Documentation

Synchronous servomotor AM8100

for compact drive technology

Version: 2.0
Date: 2018-03-06

BECKHOFF

Documented motors – AM8100

AM8tuv-wxyz	Standstill torque	Stand-still current	Rated speed at rated supply voltage		Rotor moment of inertia		Weight	
			24 V DC	48 V DC	without brake	with brake	without brake	with brake
AM8111-wFyz	0.20 Nm	2.85 A	1700 min^{-1}	4000 min^{-1}	0.0294 kg cm^2	0.0521 kg cm^2	0.62 kg	0.81 kg
AM8112-wFyz	0.38 Nm	4.70 A	1700 min^{-1}	4500 min^{-1}	0.0482 kg cm^2	0.0709 kg cm^2	0.74 kg	0.93 kg
AM8113-wFyz	0.52 Nm	4.80 A	1200 min^{-1}	3000 min^{-1}	0.0670 kg cm^2	0.0897 kg cm^2	0.86 kg	1.05 kg
AM8121-wFyz	0.50 Nm	4.0 A	1000 min^{-1}	3000 min^{-1}	0.134 kg cm^2	0.204 kg cm^2	1.00 kg	1.10 kg
AM8122-wFyz	0.80 Nm	4.0 A	600 min^{-1}	2000 min^{-1}	0.253 kg cm^2	0.276 kg cm^2	1.30 kg	1.60 kg
AM8122-wJyz	0.80 Nm	8.0 A	2000 min^{-1}	4500 min^{-1}	0.253 kg cm^2	0.324 kg cm^2	1.30 kg	1.66 kg
AM8131-wFyz	1.35 Nm	5.0 A	300 min^{-1}	1000 min^{-1}	0.462 kg cm^2	0.541 kg cm^2	1.80 kg	2.20 kg
AM8131-wJyz	1.35 Nm	8.0 A	600 min^{-1}	1800 min^{-1}	0.842 kg cm^2	0.921 kg cm^2	2.40 kg	2.80 kg
AM8132-wJyz	2.37 Nm	8.0 A	300 min^{-1}	1000 min^{-1}	0.842 kg cm^2	0.921 kg cm^2	2.40 kg	2.80 kg
AM8141-wJyz	2.40 Nm	8.0 A	300 min^{-1}	1000 min^{-1}	1.080 kg cm^2	1.730 kg cm^2	2.80 kg	3.60 kg

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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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Patent Pending

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EP1590927, EP1789857, DE102004044764, DE102007017835
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1.2 Documentation Issue Status

Version	Comment
2.0	**Chapter update:** EC Declaration of conformity **2.1;** Name plate AM8100 **5.2**
1.9	**Chapter update:** Disposal **4.5**
1.8	**Chapter update:** Documented motors; EC Declaration of conformity **2.1**; Packaging **4.2**; Maintenance / Cleaning **4.4**; Name plate **5.2**; Type key **5.3**; Flange **6.3.3**; Feedback system **6.3.10**; Pole number **6.3.12**; Flange mounts **7.2**; AM812x **10.2;** AM813x **10.3**; **New chapter**: **Shaft 6.3.4**; AM814x **10.4**
1.7	**Chapter update:** Foreword 1.0 and Safety 3.0
1.6	**Chapter update:** 5.2; 6.3.9
1.5	**Chapter update:** 2.1, 7.1
1.4	**Chapter update:** 3.1; 6.2; 8.1; 8.2
1.3	**Chapter update:** 10.1.1; 10.2.1; 10.3.1
1.2	**Chapter update:** 10.1; 10.2; 10.3
1.1	**New chapter:** 10.1; 10.1.1; 10.1.2 **Chapter update:** 2.1; 3.2; 4.4; 5.2; 5.3; 6.1; 6.2.1; 6.3.3; 6.3.10; 6.3.11; 6.4; 7.1; 7.2; 10; 10.2; 10.3
1.0	First published

1.3 Appropriate use

Synchronous servomotors of the AM8100 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 AM8100 series are **exclusively** intended for speed- and/or torque-controlled operation via servo terminal EtherCAT EL72xx from Beckhoff Automation GmbH & Co. KG.

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

 **CAUTION**	**Danger for persons, the environment or equipment** The motors are operated in the drive system in conjunction with Beckhoff servo terminal EtherCAT EL72xx. Please observe the entire documentation which consists of: • AM8100 documentation (this Manual) • Complete documentation (online and paper) for Beckhoff servo terminal EtherCAT EL72xx available at www.beckhoff.com. • Complete machine documentation (provided by the machine manufacturer)

 **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.

 **Note**	**Special safety instructions for AM8100!** The general safety instructions [▶ 11] and the special safety instructions for AM8100 [▶ 12] sections are also essential. Read carefully!

The servomotors from the AM8100 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** Linear servomotors from the AM81xx series are **not** products within the meaning of the EU 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

 Note	**Supply of EC declaration of conformity:** Beckhoff Automation GmbH & Co. KG will gladly provide you with the certificates for all products on request at: 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.
 Attention	**Damage to the environment or devices** Failure to follow the 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 pointer** This symbol indicates important information about the UL-compliant.

3.2 Special safety instructions for AM8100

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 AM8100 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.
- 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.
- Before working on the AM8100 the servomotor must be disconnected from the servo terminal and secured against switching on again.

WARNING

Serious risk of injury through hot surfaces!

- The surface temperature may exceed 100 °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.
- 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 60721
- 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

- The max. stacking height by the servo motors AM8100 is 10 cardboard packaging.

4.3 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
- 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 30,000 hours under normal operating conditions. The bearings should be replaced after 30,000 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.
- In motors with **optional shaft seal ring** the ring must be lubricated every 5,000 hours. We recommend „Mobilgrease™ FM 222“ from Mobil.
- Opening the motor invalidates the warranty.
- Clean the housing with isopropanol or similar.
- Never immerse or spray the servomotor.

4.5 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

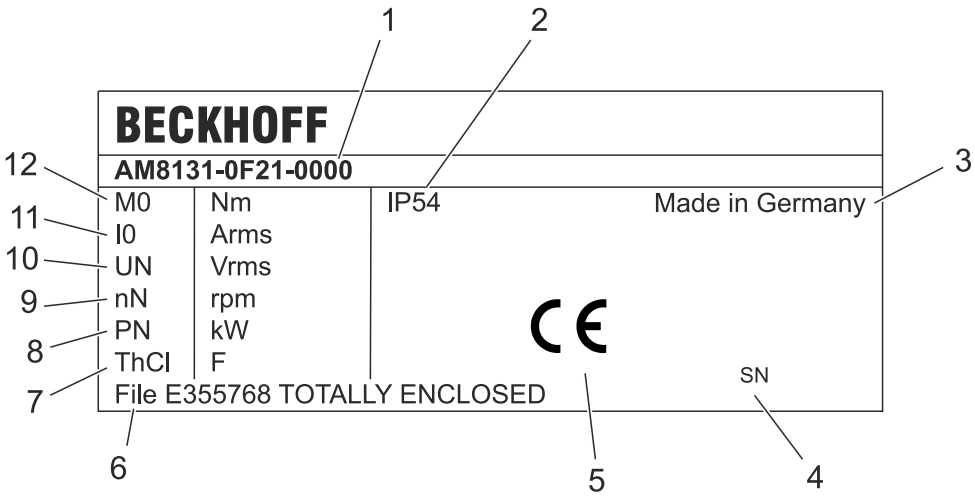
5 Product identification

5.1 Scope of supply AM8100

Please check that the delivery includes the following items

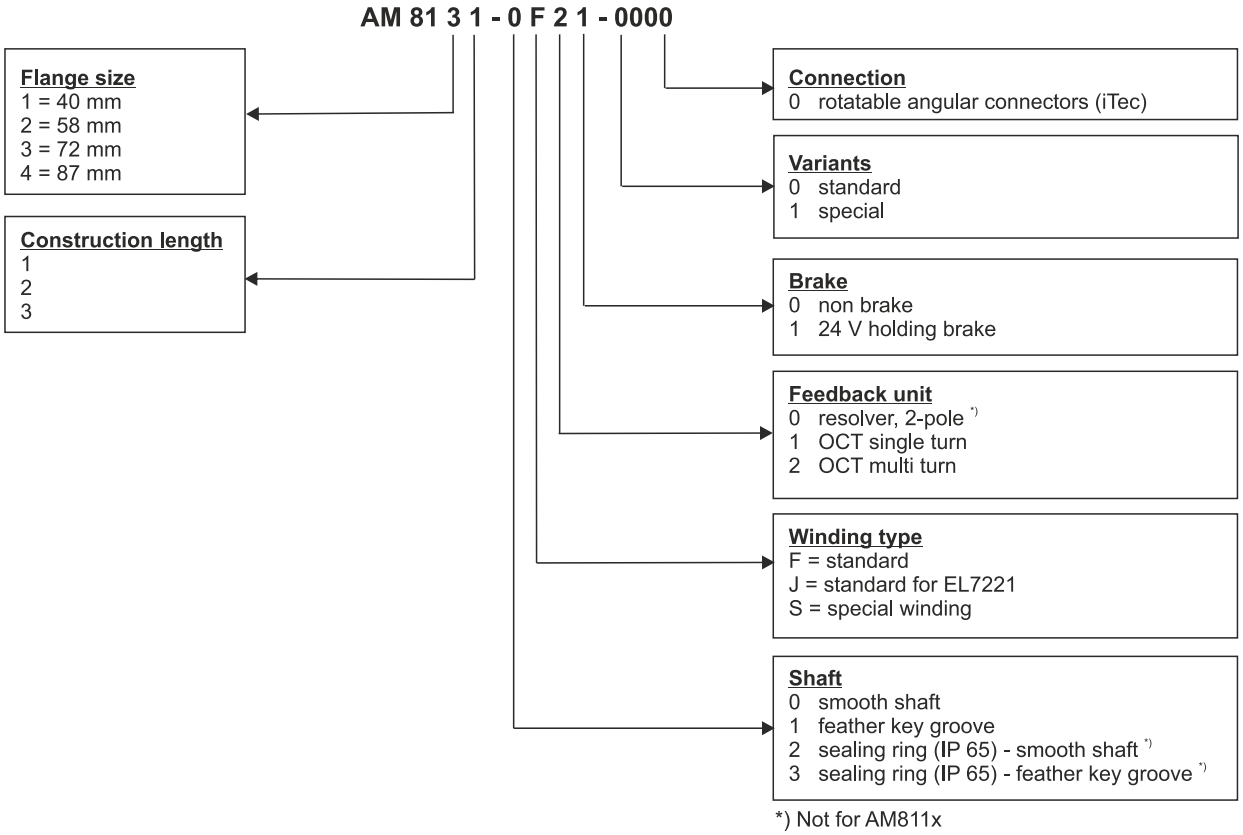
- Motor from the AM8100 series
- Motor package leaflet (short info)

5.2 Name plate AM8100



Item number	Explanation
1	Servomotor AM8100 (with order key)
2	Protection class
3	Country of manufacture
4	Serial number
5	CE certification
6	UL certification
7	Insulation class
8	Rated output
9	Nominal speed
10	Rated voltage
11	Standstill current
12	Standstill torque

5.3 Type key AM8100



This matrix should explain the motor flange sizes related to a gearbox mounting.

Motor sizes, named in the same line use the same adapter unit for a gearbox coupling.

Beckhoff Flange size	AM3000	AM3100	AM3500	AM8000	AM8100	AM8500
F1	AM301x	AM311x	-	AM801x	AM811x	-
F2	AM302x	-	-	AM802x	AM812x	-
Exception	-	AM312x	-	-	-	-
F3	AM303x	-	-	AM803x	AM813x	AM853x
F4	AM304x	-	AM354x	AM804x	-	AM854x
F5	-	-	-	AM805x	-	AM855x
Exception	AM305x	-	AM355x	AM805x-xxxx-9	-	-
F6	AM306x	-	AM356x	AM806x	-	AM856x
F7	AM307x	-	-	AM807x	-	-
Exception	AM308x	-	-	-	-	-

6 Technical description

6.1 Design of the motors

The synchronous servomotors of the AM8100 series are brushless three-phase motors for demanding servo-applications. In conjunction with our digital servo drives they are particularly suitable for positioning tasks in industrial robots, machine tools, transfer lines etc. with demanding requirements in terms of dynamics and stability.

The servo motors 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 terminal. The motor has no brushes, the commutation being implemented electronically in the servo terminal.

The motors are available with or without built-in holding brake. The brake cannot be retrofitted.

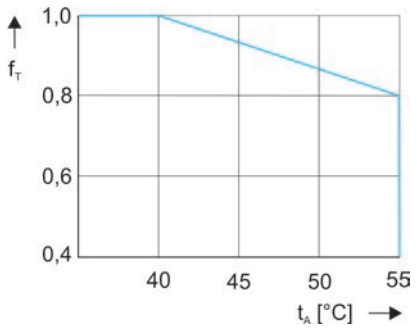
The motors have a matt dark grey powder coating (similar to RAL 7016).The finish is not resistant against solvents (e.g. trichlorethylene, thinners or similar).

6.2 General technical data

Climate category	3K3 according to EN 60721
Ambient temperature (at rated values)	+5 - +40 °C for site altitudes up to 1000 m amsl
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
Ball bearing service life	≥30.000 operating hours
Technical data	→ see section --- FEHLENDER LINK ---
Storage and transport data	→ see section --- FEHLENDER LINK ---

6.2.1 Power derating

Ambient temperature



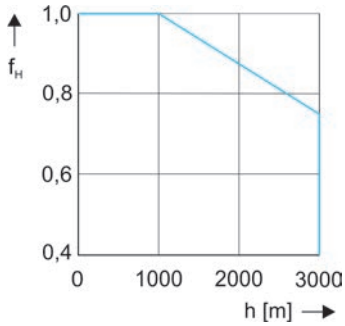
f_T = Temperature utilisation factor

t_A = Ambient temperature in °C

Calculation of the power data when exceeding the specified temperature limit > 40 °C up to 55 °C:

$\mathbf{M_{0\_red} = M_0 \times f_T}$

Installation altitude



f_H = Altitude utilisation factor

h = Altitude in metres

Calculation of the power data when exceeding the specified installation altitude > 1000 m up to 3000 m:

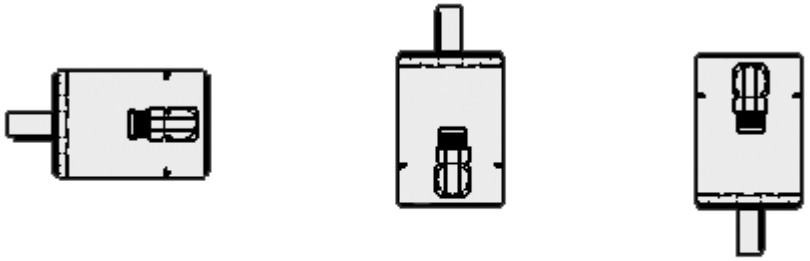
$\mathbf{M_{0\_red} = M_0 \times f_H}$

Ambient temperature and installation altitude
Calculation of the power data when exceeding the specified limits:
Ambient temperature > 40 °C and installation altitude > 1000 m
$\mathbf{M_{0\_red} = M_0 \times f_T \times f_H}$

6.3 Standard features

6.3.1 Style

The basic style for the AM8100 synchronous servomotors is IM B5 according to DIN EN 60034-7.



The permitted mounting positions are specified in the technical data.

Attention	**Motor damage** To avoid liquid entry damaging the motor, fluids (i.e. used for cleaning purposes) must be removed from shaft when motor is mounted according to IM V3.

6.3.2 Shaft end, A-side

Load transmission occurs force locked (zero-play) with a clutch on the cylindric end of the shaft A or optionally by keyed connection with feather key groove according to DIN 6885. The lifecycle of the bearings is 30.000 operating 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 technical data. Please use the force calculation program available from our website (www.beckhoff.com) for exact calculation of the radial Forces.

Axial force
Axial forces arise when assembling pinions or pulleys on the shaft and using angular gearheads, for example. Please use the force calculation program available from our website (www.beckhoff.com) for exact calculation of the axial Forces.

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 j6 (h7 at AM811x), accuracy according to DIN 42955
Tolerance class: **N**

6.3.4 Shaft

Cylindrical shaft according to DIN 748 part 3, centering bore with thread (DIN 332 part 2) for motors of the series AM812x, AM813x and AM814x.

6.3.5 Protection class (EN 60034-5)

Standard version - housing	IP65 (IP54 = AM811x)
Standard version - shaft feedthrough	IP54
Shaft feedthrough with shaft sealing ring	IP65

6.3.6 Insulation material class

The motors conform to insulation material class F according to IEC 60085 (UL 1446 class F).

6.3.7 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 54 - 97 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	90	23
> 1800	65	16

6.3.8 Vibrations and shocks

OCT and Multiturn:
Vibration according to EN 60068-2-6 50 g / 10…2000 Hz
Shocks according to EN 60068-2-27 100 g / 6 ms

6.3.9 Connection technology

The motors are fitted with rotatable, angular connectors for the power supply and the feedback signals (only resolver).
The mating connectors are not included in the scope of supply. We can supply preassembled feedback (only resolver) and power cables.

6.3.10 Feedback-System

Feedback-System	Impulse per rotation	System accuracy		Comment
OCT, Singleturn OCT, Multiturn	33554432	± 120 Angle sec.	approx. 0.03°	Standard
Resolver	16384	± 600 Angle sec.	approx.0.17°	Option: AM812x, AM813x and AM814x

Note	**Feedback exchange** The feedback system installed can only be replaced with an identical system. Retrofitting a different system is not possible.

6.3.11 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 motors are optionally available with an in-built holding brake free from backlash. The permanent magnet brake blocks the rotor in de-energised state. **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!). The brake voltage is then switched off in the servo terminal — no additional wiring is required.

If the holding brake is not controlled directly by the servo terminal, additional circuitry (e.g. varistor) is required. Consult our applications department beforehand.

The maximum number of brake cycles is 10 million.

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.

6.3.12 Pole number

Motor	Pole number
AM811x	6
AM812x	6
AM813x	8
AM814x	8

6.4 Options

Holding brake
The holding brake is integrated in the motor. It increases the motor length and the rotor moment of inertia.

Radial shaft-sealing ring
Radial shaft-sealing ring (FKM) for sealing against splash water. This increases the protection class of the shaft bushing to IP65.

Feather key
The motors are available with feather key groove and fitted feather key according to DIN6885. The rotor is balanced with half a feather key.

OCT
This model features a different feedback system in place of the resolver.

Note	**Installation options and reduction of rated values** • With the exception of the sealing ring, the options cannot be retrofitted. • The option sealing ring can lead to a reduction of the rated data.

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]**
- **Maximal torque** **Mmax [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 terminals. Formulas and calculation example are available from our applications department on request.

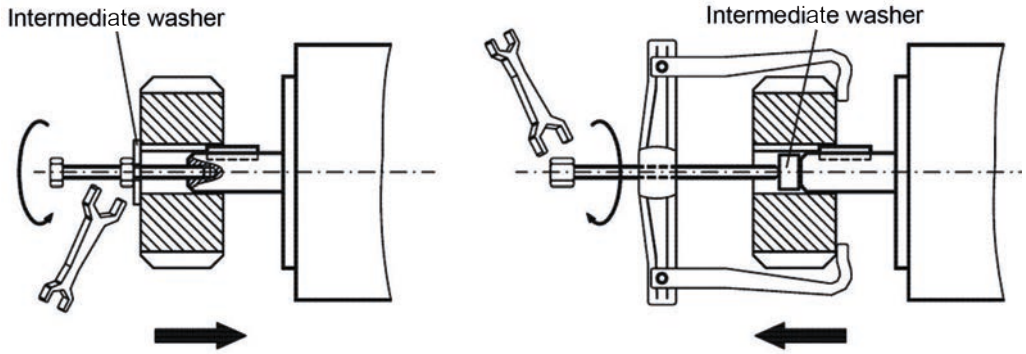
7 Mechanical installation

7.1 Important notes

Attention

Motor damage

- 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, shaft, holding brake and feedback System.



- 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. Furthermore, it must be ensured that when using a collet, the motor shaft is degreased.
- 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 terminals. 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:

$$d_{min} \geq \frac{M_0}{F_R} \times 2$$

7.2 Flange mounts

Information on correct flange-mounting of the motors is provided below.

Size	Bore diameter [mm]	Cheese-head screw DIN EN ISO 4762 (8.8)	Tightening torque [Nm]	Plain washer DIN EN ISO 7089
AM811x	4.3	M4 x 16	2.7	Washer M4 DIN 127
AM812x	5.5	M5x16	5.5	5.3
AM813x	6.0	M5x16	5.5	5.3
AM814x	7.0	M6x20	10.0	6.4

8 Electrical installation

8.1 Important notes

DANGER

Serious risk of injury through electric shock!

- Only staffs 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

Failure free operation

- Ensure that the servo terminal and the motor are earthed properly.See below for further information regarding EMC shielding and earthing.Earth the mounting plate and motor housing.
- Only use cables approved by Beckhoff for operating the AM8100 with the “one-cable technology” (OCT).
- 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 sectionShielding concept)
- Install all cables carrying a heavy current with an adequate cross-section, as per EN 60204. The recommended cross-section can be found in the technical data.
- Wiring

  ⇨ Connect the feedback cable

  ⇨ 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).

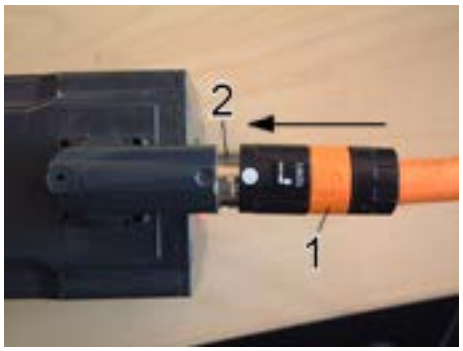
8.2 Connection of motors with preassembled cables

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.
- Connect up the shielding according to the wiring diagrams in section shielding according. Incorrectly installed shielding inevitably leads to EMC interference.

Detailed specifications of the cables can be found on our homepage under
Download→ Documentation→ Drive Technology→ Cables.

Power box of the servomotor with iTec connector



Align the iTec connector (item 1) with the power box of the servomotor (item 2). The iTec connector (item 1) should fully enclose the silver-colored housing of the power box (item 2).

Note!:
Avoid contamination of or damage to the poles and the interior of the box and the connector!

When connecting the two components, make sure that both marking points (item 3) (white marking point on the iTec connector, recessed grey marking point on the power box) face each other.

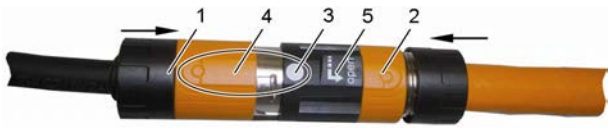
Now push the iTec connector onto the power box of the servomotor. This procedure causes the iTec connector to turn. After the rotary motion the iTec connector engages on the power box of the servomotor.

Note!:
When the connector engages on the power box, a “click” sound can be heard. This indicates that the components were installed correctly.

If the iTec connector cannot easily be pushed onto the power box and made to engage, manually turn the white marking point into the correct position (see Fig. 2 and 3).

iTec extension cable

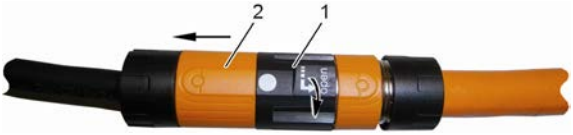
Connecting the plug connection



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.

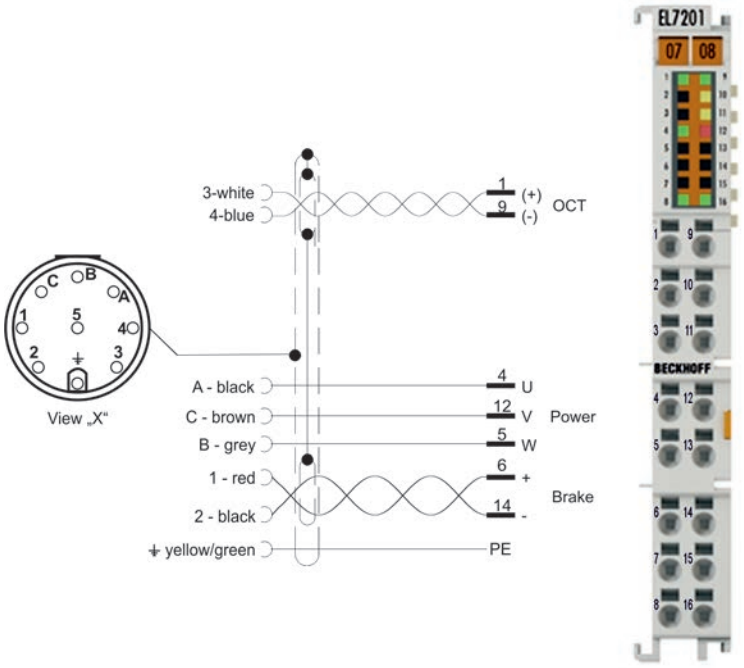
Note!:
When the connector engages, a “click” sound can be heard. This indicates that the components were installed correctly.
If the connector does not engage automatically, manually turn the white marking point into the correct position.

To disconnect the plug connection



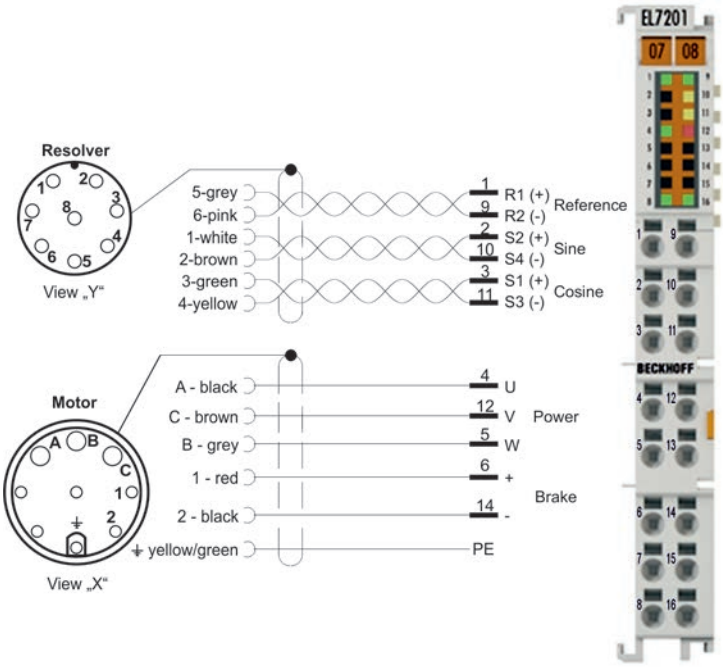
Hold the plug connector (2), turn the black locking ring (1) downwards in the direction of the arrow and hold it in this position. Now pull the plug connector (2) apart to the left in the direction of the arrow.

8.2.1 EL72xx-0010 Connection diagram for 8100 Motors with OCT



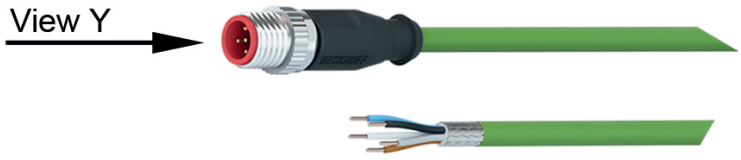
Motor cable ZK4704-0421-2000

8.2.2 EL72xx-0000 Connection diagram for AM8100 Motors with resolver



Motor cable ZK4704-0411-2xxx

Resolver cable ZK4724-0410-2xxx

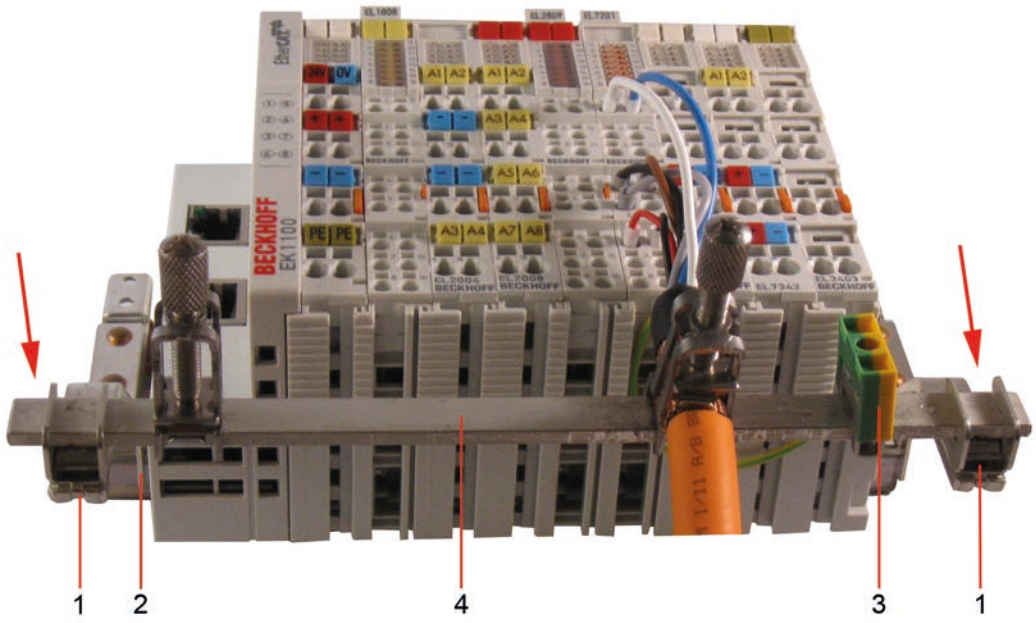


8.2.3 Shielding concept

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

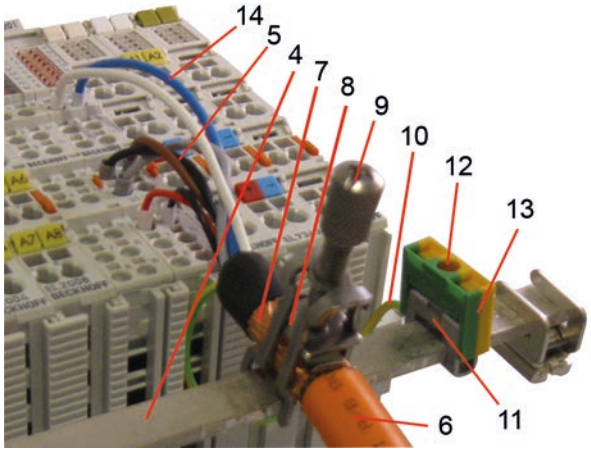
Fasten the shield busbar supports (1) to the DIN rail (2). The DIN rail (2) must be in contact with the metallic rear wall of the control cabinet over a wide area. Push the PE clip (3) over the shield busbar (4) and press the shield busbar (4) into the receptacles of the shield busbar supports (1).



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.

Connect all wires for the feedback system (14).

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.



9 Comissioning

9.1 Important notes

 **DANGER**	**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 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_{DC}, 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.
- In multi-axis systems, individually commission each drive unit (servo terminal/motor(s)).

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 terminal. Please refer to the documentation for the servo terminal and the commissioning software.

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

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

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

10 Technical data

All data, excluding the voltage constant, valid for 40 °C ambient temperature and 100 K overtemperature of the winding.

The data can have a tolerance of +/- 10%.
If a gear unit is attached the power may be reduced by up to 20%. This loss in performance has thermal reasons, since a gear unit that is subject to warming is installed at the motor flange intended for heat Dissipation.

Term definitions

Standstill torque M0 [Nm]
The standstill torque can be maintained indefinitely at a speed n<100 rpm and rated ambient conditions.

Rated torque Mn [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).

Nominal speed nn [rpm]
At the nominal speed motor output corresponds to the rated torque and the rated output. The nominal speed depends on the supply voltage. The example below refers to supply voltages of 24 and 48 VDC. The supply voltages are specified without tolerances.

Standstill current I0rms [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) I0max [A]
The peak current (effective sinusoidal value) is approximately equivalent to 5-times the rated standstill current. The configured peak current of the servo terminal used must be smaller.

Torque constant KTrms [Nm/A]
The torque constant defines how much torque in Nm is produced by the motor with standstill current. The relationship is $M_0 = I_0 \times KT$

Voltage constant KErms [mVmin]
The voltage constant defines the induced motor EMF at 20 °C, 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:

$$t_b\,[S] = \frac{3000 \times 2\pi}{M_0 \times 60s} \times \frac{m^2}{10^4\,cm^2} \times J$$ with M_0 in Nm and J in $kgcm^2$

Thermal time constant tTH [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 tBRH [ms] / Application delay time tBRL [ms] of the brake
These constants define the response times of the stopping brake when operated with the rated voltage at the servo terminal.

10.1 AM811x

Electrical data		Symbol [Unit]	AM8111-F	AM8112-F	AM8113-F
	Standstill torque	M_0 [Nm]	0.20	0.38	0.52
	Standstill current	I_{orms} [A]	2.85	4.7	4.8
	Max. mech. speed	N_{max} [min^{-1}]	10000		
	Max. mains voltage	U_N [V_{DC}]	50		
U_N = 24 VDC	Rated speed	N_n [min^{-1}]	1700	1700	1200
	Rated torque	M_n [Nm]	0.20	0.38	0.52
	Rated power	P_n [W]	36	68	65
U_N = 48 VDC	Rated speed	N_n [min^{-1}]	4000	4500	3000
	Rated torque	M_n [Nm]	0.19	0.36	0.50
	Rated power	P_n [W]	80	170	160
	Peak current	I_{0max} [A]	8.6	16.5	18.0
	Peak torque	M_{0max} [Nm]	0.68	1.36	2.04
	Torque constant	K_{Trms} [Nm/A]	0.070	0.080	0.108
	Voltage constant	K_{Erms} [mVmin]	5	5	7
	Winding resistance	R20 [Ω]	2.30	1.20	1.38
	Winding inductance	L [mH]	1.50	0.79	0.97

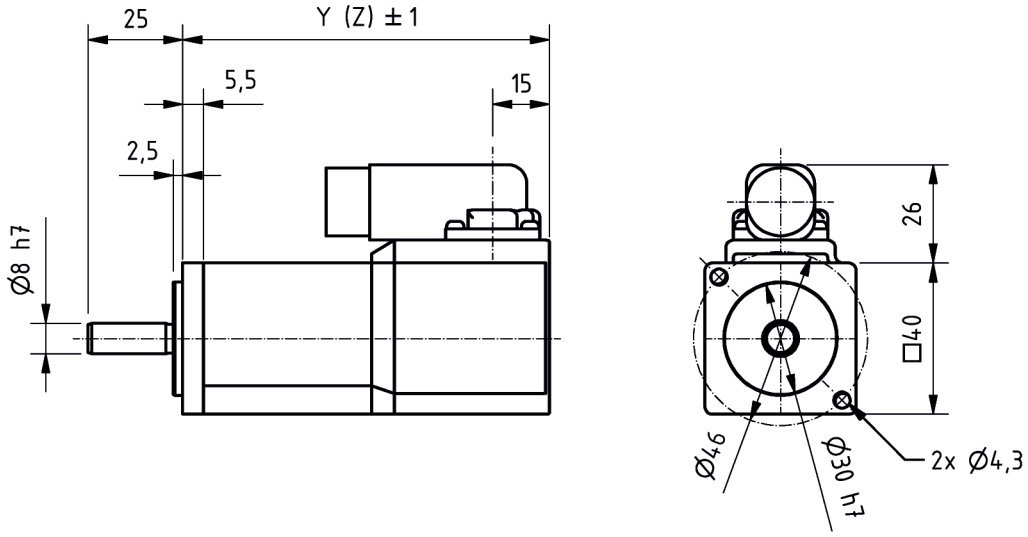
* reference flange aluminium 130 mm x 230 mm x 10 mm

Mechanical data	Symbol [Unit]	AM8111	AM8112	AM8113
Rotor moment of inertia (without brake)	J [kgcm^2]	0.0294	0.0482	0.0670
Rotor moment of inertia (with brake)	J [kgcm^2]	0.0521	0.0709	0.0897
Number of contacts		6	6	6
Static friction torque	M_R [Nm]	0.0009	0.0018	0.0027
Thermal time constant	t_{TH} [min]	9	9	10
Weight (without brake)	G [kg]	0.62	0.74	0.86
Weight (with brake)	G [kg]	0.81	0.93	1.05
Permitted radial force at shaft end	F_R [N]	See 10.1.2		
Permitted axial force	F_A [N]			

Data for optional brake

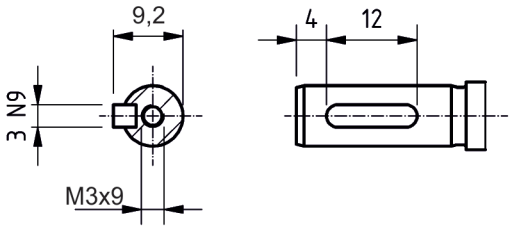
Data	Symbol [Unit]	AM811x
Holding torque at 120 °C	M_{BR} [Nm]	0.6
Supply voltage	U_{BR} [V_{DC}]	24 +6 -10%
Electrical power	P_{BR} [W]	10
Current	I_{on} [A]	0.3
Release delay time	t_{BRH} [ms]	14
Application delay time	t_{BRL} [ms]	8

10.1.1 Dimensional drawing AM811x

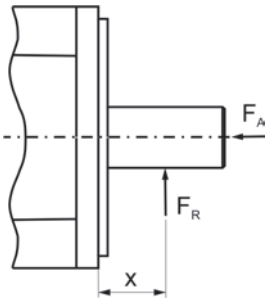


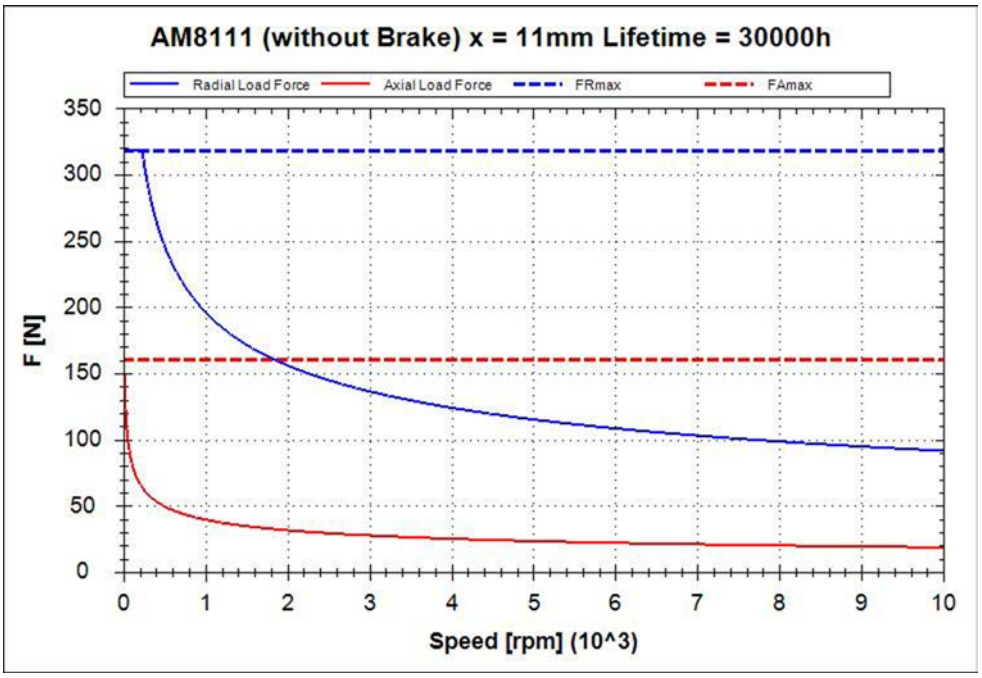
Motor type	Y	Z (Brake)
AM8111	97	129
AM8112	117	149
AM8113	137	169

Option: Feather key



10.1.2 Radial / axial forces at the shaft end





10.1.3 Characteristic torque / speed curves

Characteristic torque / speed curves can be found on the Beckhoff-website under Motion

10.2 AM812x

Electrical data		Symbol [Unit]	AM8121-F	AM8121-F at EL7201	AM8122-F	AM8122-F at EL7201	AM8122-J
	Standstill torque	M_0 [Nm]	0,5	0,35	0,8	0,56	0,8
	Standstill current	I_{orms} [A]	4,0	2,8	4,0	2,8	8,0
	Max. mech. speed	N_{max} [min^{-1}]	12000	12000	12000	12000	12000
	Max. mains voltage	U_N [V_{DC}]	50	50	50	50	50
U_N = 24 VDC	Rated speed	N_n [min^{-1}]	1000	1000	600	600	2000
	Rated torque	M_n [Nm]	0,5	0,35	0,8	0,56	0,78
	Rated power	P_n [W]	52	36	50	35	163
U_N = 48 VDC	Rated speed	N_n [min^{-1}]	3000	3000	2000	2000	4500
	Rated torque	M_n [Nm]	0,5	0,35	0,8	0,56	0,75
	Rated power	P_n [W]	157	110	167	117	353
	Peak current	I_{0max} [A]	17	5,66	22,4	5,66	48,0
	Peak torque	M_{0max} [Nm]	1,97	0,69	4,06	1,09	4,06
	Torque constant	K_{Trms} [Nm/A]	0,125	0,125	0,2	0,2	0,1
	Voltage constant	K_{Erms} [mVmin]	8	8	13	13	6
	Winding resistance	R20 [Ω]	1,6	1,6	1,5	1,5	0,34
	Winding inductance	L [mH]	3	3	3,7	3,7	0,7

* reference flange aluminium 230 mm x 130 mm x 10 mm

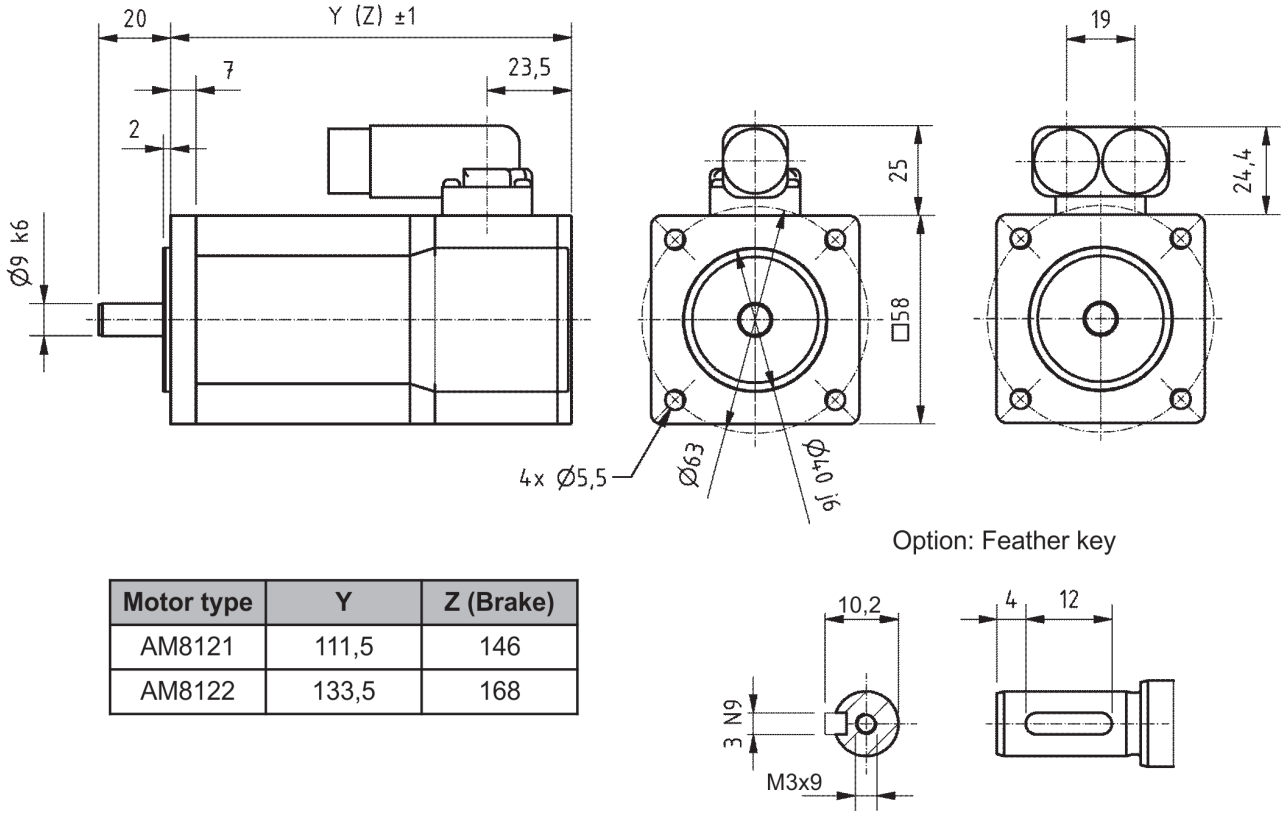
Installation of a shaft seal ring leads to a reduction of the rated values.

Mechanical data	Symbol [Unit]	AM8121	AM8122
Rotor moment of inertia (without brake)	J [$kgcm^2$]	0,134	0,253
Rotor moment of inertia (with brake)	J [$kgcm^2$]	0,156	0,276
Number of contacts		6	6
Static friction torque	M_R [Nm]	0,002	0,004
Thermal time constant	t_{TH} [min]	10	13
Weight (without brake)	G [kg]	1,00	1,30
Weight (with brake)	G [kg]	1,10	1,60
Permitted radial force at shaft end	F_R [N]	See 10.2.2	
Permitted axial force	F_A [N]		

Data for optional brake

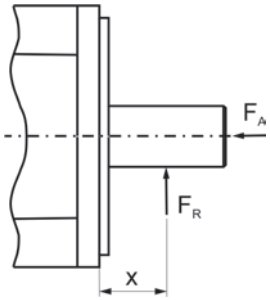
Data	Symbol [Unit]	AM812x
Holding torque at 120 °C	M_{BR} [Nm]	0,8
Supply voltage	U_{BR} [V_{DC}]	24 +6 -10 %
Electrical power	P_{BR} [W]	10
Current	I_{on} [A]	0,3
Release delay time	t_{BRH} [ms]	8
Application delay time	t_{BRL} [ms]	12

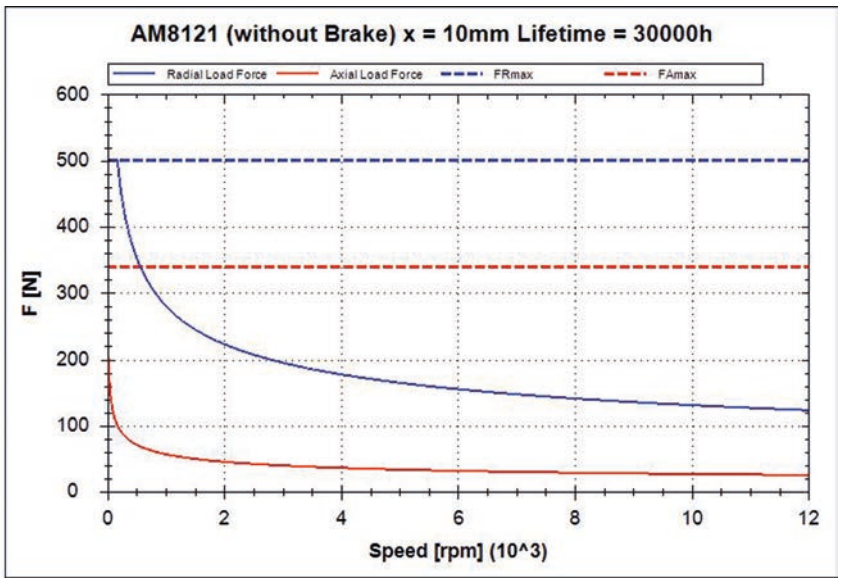
10.2.1 Dimensional drawing AM812x



Motor type	Y	Z (Brake)
AM8121	111,5	146
AM8122	133,5	168

10.2.2 Radial / axial forces at the shaft end





10.2.3 Characteristic torque / speed curves

Characteristic torque / speed curves can be found on the Beckhoff-website under Motion

10.3 AM813x

Electrical data		Symbol [Unit]	AM8131-F	AM8131-F at EL7201	AM8131-J	AM8132-J
	Standstill torque	M_0 [Nm]	1.35	0.80	1,35	2,37
	Standstill current	I_{orms} [A]	5.0	2.8	8,0	8,0
	Max. mech. speed	N_{max} [min^{-1}]	10000	10000	10000	10000
	Max. mains voltage	U_N [V_{DC}]	50	50	50	50
U_N = 24 VDC	Rated speed	N_n [min^{-1}]	300	300	600	300
	Rated torque	M_n [Nm]	1.35	0.80	1,35	2,36
	Rated power	P_n [W]	28	25	94	7,4
U_N = 48 VDC	Rated speed	N_n [min^{-1}]	1000	1000	1800	1000
	Rated torque	M_n [Nm]	1.34	0.80	1,34	2,35
	Rated power	P_n [W]	140	84	253	246
	Peak current	I_{0max} [A]	27.80	5.66	44,7	44,3
	Peak torque	M_{0max} [Nm]	6.07	1.76	6,07	11,7
	Torque constant	K_{Trms} [Nm/A]	0.27	0.28	0,169	0,296
	Voltage constant	K_{Erms} [mVmin]	19	19	11,8	21
	Winding resistance	R20 [Ω]	1.95	1.95	0,73	0,96
	Winding inductance	L [mH]	6.1	6.1	2,05	3,4

* reference flange aluminium 230 mm x 130 mm x 10 mm

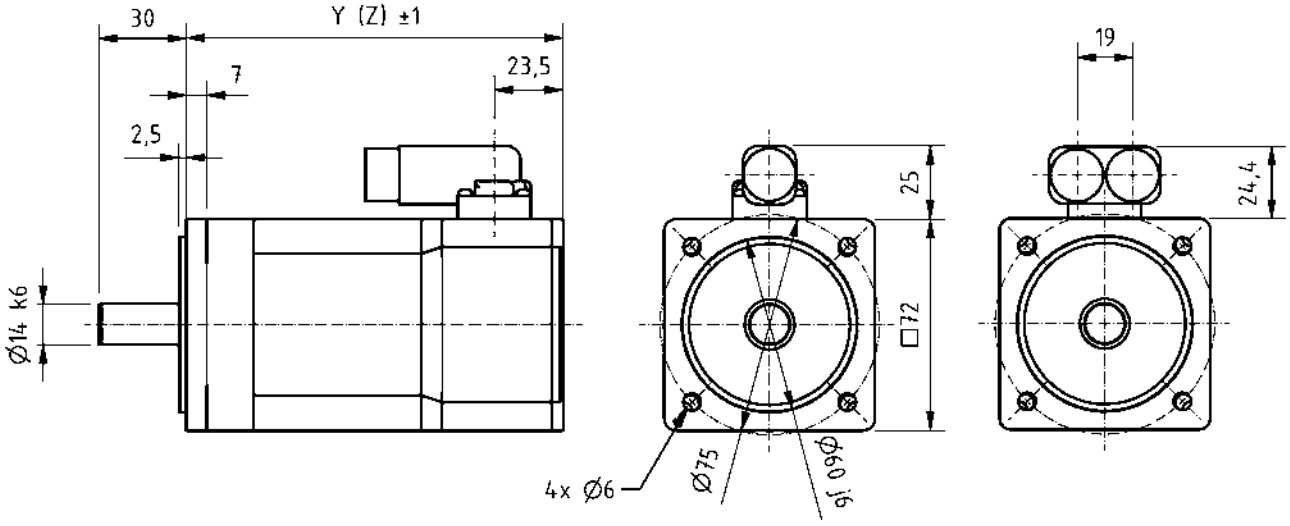
Installation of a shaft seal ring leads to a reduction of the rated values.

Mechanical data	Symbol [Unit]	AM8131	AM8132
Rotor moment of inertia (without brake)	J [$kgcm^2$]	0.462	0,842
Rotor moment of inertia (with brake)	J [$kgcm^2$]	0.541	0,921
Number of contacts		8	8
Static friction torque	M_R [Nm]	0.009	0,009
Thermal time constant	t_{TH} [min]	24	24
Weight (without brake)	G [kg]	1.80	2,4
Weight (with brake)	G [kg]	2.20	2,8
Permitted radial force at shaft end	F_R [N]	See 10.3.2	
Permitted axial force	F_A [N]		

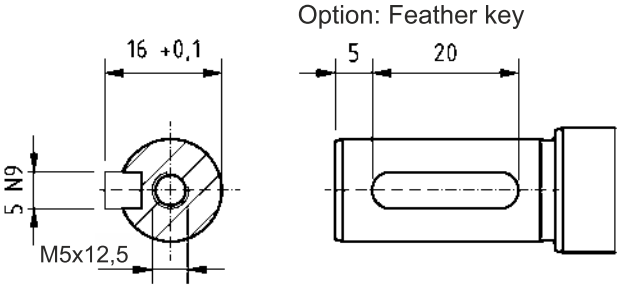
Data for optional brake

Data	Symbol [Unit]	AM813x
Holding torque at 120 °C	M_{BR} [Nm]	2.0
Supply voltage	U_{BR} [V_{DC}]	24 +6 -10 %
Electrical power	P_{BR} [W]	11
Current	I_{on} [A]	0.33
Release delay time	t_{BRH} [ms]	8
Application delay time	t_{BRL} [ms]	25

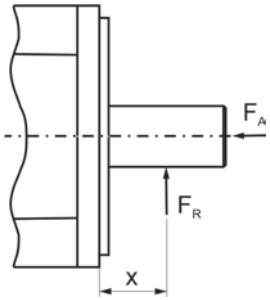
10.3.1 Dimensional drawing AM813x

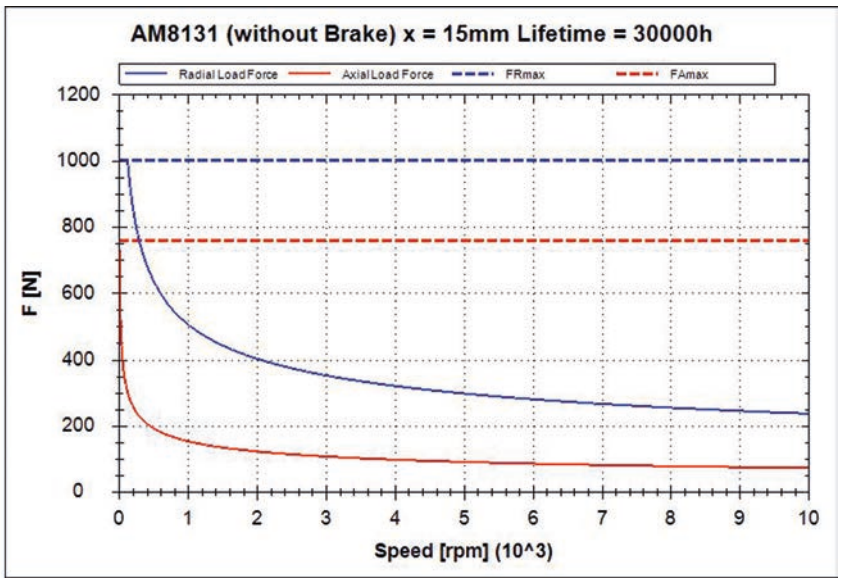


Motor type	Y	Z (Brake)
AM8131	129	168
AM8132	154	194



10.3.2 Radial / axial forces at the shaft end





10.3.3 Characteristic torque / speed curves

Characteristic torque / speed curves can be found on the Beckhoff-website under Motion

10.4 AM814x

Electrical data		Symbol [Unit]	AM8141-J
	Standstill torque	M_0 [Nm]	2,4
	Standstill current	I_{orms} [A]	8,0
	Max. mech. speed	N_{max} [min^{-1}]	9000
	Max. mains voltage	U_N [V_{DC}]	50
U_N = 24 VDC	Rated speed	N_n [min^{-1}]	300
	Rated torque	M_n [Nm]	2,4
	Rated power	P_n [W]	75
U_N = 48 VDC	Rated speed	N_n [min^{-1}]	1000
	Rated torque	M_n [Nm]	2,4
	Rated power	P_n [W]	250
	Peak current	I_{0max} [A]	36,2
	Peak torque	M_{0max} [Nm]	9,13
	Torque constant	K_{Trms} [Nm/A]	0,3
	Voltage constant	K_{Erms} [mVmin]	21
	Winding resistance	R20 [Ω]	0,9
	Winding inductance	L [mH]	3,5

* reference flange aluminium 230 mm x 130 mm x 10 mm

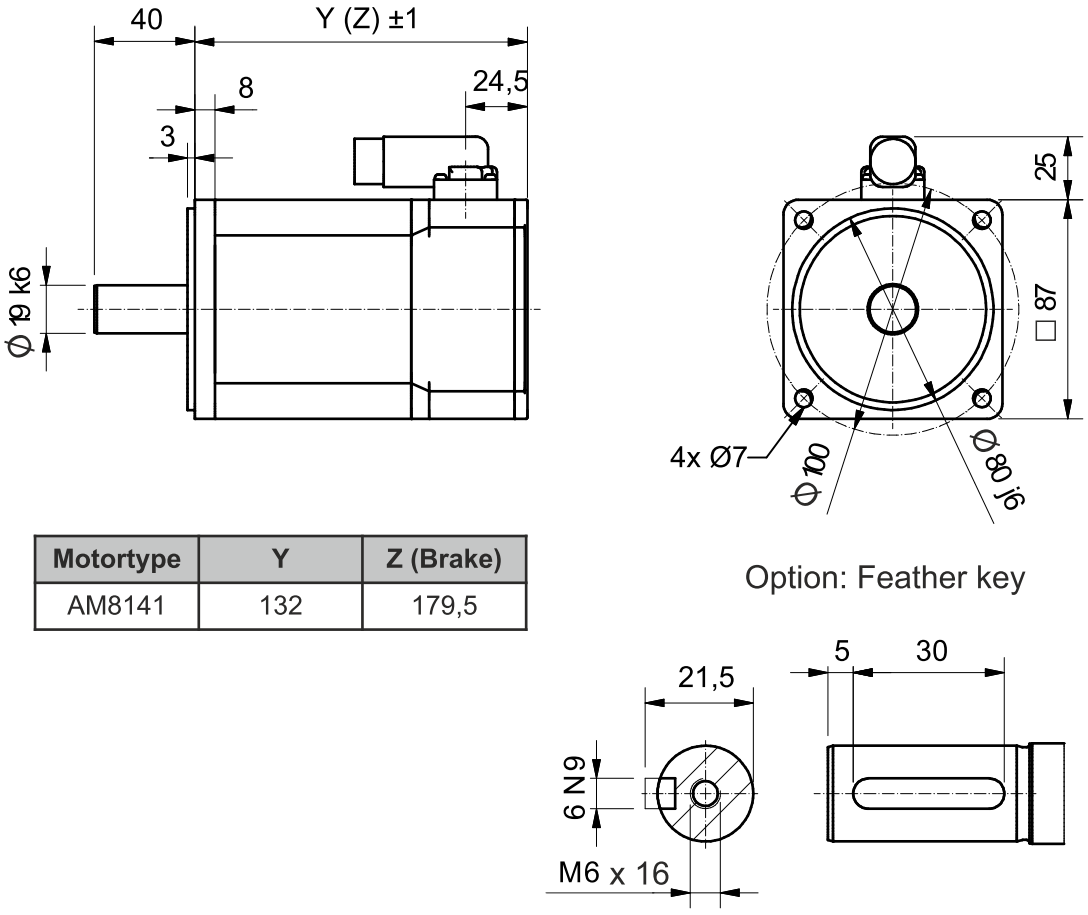
Installation of a shaft seal ring leads to a reduction of the rated values.

Mechanical data	Symbol [Unit]	AM8141
Rotor moment of inertia (without brake)	J [$kgcm^2$]	1,080
Rotor moment of inertia (with brake)	J [$kgcm^2$]	1,730
Number of contacts		8
Static friction torque	M_R [Nm]	0,020
Thermal time constant	t_{TH} [min]	30
Weight (without brake)	G [kg]	2,8
Weight (with brake)	G [kg]	3,6
Permitted radial force at shaft end	F_R [N]	See 10.3.2
Permitted axial force	F_A [N]	

Data for optional brake

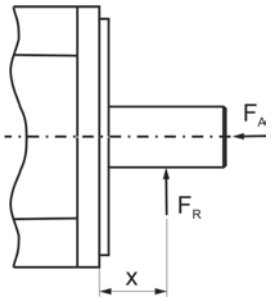
Data	Symbol [Unit]	AM814x
Holding torque at 120 °C	M_{BR} [Nm]	2,5
Supply voltage	U_{BR} [V_{DC}]	24 +6 -10%
Electrical power	P_{BR} [W]	12
Current	I_{on} [A]	0,5
Release delay time	t_{BRH} [ms]	20
Application delay time	t_{BRL} [ms]	15

10.4.1 Dimensional drawing AM814x



Motortype	Y	Z (Brake)
AM8141	132	179,5

10.4.2 Radial / axial forces at the shaft end



10.4.3 Characteristic torque / speed curves

Characteristic torque / speed curves can be found on the Beckhoff-website under Motion

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.

Beckhoff's branch offices and representatives

Please contact your Beckhoff branch office or representative for local support and service on Beckhoff products!

The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages:
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You will also find further documentation for Beckhoff components there.

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Beckhoff Support

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- and extensive training program for Beckhoff system components

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