

Operating instructions | EN

AMI8100

Compact integrated Servo Drives



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- EP1789857
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Version numbers



Provision of revision levels

On request, you can obtain a list of revision levels for changes in the operating instructions.

- Send your request to: motion-documentation@beckhoff.de

Origin of the document

These operating instructions were originally written in German. All other languages are derived from the German original.

Product features

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

Scope of the documentation

Apart from these operating instructions, the following documents are part of the overall documentation:

Documentation	Definition
Short information	Accompanying document with general notes on handling the product.

Staff qualification

These operating instructions are intended for trained control and automation specialists with knowledge of the applicable and required standards and directives.

Specialists must have knowledge of drive technology and electrical equipment as well as knowledge of safe working on electrical systems and machines. This includes knowledge of proper setup and preparation of the workplace as well as securing the working environment for other persons.

The operating instructions published at the respective time of each installation and commissioning is to be used. The products must be used in compliance with all safety requirements, including all applicable laws, regulations, provisions and standards.

Instructed person

Instructed persons have a clearly defined task area and have been informed about the work to be carried out. Instructed persons are familiar with:

- the necessary protective measures and protective devices
- the intended use and risks that can arise from use other than for the intended purpose

Trained person

Trained persons meet the requirements for instructed persons. Trained persons have additionally received training from the machine builder or vendor:

- machine-specific or
- plant-specific

Trained specialists

Trained specialists have received specific technical training and have specific technical knowledge and experience. Trained specialists can:

- apply relevant standards and directives
- assess tasks that they have been assigned
- recognize possible hazards
- prepare and set up workplaces

Qualified electricians

Qualified electricians have comprehensive technical knowledge gained from a course of study, an apprenticeship or technical training. They have an understanding of control technology and automation. They are familiar with relevant standards and directives. Qualified electricians can:

- independently recognize, avoid and eliminate sources of danger
- implement specifications from the accident prevention regulations
- assess the work environment
- independently optimize and carry out their work

Safety and instruction

Read the contents that refer to the activities you have to perform with the product. Always read the chapter For your safety in the operating instructions. Observe the warnings in the chapters so that you can handle and work with the product as intended and safely.

Explanation of symbols

Various symbols are used for a clear arrangement:

- ▶ The triangle indicates instructions that you should execute
- The bullet point indicates an enumeration
- [...] The square parentheses indicate cross-references to other text passages in the document
- [+] The plus sign in square brackets indicates ordering options and accessories

Pictograms

In order to make it easier for you to find text passages, pictograms and signal words are used in warning notices:

DANGER

Failure to observe will result in serious or fatal injuries.

WARNING

Failure to observe may result in serious or fatal injuries.

CAUTION

Failure to observe may result in minor or moderate injuries.

**Notes**

Notes are used for important information on the product. The possible consequences of failure to observe these include:

- Malfunctions of the product
- Damage to the product
- Damage to the environment

**Information**

This sign indicates information, tips and notes for dealing with the product or the software.

**Examples**

This symbol shows examples of how to use the product or software.

**QR-Codes**

This symbol shows a QR code, via which you can watch videos, animations or other documents. Internet access is required in order to use it.

You can read the QR code, for example, with the camera of your smartphone or tablet. If your camera doesn't support this function you can download a free QR code reader app for your smartphone. Use the Appstore for Apple operating systems or the Google Play Store for Android operating systems.

If you cannot read the QR code on paper, make sure that the lighting is adequate and reduce the distance between the reading device and the paper. In the case of documentation on a monitor screen, use the zoom function to enlarge the QR code and reduce the distance.

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The Beckhoff Support offers technical advice on the use of individual Beckhoff products and system planning. The employees support you in the programming and commissioning of complex automation systems.

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Download area

In the download area you can obtain product information, software updates, the TwinCAT automation software, documentation and much more.

Web: www.beckhoff.de/download

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The addresses of the international Beckhoff branch offices can be found on the Beckhoff website: <http://www.beckhoff.de>

Read this chapter containing general safety information. The chapters in these operating instructions also contain warning notices. Always observe the safety instructions for your own safety, the safety of other persons and the safety of the product.

When working with control and automation products, many dangers can result from careless or incorrect use. Work particularly thoroughly, not under time pressure and responsibly towards other people.

Safety pictograms

Beckhoff products feature safety pictograms, either on stickers or printed, which vary depending on the product. They serve to protect people and to prevent damage to the products. Safety pictograms must not be removed and must be legible for the user.



Warning of a hot surface

During and after operation there is a risk of burns at the housing due to hot surfaces over 60 °C. Allow the housing to cool down for the specified time, at least 15 minutes.



Avoid shocks to the shaft

Impacts on the shaft may cause the maximum permissible axial and radial values to be exceeded. Encoder systems can thus be destroyed.

General safety instructions

This chapter provides you with instructions on safety when handling the product. This product is not capable of stand-alone operation and is therefore categorized as an incomplete machine. The product must be installed in a machine or plant by the machine manufacturer. Read the documentation prepared by the machine manufacturer.

Before operation

Protective equipment

Do not remove or bypass any protective devices. Check all protective devices before operation. Make sure that all emergency switches are present at all times and can be reached by you and other people. People could be seriously or fatally injured by unprotected machine parts.

Shut down and secure the machine or plant

Shut down the machine or plant. Secure the machine or plant against being inadvertently started up.

Correctly ground electrical components or modules

Avoid electric shocks due to improper grounding of electrical components or modules. Ground all conductive components according to the specifications in the chapters "Electrical Installation" and "Mechanical Installation".

Keep the immediate environment clean

Keep your workplace and the surrounding area clean. Ensure safe working.

Check safety pictograms

Check whether the designated pictograms are on the product. Replace missing or illegible stickers.

Observe tightening torques

Mount and repeatedly check connections and components, complying with the prescribed tightening torques.

Use the original packaging only

When shipping, transporting, storing and packing, use the original packaging or conductive materials.

During operation

Do not work on live electrical parts

Never carry out any work on the motor or motor cable when they are live. Measure the voltage on the DC link test contacts DC+ und DC-. Only work on the motor when the voltage has dropped to < 50 V. Ensure that the protective conductor is connected properly. Never loosen electrical connections when live. Disconnect all components from the mains and secure them against being switched on again.

Do not touch hot surfaces

Check the cooling of the surfaces with a thermometer. Do not touch the components during and immediately after operation. Allow the components to cool sufficiently after switching off.

Avoid overheating

Operate the servo drive according to the technically foreseen specifications. Refer here to the chapter: "Technical data". Activate and monitor the temperature contact of the servo drive. Provide for sufficient cooling. Switch off the servo drive immediately if the temperature is too high.

Do not touch any moving or rotating components

Do not touch any moving or rotating components. Fasten all parts or components on the machine or plant.

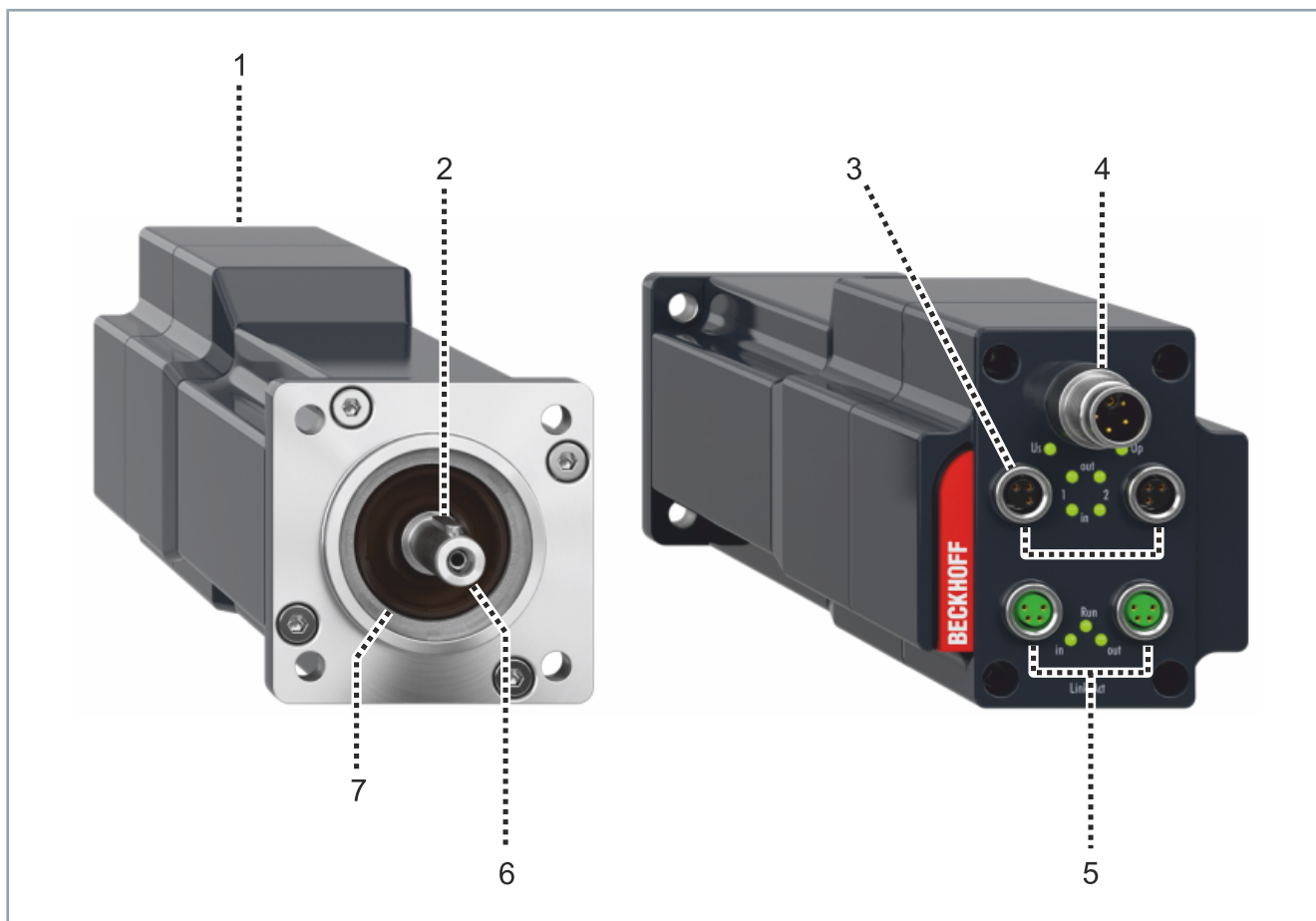
After operation

De-energize and switch off components before working on them

Check the functionality of all safety-relevant devices. Secure the working environment. Secure the machine or plant against being inadvertently started up. Observe the chapter: "Decommissioning".

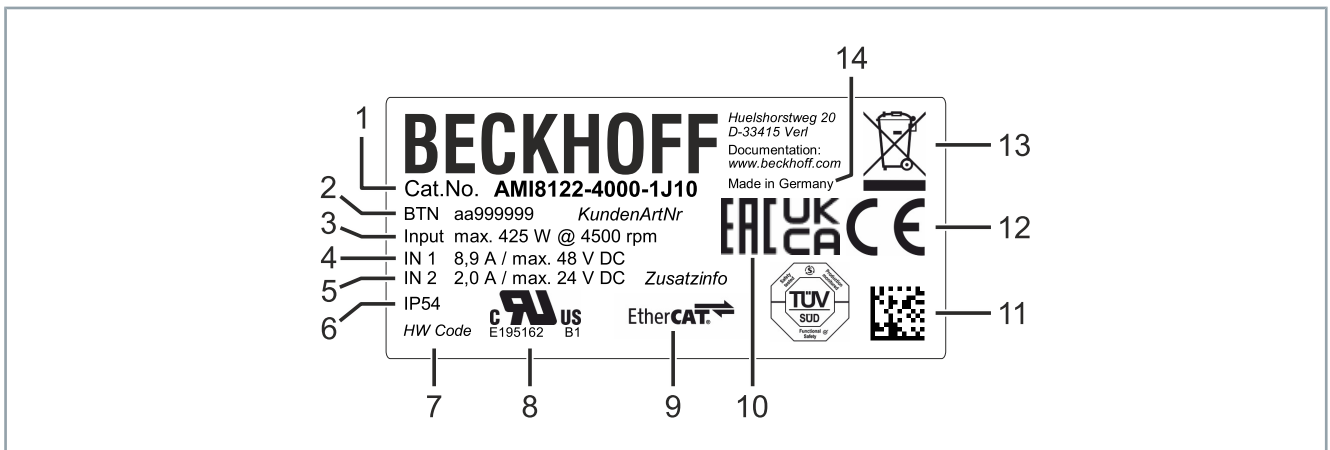
No direct skin contact with solvents or lubricants

In case of improper use, the solvents or lubricants used can lead to skin irritations. Therefore, avoid direct skin contact.



Item number	Explanation
1	Housing
2	Feather key [+]
3	Sensor connection M8; 3-pin
4	Power connection M12; 5-pin, L-coded
5	EtherCAT connection M8; 4-pin
6	Shaft
7	Radial shaft-sealing ring [+]

Name plate



Item number	Explanation
1	Motor type
2	Beckhoff Traceability Number, BTN
3	Nominal output
4	Max. supply voltage 48 VDC
5	Max. supply voltage 24 VDC
6	Protection class
7	Hardware code
8	UL approval for USA / CAN
9	Bus system
10	EAC approval / UKCA approval
11	Data-Matrix Code; BIC = Beckhoff Identification Code
12	CE conformity
13	Note on proper disposal

Type key

AMI81 u v - a b 00 - w x y z	Explanation
AMI81	Product area Compact integrated servo drive
u	Flange code F2
v	Overall length 1 = mm 2 = mm 3 = mm
a	Feedback system 3 = single-turn encoder 17-bit 4 = multi-turn encoder 17-bit
b	Drive-integrated safety technology 0 = without TwinSAFE 1 = TwinSAFE STO via FSoE
00	Not defined
w	Shaft version 0 = smooth shaft 1 = shaft with groove and feather key according to DIN 6885 2 = shaft with radial shaft-sealing ring IP 65 and smooth shaft 3 = shaft with radial shaft-sealing ring IP 65, groove and feather key
x	Winding type
y	Fieldbus 1 = EtherCAT
z	Holding brake 0 = without holding brake 1 = with 24 V holding brake

Product characteristics

Compact design

The integrated servo drives of the AMI812x series combine servomotor, servo drive and fieldbus connection in a space-saving design for all motion requirements in the power range up to 400 W.

Machines without control cabinet

You can place the integrated servo drives of the AMI812x series as EtherCAT slave directly at the machine without control cabinet and without upstream I/O level. This allows compact machines to be realized without a control cabinet.

Neodymium permanent magnets

The magnets installed in the servo drives are permanent magnets. Neodymium is a hard magnetic material that enables the precise and highly dynamic positioning of the servo drives.

Three-phase stator winding

The three-phase winding in the stator reduces the amount of material required while maintaining the same electrical output. All phase angles are 120°.

Electronic commutation in the power section

The servo drives are commutated electronically. The three coil turns are supplied from a bridge circuit.

Thermal contacts

A thermal contact LPTC-600 is installed to monitor and measure the winding temperature and to protect the servo drive against overheating. This can be read out by the user.

Temperature warning and switch-off:

- Warning temperature at 120 °C
- Switch-off temperature at 140 °C

Holding brake [+]

The servo drives can be equipped as an option with permanent magnet holding brakes. These operate according to the quiescent current principle and open at a voltage of $24 V_{DC} +6/-10 \%$ with $> 10,000,000$ switching cycles.

The installed holding brake is not suitable for service braking, since there is no monitoring for wear and functionality by the servo drive and the configuration. This applies in particular to vertical axes.



Safety measures for vertical axes must be applied

When operating vertical axes, appropriate additional measures must be taken; for example, including but not only:

- additional redundant brake units
- mechanical safeguards or interlocks
- attachment of a balancing weight

Permanent magnet holding brakes alone are not approved for the protection of persons. In consideration of ISO 13849-1 and 13849-2, additional precautions must be taken for personal protection.

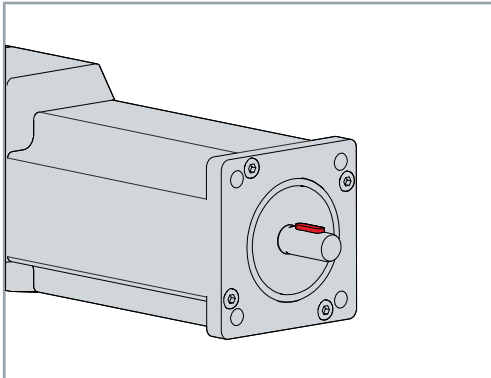
If the voltage is interrupted by emergency stop or power failure, the holding brake is conditionally permissible as a service brake. You can perform a maximum of 2000 emergency stops from a maximum of 3000 rpm with a maximum of three times the intrinsic inertia of the motor. These maximum values may vary due to increased load inertia.

The function of the holding brake can be checked with a torque wrench or with TwinCAT Scope.

Ordering options

Ordering options are defined via the type key. The listed components cannot be retrofitted.

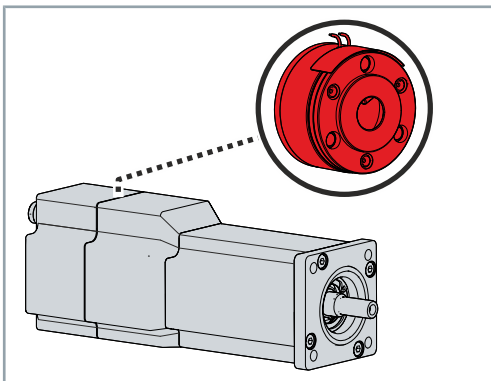
Feather key



A feather key transmits torque to an output element.

The servo drives are available with feather key groove and inserted feather key according to DIN6885/ISO2491. The rotor is balanced with half a feather key according to DIN ISO 21940-32:2012-08.

Holding brake



A holding brake blocks the rotor in the de-energized state. The holding brake increases the motor length and the rotor moment of inertia. The holding brake cannot be retrofitted and is mounted on the B bearing side of the servo drive.

Drive-integrated safety technology



Use Beckhoff connection cables

For the operation of the servo drives with integrated safety technology original Beckhoff connection cables are mandatory. This is part of the safety certification.

Observe the **TwinSAFE** documentation

Before putting the servo drives with integrated safety technology into operation, read the documentation:

- AMI8911 TwinSAFE card for AMI81xx servo drive

The servo drives are optionally available with integrated safety functions. These conform to IEC 61800-5-2 and fulfill the following safety standards:

- DIN EN ISO 13849-1:2015, Cat 4, PL e
- IEC 61508:2010 and IEC 62061:2015, SIL 3

Communication takes place via the Safety over EtherCAT (FSoE) protocol according to IEC 61784-3-12. The safety function STO can be activated via FSoE.

Order identifier	Safety functions	
AMI812x-a100	STO	Safe Torque Off
	SS1	Safe Stop 1

Intended use

The compact integrated servo drives of the AMI8100 series may only be operated for the purposes as defined in this documentation and under the specified ambient conditions.

The components are installed in electrical plants or machines. Stand-alone operation of the components is not permitted.

The thermal protection contact incorporated in the motor windings must be analyzed and monitored on a regular basis.



Read the entire drive system documentation:

- This translation of the original instructions
- Complete machine documentation provided by the machine manufacturer

Improper use

Any type of use that exceeds the permissible values from the technical data is regarded as inappropriate and is thus prohibited.

The compact integrated servo drives of the AMI8100 series are not suitable for use in the following areas:

- ATEX zones without suitable housing
- Areas with aggressive environments, for example aggressive gases or chemicals

The relevant standards and directives for EMC interference emissions must be complied with in residential areas.

Definitions



Characteristic torque and speed curves

Detailed information on characteristic curves can be found under: TE5910 | TwinCAT 3 Motion Designer

All data, with the exception of the voltage constant, are based on 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 %.

The A-side flange is intended for heat dissipation. If a gear unit is attached, the heat dissipation is interrupted and reduces the power of the servo drive.

By default, the heat is dissipated via the A-flange into the machine bed. Due to heating of the gear unit, this is not possible for thermal reasons. This configuration leads to a reduction of the nominal output.

Technical terms

This chapter provides information on various technical terms and their meaning.

Standstill torque M_0 [Nm]

Torque, also referred to as starting torque, that the servo drive can generate at standstill. It can be maintained indefinitely at a speed $n < 100 \text{ min}^{-1}$ and nominal ambient conditions.

Nominal torque M_n [Nm]

The torque that the servo drive delivers when it is operated at nominal speed and nominal current. Can be output in continuous operation S1 for an unlimited period of time.

Standstill current $I_{0\text{rms}}$ [A]

Sinusoidal current RMS value. This is consumed at a speed of $n < 100 \text{ min}^{-1}$ in order to generate the standstill torque.

Peak current / pulse current $I_{0\text{max}}$ [A]

Sinusoidal peak current RMS value. The configured peak current of the servo drive used must be less or equal.

Torque constant $K_{T\text{rms}}$ [Nm/A]

Indication of the torque in Nm generated by the servo drive per ampere of standstill current. The following applies: $M_0 = I_0 \times K_T$

Voltage constant $K_{E_{rms}}$ [mVmin]

Indication of the induced servo drive EMK at 20 °C, based on 1000 rpm. This is specified as the sine RMS value between two terminals.

Rotor moment of inertia J [kgcm²]

Measure of the acceleration capacity of the servo drive. For example, at J_0 the acceleration time t_b from 0 to 3000 rpm can be calculated based on the following formula:

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

with M_0 in Nm and J in kgcm²

Thermal time constant t_{TH} [min]

Specification of the heating time of the cold servo drive under load with I_0 until an overtemperature of 0.63 x 100 Kelvin is reached. This temperature rise happens in a much shorter time when the motor is loaded with the peak current.

Release delay time / application delay time of the brake t_{BRH} [ms]/ t_{BRL} [ms]

Specification of the response times of the holding brake [+] when operated with the nominal voltage

Winding inductance L [mH]

Specification of the servo drive inductance. It is the average value for one revolution, with two energized phases, at 1 kHz. Saturation of the servo drive must be taken into account.

Data for operation and environment

Beckhoff products are designed for operation under certain environmental conditions, which vary according to the product. The following specifications must be observed for operation and environment in order to achieve the optimum service life of the products.



Operate servo drives only under the specified environmental conditions

Operate the servo drives only in accordance with the specifications for operation and the environment listed in this chapter. This ensures a long service life and proper operation.

Temperatures above 40 °C and encapsulated installation can shorten the service life of the servomotor.

Environmental requirements	
Climate category - operation	2K3 according to EN 60721
Ambient temperature during operation	0 °C to +40 °C, extended temperature range
Ambient temperature during transport	-25 °C to +70 °C, maximum fluctuation 20 K/hour
Ambient temperature during storage	-25 °C to +70 °C, maximum fluctuation 20 K/hour
Permissible humidity in operation	5 % to 95 % relative humidity, no condensation
Permissible humidity during transport and storage	5 % to 95 % relative humidity, no condensation
Specifications for intended use	
Cooling	Convection
Degree of protection	Housing: IP54 Shaft feedthrough: IP20 in mounting position V3 / IP54 Shaft feedthrough with double-lipped FKM shaft seal ring: IP65
Feedback system	Absolute encoder, single-turn and multi-turn encoder
Vibration resistance	conforms to EN 60068-2-6
Shock resistance	conforms to EN 60068-2-27
EMC requirements	Conforms to EN 61000-6-2 and EN 61000-6-4
Approvals	CE, cURus EAC See chapter: Guidelines and Standards

AMI812x

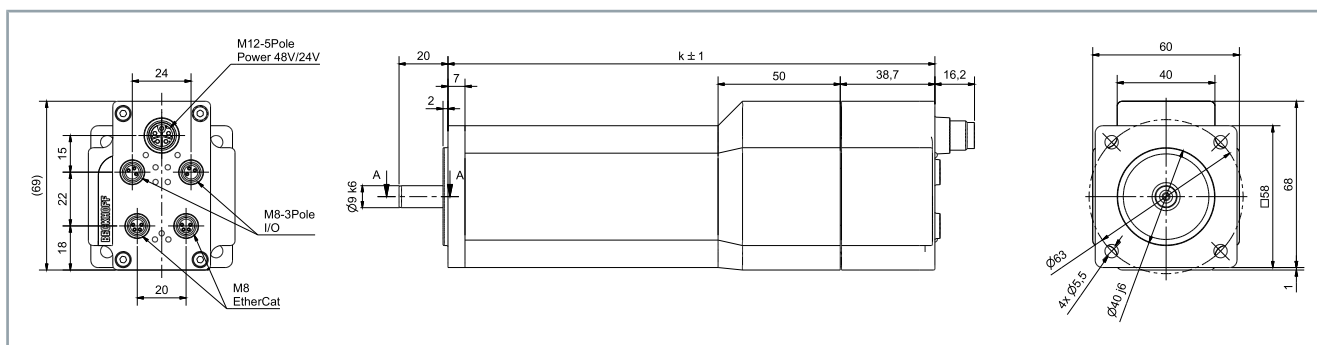
Electrical data	AMI81xx			
	21F	22F	22J	23J
Standstill torque M_0 [Nm]	0.48	0.78	0.78	1.0
Standstill current I_{orms} [A]	4	4	8	8
Maximum mechanical speed N_{max} [min ⁻¹]	3000	2000	4500	3500
Maximum nominal mains voltage U_N [V _{AC}]	50	50	50	50
Peak current I_{0max} [A]	18	18	18	18
Peak torque M_{0max} [Nm]	1.88	3.12	1.60	2.22
Torque constant K_{Trms} [Nm/A]	0.120	0.195	0.098	0.125
Voltage constant $K_{E rms}$ [mVmin]	7.5	11.9	5.6	7.8
Winding resistance Ph-Ph R_{20} [Ω]	1.650	1.580	0.355	0.410
Winding inductance Ph-Ph, measured at 1 kHz L [mH]	2.80	3.30	0.70	0.92
Power supply $U_N = 24$ V DC				
Nominal speed N_n [min ⁻¹]	1000	600	2000	1500
Nominal torque M_n [Nm]	0.48	0.78	0.78	1.0
Nominal output P_n [W]	50	49	163	157
Power supply $U_N = 48$ V DC				
Nominal speed N_n [min ⁻¹]	3000	2000	4500	3500
Nominal torque M_n [Nm]	0.45	0.78	0.75	0.97
Nominal output P_n [W]	141	163	353	355
Nominal current I_n [A]	4.0	4.0	8.0	8.0
Reference flange aluminum 230 mm x 130 mm x 10 mm Installation of a shaft sealing ring leads to a reduction of the nominal values.				

Technical data

Mechanical data	AMI81xx		
	21	22	23
Rotor moment of inertia J [kgcm ²]	0.134	0.253	0.376
Rotor moment of inertia with brake J [kgcm ²]	0.208	0.328	0.448
Number of poles	6		
Static friction torque M _R [Nm] Without shaft sealing ring Without holding brake	0.02	0.04	0.06
Thermal time constant t _{TH} [min]	10	13	16
Weight [kg]	1.35	1.65	2.05
Weight with brake [kg]	1.51	2.01	2.31
Flange			
Fit	6J		
Tolerance class	N		
Degree of protection			
Standard housing version	IP65		
Standard shaft feedthrough version	IP54		
Paint finishes			
Properties	acrylic powder-coated		
Hue	Anthracite gray; RAL 7016		
Optional holding brake [+]			
AMI812x			
Holding torque at 120 °C M _{BR} [Nm]	2.0		
Supply voltage U _{BR} [V _{DC}]	24; +6% to -10%		
Electrical power P _{BR} [W]	10		
Current at 120 °C I _{on} [A]	0.3		
Release delay time t _{BRH} [ms]	25		
Application delay time t _{BRL} [ms]	8		

Dimensional drawing

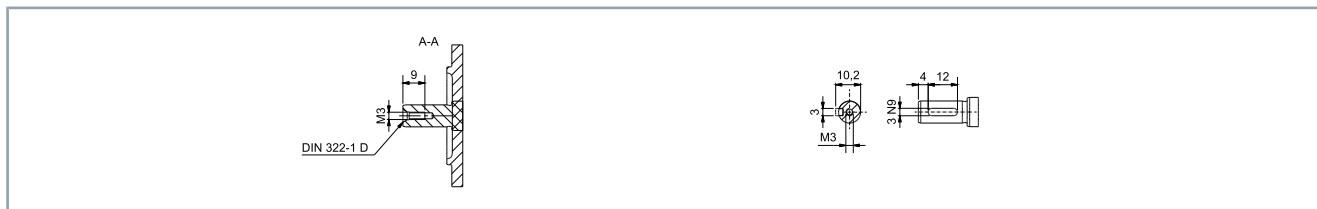
- All figures in millimeters



Motor	y	Z - brake
AMI8121	155	189.5
AMI8122	177	211.5
AMI8123	199	233.5

Feather key [+]

- Center bore according to DIN 332-D



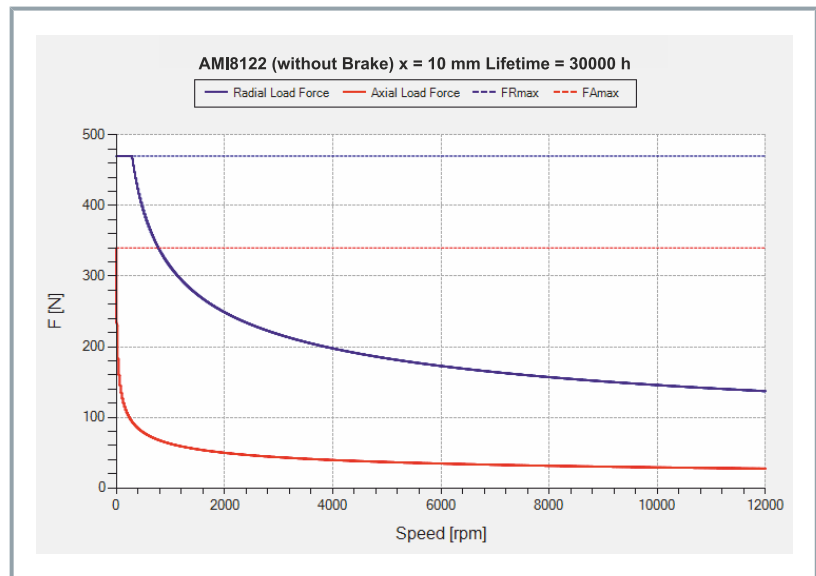
Force diagram



Beckhoff load/force calculator

The software represents axial and radial forces on the servo drive shaft. The following example shows an AMI8122 without a holding brake.

- [Download load/force calculator](#)





Check the scope of supply for missing or damaged parts

Check your delivery for completeness. If any parts are missing or became damaged during transport, contact the carrier, vendor or our service department immediately.

Check the shipment for the following contents:

- Servo drive of the AMI812x series with yellow protective cap
- Short information

Packaging

Instructions for handling are printed on the packaging:

Symbol	Explanation
	These are the permitted maximum and minimum temperatures at which the device may be stored and transported.
	This is the correct position for the packaging.
	Protect the packaging against wetness.
	The contents are fragile.



Avoid damage to the servo drives and loss of guarantee

Observe the conditions and the following chapters on transport and storage.

Failure to observe the conditions may result in damage to the servo drives and void the warranty.

Do not remove the yellow protective cap

Do not remove the yellow protective cap on the drive shaft.

The protective cap protects against mechanical damage and environmental influences. If you remove the protective cap, the shaft may be damaged.

Conditions

During transport and storage ensure that the servo drives and individual components are not damaged. Observe the specifications in the following chapters and comply with the following conditions:

- Climate category: 2K3 according to EN 60721
- Temperature: -25 °C to +70 °C, maximum fluctuation 20 K per hour
- Humidity: relative humidity 5 % to 95 %, no condensation
- Use of suitable means of transport
- The device should be transported and stored in a horizontal position
- Use of the vendor's original packaging

The table shows the maximum stacking height at which you may store and transport the servo drives on a pallet in the original packaging:

Motor type	Stacking height [pieces]
AMI812x	10

Transport

WARNING

Do not move under suspended loads

Use suitable means of transport and secure components of the decentralized servo drive system against falling down.

If the motor falls down, this can lead to serious or even fatal accidents.



Avoid high mechanical stresses

Use suitable means of transport and secure components of the decentralized servo drive system against high mechanical stress.

High mechanical stresses will damage the distributed servo drive system and individual components.

AMI81xx

Transport of the compact integrated servo drives of the AMI81xx series without auxiliary means.

Long-term storage



Observe the maximum storage time

Do not exceed the maximum storage time of two years.

Exceeding the specified maximum storage time can lead to changes in the properties of the lubricant used and damage the servo drive during subsequent operation.

Perform recurring inspections

Check the servo drive every six months to ensure it is in good condition.

Damage to the servo drive or maintenance work not carried out will affect the service life of the installed components and parts.

Prevent the formation of condensation

Keep the ambient temperature constant. Avoid solar radiation and high air humidity.

Condensation water can lead to damage during subsequent operation or to rust formation.

The servo drives can be stored for shorter or longer periods. For storage we always recommend the original packaging. Adhere to the conditions specified in the chapter: "Transport and storage", [Page 32].

The servo drives are protected against chemical and aggressive substances through the classes 1C2, chemical substances and 1B2, biological conditions.

Ensure the storage space is vibration-free.

Mounting position



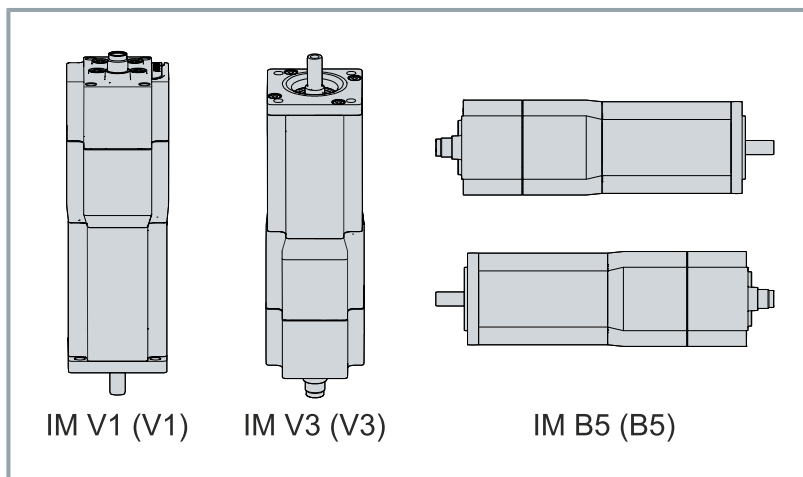
Observe the maintenance intervals and installation positions

Carry out maintenance at regular intervals.

In the horizontal installation position IM V3, liquid which has been left on the flange for a longer period can penetrate the servo drive through capillary action. In installation position IM V1 liquid can escape.

If you do not observe the maintenance intervals, the servo drive may overheat depending on the installation position. Ingress and leakage of liquids may damage the servo drive.

The standard installation position of the servo drives is the design IM B5 according to DIN EN 60034-7.



Feedback



Feedback exchange

The feedback system installed can only be replaced with an identical system. It is not possible to change the feedback system retrospectively.

The table below provides information about system accuracies and resolutions of the servo drive feedback systems:

Feedback	Resolution	System accuracy	Comment
Encoder, single-turn	17-bit	± 316 angular seconds	Standard:
Encoder, multi-turn			AMI812x

Protection equipment

The temperature sensor LPTC-600 is installed in all servo drives of the AMI812x series.

The LPTC-600 is integrated into the monitoring system of the servo drive when using the pre-assembled cable. Configure the servo drive according to the temperature warning at 120 °C and the switch-off temperature at 140 °C.

The LPTC-600 is identical to the KTY 84,130 used previously.

LPTC-600 sensor

The following table shows the resistance values of the temperature sensor:

Temperature [°C]	T/°C [%/K]	LPTC-600 Resistance [Ω]			Temperature error [K]
		minimum	Nominal value	maximum	
-40	0.84	340	359	379	± 6.48
-30	0.83	370	391	411	± 6.36
-20	0.82	403	424	446	± 6.26
-10	0.80	437	460	483	± 6.16
0	0.79	474	498	522	± 6.07
10	0.77	514	538	563	± 5.98
20	0.75	555	581	607	± 5.89
25	0.74	577	603	629	± 5.84
30	0.73	599	626	652	± 5.79
40	0.71	645	672	700	± 5.69
50	0.70	694	722	750	± 5.59
60	0.68	744	773	801	± 5.47
70	0.66	797	826	855	± 5.34
80	0.64	852	882	912	± 5.21
90	0.63	910	940	970	± 5.06
100	0.61	970	1000	1030	± 4.90
110	0.60	1029	1062	1096	± 5.31
120	0.58	1089	1127	1164	± 5.73
130	0.57	1152	1194	1235	± 6.17
140	0.55	1216	1262	1309	± 6.63
150	0.54	1282	1334	1385	± 7.10
160	0.53	1350	1407	1463	± 7.59
170	0.52	1420	1482	1544	± 8.10
180	0.51	1492	1560	1628	± 8.62

Shaft end A

The A-side is used for force transmission via a backlash-free and frictional connection. This is achieved by means of a coupling and a cylindrical shaft end according to DIN 748-3 with a center bore at the front according to DIN 332-2. Alternatively, forces can be transmitted via a frictional connection and a feather key groove according to DIN 6885/ISO 2491.

Radial forces

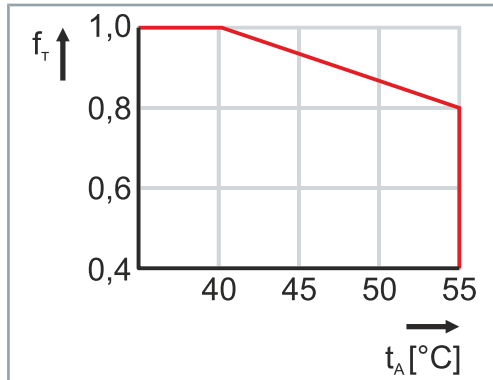
- Motors driven via pinion/toothed belt
- Permissible values depend on the speed

Axial forces

- Pinion or pulley mounted on the shaft
- For example, when operating right-angle gear units

Power derating

Derating may be necessary at high ambient temperature or when operating at a great height above sea level. In addition, some servo drives may experience power reductions depending on the feedback system installed or the holding brake [+]. The reduction affects the standstill current and the standstill torque.



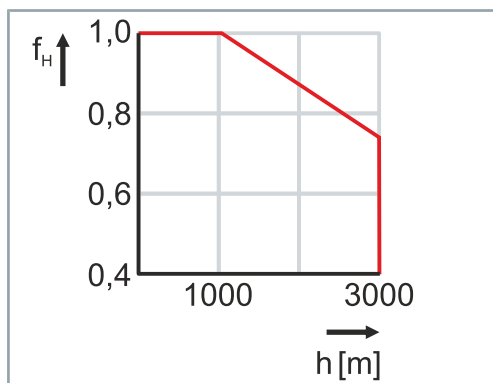
Ambient temperature

f_T = Temperature utilization factor

t_A = Ambient temperature in °C

Calculation of the performance data if the specified temperature limit > 40 °C to 55 °C is exceeded:

$$M0_{red} = M0 \times f_T$$



Installation altitude

f_H = Altitude utilization factor

h = Altitude in meters

Calculation of the performance data if the specified installation altitude is exceeded > 1000 m to 3000 m:

$$M0_{red} = M0 \times f_H$$

Ambient temperature and installation altitude

Calculation of the power data when exceeding the specified limits:

Ambient temperature > 40 °C, altitude > 1000 m and < 3000 m:

$$M0_{red} = M0 \times f_T \times f_H$$

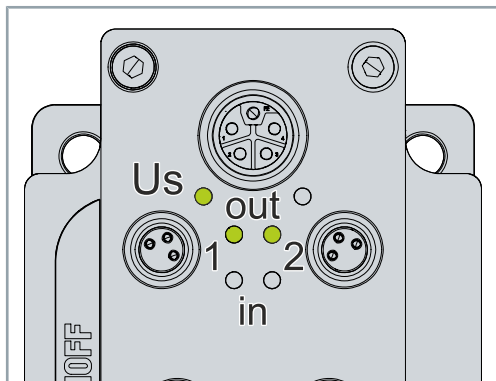
Display

The LEDs of the AMI812x compact integrated servo drive provide you with information about the operating state. There are different light sequences for each operating state.

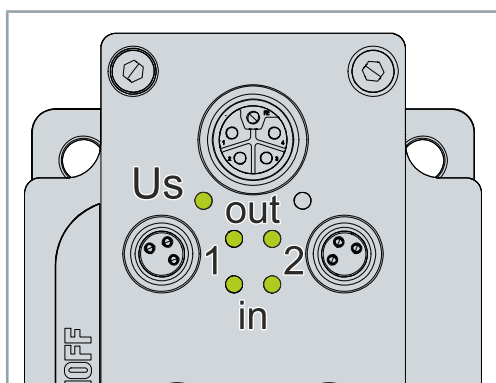
Status LEDs

This section provides information about the meaning of the different status LEDs on the AMI812x compact integrated servo drive.

Supply voltage

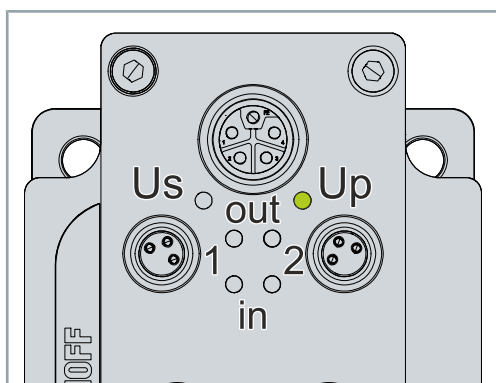


Us out 1 and 2 = status display of the supply voltage	
LED	Status
lit	Supply voltage present at outputs 1 and 2
Off	No supply voltage present at outputs 1 and 2



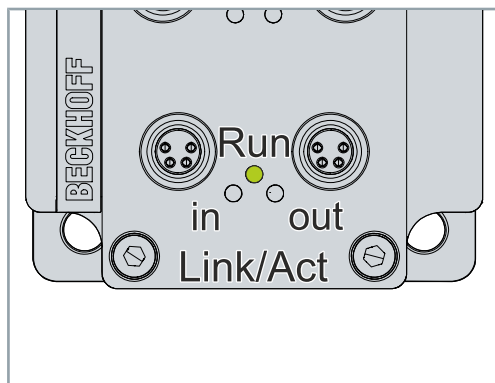
Us in 1 and 2 = status display of the supply voltage	
LED	Status
lit	Supply voltage present at inputs 1 and 2
Off	No supply voltage present at inputs 1 and 2

Motor voltage



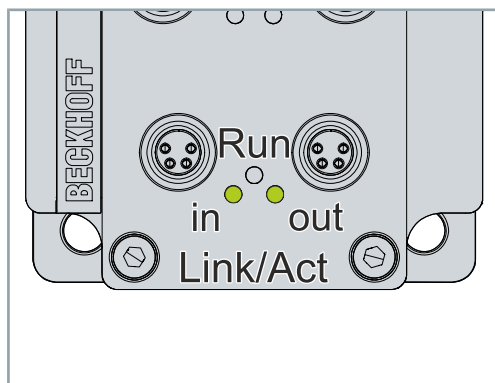
Up = status display of the power supply of the servo drive	
LED	Status
lit	Peripheral voltage present
Off	No peripheral voltage present

Operation



Run = display of the EtherCAT operating states	
LED	Status
lit	Operational; Op
Flashes uniformly	Pre-Operational; Pre-Op
Flashes sporadically	Safe-Operational; Safe-Op
Flashes very quickly	BOOT
Off	INIT

EtherCAT



Link/Act with in and out = display of the communication state	
LED	Status
lit	Link: connection to the connected EtherCAT module; no communication
Flashes	Act: communication with connected EtherCAT module
Off	No connection to the connected EtherCAT module

Carry out all work with great care and without time pressure.

Flange mounting

The following table provides information on components for mounting the servo drive on the machine or plant:

Quality of the cheese-head screw DIN EN ISO 4762 = 8.8				
Motor	Bore diameter [mm]	Screw size	Tightening torque [Nm]	Washer DIN
AMI812x	5.5	M5 x 16	5.5	5.3; DIN 7980

Output elements

WARNING

Secure moving parts against ejection

Make sure there are no moving parts on or in the machine during operation. Feather keys [+] are only secured during transport.

Unsecured parts can be ejected from the machine during operation and cause serious or fatal injuries.



Protect servo drive from impermissible stresses

Avoid bending components during transport or handling and do not change any insulation distances. Avoid hard shocks to the shaft end, the ball bearings or the feedback system. Furthermore, note vibration qualities and vibration resistance. If necessary, provide additional support for the servo drive.

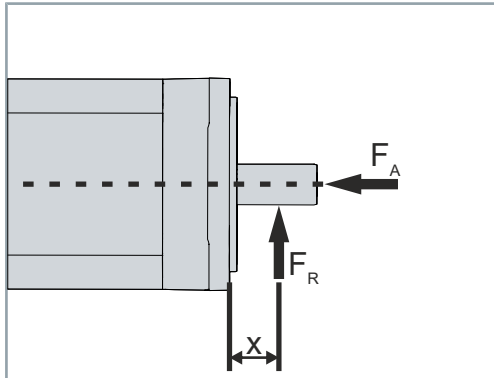
An impermissible load on the components can have a negative effect on the performance of the servo drive. Impacts on the shaft impair the concentricity of the servo drive.

Ensure adequate grounding via the protective conductor

The thermal connection of the flange determines the power loss.

Ensure adequate grounding via the protective conductor or the flange.

Bearing load during installation



Avoid mechanically overdetermined support of the shaft through rigid coupling and additional external support.

When assembling output elements, care must be taken to minimize the load on the shafts and bearing due to shear forces such as radial force F_R and axial force F_A . Axial loads shorten the service life and can lead to malfunctions of the holding brake [+].

Special features when using toothed belt drives:

When using a toothed belt drive, the radial and axial loads on the shaft must not be exceeded. Excessive load can lead to fatigue fracture of the shaft. Be sure to read the chapter Technical data.

Storage

The servo drives are equipped with sealed grooved ball bearings. The fixed bearing is located on the B-side of the servo drive and the floating bearing on the A-side; shaft output side of the servo drive. Oscillatory bearing movements $< 180^\circ$ shaft rotation are not permissible. Use the Beckhoff load/force calculator for a detailed calculation of the bearing forces on the shaft.

Servo drive	A-bearing sizes	B-bearing sizes
AMI812x	6001	609

Mounting

⚠ WARNING

Do not touch hot output elements without personal protective equipment

Only handle hot output elements, such as couplings or pulleys, with special thermal gloves. Avoid prolonged contact with hot components.

Hot components can cause severe burns to body parts and limbs.

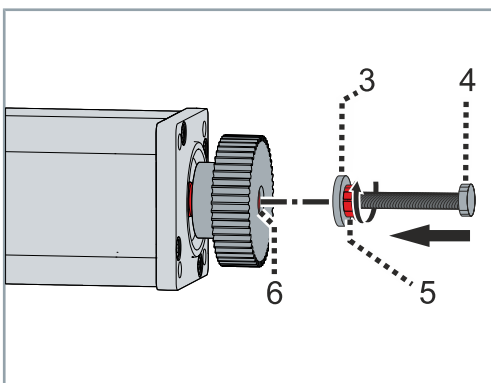
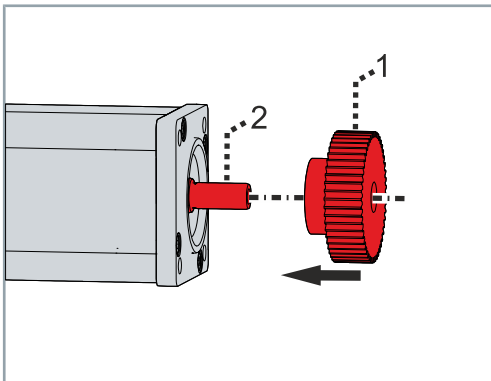


Do not mount the drive element offset

Place the drive element centered and straight on the shaft.

An offset will cause unacceptable vibration and the destruction of the ball bearings and the coupling.

- ▶ Warm up the output elements according to manufacturer's instructions
- ▶ Remove the protective cap
- ▶ Degrease and clean shaft
- ▶ Remove the output element from the oven and transport it to the workstation
- ▶ Place output element [1] centered and straight on the shaft [2]



- ▶ Insert washer [3] with bolt [4] of strength class 8.8 and nut [5] into the locking thread [6] of the shaft

- ▶ Tighten nut [5]

The output element is pulled onto the shaft by the nut.

Dismantling

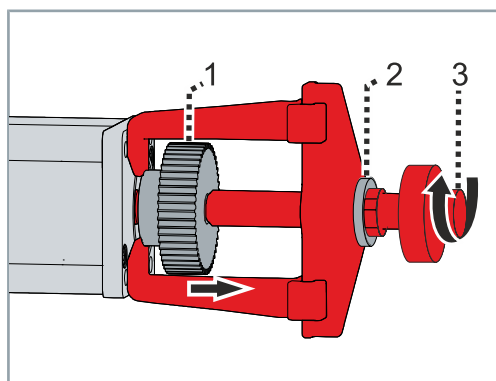
Use only backlash-free and friction-locked collets, gear pullers or suitable couplings to dismantle the output elements.

▶ Degrease shaft

▶ Screw puller [3] and intermediate disc [2] into the locking thread of the shaft

▶ Place the puller fully on the drive element [1]

▶ Pull the output element [1] with the puller [3] from the shaft



Connection technology

Beckhoff supplies pre-assembled connection cables. Mating connectors are not included in the scope of supply. For the selection of the necessary cables, refer to the Beckhoff documentation for the connecting cables [+]. In the documentation you will find a complete overview of the available cables and information on the technical data.

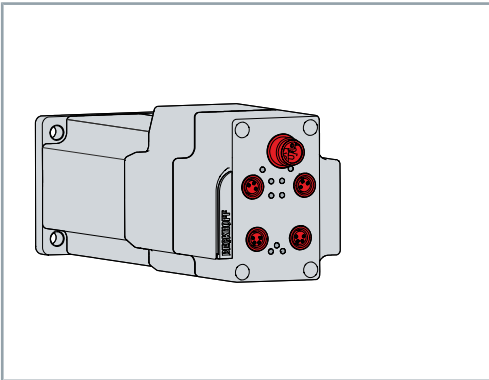


For interference-free data transmission, please note:

- Maximum number of mating cycles for the connectors: 500
- Maximum number of rotations of the power box: 10

If the maximum number of mating cycles or rotations is exceeded, clean data transmission can no longer be guaranteed. This results in signs of wear.

Sockets



The servo drives are equipped with sockets for the power supply, the sensors and the feedback signals.

Cables



Avoid soiling and damage

When connecting the socket and connector, make sure that the poles and the inside of the component are not soiled or damaged. *Failure to do so may adversely affect the function of the connections.*



Hint for trouble-free application and assembly:

- Wiring in accordance with applicable regulations and standards
- Pre-assembled and shielded Beckhoff cables

Beckhoff offers pre-assembled cables for faster and flawless installation of the servo drives. These cables are tested with regard to the material used, shielding and connection type. Perfect functioning and compliance with legal regulations, such as EMC and UL, are guaranteed. The use of other cables can cause unexpected malfunctions and result in exclusion of warranty.

Choice of cable



Observe the maximum permissible cable length

Use a maximum of 20 m cable length. *In case of non-observance, compliance with legal requirements is not guaranteed. Faults and malfunctions as well as exclusion of warranty can be the result.*

Beckhoff connection cables differ from one another in the method of laying, the type of connection and the core cross-section. In the table below you will find an assignment of the different connection cables.

Connection cables for AMI812x

Order identifier	Description
ZK2053-5200-0050	Power cable; 5 G 0.75 mm ² , M12, socket, straight, female, 5-pin, L-coded - open end, 5-core, length 5 m
ZK2000-2100-0050	Sensor cable, 3 x 0.25 mm ² , M8, plug, straight, male, 3-pin, A-coded - open end, 3-wire, length 5 m
ZK1090-3191-0050	EtherCAT cable, AWG 26, M8, plug, straight, male, 4-pin, A-coded - RJ45, plug, straight, male, 8-pin, length 5 m
ZK1090-3131-2005	EtherCAT cable, AWG 26, M8, plug, straight, male, 4-pin, A-coded - M8, plug, straight, male, 4-pin, A-coded

Rotary joints

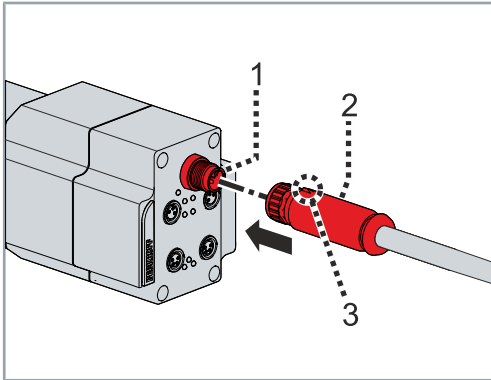


Available tool

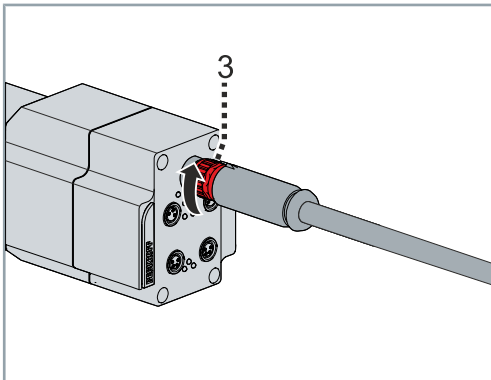
For the assembly of the rotary joints you can purchase the following tool:

- Torque wrench ZB8801-0000

Power

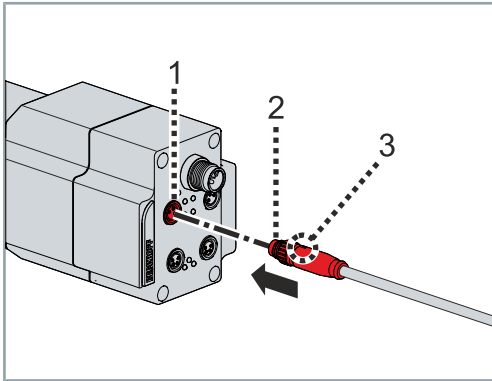


- ▶ Make sure that the poles and the interior of the socket as well as the threads on the connector are not dirty or damaged
- ▶ Push the plug [1] straight onto the socket [2]
- ▶ Make sure that the marking point [3] points upwards



- ▶ Screw thread [3] into the socket

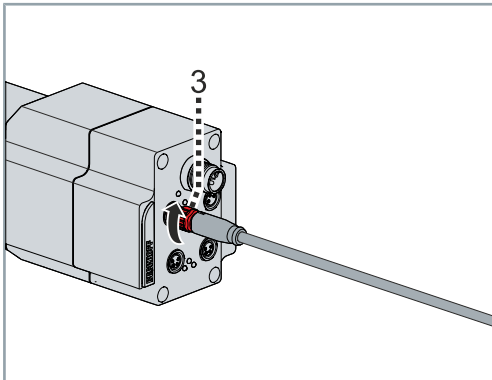
EtherCAT or sensors



- ▶ Make sure that the poles and the interior of the socket as well as the threads on the connector are not dirty or damaged
- ▶ Push the plug [1] straight onto the socket [2]

If present:

- ▶ Make sure that the marking point [3] points upwards



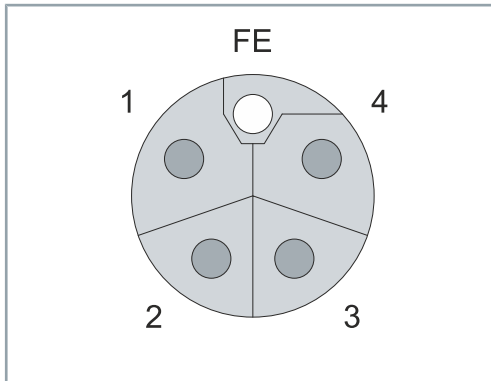
- ▶ Screw thread [3] into the socket

Connector assignment

Beckhoff offers various power connectors, sensor connectors and feedback connectors. All plugs are IP65 rated. A protective conductor connection according to VDE 0627 is provided on the housing.

Power

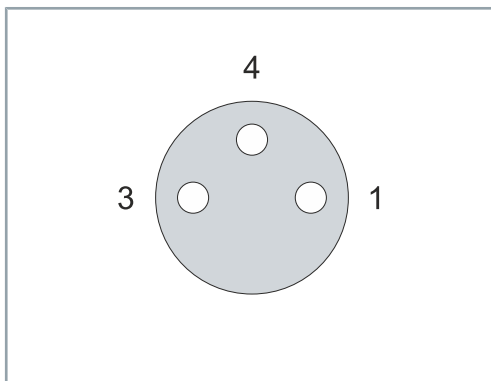
The following table shows the plug assignment on the motor side for the power connection:



Pin assignment M12 connector		
Contact	Function	Core identification
1	U_p+ ; +8...48 V _{DC}	Brown
2	GND; U_p-	White
3	U_s+ ; +24 V _{DC}	Blue
4	GND; U_s-	Black
5	FE	Gray

Sensors

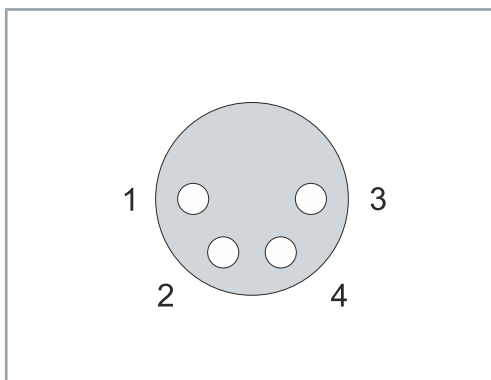
The following table shows the plug assignment on the motor side for the sensor connection:



Pin assignment M8 connector		
Contact	Function	Core identification
1	+24 V _{DC}	Brown
3	GND	Blue
4	Input	Black

Feedback

The following table shows the plug assignment on the motor side for the feedback connection:



Pin assignment M8 EtherCAT connector		
Contact	Function	Core identification
1	Tx+	Yellow
2	Rx+	White
3	Rx-	Blue
4	Tx-	Orange



Exemplary commissioning

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

Before commissioning

Observe the following points before commissioning:

- Make sure that an emergency stop switch complying with the valid regulations is fitted to the control station
- Check servo drive for damage
- Check mounting and alignment
- Tighten screw connections correctly
- Installing mechanical, thermal and electrical protective devices
- Check the wiring, connection and proper grounding on the servo drive

In case of motors with holding brake [+]

- Check the function of the holding brake [+]
- Check emergency stop functions

During commissioning

Pay attention to the following points during commissioning:

- Check function and adjustment of attachments
- Observe information for environment and operation
- Check protective measures against moving and live parts

Configuration

Beckhoff recommends the configuration of integrated servo drives of the AMI812x series in the Beckhoff TwinCAT 3 Drive Manager 2:

- Build Project and Choose Target System
- Implement devices by scanning or manually
- Configure devices, determine and set servo drive
- Create axis configuration
- Drive Manager 2 create project and scan drive or select manually
- Set scaling factor and speeds
- Check status and activate control system
- Adjust controller parameters if necessary

Prerequisites during operation

Pay attention to the following points during operation:

- Listen for atypical noises
- Check for unusual smoke formation
- Always check drive surfaces and cables for dirt, leaks, moisture or dust
- Check temperature development
- Check for lubricant leakage
- Observe recommended maintenance intervals
- Check function of safety devices

After operation

WARNING

Place the machine or plant in a safe state

Make sure that the rotor comes to a complete stop.

When the holding brake [+] is released, the rotor moves without remanent torque. Rotating components can lead to serious injuries.

⚠ WARNING

Ensure safe condition for cleaning work

Basically, electronic devices are not fail-safe. The condition is always safe when the unit is switched off and not energized. For cleaning work, place the connected servo drives and the machine in a safe state.

Carrying cleaning work during operation can lead to serious or fatal injuries.



Do not immerse or spray the servo drive

Wipe off the servo drive only with a cleaning agent and a cloth.

Due to impermissible solutions, cleaning by immersion can lead to damage to the surface and the servo drive as well as to leak-tightness problems.

Contamination, dust or chips can have a negative effect on the function of the components. In the worst case, contamination can lead to failure. Therefore, clean and service the components at regular intervals.

Cleaning materials

Carefully clean the components with a damp cloth or brush.

Use grease-dissolving and non-aggressive cleaning agents such as isopropanol for cleaning. You will also receive information about non-approved cleaning agents.

Not applicable

Cleaning agents	Chemical formula
Aniline hydrochloride	$C_6H_5NH_2HCl$
Bromine	Br_2
Sodium hypochlorite; bleaching solution	$NaClO$
Mercury (II) chloride	$HgCl_2$
Hydrochloric acid	HCl

Intervals

Under nominal conditions, the motor components have different operating hours. We have provided you with a list of maintenance work and intervals for the associated components below:

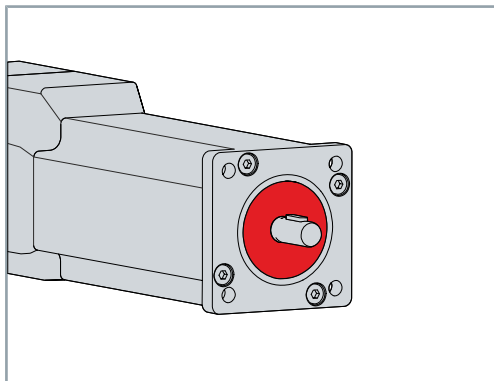
Component	Interval	Maintenance
Ball bearing	30000 operating hours	Replace bearing
Servo drive	2500 operating hours/annually	Check servo drive for bearing noises If noises are detected: do not continue to operate the servo drive; replace bearing
Shaft sealing ring	5000 operating hours	Perform visual inspection Lubricate the shaft sealing ring Recommended lubricants: „Mobilgrease™ FM22“ from Mobil In case of damage and pressure drop: Replace shaft sealing ring
Cables	Regular intervals	Perform visual inspection and check for damage If required: Replace cables
	5 million bending cycles	Replace cables
Sockets	500 cycles	In case of damage: Contact Beckhoff Service

Connection cables



For the connection from the servo drive to the machine or plant, there are different connection cables. For information on connecting a servo drive to a machine or system, refer to the chapter: Electrical installation.

Shaft sealing ring



The FKM radial shaft sealing ring serves to seal against splash water and to protect the servo drive shaft against the ingress of dust or dirt. This increases the degree of protection of the shaft feedthrough to IP65.

The radial shaft-sealing ring can be replaced at any time. Please note, however, that the exchange may lead to a reduction in the nominal values.

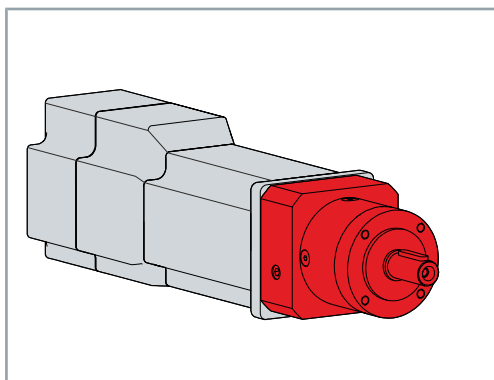
Gear unit



Axial load due to thermal expansion of the motor shaft

To avoid displacement of the motor shaft at high temperatures, use couplings as length compensation.

Directly mounted bevel gears or helical gear wheels can exceed the axial load of the floating bearing on the shaft end A.



A gear unit serves to transmit a moment of force or a torque and is used on the servo drive as an output element. Information on flange sizes for combinations of servo drive and gear unit can be found in the chapter: Type key.

Disassembly may only be carried out by qualified and trained personnel.

Read the chapter Documentation notes.

When disposing of electronic waste, make sure that you dispose of it in accordance with the regulations applicable in your country. Read and follow the instructions for proper disposal.

Disassembly

WARNING

Risk of injury from leaking oil

Prevent oil from leaking. Let it cool down before starting work. Soak up any leaked oil with approved binding agents. Mark the danger spot.

Leaking oil can cause slips and falls, resulting in serious or fatal injury. Hot oil can cause severe burns.



Do not remove components from the products

Only Beckhoff Automation GmbH & Co. KG is permitted to remove components.

Contact Beckhoff Service if you have any questions.

Removal of the servo drive from the machine

- Remove cables and electrical connections
- Cool and drain liquids, then remove
- Remove supply lines and water hoses
- Loosen and remove the servo drive fixing screws
- Transport the servo drive to the workplace or put it into storage

Disposal

Depending on your application and the products used, ensure the professional disposal of the respective components:

Cast iron and metal

Dispose of cast and metal parts as scrap metal for recycling.

Cardboard, wood and foam polystyrene

Dispose of packaging materials made of cardboard, wood or foam polystyrene in accordance with the regulations.

Plastics and hard plastics

You can recycle parts made of plastic and hard plastic via the recycling depot or re-use them depending on the component designations and markings.

Oils and lubricants

Dispose of oils and lubricants in separate containers. Hand over the containers at the used oil collection station.

Batteries and rechargeable batteries

Batteries and rechargeable batteries may also be marked with the crossed-out trash can symbol. You must separate these components from the waste and are legally obliged to return used batteries and rechargeable batteries within the EU. Observe the relevant provisions outside the area of validity of the EU Directive 2006/66/EC.



Electronic components

Products marked with a crossed-out waste bin must not be disposed of with general waste. Electronic components and equipment must be disposed of properly. The national regulations for the disposal of electrical and electronic equipment must be observed.

Returning to the vendor

In accordance with the WEEE-2012/19/EU directives, you can return used devices and accessories for professional disposal. The transport costs are borne by the sender.

Send the used devices with the note "For disposal" to:

Beckhoff Automation GmbH & Co. KG
"Service" Building
Stahlstrasse 31
D-33415 Verl

In addition, you have the option to contact a local certified specialist company for the disposal of used electrical and electronic appliances. Dispose of the old components in accordance with the regulations applicable in your country.

Standards

Product standard EN 61800-3:2004+A1:2012

"Adjustable speed electrical power drive systems. EMC requirements and specific test methods"

EN 60034-1:2010+Corr.:2010

"Rotating electrical machines – Rating and performance"

RoHS: EN 50581:2012

"Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances"

Guidelines

2014/35/EU

Low Voltage Directive




2014/30/EU

EMC Directive

2011/65/EU

RoHS Directive

Test centers

	<p>The servo drives do not fall within the scope of the Machinery Directive. However, Beckhoff products are designed and evaluated in full compliance with all relevant regulations for personal safety and use in a machine or system.</p>
	<p>The servo drives meet all the requirements of the Eurasian Economic Union. These include Russia, Belarus, Armenia, Kazakhstan and Kyrgyzstan. The EAC logo can be found on the name plate.</p>
	<p>The servo drives comply with UL requirements and are certified as cURus components for the US and Canadian markets in accordance with the standards applicable in the USA and Canada. The cURus logo can be found on the name plate.</p>

EU conformity



Provision

Beckhoff Automation GmbH & Co KG will be pleased to provide you with EU declarations of conformity and manufacturer's declarations for all products on request.

Please send your request to: info@beckhoff.com

CCC conformity



Export to Chinese Economic Area

Beckhoff compact integrated servo drives of the AMI812x series are not subject to the **C**hina **C**ompulsory **C**ertificate (CCC). The products are exempt from this certification and can be exported to the Chinese economic area.

UL conformity



Certification for USA and Canada

Beckhoff compact integrated servo drives from the AMI810x series are approved as certified cURus components, E195162, for the American and Canadian economic area. The motors may be used as components in a system with UL-Listing test mark.

A		Drive-integrated safety technology	22
Accessories		Feather key	21
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