BECKHOFF New Automation Technology

Operating instructions | EN

ASI8100

Compact integrated stepper motor drive

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1 Documentation notes

1.1 Disclaimer

Beckhoff products are subject to continuous further development. We reserve the right to revise the documentation at any time and without notice. No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams, and descriptions in this documentation.

1.1.1 Trademarks

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1.1.2 Patents

The EtherCAT technology is protected by patent rights through the following registrations and patents with the relevant applications and registrations in various other countries:

- EP1590927
- EP1789857
- EP1456722
- EP2137893
- DE102015105702

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1.1.3 Limitation of liability

All components of this product described in the original operating instructions are delivered in a hardware and software configuration, depending on the application requirements. Modifications and changes to the hardware or software configuration that go beyond the documented options are prohibited and nullify the liability of Beckhoff Automation GmbH & Co. KG.

The following is excluded from the liability:

- Failure to comply with this documentation
- Improper use
- Use of untrained personnel
- Use of unauthorized spare parts

1.1.4 Copyright

1.2 Version numbers

On request we can send you a list of revision levels for changes to the documentation. Please send your request to:


motion-documentation@beckhoff.com

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

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

1.3 Scope of the documentation

In addition to this documentation, the following documents are part of the complete documentation:

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

1.4 Staff qualification

This documentation is aimed at trained specialists working in control technology and automation who have 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 documentation published at the time must be used for each installation and commissioning. 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

1.5 Safety and instruction

Read the contents that are related to the activities you will perform with the product. Always read the For your safety chapter in the documentation. Observe the warning notes in the chapters so that you can handle the product and work with it properly and safely.

1.5.1 Notes on information security

The products of Beckhoff Automation GmbH & Co. KG (Beckhoff), insofar as they can be accessed online, are equipped with security functions that support the secure operation of plants, systems, machines and networks. Despite the security functions, the creation, implementation and constant updating of a holistic security concept for the operation are necessary to protect the respective plant, system, machine and networks against cyber threats. The products sold by Beckhoff are only part of the overall security concept. The customer is responsible for preventing unauthorized access by third parties to its equipment, systems, machines and networks. The latter should be connected to the corporate network or the Internet only if appropriate protective measures have been set up.

In addition, the recommendations from Beckhoff regarding appropriate protective measures should be observed. Further information regarding information security and industrial security can be found in our https://www.beckhoff.com/secguide.

Beckhoff products and solutions undergo continuous further development. This also applies to security functions. In light of this continuous further development, Beckhoff expressly recommends that the products are kept up to date at all times and that updates are installed for the products once they have been made available. Using outdated or unsupported product versions can increase the risk of cyber threats.

To stay informed about information security for Beckhoff products, subscribe to the RSS feed at https://www.beckhoff.com/secinfo.

1.6 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 brackets indicate cross-references to other text passages in the document.

[1] The number in the square brackets refers to the position in the adjacent figure.

[+] The plus sign in square brackets indicates ordering options and accessories.

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

⚠ DANGER

Failure to comply will result in serious or fatal injuries.

⚠ WARNING

Failure to comply may result in serious or fatal injuries.

⚠ CAUTION

Failure to comply may result in minor or moderate injuries.

NOTICE

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

- product malfunctions
- damage to the product
- damage to the environment

Information
This symbol indicates information, tips, and notes for handling the product or the software.

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

Required tool
This symbol indicates a tool that is required for the following steps.

Required accessories [+]
This symbol shows the accessories required for the following steps. The accessories are not included in the scope of delivery and can be ordered from Beckhoff.

Assembly material required
This symbol shows the assembly material required for the following steps. The assembly material is not included in the scope of delivery and must be purchased separately.

QR codes
This symbol shows a QR code that you can scan to watch videos or animations. Internet access is required in order to use it.

1.7 Beckhoff Services

Beckhoff and its international partner companies offer comprehensive support and service.

www.beckhoff.com/en-en/support/global-availability/

1.7.1 Support services

The Beckhoff Support offers technical advice on the use of individual Beckhoff products and system planning. The support engineers offer you competent assistance, for comprehension questions as well as for commissioning.

+49 5246 963-157
support@beckhoff.com
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1.7.2 Training offerings

Training in Germany takes place at the Beckhoff branches or, after consultation, at the customer's premises. Beckhoff offers both face-to-face and online training courses.

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1.7.3 Service offerings

The Beckhoff service experts support you worldwide in all areas of after-sales service.

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1.7.4 Headquarters Germany

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A detailed overview of the Beckhoff locations worldwide can be found at:

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1.7.5 Downloadfinder

In the Download finder you will find configuration files, technical documentation and application reports to download.

www.beckhoff.com/documentations

2 For your safety

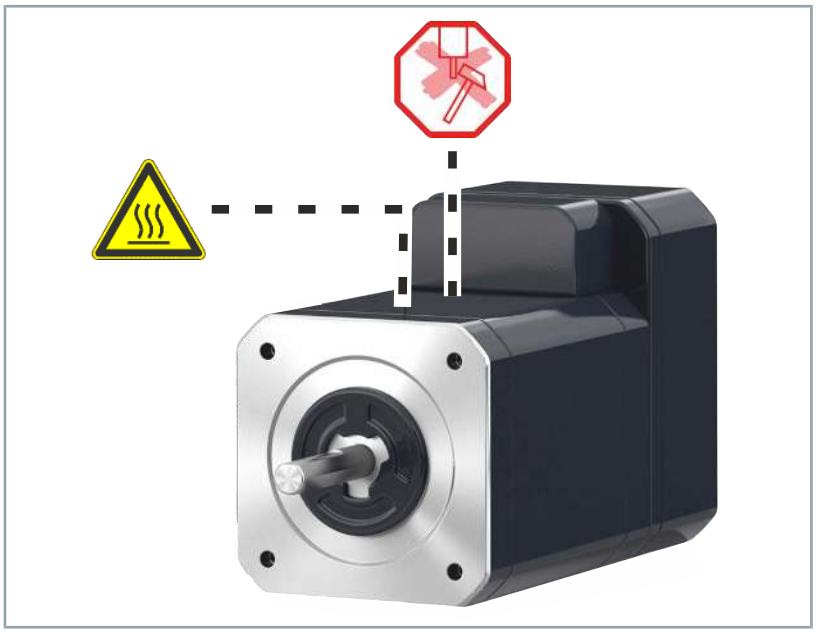
Read this chapter containing general safety information. Furthermore, the chapters in this documentation contain warning notices. Always observe the safety instructions for your own safety, the safety of other persons and the safety of the product.

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.

2.1 Safety pictograms

You will find safety symbols on Beckhoff products and packaging. The symbols may be glued, printed, or lasered on and may vary depending on the product. They serve to protect people and to prevent damage to the products. Safety pictograms may not be removed and must be legible for the user.

2.1.1 Safety pictograms



Warning: Hot surface

During and after operation, there is a risk of burns at the housing from hot surfaces above 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.

2.2 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.

2.2.1 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 non-conductive materials.

2.2.2 During operation

Do not work on live electrical parts
Do not open any motors while they are live. Ensure that the protective conductor is properly connected. Never loosen electrical connections when live. Only work on motors when the device is switched off. Disconnect all components from the mains and protect them against unintentional reconnection.

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.

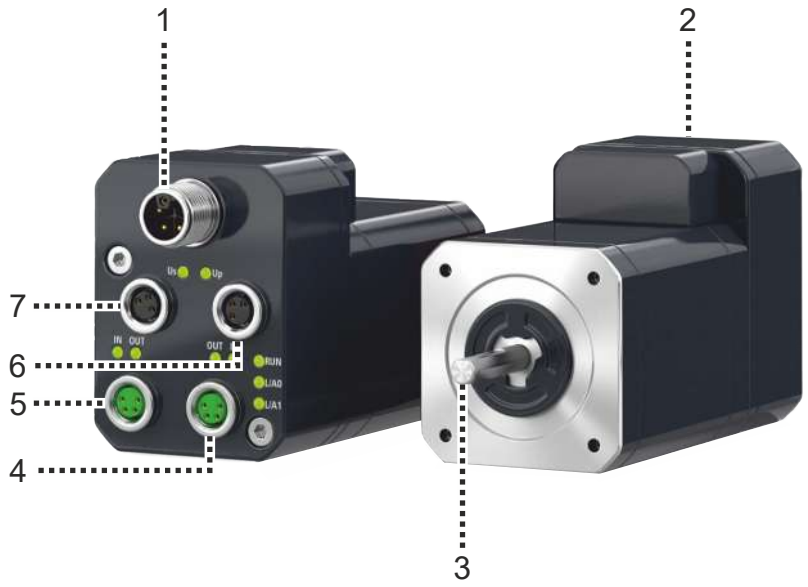
Do not touch any moving or rotating components
Do not touch any moving or rotating components. Fasten all parts or components on the machine or plant.

2.2.3 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 and comply with the chapter: Decommissioning.

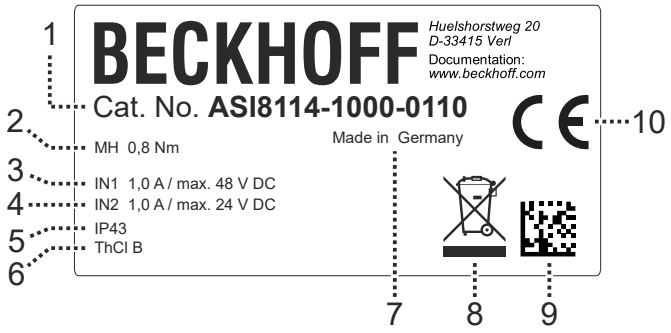
No direct skin contact with solvents or lubricants
In case of improper use, the solvents or lubricants used can lead to skin irritations. Avoid direct skin contact.

3 Product overview



Item number	Explanation
1	X5: Power connection (M12, 5-pin, L-coded)
2	Housing
3	Shaft with flattening (D-shape)
4	X2/OUT: EtherCAT connection (M8, 4-pin)
5	X1/IN: EtherCAT connection (M8, 4-pin)
6	X4: Sensor connection (M8, 3-pin)
7	X3: Sensor connection (M8, 3-pin)

3.1 Name plate



Item number	Explanation
1	Motor type
2	Holding torque
3	max. current consumption for power supply 24/48 V DC
4	max. current consumption for control voltage 24 V DC
5	Protection rating
6	Insulation class
7	Country of manufacture
8	WEEE compliance
9	Data-Matrix Code; BIC = Beckhoff Identification Code
10	CE conformity

3.2 Type key

ASI81 u v – a b 00 – w x y z	Explanation
ASI81	*Product area* • Compact integrated stepper motor drive
u	*Flange code* • 1 = N1 NEMA17, 42 mm
v	*Overall length* • 1 • 4
a	*Feedback system* • 1 = single-turn encoder, magnetic, 16-bit
b	*Drive-integrated safety technology* • 0 = Without TwinSAFE
w	*Shaft version* • 0 = Smooth shaft with one flattening (D-shape)
x	*Winding type* • 1 = 1 A
y	*System bus/drive profile* • 1 = EtherCAT/MDP profile • 2 = EtherCAT/DS402 profile (in preparation)
z	*Holding brake* • 0 = Without holding brake

3.3 Product characteristics

Compact design

The integrated stepper motor drives of the ASI8100 series combine stepper motor, stepper motor output stage and fieldbus connection in a space-saving design for all motion requirements in the power range up to 50 watts.

Machines without control cabinet

The integrated ASI8100 stepper motor drive can be placed directly on the machine as an EtherCAT slave without a control cabinet and without an upstream I/O level in order to implement compact machines without a control cabinet.

Standardized NEMA flange sizes

Adaptation to international standards through flange sizes N1 = NEMA17, N2 = NEMA23 and N3 =NEMA34.

Step angle

A small step angle of 1.8° enables high precision and accurate movements.

Electronic identification plate

The electronic identification plate contains all specific data of the drive and can be read directly from the Beckhoff drive system for automatic parameterization.

Daisy Chain

The ASI8100 is an independent EtherCAT slave and can be connected directly to other EtherCAT slaves via Daisy Chain.

Integrated power electronics

The integrated power electronics are controlled quickly and easily via EtherCAT and the motor is commissioned with TwinCAT 3 Drive Manger 2.

3.4 Ordering options

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

3.4.1 Drive profiles MDP and DS402

The ASI8100 supports the drive profiles MDP and DS402.

ASI8111-xx1x
ASI8114-xx1x

MDP profile
The CoE objects in the MDP profile (Modular Device Profile) are allocated in the way that is common for the Beckhoff EtherCAT Terminals.

ASI8111-xx2x
ASI8114-xx2x

DS402 profile
The DS402 drive profile is specified in IEC 61800-7-200 (CiA402). It uses a different object directory structure.

3.5 Intended use

The compact integrated stepper motor drives of the ASI8100 series are designed especially as actuators for handling devices, textile machines, machine tools, packaging machines and similar machines. They are intended to be controlled and operated in terms of speed and position. For this purpose, the ASI8100 is equipped with a magnetic encoder that enables controlled operation (FOC). If the ASI8100 is used in areas with magnetic fields (e.g. caused by permanent magnets or solenoids), only controlled operation is possible.

The stepper motor drives from the ASI8100 series may be operated exclusively for the activities foreseen and defined in this documentation, taking into account the prescribed environmental conditions.

The components are to be installed in electrical systems or machines and only put into operation as integrated components of the system or machine.

Read the entire drive system documentation:

- This translation of the original instructions
- The machine manufacturer's complete documentation for the machine

3.5.1 Improper use

Any use exceeding the permissible values specified in the technical data is considered improper and therefore prohibited!

The compact integrated stepper motor drives of the ASI8100 series are not suitable for use in the following areas:

- Areas with magnetic fields
- 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.

4 Technical data

4.1 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 and the resistance per phase, are based on 40 °C ambient temperature and 90 K overtemperature of the winding. The data can have a tolerance of ±10%.

If a gear unit is attached to the A-side motor flange, the power may be reduced.

4.1.1 Technical terms

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

Holding torque T_H [Nm]

The holding torque states the torque that the energized motor can hold at standstill without causing continuous rotation of the rotor.

Rotor moment of inertia J [kgcm²]

Measure of the acceleration capacity of the motor. For example, at J_0 the acceleration time t_b from 0 to 3000 min^{-1} can be calculated based on the following formula:

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

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

Winding inductance L [mH]

Indication of the motor inductance. It is the mean value for one motor revolution, with two energized phases, at 1 kHz. Saturation of the motor must be taken into account.

Winding resistance R [Ω]

Specification of the resistance of a motor phase, measured at 25 °C. The winding resistance indicates the electrical resistance of the motor's coil winding

4.2 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.

NOTICE

Operate the motor only under the specified conditions
Operate motors only under the operating and environmental conditions specified in this chapter. This ensures a long service life and proper operation.

The stepper motor can be damaged at temperatures above 40 °C and encapsulated installation.

4.2.1 General housing specifications

Property	
Material	Aluminum
Surface coating	Partially anodized
Color	black similar to RAL 9005, silver
Design	Flange mounting according to IM B14, IM V18, IM V19
Protection rating	IP43

Further information can be found in the

- Dimensional drawing "ASI8111", [Page 24]
- Dimensional drawing "ASI8114", [Page 25]

4.2.2 Environmental conditions

Environmental requirements	
Climate category	3K3 according to EN 60721
Ambient temperature during operation	-10 °C to +40 °C, with power derating to +50 °C
Ambient temperature during transport	Maximum fluctuation 20 K/hour: -20 °C to +60 °C
Ambient temperature during storage	Maximum fluctuation 20 K/hour: -20 °C to +60 °C
Permissible humidity in operation	20 % to 90 % relative humidity, no condensation
Permissible humidity during transport and storage	90 % relative humidity, no condensation

4.2.3 Specifications for intended use

Specifications for intended use	
Cooling	Convection: Adequate self surface cooling is to be ensured.
Insulation material class	B; 130 °C according to IEC 60085
Feedback system	Magnetic single-turn encoder, resolution 16 bit
Drive profile	MDP profile, DS402 profile (in preparation)
Approvals	CE, EAC, UL (in preparation)

4.3 Size ASI8111

Electrical data

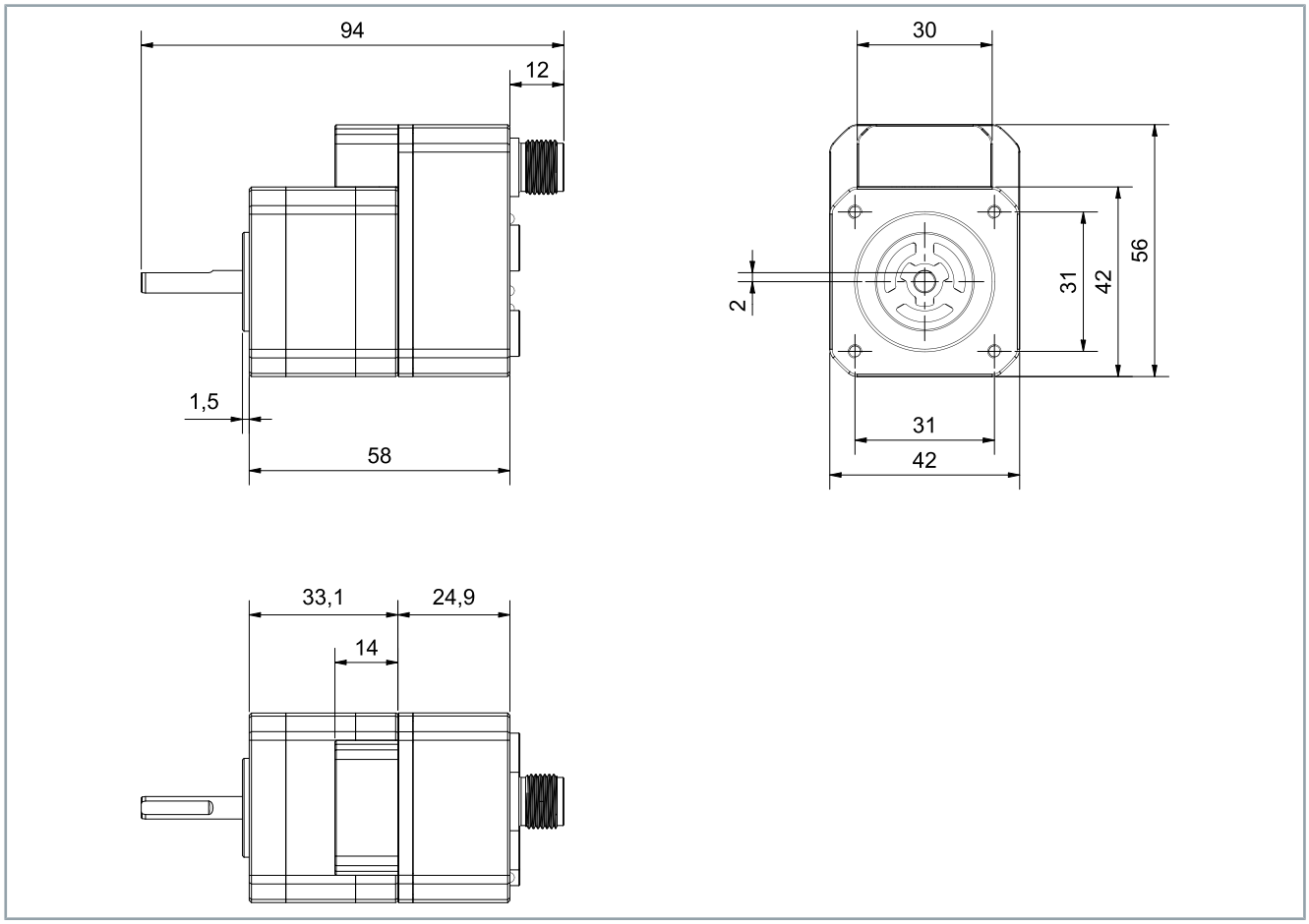
	ASI8111
Holding torque T_H [Nm]	0.29
Supply voltage [V_{DC}]	24…48
Nominal current per phase [A]	1.0
Winding resistance per phase R_{25} [Ω]	3.6
Winding inductance phase L [mH]	7
Resolution [steps]	1.8°/200 full steps

Mechanical data

	ASI8111
Axial load [N]	10
Radial load 0 mm from shaft end [N]	20
Rotor moment of inertia J [kgcm²]	0.031
Weight [kg]	0.4
Maximum winding temperature [°C]	120
Flange size	N1, NEMA 17/42 mm

4.3.1 Dimensional drawing ASI8111

All figures in millimeters



4.4 Size ASI8114

Electrical data

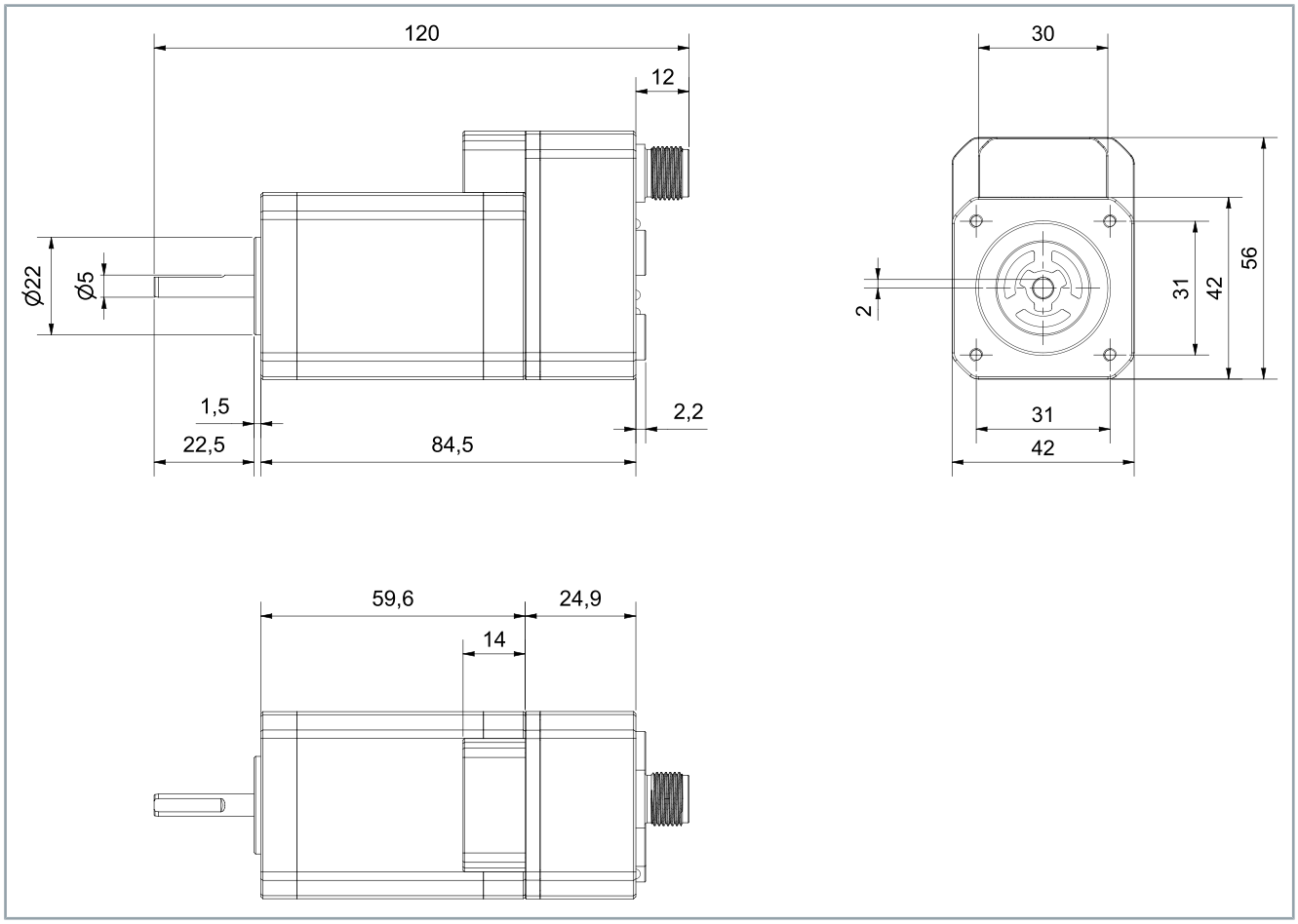
	ASI8114
Holding torque T_H [Nm]	0.8
Supply voltage [V_{DC}]	24…48
Nominal current per phase [A]	1.0
Winding resistance per phase R_{25} [Ω]	6.5
Winding inductance phase L [mH]	16
Resolution [steps]	1.8°/200 full steps

Mechanical data

	ASI8114
Axial load [N]	10
Radial load 0 mm from shaft end [N]	20
Rotor moment of inertia J [kgcm²]	0.094
Weight [kg]	0.7
Maximum winding temperature [°C]	120
Flange size	N1, NEMA 17/42 mm

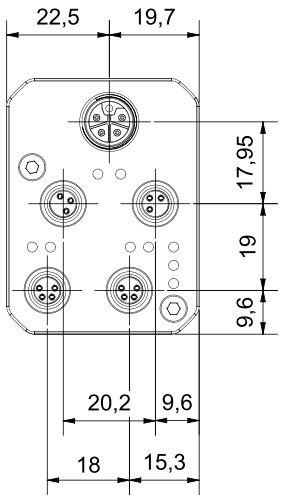
4.4.1 Dimensional drawing ASI8114

All figures in millimeters



4.5 Dimensional drawing of the connection level size ASI811x

All figures in millimeters



5 Scope of supply

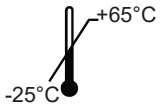
Check the scope of supply for missing or damaged parts
Check your delivery for completeness. If any parts are missing or became damaged during transport, contact the carrier, vendor or our service department immediately.

Check the shipment for the following contents:

- Compact integrated stepper motor drives from the ASI8100 series with yellow protective cap
- Short information

5.1 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 moisture
	The contents are fragile

6 Transport and storage

NOTICE

Loss of warranty due to non-compliance with transport and storage conditions
Failure to observe the conditions for transportation and storage may result in damage the stepper motor drives and invalidate the warranty.

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

NOTICE

Damage due to removal of the protective cap
The yellow protective cap on the shaft protects against mechanical damage and environmental influences. If you remove the protective cap, the shaft may be damaged.

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

6.1 Conditions

During transport and storage ensure that the motors 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 +65 °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 motors on a pallet in the original packaging:

Motor type	Stacking height [pieces]
ASI8100	10

6.2 Transport

⚠ WARNING

Risk of injury due to suspended loads
If the motor falls down, this can lead to serious or even fatal accidents.

- Use suitable means of transport
- Secure the motor against falling.
- Do not move under suspended loads

NOTICE

Damage due to high mechanical loads
High mechanical loads damage the compact integrated stepper motor drives and individual components.

- Use suitable means of transport
- Secure components of the stepper motor drives against high mechanical loads

6.2.1 ASI8100

Transport of the compact integrated stepper motor drives of the ASI8100 series without tools.

6.3 Long-term storage

NOTICE

Damage due to excessive storage time
Exceeding the specified maximum storage time can lead to changes in the properties of the lubricant used and damage the stepper motor drives during operation.

- Do not exceed the maximum storage time of two years

NOTICE

Damage due to lack of maintenance
Damage to the stepper motor drives is not detected due to a lack of maintenance work and affects the service life of the installed components and parts.

- Check stepper motor drives for proper state every six months

NOTICE

Damage due to condensation
Condensation can lead to damage during subsequent operation or to rust formation.

- Keep the ambient temperature constant
- Avoid solar radiation
- Avoid high air humidity

The stepper motor drives can be stored for shorter or longer periods.

► Store the product in its original packaging.

► Observe the conditions specified in chapter "Transport and storage", [Page 28].

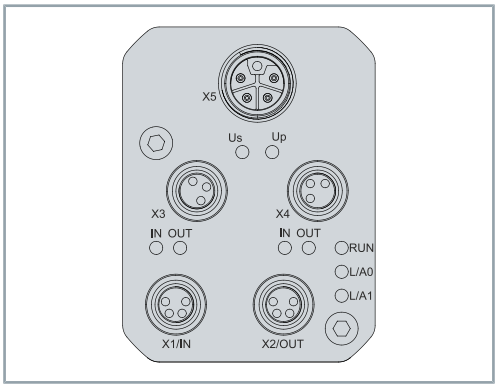
► Ensure the storage space is vibration-free.

7 Technical description

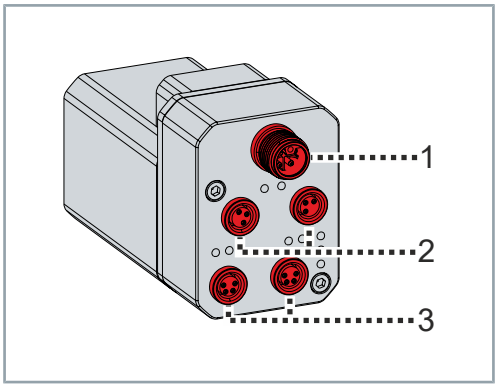
7.1 Functional description

The ASI8100 integrated stepper motor drive is a stepper motor with integrated stepper motor output stage and fieldbus connection. The power electronics are mounted on the B bearing plate (rear of the motor) so that the motor and electronics are located in a common housing. The ASI8100 has an integrated encoder and can be controlled via vector control, similar to a servomotor. For operation, it requires a load voltage supply for the motor and a control voltage supply for the electronics. It has two integrated digital inputs/outputs with a voltage of 24 V DC for drive-related functions such as limit switches or external sensors. They can be connected directly to the drive and do not require any additional hardware. The ASI8100 is a complete EtherCAT slave and is bolted directly to the machine without a control cabinet and without an upstream I/O level. It can be connected directly to other EtherCAT slaves via Daisy Chain.

7.2 Connection description



Each connection level of the integrated stepper motor is designed with standardized connectors with LEDs to indicate the operating state of the connection. The LEDs on the compact integrated ASI8100 stepper motor drive provide you with information about the operating state. There are different light sequences for each operating state.



There are three connection levels on the B bearing plate of the ASI8100 integrated stepper motor drives.

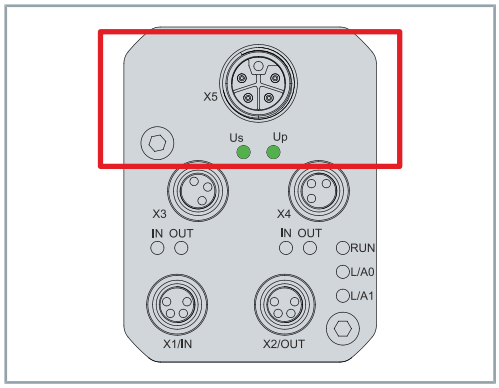
The ASI8100 has an M12 connection [1] for the supply voltages.

The ASI8100 has two black M8 sockets [2] for two digital I/Os with a voltage of 24 V DC.

The ASI8100 has two green M8 sockets [3] for connecting the incoming and outgoing EtherCAT signals.

Position	Function	Connection ID
1	Power connection	X5
2	I/O connection	X3; X4
3	EtherCAT connection	X1/IN; X2/OUT

7.2.1 Power connection X5



The integrated ASI8100 stepper motor drive has a connection (M12 socket, 5-pin, L-coded) at slot X5 for connecting the power supply. The ASI8100 requires a peripheral voltage U_P (load voltage) and a control voltage U_S for operation.

Signals/level X5 [supply]

The load voltage U_P supplies the motor and must be fed separately. If U_P is switched off, the fieldbus function, the function of the inputs and the supply of the sensors are maintained. The control voltage U_S supplies the fieldbus, the processor logic and the digital I/Os. It must be fed separately.

Contact	Function	Level/source
1	U_P+	+8…48 V DC
2	U_P-	GND
3	U_S+	+24 V DC
4	U_S-	GND
5	FE	(internally connected to the housing)

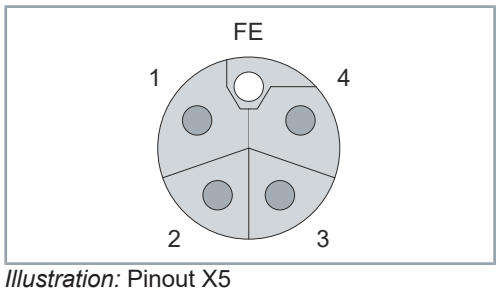


Illustration: Pinout X5

Pin assignment X5 [supply]

Contact	Function	Core color/ Core identification
1	U_P+	Brown
2	U_P-	White
3	U_S+	Blue
4	U_S-	Black
5	FE	Gray

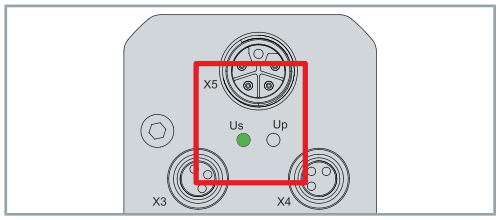
The connection cables are not included in the scope of delivery. The wire colors are valid for power cables from Beckhoff. See "power cables", [Page 43] for suitable connection cables.

Display

Status LED

Slot X5 has a green LED labeled “Us”. It signals the status of the control voltage U_S. Slot X5 has a green LED labeled “Up”. It signals the status of the load voltage U_P.

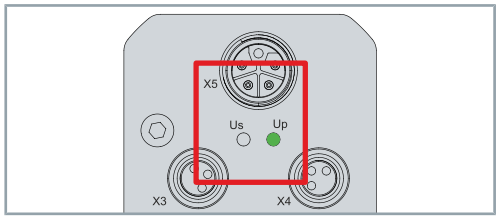
LED “Us”



Status display of the control voltage

LED	Meaning
off	No control voltage present
lit	Control voltage present

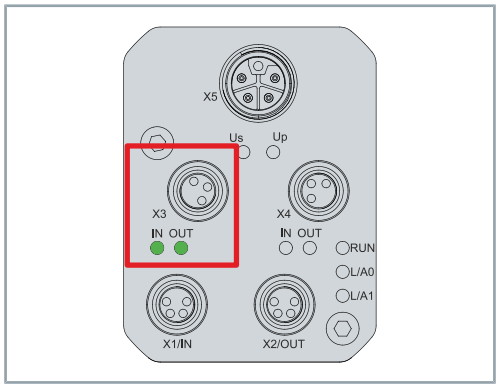
LED “Up”



Status display of the load voltage

LED	Meaning
off	No load voltage present
lit	Load voltage present

7.2.2 I/O connection X3



The integrated ASI8100 stepper motor drive has a connector (M8 socket, 3-pin, A-coded) for integrated I/Os at slot X3. It is suitable for connecting end positions or external sensors and is designed as a fast digital input. It can be configured as a digital output via the CoE object *0x8030: DO Settings*.

Signal/level X3 [Touch probe]

Contact	Function	Level/source
1	Output	24 V DC, 500 mA
3	GND	Externally connected
4	Input	1-wire connection, 24 V DC

Digital inputs (Touch probe)	
Signal level high	≥ 5 V
Signal level low	≤ 2 V
Input current	5 … 6 mA

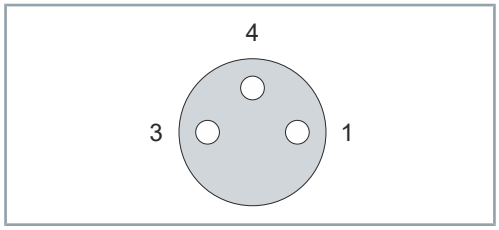


Illustration: Pinout X3

Pin assignment X3 [M8 socket, 3-pin, A-coded]

Contact	Function	Core color/ Core identification
1	Output	Brown
3	GND	Blue
4	Input	Black

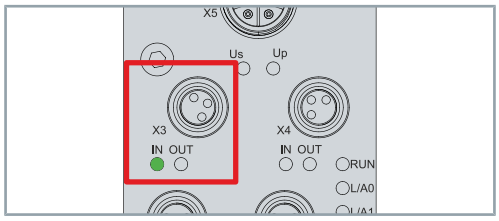
The connection cables are not included in the scope of delivery. The wire colors apply to sensor cables from Beckhoff. For suitable connection cables, see "sensor cable", [Page 44].

Display

Status LED

Slot X3 has a green LED labeled “IN”. It signals the status of the digital input. Slot X3 has a green LED labeled “OUT”. It signals the status of the digital output.

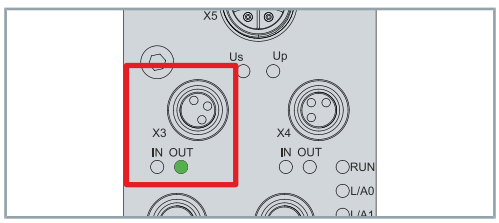
LED “IN”



Status display of digital input TP1

LED	Meaning
Off	No control voltage present at the input, input inactive
Lit	Control voltage is present at the input, input active

LED “OUT”



Status display of digital output TP1

LED	Meaning
Off	No control voltage at the output, output inactive
Lit	Control voltage is present at the output, output active

7.2.3 I/O connection X4

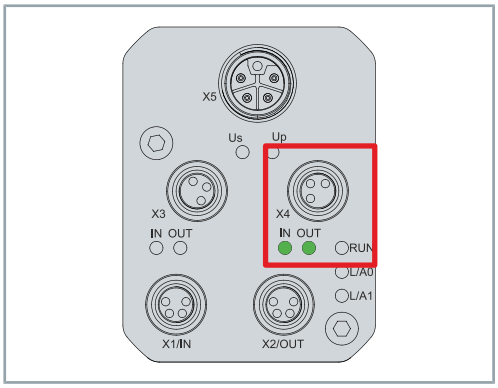


Illustration: X4 – I/O connection

The integrated ASI8100 stepper motor drive has a connector (M8 socket, 3-pin, A-coded) for integrated I/Os at slot X4. It is suitable for connecting end positions or external sensors and is designed as a fast digital input. It can be configured as a digital output via the CoE object *0x8030: DO Settings*.

Signal/level X4 [Touch probe]

Contact	Function	Level/source
1	Output	24 V DC, 500 mA
3	GND	Externally connected
4	Input	1-wire connection, 24 V DC

Digital inputs (Touch probe)	
Signal level high	≥ 5 V
Signal level low	≤ 2 V
Input current	5 … 6 mA

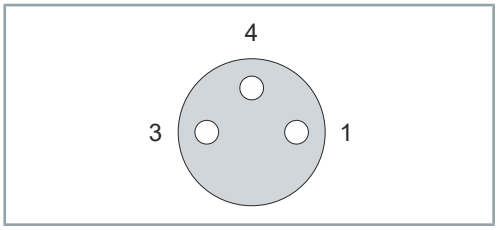


Illustration: Pinout X4

Pin assignment X4 [M8 socket, 3-pin, A-coded]

Contact	Function	Core color/ Core identification
1	Output	Brown
3	GND	Blue
4	Input	Black

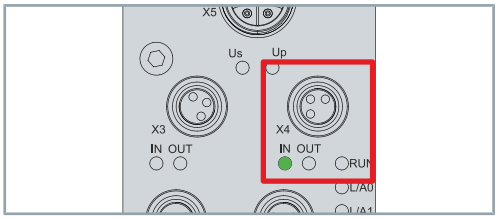
The connection cables are not included in the scope of delivery. The wire colors apply to sensor cables from Beckhoff. For suitable connection cables, see "sensor cable", [Page 44].

Display

Status LED

Slot X4 has a green LED labeled “IN”. It signals the status of the digital input. Slot X4 has a green LED labeled “OUT”. It signals the status of the digital output.

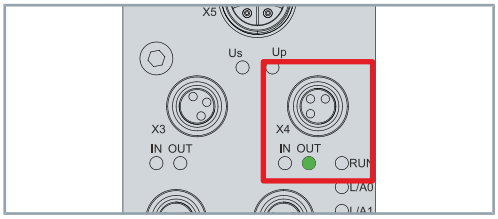
LED “IN”



Status display of digital input TP2

LED	Meaning
Off	No control voltage present at the input, input inactive
Lit	Control voltage is present at the input, input active

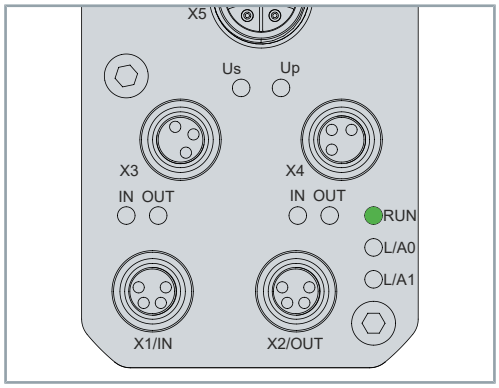
LED “OUT”



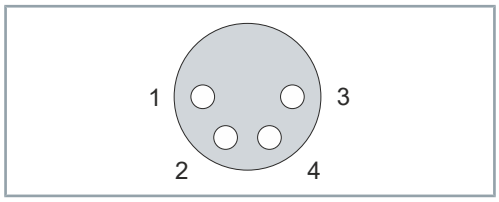
Status display of digital input TP2

LED	Meaning
Off	No control voltage at the output, output inactive
Lit	Control voltage is present at the output, output active

7.2.4 EtherCAT connection X1, X2



The integrated stepper motor drive ASI8100 is an EtherCAT slave and has two connections (M8 socket, 4-pin, A-coded, shielded) at slot X1, X2 for the incoming and outgoing EtherCAT signals



Pin assignment X1, X2 [M8 socket, 4-pin, A-coded, shielded]

Contact	Function	Core color/ Core identification
1	Tx+	Yellow
2	Rx+	White
3	Rx-	Blue
4	Tx-	Orange
Housing	Shield	Shield

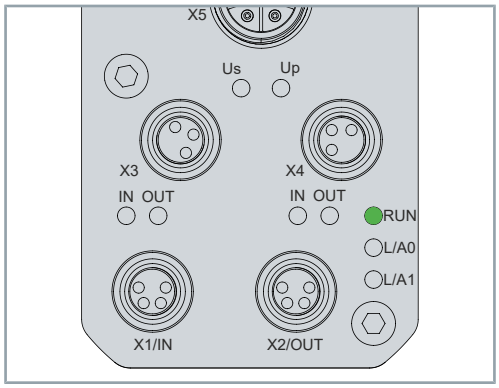
The connection cables are not included in the scope of delivery. The wire colors apply to EtherCAT cables from Beckhoff. For suitable connection cables, see "EtherCAT cable", [Page 44].

Display

Status LED

The integrated ASI8100 stepper motor drive is an EtherCAT slave and has three green LEDs "Run", "L/A0" and "L/A1". "Run" shows the status of the slave in the EtherCAT network and "L/A0" and "L/A1" show the status of the EtherCAT communication of the respective port.

LED “Run”



Status display of the EtherCAT slave

Each EtherCAT slave has a green LED labeled “Run”. The LED signals the status of the slave in the EtherCAT network:

LED	Meaning
Off	Slave is in “Init” state
flashes uniformly	Slave is in “Pre-Operational“ state
flashes sporadically	Slave is in “Safe-Operational” state
flashes very quickly	BOOT
lit	Slave is in “Operational” state

Description of the states of EtherCAT slaves

LED “L/A0”

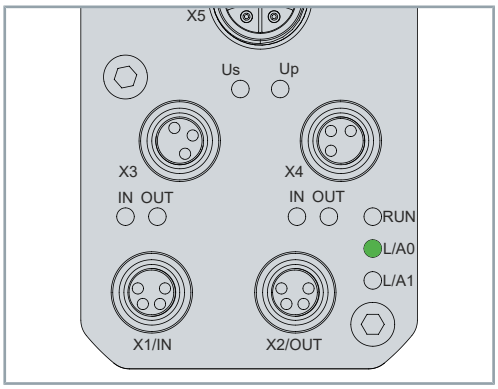


Illustration: "L/A0" indicates the communication state of X1/IN

Link/Act LED

There is a green LED labeled "L/A0" on the right side of the housing. The LED indicates the communication state of the respective socket.

LED	Meaning
off	no connection to the connected EtherCAT device
lit	LINK: connection to the connected EtherCAT device
flashes	ACT: communication with the connected EtherCAT device

LED "L/A1"

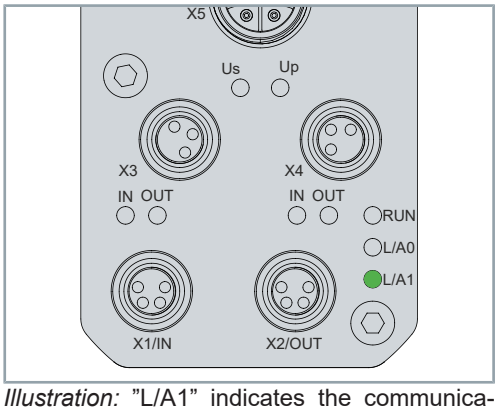


Illustration: "L/A1" indicates the communication state of X2/OUT.

Link/Act LED

There is a green LED labeled "L/A1" on the right side of the housing. The LED indicates the communication state of the respective socket.

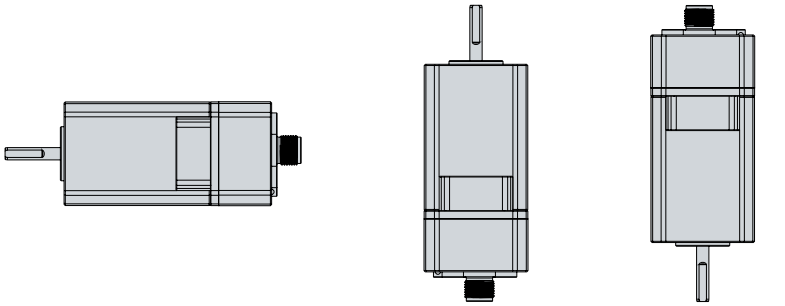
LED	Meaning
off	no connection to the connected EtherCAT device
lit	LINK: connection to the connected EtherCAT device
flashes	ACT: communication with the connected EtherCAT device

7.3 Mounting position

NOTICE

Observe the maintenance intervals and installation positions
Carry out maintenance at regular intervals.
In the horizontal installation position IM V19, liquid which has been left on the flange for a longer period can penetrate the stepper motor drive through capillary action. In installation position IM V18 liquid can escape.
If you do not observe the maintenance intervals, the stepper motor drive may overheat depending on the installation position. Ingress and leakage of liquids may damage the stepper motor drive.

The standard installation position of the stepper motor drive is the design IM B14 in accordance with DIN EN 60034-7.



IM B14 (B14) IM V19 (V19) IM V18 (V18)

7.4 Drive profile

The ASI8100 supports the drive profiles MDP and DS402.

The profiles define the presentation of parameters for the EtherCAT slave of the AMI8100 and the index, under which the respective parameters are arranged in the object directory:

- The CoE objects in the MDP profile (Modular Device Profile) are allocated in the way that is common for the Beckhoff EtherCAT Terminals.
- The DS402 drive profile is specified in IEC 61800-7-200 (CiA402). It uses a different object directory structure.

Both profiles contain the same parameters. They only differ in terms of the specified designations and the parameter index. In both profiles, the drive state machine of the ASI8100 is based on the CiA402 State Machine, which means the functional behavior is identical.

NOTICE

Different CoE object descriptions and process data
It is not possible to change the profile after delivery.

7.5 Shaft end A

The A-side is used for force transmission via a backlash-free and frictional connection. This is achieved using a coupling in accordance with 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

8 Mechanical installation

All work should be carried out with great care and without time pressure.

8.1 Flange mounting

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

Size	ASI811x
Thread	M3
Quality	8.8
Screw depth max. [mm]	4
Tightening torque [Nm]	0.6

8.2 Drive elements

⚠ WARNING

Risk of injury due to unsecured parts
Unsecured parts can be ejected from the machine during operation and cause serious or fatal injuries.

- Make sure there are no moving parts on or in the machine during operation.

NOTICE

Damage due to impermissible stress on the components
An impermissible load on the components can have a negative effect on the performance of the stepper motor drive. Impacts on the shaft damage the concentricity of the stepper motor drive.

- Do not bend any components during transport or handling
- Do not change any insulation distances
- Avoid hard shocks to the shaft end, the ball bearings or the feedback system
- Observe the prescribed vibration qualities and vibration resistance
- Provide additional support for the stepper motor drives if required

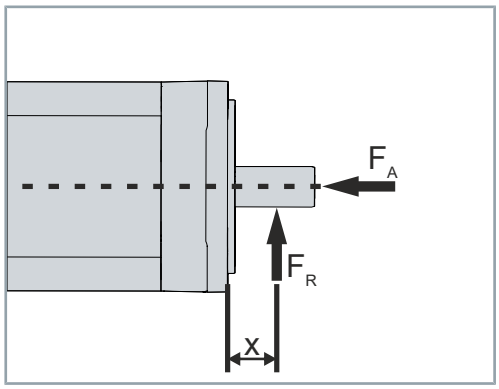
NOTICE

High power loss due to insufficient thermal connection
The thermal connection of the flange determines the power loss.

- Ensure adequate grounding via the protective conductor or the flange

8.2.1 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.

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

8.2.2 Mounting motor to gear unit

⚠ WARNING

Burns due to contact with hot output elements
Hot components can cause severe burns to body parts and limbs.

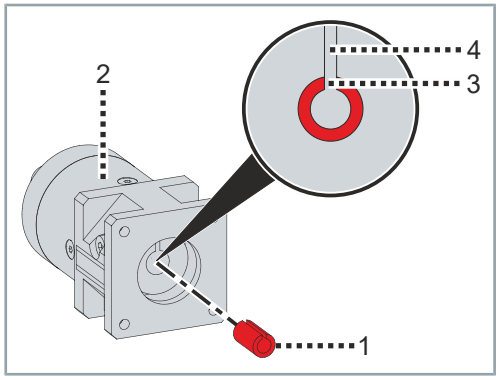
- Only handle hot output elements, such as couplings or pulleys, with special thermal gloves
- Avoid prolonged contact with hot components

NOTICE

Damage due to offset mounting
An offset will cause unacceptable vibration and the destruction of the ball bearings and the coupling.

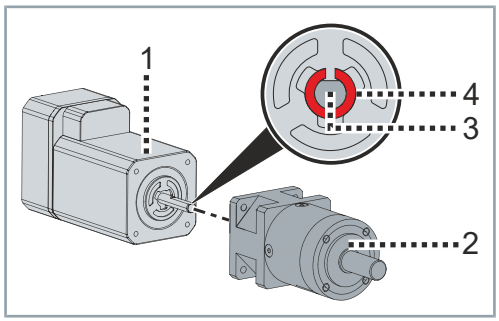
- Place the drive elements centered and straight on the shaft

Insert reducing sleeve into gear unit



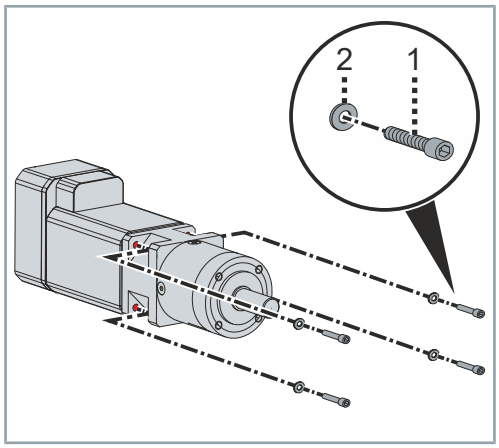
► Insert the reducing sleeve [1] centered and straight into the gear unit [2]
► The opening of the reducing sleeve [3] should be in line with the opening of the clamping hub [4]

Bring ASI8100 and gear unit together



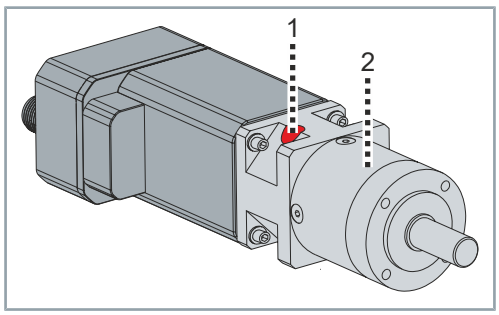
- ► Align the drive shaft of the stepper motor [1] and the bearing of the gear unit [2] in the center and push them together
- ► Ensure that the flattened side of the drive shaft [3] is under the opening of the reducing sleeve [4]

Screw stepper motor and gear unit together



- ► Fit a washer [2] to each of the four fastening screws [1]
- ► Insert the fastening screws [1] in the through holes in the gear flange and screw them into the threaded holes in the stepper motor
- ► Tighten the fastening screws [1] to a torque of 0.6 Nm

Screw on clamping hub



- ► Rotate assembly by 90 degrees
- ► Insert the hex key through the opening [1] of the gear unit [2] and screw the clamping hub inside

9 Electrical installation

9.1 Power supply

The integrated stepper motor drive ASI8100 requires two supply voltages for operation:

- Control voltage U_S = 24 V DC
- Peripheral voltage U_P = 48 V DC (load voltage)

The voltages must be fed in at slot X5.

NOTICE

Fuse protection of the load voltage
The electrical fuse protection of the load voltage must be selected in such a way that the maximum current flowing is limited to 3 times the nominal current (max. 1 second)!

NOTICE

Malfunction due to equalizing currents on the protective conductor
In the event of a fault, the resulting equalizing currents can lead to higher currents on the return conductors of the circuits and can damage them and/or the product.

- The power supplies U_P and U_S of the integrated stepper motor drive must either both be designed as SELV or both as PELV.
- Design the power supplies for the load voltage U_P and the control voltage U_S as SELV (Safety Extra Low Voltage) with safe isolation so that there is no connection to earth, protective conductor or active parts of the two circuits with each other.
- Design the power supplies for the load voltage U_P and the control voltage U_S as PELV (Protective Extra Low Voltage) with safe isolation so that there is no connection to earth, protective conductor or active parts of the two circuits with each other. Use a circuit breaker according to the power supply, e.g.
  circuit breaker 400 V 10 kA, 2-pole, B, 6 A, D=70 mm, article number 5SY4206-6, manufacturer Siemens.

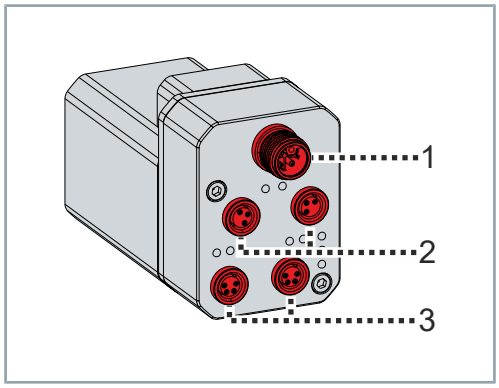
9.2 Cables

Beckhoff offers pre-assembled cables for faster and flawless installation of the stepper motor 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 faults and result in exclusion of warranty.

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.

Hint for trouble-free application and assembly:

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



Connection cables for ASI8100

You need three different types of cable to connect the ASI8100:

1. Power cable for power supply
2. Sensor cable for I/O connection
3. EtherCAT cable for communication connection

NOTICE

Observe the maximum permissible cable length

Use a maximum of 10 m cable length.

In the event of non-observance, compliance with legal requirements is not guaranteed. Faults and malfunctions along with exclusion from warranty can be the result.

9.2.1 Power cable

- X5 | Power connection

Ordering information	Description
ZK2050-5200-0xxx	Power cable, 1.5 mm², PUR, flex, M12, socket, straight, female, 5-pin, L-coded – open end
ZK2050-5400-0xxx	Power cable, 1.5 mm², PUR, flex, M12, socket, angled, female, 5-pin, L-coded – open end
ZK2051-5200-0xxx	Power cable, 2.5 mm², PUR, flex, M12, socket, straight, female, 5-pin, L-coded – open end
ZK2051-5400-0xxx	Power cable, 2.5 mm², PUR, flex, M12, socket, angled, female, 5-pin, L-coded – open end
ZK2053-5200-0xxx	Power cable, 0.75 mm², PUR, flex, M12, socket, straight, female, 5-pin, L-coded – open end
ZK2053-5400-0xxx	Power cable, 0.75 mm², PUR, flex, M12, socket, angled, female, 5-pin, L-coded – open end

Ordering information	Description
ZS2030-4812	M12, T splitter, 1 x M12 (male) – 2 x M12 (female), pin assignment 1:1, L-coded

9.2.2 Sensor cable

- X3 | I/O connection 1
- X4 | I/O connection 2

Ordering information	Description
ZK2000-2100-0xxx	Sensor cable, PUR, 3 x 0.25 mm², drag-chain suitable M8, plug, straight, male, 3-pin – 3-pin, open end (3 x 0.25 mm²)
ZK2000-2122-0xxx	Sensor cable, PUR, 3 x 0.25 mm², drag-chain suitable M8, plug, straight, male, 3-pin, A-coded – M8, socket, straight, female, 3-pin, A-coded
ZK2000-2124-0xxx	Sensor cable, PUR, 3 x 0.25 mm², drag-chain suitable M8, plug, straight, male, 3-pin, A-coded – M8, socket, angled, female, 3-pin, A-coded
ZK2000-2162-0xxx	Sensor cable, PUR, 3 x 0.25 mm², drag-chain suitable M8, plug, straight, male, 3-pin, A-coded – M12, socket, straight, female, 4-pin, A-coded
ZK2000-2300-0xxx	Sensor cable, PUR, 3 x 0.25 mm², drag-chain suitable M8, plug, angled, male, 3-pin, A-coded – 3-pin, open end (3 x 0.25 mm²)
ZK2000-2322-0xxx	Sensor cable, PUR, 3 x 0.25 mm², drag-chain suitable M8, plug, angled, male, 3-pin, A-coded – M8, plug, angled, male, 3-pin A-coded
ZK2000-2324-0xxx	Sensor cable, PUR, 3 x 0.25 mm², drag-chain suitable M8, plug, angled, male, 3-pin, A-coded – M8, socket, angled, female, 3-pin, A-coded
ZK2000-2362-0xxx	Sensor cable, PUR, 3 x 0.25 mm², drag-chain suitable M8, plug, angled, male, 3-pin, A-coded – M12, socket, straight, female, 4-pin, A-coded

9.2.3 EtherCAT cable

- X1/IN | EtherCAT connection IN
- X2/OUT | EtherCAT connection OUT

Ordering information	Description
ZK1090-3131-0xxx	EtherCAT cable, PUR, AWG26, drag-chain suitable, M8, plug, straight, male, 4-pin, A-coded – M8, plug, straight, male, 4-pin, A-coded
ZK1090-3131-3xxx	EtherCAT cable, PVC, AWG26, fixed installation, M8, plug, straight, male, 4-pin, A-coded – M8, plug, straight, male, 4-pin, A-coded
ZK1090-3131-6xxx	EtherCAT cable, PUR, 1 x 4 x AWG22, capable of torsion M8, plug, straight, male, 4-pin, A-coded – M8, plug, straight, male, 4-pin, A-coded
ZK1090-3191-0xxx	EtherCAT cable, PUR, AWG26, drag-chain suitable, M8, plug, straight, male, 4-pin, A-coded – RJ45, plug, straight, male, 8-pin
ZK1090-3191-3xxx	EtherCAT cable, PVC, AWG26, fixed installation, M8, plug, straight, male, 4-pin, A-coded – RJ45, plug, straight, male, 8-pin

Ordering information	Description
ZK1090-3191-6xxx	EtherCAT cable, PUR, 1 x 4 x AWG22, capable of torsion, M8, plug, straight, male, 4-pin, A-coded – RJ45, plug, straight, male, 8-pin

9.3 Establishing the connection

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

- Torque wrench ZB8801-0000

For interference-free data transmission, please note:

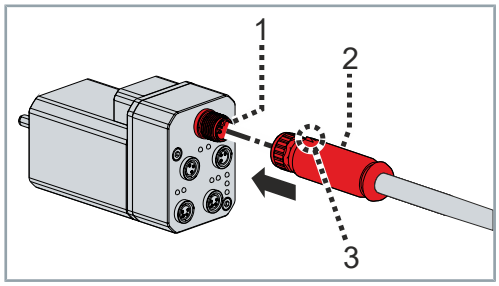
- Maximum number of mating cycles for the connectors: 500

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

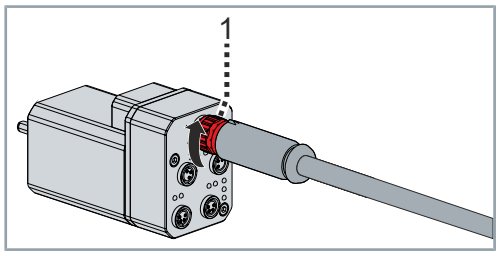
NOTICE

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.

9.3.1 Power

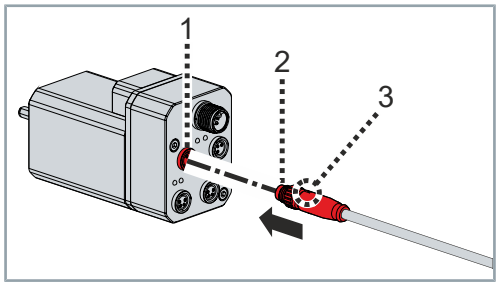


► Make sure that the poles and the interior of the socket as well as the threads on the connector are not dirty or damaged
► Push the plug [1] straight onto the socket [2]
► Make sure that the marking point [3] points upwards



► Screw thread [1] into the socket

9.3.2 I/O and EtherCAT

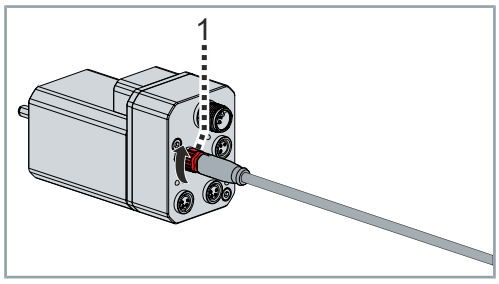


► Make sure that the poles and the interior of the socket as well as the threads on the connector are not dirty or damaged

► Push the plug [1] straight onto the socket [2]

If present:

► Make sure that the marking point [3] points upwards



► Screw thread [1] into the socket

10 Commissioning

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.

10.1 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 stepper motor drive for damage
- Check mounting and alignment
- Tighten screw connections correctly
- Installing mechanical, thermal and electrical protective devices
- Check wiring, connection and proper grounding on stepper motor drive

When using the "Field-oriented control" operation mode

- Ensure that there is no magnetic field in the area where the stepper motor drive is used.

10.2 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 stepper motor drives of the ASI81xx series in Beckhoff TwinCAT 3 Drive Manager 2:

- Build Project and Choose Target System
- Implement devices by scanning or manually
- Configure devices, determine and set stepper motor 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

10.3 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

When using the "Field-oriented control" operation mode

- Ensure that there is no magnetic field in the area where the stepper motor drive is used.

10.4 After operation

⚠ WARNING

Place the machine or plant in a safe state
Make sure that the rotor comes to a complete stop.
Rotating components can lead to serious injuries.

11 Maintenance and cleaning

11.1 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

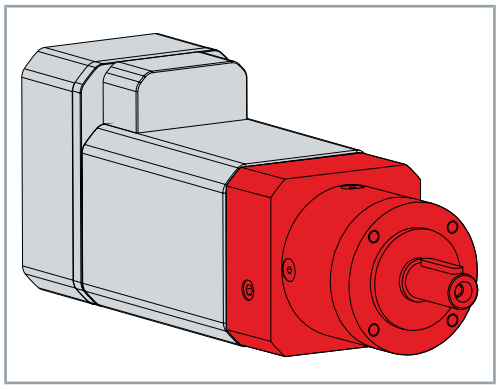
11.2 Intervals

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	10000 operating hours	Replace bearing
stepper motor drive	2500 operating hours/annually	Check stepper motor drive for bearing noises **If noises are detected:** • Do not continue to operate stepper motor drive; replace bearings
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

12 Accessories

12.1 Gear unit



A gear unit serves to transmit a moment of force or a torque and is used on the stepper motor 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.

13 Decommissioning

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

Refer to 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.

13.1 Disassembly

⚠ WARNING

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

- Prevent oil from leaking
- Allow the oil to cool down before starting work
- Absorb leaking oil with suitable binding agents
- If oil is leaking, mark the danger zone

Do not remove components from the products
Only Beckhoff Automation GmbH & Co. KG is permitted to remove components.
Contact Beckhoff Service for further information.

13.2 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 device are considered as waste electrical and electronic equipment for disposal. Observe the national regulations for the disposal of old electrical and electronic equipment.

14 Guidelines and Standards

14.1 Standards

Product standard EN IEC 61800-3
"Adjustable speed electrical power drive systems. EMC requirements and specific test methods"

EN 60034-1:2010+Corr.:2010
"Rotating electrical machines – Rating and performance"

EN IEC 63000
"Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances"

14.2 Guidelines

2014/35/EU
Low Voltage Directive

2014/30/EU
EMC Directive

2011/65/EU
RoHS Directive

14.3 Notified bodies

CE

The compact integrated stepper motor drive ASI8100 product does not fall within the scope of the Machinery Directive. However, Beckhoff products are designed and evaluated for personal safety and use in a machine or system in full compliance with all relevant regulations.

EAC

The product compact integrated stepper motor drive ASI8100 meets all the requirements of the Eurasian Economic Union. These include Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia. The EAC logo can be found on the nameplate.

14.4 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.
Send your request to:

info@beckhoff.com

14.5 CCC conformity

Export to Chinese Economic Area
Beckhoff Compact integrated stepper motor drives of the ASI8100 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.

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More Information:
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