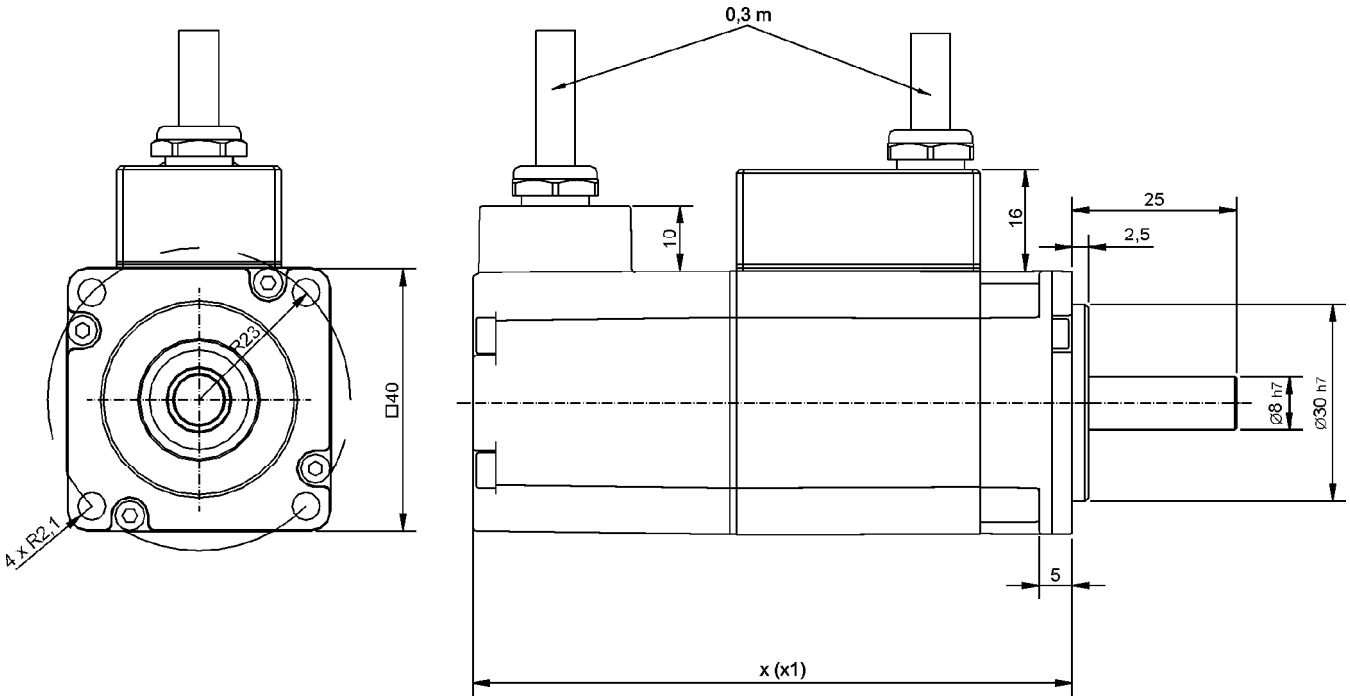
10.3.1 Radial / axial forces at the shaft end



10.3.2 Characteristic torque / speed curves

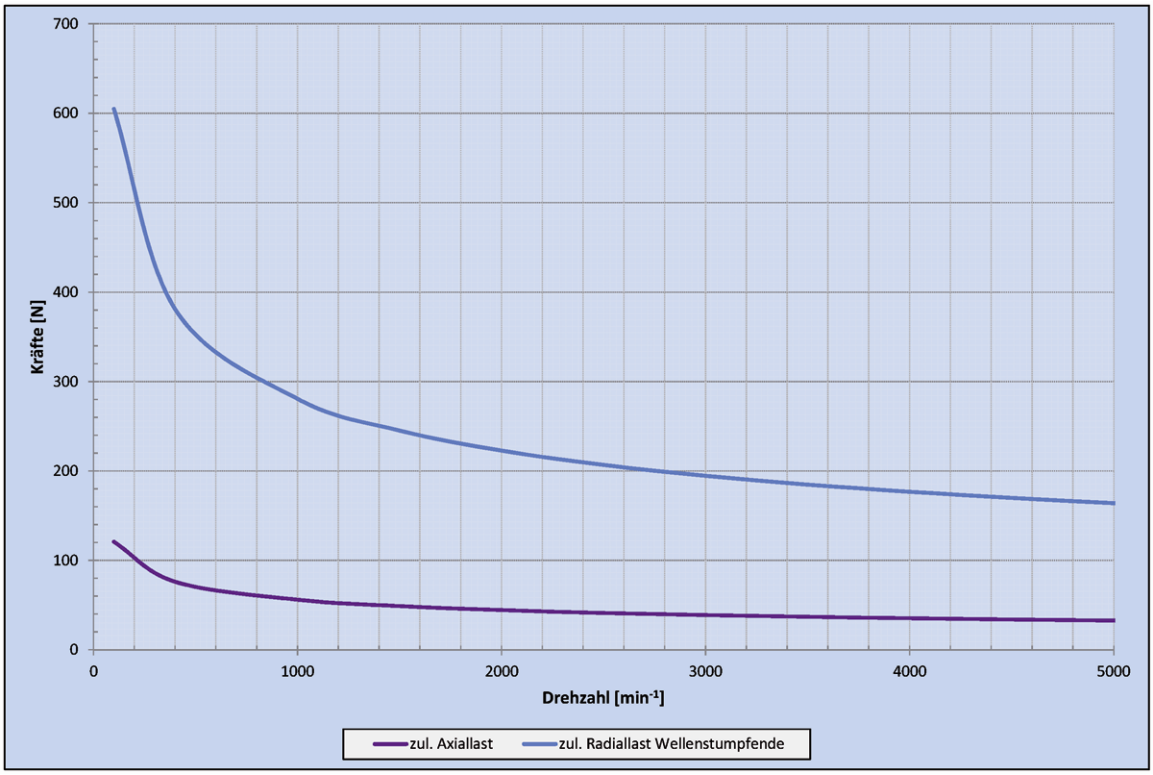
Characteristic torque / speed curves see section 10.5.

10.4 Dimensional drawing AM3112



Motor type	Resolver	
	x - without brake	x1 - with brake
AM3112	109	140

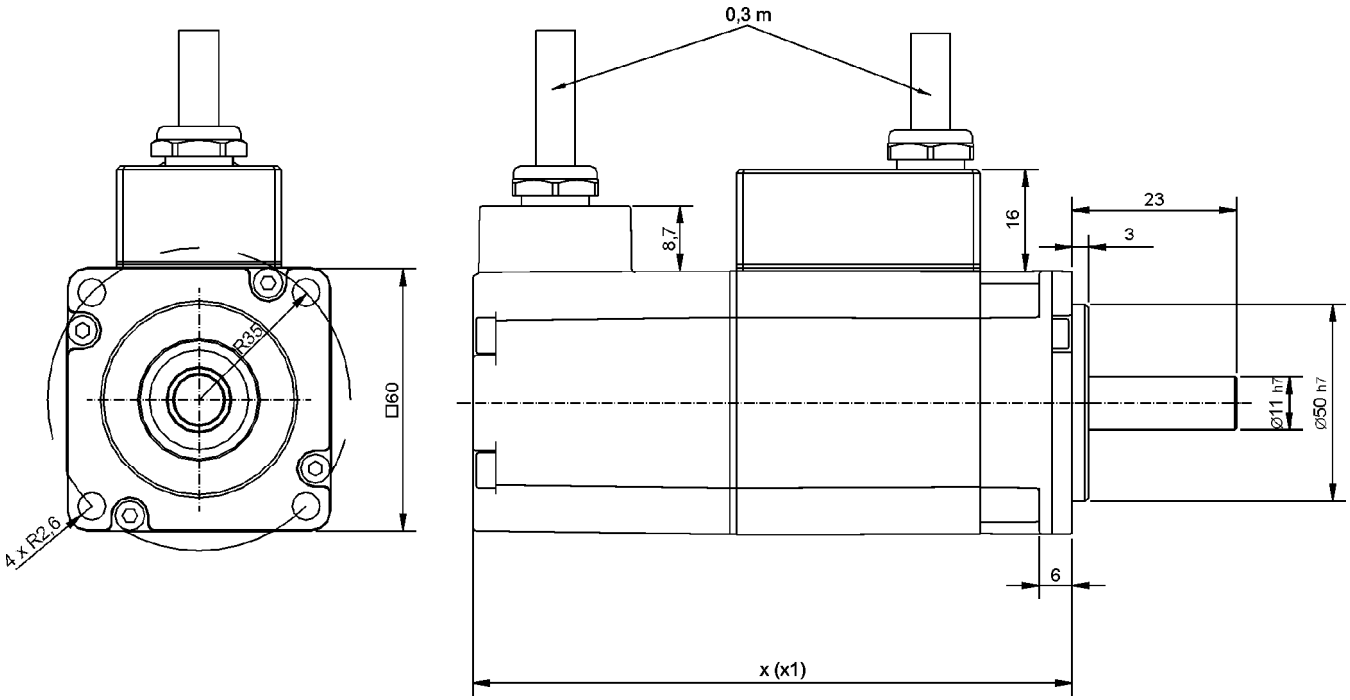
10.4.1 Radial / axial forces at the shaft end



10.4.2 Characteristic torque / speed curves

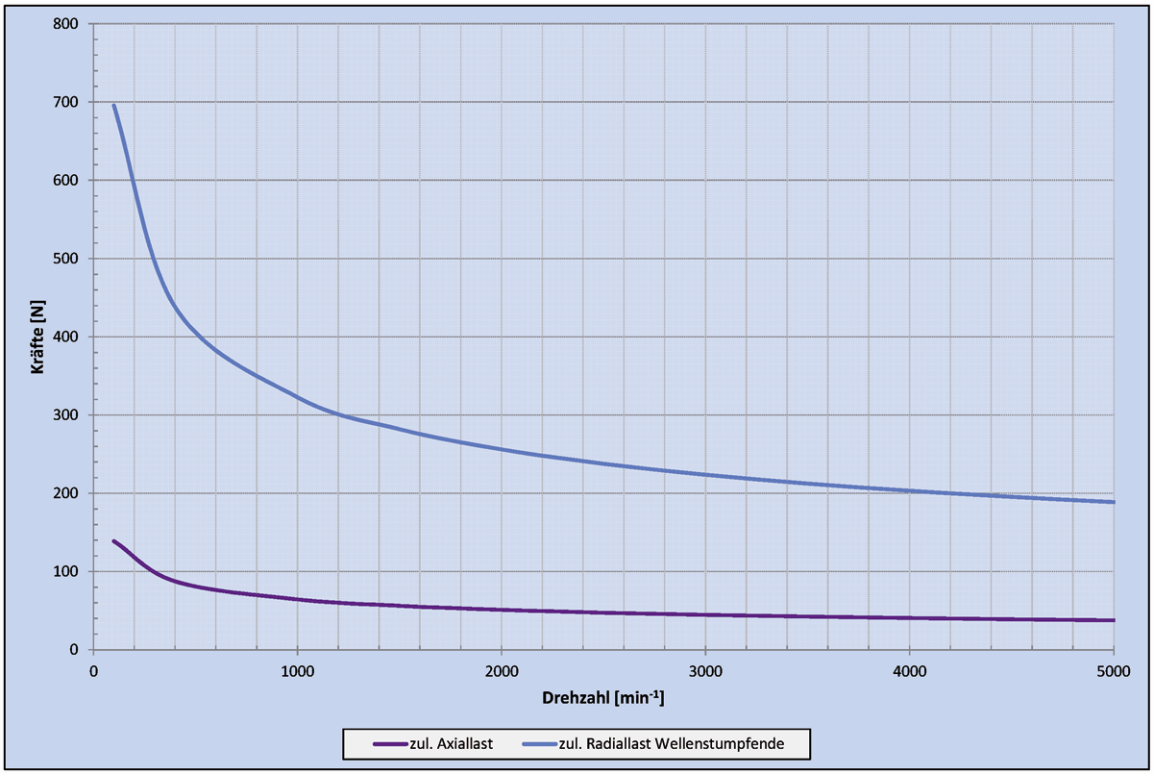
Characteristic torque / speed curves see section 10.5.

10.5 Dimensional drawing AM3121



Motor type	Resolver	
	x - without brake	x1 - with brake
AM3121	111	148

10.5.1 Radial / axial forces at the shaft end

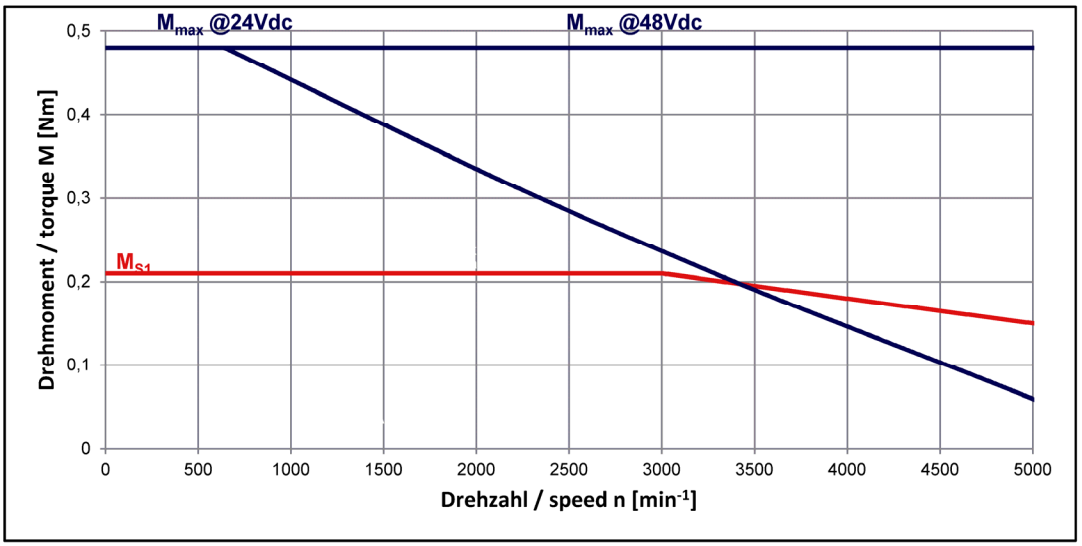


10.5.2 Characteristic torque / speed curves

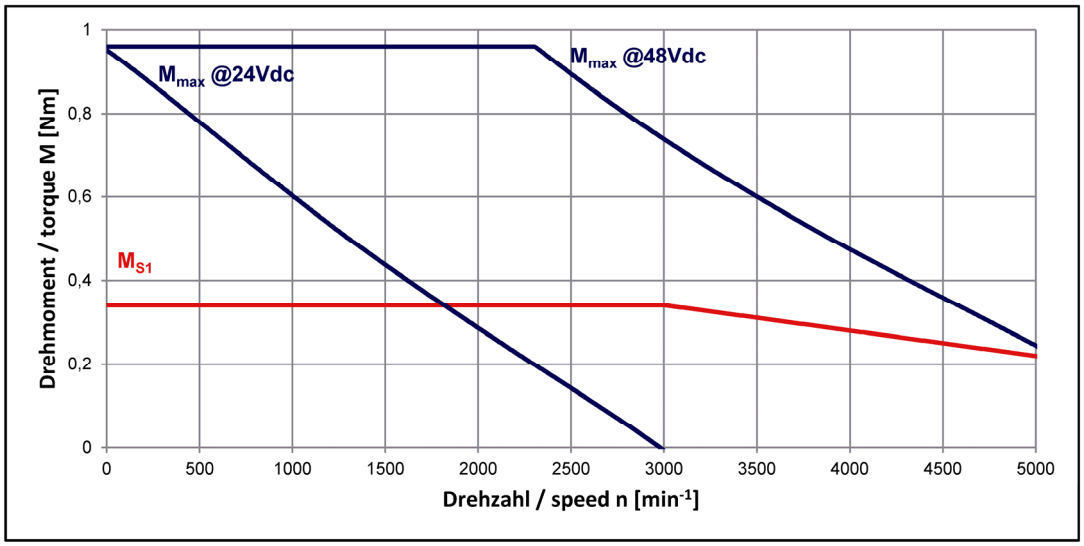
Characteristic torque / speed curves see section 10.5.

10.6 Characteristic torque / speed curves

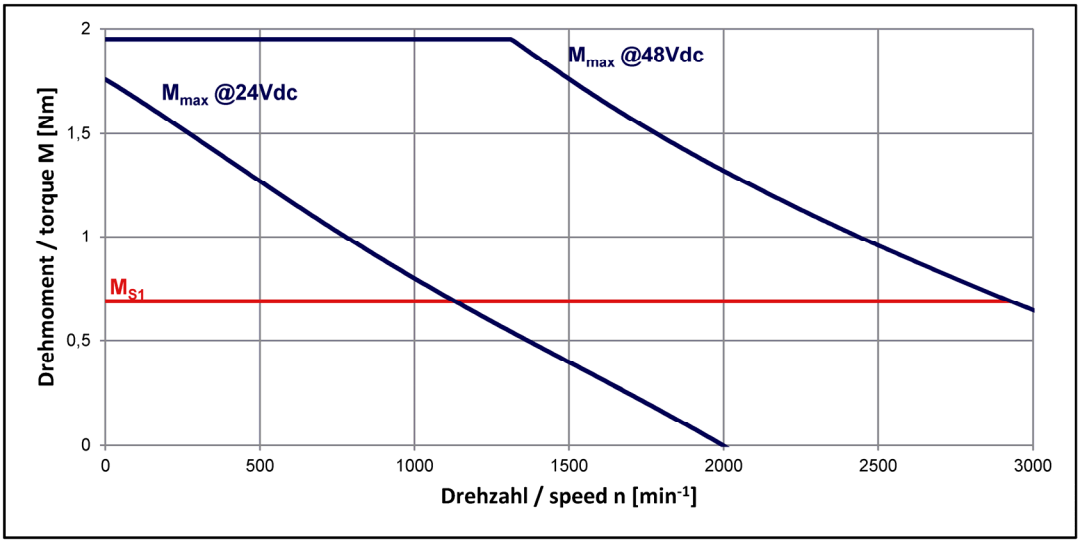
AM3111



AM3112



AM3121



11 Appendix

11.1 Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

11.1.1 Beckhoff Support

Beckhoff offers comprehensive technical support that deals not only with the application of individual Beckhoff products, but offers extensive additional services:

- support
- design, programming and commissioning of complex automation systems
- extensive training program for Beckhoff system components

Hotline : +49(0)5246/963-157
Fax : +49(0)5246/963-9157
e-mail : support@beckhoff.com

11.1.2 Beckhoff Service

The Beckhoff Service Center supports you in all matters of after-sales service:

- local service
- repair service
- spare parts service

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