maxon

«EC frameless»

Installation Manual

«EC frameless» | maxon Frameless Drives
Installation Manual
mmag | Edition 2021-03 | DocID rel10039

maxon

TABLE OF CONTENTS

READ THIS FIRST

BY PRINCIPLE, THE «EC FRAMELESS» COMPRISES PARTS THAT PRODUCE STRONG MAGNETIC FIELDS. IT IS THEREFORE MOST IMPORTANT THAT YOU ARE AWARE OF THE CONSEQUENCES OF THESE MAGNETIC FORCES, THAT YOU TAKE THE APPROPRIATE PRECAUTIONARY MEASURES, AND THAT YOU COMMUNICATE THIS FACT TO PERSONS IN YOUR VICINITY!

***These instructions are intended for qualified technical personnel. Prior commencing with any activities**…*

- *you must carefully read and understand this manual and*
- *you must follow the instructions given therein.*

***The «EC frameless»** is considered as partly completed machinery according to EU Directive 2006/42/EC, Article 2, Clause (g) and **is intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment**.*

***Therefore, you must not put the device into service**,…*

- *unless you have made completely sure that the other machinery fully complies with the EU directive's requirements!*
- *unless the other machinery fulfills all relevant health and safety aspects!*
- *unless all respective interfaces have been established and fulfill the herein stated requirements!*

1 GENERAL INFORMATION

1.1 About this Document

1.1.1 Intended Purpose

The purpose of the present document is to familiarize you with the direct drive «EC frameless». It will highlight the tasks for safe and adequate installation and/or commissioning. Follow the described instructions …

- to avoid dangerous situations,
- to keep installation and/or commissioning time at a minimum,
- to increase reliability and service life of the described equipment.

1.1.2 Target Audience

The present document is intended for trained and skilled personnel. It conveys information on how to understand and fulfill the respective work and duties.

1.1.3 How to use

Throughout the document, the following notations and codes will be used.

Notation	Meaning
(n)	refers to an item (such as part number, list item, etc.)
➔	denotes “see”, “see also”, “take note of” or “go to”
Color coding	find information on the colors used on page 9

Table 1-1 Notation used

1.1.4 Symbols & Signs

In the course of the present document, the following symbols and signs will be used.

Type	Symbol	Meaning	
Safety alert	 (typical)	DANGER	Indicates an **imminent hazardous situation**. If not avoided, it **will result in death or serious injury**.
		WARNING	Indicates a **potential hazardous situation**. If not avoided, it **can result in death or serious injury**.
		CAUTION	Indicates a **probable hazardous situation** or calls the attention to unsafe practices. If not avoided, it **may result in injury**.
Prohibited action	 (typical)	Indicates a dangerous action. Hence, **you must not**!	
Mandatory action	 (typical)	Indicates a mandatory action. Hence, **you must**!	

Continued on next page.

Type	Symbol	Meaning	
Information		Requirement Note Remark	Indicates an activity you must perform prior continuing, or gives information on a particular item you need to observe.
		Best practice	Indicates an advice or recommendation on the easiest and best way to further proceed.
		Material damage	Indicates information particular to possible damage of the equipment.

Table 1-2 Symbols and signs

1.1.5 Trademarks and Brand Names

For easier legibility, registered brand names are listed below and will not be further tagged with their respective trademark. It must be understood that the brands (the list below is not necessarily concluding) are protected by copyright and/or other intellectual property rights even if their legal trademarks are omitted in the later course of this document.

Brand Name	Trademark Owner
DELO-ML®	© DELO Industrie Klebstoffe GmbH & Co. KGaA, DE-Windach
EPO-TEK®	© Epoxy Technology, Inc., USA-Billerica, MA
Loctite®	© Henkel AG & Co. KGaA, DE-Düsseldorf
Micro-Fit™ **Mini-Fit Jr.™**	© Molex, USA-Lisle, IL
omniFIT®	© Henkel AG & Co. KGaA, DE-Düsseldorf

Table 1-3 Brand names and trademark owners

1.1.6 Copyright

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maxon motor ag
Brünigstrasse 220 +41 41 666 15 00
CH-6072 Sachseln www.maxongroup.com

1.2 About the Device

The direct drive «EC frameless» is a high-performance, high-torque brushless DC external rotor motor (BLDC motor). It is available in various sizes and is designed to be incorporated into a specially adapted outer body that serves both as the motor's supporting structure and as torque-carrying device.

The «EC frameless» composes two main parts:

- **Stator with electric connections**; for installation into a customer-provided outer body (such as housing, machine structure, or carrier system)
- **Magnetic rotor**; for on-site assembly with the installed stator and the customer-provided torque-carrying device

Outer body, motor shaft, and bearings are not part of the «EC frameless»'s scope of delivery and are being designed for a particular case of application by the customer.

1.3 About the Safety Precautions

Safety first— always!

BY PRINCIPLE, THE «EC FRAMELESS» COMPRISES PARTS THAT PRODUCE STRONG MAGNETIC FIELDS. IT IS THEREFORE MOST IMPORTANT THAT YOU ARE AWARE OF THE CONSEQUENCES OF THESE MAGNETIC FORCES, THAT YOU TAKE THE APPROPRIATE PRECAUTIONARY MEASURES, AND THAT YOU COMMUNICATE THIS FACT TO PERSONS IN YOUR VICINITY!

READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE YOU ENGAGE WITH ANY WORK AND FOLLOW THE INSTRUCTIONS GIVEN AT ALL TIMES!

- Make sure that you have read and understood the note "READ THIS FIRST" on page 2!
- Do not engage with any work unless you possess the stated skills (➔chapter "1.1.2 Target Audience" on page 3)!
- Consult ➔chapter "1.1.4 Symbols & Signs" on page 3 to understand the subsequently used indicators!
- You must observe any regulation applicable in the country and/or at the site of implementation with regard to health and safety/accident prevention and/or environmental protection!

DANGER

High voltage and/or electrical shock
Touching live wires causes death or serious injuries!

- *Consider any power cable as connected to live power, unless you have proven the opposite!*
- *Make sure that neither end of cable is connected to live power!*
- *Make sure that the power source cannot be engaged while work is in process!*
- *Obey lock-out/tag-out procedures!*
- *Make sure to securely lock any power engaging equipment against unintentional engagement and tag it with your name!*

WARNING

Strong magnetic field
High magnetic force can cause serious injuries!

- *Keep stator and rotor mechanically blocked at all times! Do so by using a mechanical locking device, a mounting aid, or non-magnetic spacers!*
- *Make sure to remove/keep clear any metal parts or metallic items—also such as cardiac pacemakers, implants, watches, bracelets, credit cards, mobile phones, etc—before you approach the motor!*
- *Use only non-magnetic tools when you work on the motor or in its vicinity!*
- *Put up warning signs stating STRONG MAGNETIC FIELDS around the installation area and at the storage location!*
- *Inform persons around of the potential danger. Instruct them accordingly and request them to follow the precautionary measures!*

WARNING

Pinching and shearing risk
Sudden movement and shift of rotor can cause serious injuries!
To prevent sudden shift during installation you must keep both stator and rotor blocked at all times. Do so by using a mechanical locking device, a mounting aid, or non-magnetic spacers!

Strong magnetic field

The high magnetic forces produced by the device constitute an imminent hazard to persons wearing a cardiac pacemaker or metal implants.

All persons who possibly may suffer impairment caused by strong magnetic fields must not approach the device and must stay clear and in a safe distance of at least two (2) meters.

General rules

- *Make sure that all associated devices and components are installed according to local regulations.*
- *Be aware that, by principle, an electronic apparatus cannot be considered fail-safe. Therefore, you must make sure that any machine/apparatus has been fitted with independent monitoring and safety equipment. If the machine/apparatus should break down, if it is operated incorrectly, if the control unit breaks down or if the cables break or get disconnected, etc., the complete drive system must return—and be kept—in a safe operating mode.*
- *Be aware that you are not entitled to perform any repair on components supplied by maxon motor.*

Electrostatic Sensitive Device (ESD)

- *Wear electrically conductive clothing and footwear.*
- *Observe ESD protective measures.*

2 SPECIFICATIONS

Listed below are generally applicable, normal case data. Customer-specific values may vary. For detailed information and values consult the data sheets in the ➔Appendix as of page 30.

2.1 Technical Data

«EC frameless»				Ø45			Ø60	Ø90	
				30 W	50 W	70 W	100 W	160 W	260 W
Key data	Assigned power rating		W	30	50	70	100	90	130
	Nominal torque		mNm	66	97	134	289	560	872
	Max. permissible speed		rpm	10’000	10’000	10’000	6’000	5’000	5’000
	Supply voltage Hall sensors		VDC	+4.5…+24					
Dimensions	Weight	Rotor	g	35	41	51	160	195	292
		Stator	g	54	69	92	173	295	522
		Total	g	89	110	143	333	490	814
	Ø outside (ØR1)		mm	43.4	43.4	43.4	60.0	90.0	90.0
	Ø inside (ØS2)		mm	14.0	14.0	14.0	20.0	38.0	38.0
	Length (LM)		mm	20.55	23.7	28.7	37.0	29.5	42.0
Environment	Ambient temperature		°C	−40…+100					
	Humidity		%	5…90 (condensation not permitted)					

Table 2-4 Technical data (typical)

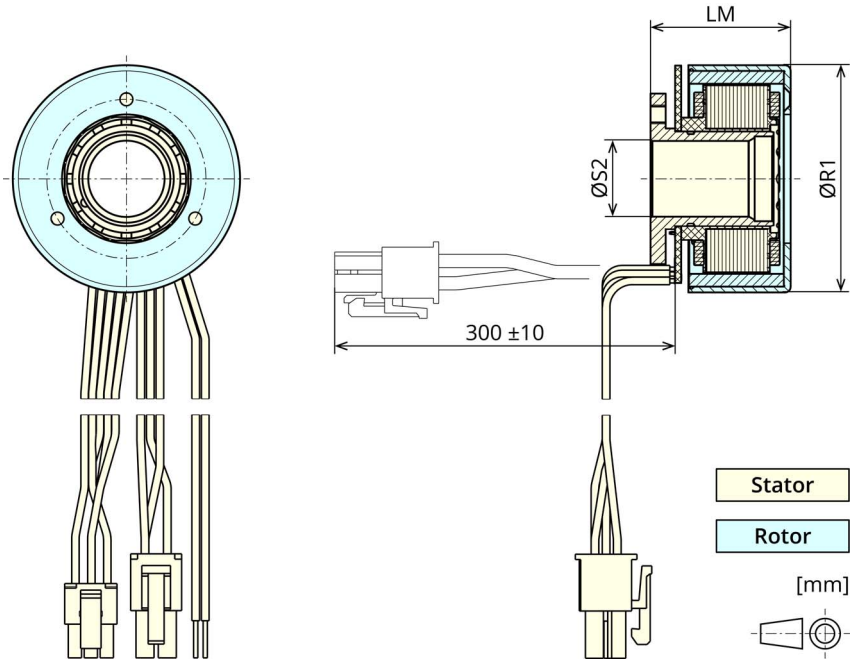


Figure 2-1 Dimensioning

2.2 Nameplate

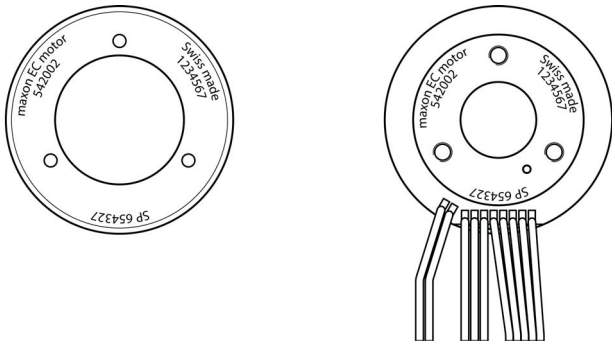


Figure 2-2 Nameplate (typical)

2.3 Standards

The described device has been successfully tested for compliance with the below listed standards.

Standards & Specifications		
Manufacturing	101	Standard Specification for maxon EC motor

Table 2-5 Standards

3 INSTALLATION

The motor's two main components—stator with electric connections and magnetic rotor—come in unmounted condition in packaged cases.

Besides special precautions in respect to health and safety, the «EC frameless» must be installed in a particular and specific way. For both safe and easy installation as well as reliable operation closely follow the below described information in given order.

Color coding in illustrations

For easier differentiation, individual components are shown in color:

Light yellow	Stator of the «EC frameless» (only displayed in selected cases)
Yellow	Customer parts that are mounted to the stator of the «EC frameless»
Light blue	Rotor of the «EC frameless» (only displayed in selected cases)
Blue	Customer parts that are mounted to the rotor of the «EC frameless»
Magenta	Customized, factory-mounted stator flange of the «EC frameless»

3.1 General Rules

Check on the safety matters and rules (➔page 5) before you proceed.

BY PRINCIPLE, THE «EC FRAMELESS» COMPRISES PARTS THAT PRODUCE STRONG MAGNETIC FIELDS. IT IS THEREFORE MOST IMPORTANT THAT YOU ARE AWARE OF THE CONSEQUENCES OF THESE MAGNETIC FORCES, THAT YOU TAKE THE APPROPRIATE PRECAUTIONARY MEASURES, AND THAT YOU COMMUNICATE THIS FACT TO PERSONS IN YOUR VICINITY!

BEFORE YOU ENGAGE WITH ANY WORK, READ, UNDERSTAND, AND FOLLOW THE SAFETY PRECAUTIONS AS OF PAGE 5!

OBSERVE THE FOLLOWING NOTICE ON THE PREREQUISITES FOR PERMISSION TO COMMENCE INSTALLATION.

The «EC frameless» is considered as partly completed machinery according to EU Directive 2006/42/EC, Article 2, Clause (g) and **is intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment**.

WARNING

Risk of injury
Operating the device without the full compliance of the surrounding system with the EU Directive 2006/42/EC may cause serious injuries!

- *Do not operate the device, unless you have made completely sure that the other machinery fully complies with the EU directive's requirements!*
- *Do not operate the device, unless the other machinery fulfills all relevant health and safety aspects!*
- *Do not operate the device, unless all respective interfaces have been established and fulfill the requirements stated in this document!*

Electrostatic Sensitive Devices (ESD)

- *Wear electrically conductive clothing and footwear.*
- *Observe ESD protective measures.*

Possible irreversible damage of motor

Until completion of the installation, individual components can be permanently damaged by improper handling.

- *Handle the components with particular care.*
- *Pay special attention to cleanliness.*
- *Make sure that no impurities, foreign objects, or particles penetrate the drive or can be attracted by the motor magnets.*

3.2 Dimensioning

Dimensions, geometric tolerances as well as fixation points differ depending on the motor version and are based on the particular case of application.

Consult dimensional drawing
You can find the relevant information for your case of application in the data sheet (➔Appendix as of page 30).

Listed below are the dimensions required for installation. In the later course of the document the respective abbreviations will be used, the effective values can be found in the data sheet.

Short	Description	Remark
◎M	Mounting dimension for concentricity	Compliance ensures the correct lateral position of stator and rotor and defines the required air gap (➔dimensional drawing in data sheet; A-B)
ØR1	Outer rotor diameter	Nominal diameter of the motor
ØR2	Inner rotor centering	
ØR3	Pitch diameter for rotor mount	Information on dimensioning and fixation can be found in the ➔data sheet
ØS1	Outer stator centering	
ØS2	Inner stator centering	
ØS3	Pitch diameter for stator mount	Information on dimensioning and fixation can be found in the ➔data sheet
LM	Mounting dimension for motor length	Compliance ensures the correct axial position of stator and rotor
L1	Height of rotor flange	
L2	Height of stator flange	
L3	Area with tolerated diameter ØS2	

Table 3-6 Dimensioning

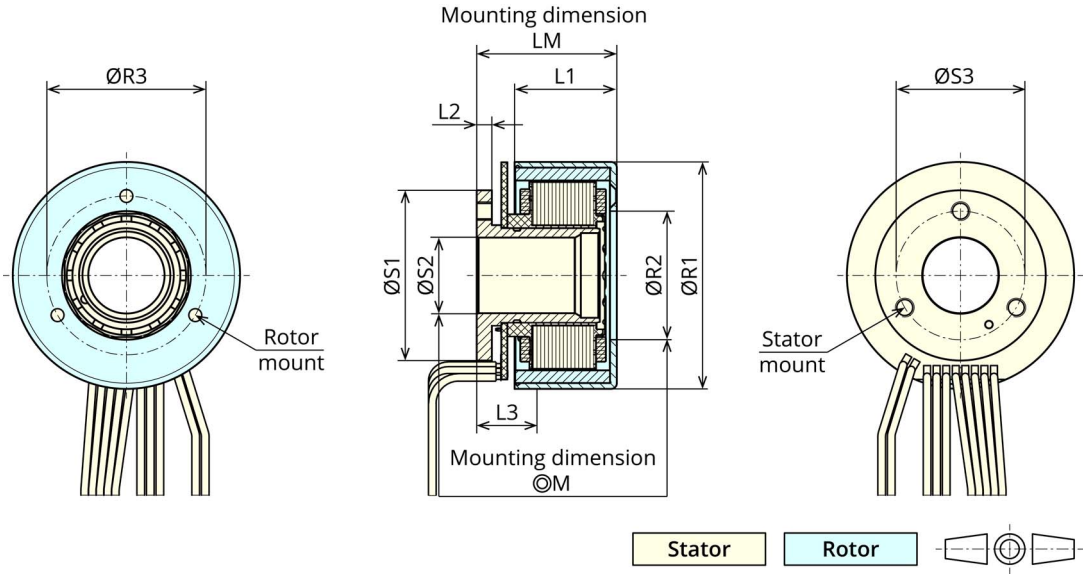


Figure 3-3 Dimensioning

3.3 Verification

The outer body (the motor's supporting structure; the part into which the motor will be incorporated) as well as the motor shaft and its bearings are not part of the «EC frameless»'s scope of delivery.

Depending on the case of application, stator and rotor of the motor can be centered towards outer body and motor shaft either on their inner or outer side, thus permitting numerous possibilities in design and construction (find a choice of examples in below figures). Thereby, compliance of dimensions and geometric tolerances specified by maxon is essentially important for safe, trouble-free, long-term operation.

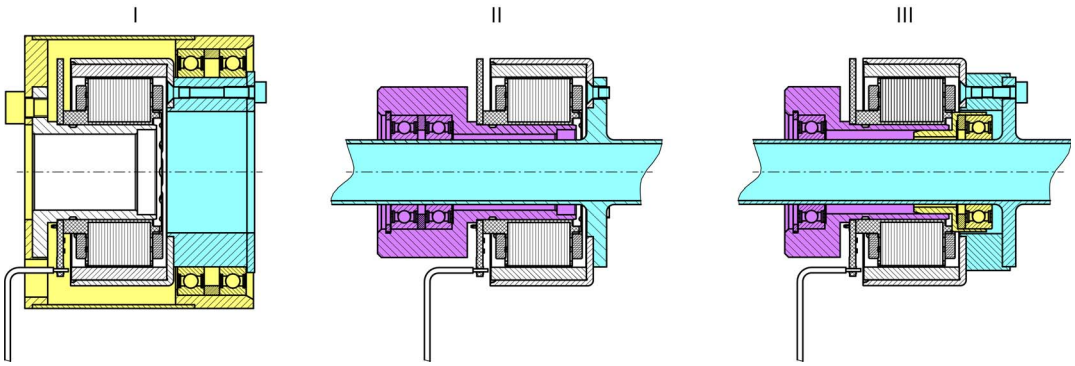
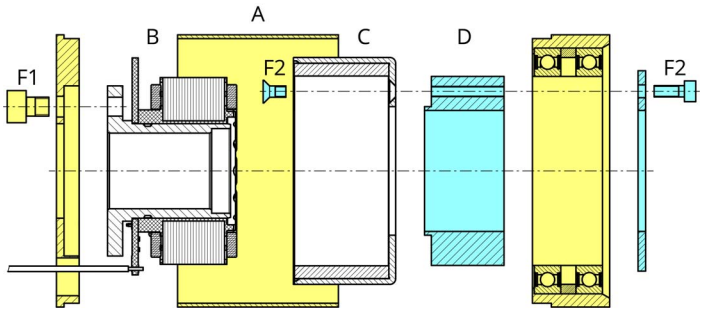


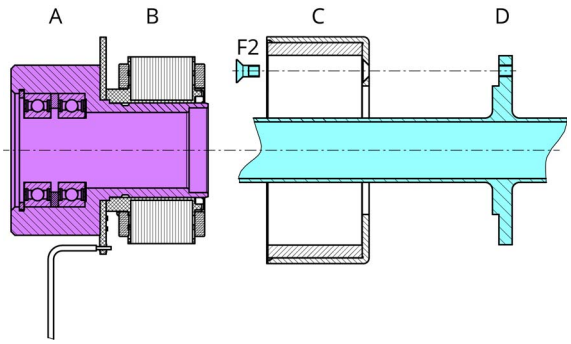
Figure 3-4 Application examples

3.3.1 Installation Examples



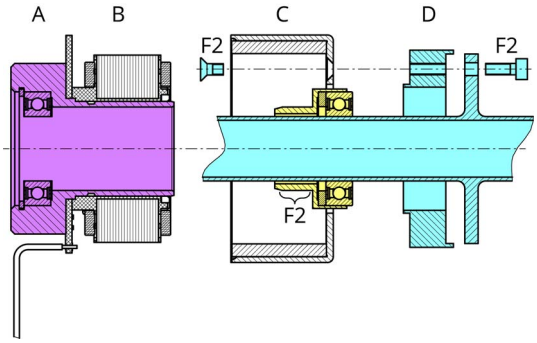
A Multipartite outer body with outer stator centering
B Stator
C Rotor
D Multipartite motor shaft
F1 Stator fixation
F2 Rotor fixation

Figure 3-5 Example I (recommended)



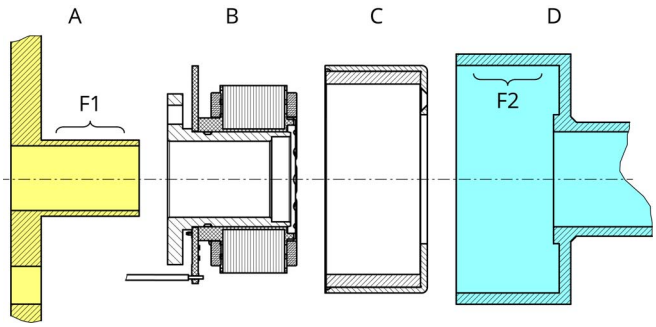
A Customized stator flange, factory-mounted
B Stator
C Rotor
D Motor shaft
F2 Rotor fixation

Figure 3-6 Example II (recommended)



A Customized stator flange, factory-mounted
B Stator
C Rotor
D Multipartite motor shaft
F1 Stator fixation
F2 Rotor fixation

Figure 3-7 Example III (recommended)



A Outer body with outer stator centering
B Stator
C Rotor
D Motor shaft
F1 Stator fixation
F2 Rotor fixation

Figure 3-8 Example IV

3.3.2 Verification of Mounting Conditions

Requirements for operation

Safe, trouble-free, long-term operation is only possible…

- *if the defined properties of the outer body (such as housing, machine structure, or carrier system) as well as the motor shaft and its bearings are met, and*
- *if centering and axial position of stator and rotor are carried out with sufficient accuracy!*

Thermal behavior

The values given in the data sheet for nominal torque (maximal continuous torque), thermal resistances, and nominal current (maximal continuous current) refer to the motor mounted to a plastic plate with limited heat dissipation capability and free convection.

When mounted to a metal flange, the thermal resistance R_{th2} can be reduced by up to 80%. Thus, technical measures (such as good ventilation, heat-conducting metallic mounts, or heat sinks) can substantially reduce temperatures and significantly increase performance.

To carry the motor, certain criteria must be met. Check the following as to the details provided in ➔chapter “3.2 Dimensioning” on page 11 and in the data sheet (➔Appendix as of page 30).

1) Before you start: Be aware of the necessary safety precautions (➔page 5) and strictly follow the general rules (➔page 9).
2) Check the tolerance chain of your application to achieve the required mounting dimensions, in particular…
   - Concentricity ◎**M**
   - Overall length **LM**
   - Depending on mounting variant: Bore diameter **ØS1** respectively **ØS2** and **ØR1** respectively **ØR2**, as well as their roundness

– With bolted connection: Circle diameter **ØS3** and **ØR3**, circle angle, and dimensioning of fixation threads
– Diameter, depth, and surface finish of centering
– Diameter, shape, and length of shaft and its bearings

3) Make sure that the outer body meets the specified characteristics (➔chapter “2.1 Technical Data” on page 7 / «Environment»):
– Heat dissipation capability (➔note “Thermal behavior” on page 13)
– Electrical connections and cable routing

Requirements for operation
The function of the drive is only guaranteed if all specified design characteristics and tolerances are met. Do only continue if this is actually the case. If this is not the case you must rectify the deviations, first.

3.4 Mechanical Installation

3.4.1 Equipment

In the later course of the installation and depending on the mounting method used, some additional equipment and components will be needed.

TOOLS & EQUIPMENT

Use	Description	
General	• Hand tools, non-magnetic • Cleaning agent	• Lint-free cloths
Mounting of rotor	• Centering aids for rotor and stator, non-magnetic (schematic example ➔Figure 3-9) • Mounting fixture (for example hand-lever press or drill stand)	

Table 3-7 Tools & equipment

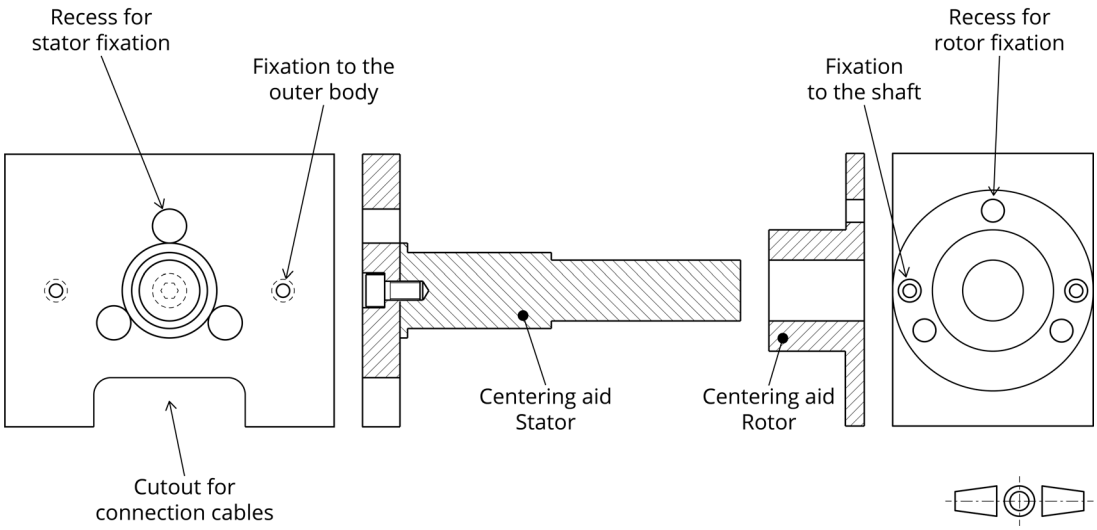


Figure 3-9 Centering aid (schematic example, symbolic)

FITTING SCREWS

The following notes are intended as recommendations and apply to common designs and methods under typical conditions and do not claim to be complete or correct. They represent approximative values for the following basic conditions:

- Standard versions as to ➔chapter “2.1 Technical Data” on page 7
- Fixation screws of property class 8.8 as to DIN EN ISO 898-1
- Customer-specific mounting parts made from aluminum (EN AW-6082) or steel (1.4305), minimum wall thickness 4 mm

Drive	Variant	Thread	Tightening torque	
			Min.	Max.
EC frameless 45	30 W (548273)	M3	47 Nmm	786 Nmm
	50 W (543631)	M3	240 Nmm	786 Nmm
	70 W (548270)	M3	250 Nmm	786 Nmm
EC frameless 60	100 W (550153)	M5	710 Nmm	3'635 Nmm
EC frameless 90	160 W (543673)	M5	1'070 Nmm	3'635 Nmm
	260 W (542099)	M5	2'000 Nmm	3'635 Nmm

Table 3-8 Tightening torques

ADHESIVES

The following notes are intended as recommendations and apply to common designs and methods under typical conditions and do not claim to be complete or correct. For manufacturers and sources of supply see ➔page 4.

Material pair or Combination of parts	Product	Note
Steel screw / **Aluminum** flange	Loctite 222	[a]
	EPO-TEK 301-2G	[b]
Steel screw / **Steel** flange	DELO-ML 5327	[b]
	omniFIT 230L	[b]
Ball bearing / **Aluminum** flange	DELO-ML 5327	
	omniFIT 230L	[c]
Ball bearing / **Steel** flange	DELO-ML 5327	
	omniFIT 230L	
Aluminum / **Aluminum**	EPO-TEK 301-2G	
	Loctite E3508	
Aluminum / **Steel**	DELO-ML 5327	
	omniFIT 230L	[c]
	EPO-TEK 301-2G	
Steel / **Steel**	DELO-ML 5327	
	omniFIT 230L	
[a] detachable connection [b] inseparable, rigid connection [c] with activation, where appropriate: copper strand, activator «Loctite 7649», or heat treatment		

Table 3-9 Recommended adhesives

3.4.2 Installing the Stator

Remember

- *Keep all parts (motor, outer body, shaft, bearings) and the surrounding area clean during the entire installation process and protect against contaminations and foreign particles.*
- *Use only non-magnetic tools.*
- *Do not apply impacts or hard strikes to the stator or rotor. These might damage the bearings.*
- *Be careful not to squeeze, kink, or excessively bend the leads and do not damage the plugs.*

The stator can be installed to the outer body by either using bolts at the axial front face (recommended) or adhesive applied to the radial circumference.

1) Before you start: Be aware of the necessary safety precautions (➔page 5) and strictly follow the general rules (➔page 9).
2) Decide on the fixation method and proceed with the respective step:
   ➔Bolted fixation (step “3”)
   ➔Adhesive fixation (step “13”)

BOLTED FIXATION

Requirements for operation

Use only screws that, once installed, do not protrude the inside front face of the stator flange. Too long screws can damage the printed circuit board, thus possibly causing electrical breakdown and destruction of the motor.

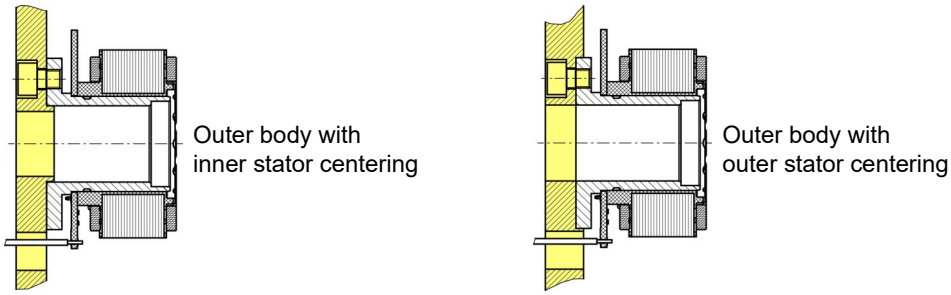


Figure 3-10 Installing the stator – Bolted fixation

3) Prepare three (3) fixation screws and verify that they do not protrude the stator’s inner axial face once installed.
4) Carefully clean and degrease the outer body’s centering and the stator flange using a lint-free cloth. Make sure that both surfaces are free of scratches and dents, clean, and grease-free.
5) Decide on the stator’s radial position in respect to the outer body.
6) Carefully insert the stator into the outer body’s centering.
7) Verify the radial alignment.
8) Apply medium strength threadlocker (for recommended types ➔Table 3-9) to the screw threads.
9) Mount the fixation screws and tighten to the specified torque (for max. tightening torque ➔Table 3-8).
10) Verify that the screw heads do not protrude the stator’s inner axial face.
11) Temporarily cover the stator opening and the surrounding area with a clean, lint-free cloth to prevent contamination.
12) Proceed with section 3.4.3 “Installing the Rotor”.

ADHESIVE FIXATION

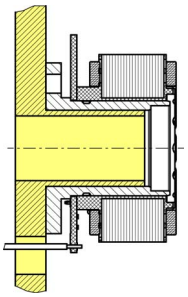


Figure 3-11 Installing the stator – Adhesive fixation

13) Carefully clean and degrease the outer body's centering and the stator flange using a lint-free cloth. Make sure that both surfaces are free of scratches and dents, clean, and grease-free.
14) Decide on the stator's radial position in respect to the outer body.
15) Apply the adhesive as to the requirements of your application. Recommended is the inner side of the joint, for example, the bore of the stator flange. For recommended adhesives ➔Table 3-9, for required quantity consult the adhesive's manufacture specification.
16) Carefully join stator and outer body's centering.
17) Verify the radial alignment.
18) Remove excess adhesive, if any.
19) Temporarily cover the stator opening and the surrounding area with a clean, lint-free cloth to prevent contamination.
20) Proceed with chapter "3.4.3 Installing the Rotor" on page 18.

3.4.3 Installing the Rotor

The rotor can be installed to the shaft by either using bolts at the axial front face (recommended) or adhesive applied to the radial circumference.

21) Decide on the fixation method and proceed with the respective step:
➔Bolted fixation (step “22”)
➔Adhesive fixation (step “30”)

BOLTED FIXATION

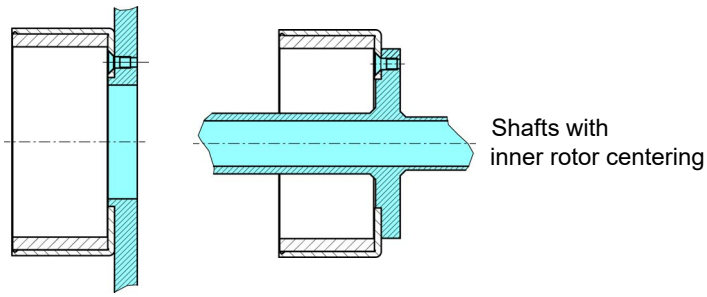


Figure 3-12 Installing the rotor – Bolted fixation

22) Prepare three (3) flush-headed countersunk head screws (preferably non-magnetic) and verify that they do not protrude the rotor’s inner axial face once installed.
23) Carefully clean and degrease the outer shaft’s centering and the rotor using a lint-free cloth. Make sure that both surfaces are free of scratches and dents, clean, and grease-free.
24) Decide on the rotor’s radial position in respect to the shaft.
25) Carefully insert the rotor into the shaft’s centering.
26) Verify the radial alignment.
27) Apply medium strength threadlocker (for recommended types ➔Table 3-9) to the screws threads.
28) Mount the flush-headed countersunk head screws and tighten to the specified torque (for max. tightening torque ➔Table 3-8).
29) Verify that the screw heads do not protrude the rotor’s inner axial face.

ADHESIVE FIXATION

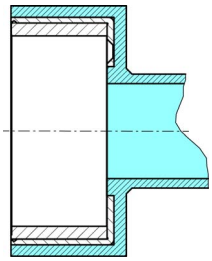


Figure 3-13 Installing the rotor – Adhesive fixation

30) Carefully clean and degrease the outer shaft's centering and the rotor using a lint-free cloth. Make sure that both surfaces are free of scratches and dents, clean, and grease-free.
31) Decide on the rotor's radial position in respect to the shaft.
32) Apply the adhesive to the inner side of the joint on the shaft. For recommended adhesives ➔Table 3-9, for required quantity consult the adhesive's manufacture specification.
33) Carefully join rotor and shaft's centering.
34) Verify the radial alignment.
35) Remove excess adhesive, if any.
36) Proceed with chapter "3.4.4 Joining Stator and Rotor" on page 20.

3.4.4 Joining Stator and Rotor

Recommended procedure
The installation approach that matches your case of application depends on the design chosen by you and the mounting conditions. The following description must therefore be understood as a proposal and is based on…

- *the above-mentioned installation example I (➔Figure 3-5 on page 12),*
- *the use of corresponding centering aids (➔Figure 3-9 on page 14),*
- *an appropriate mounting device (➔chapter "3.4.1 Equipment" on page 14), and*
- *the above described installation of stator and rotor.*

Observe the recommendations, follow the demonstrated sequence, and analogously adjust the procedure as to your case of application.

WARNING

Pinching and shearing risk
Sudden movement and shift of rotor can cause serious injuries!
To prevent sudden shift during installation you must keep stator and rotor blocked at all times. Do so by using a mechanical locking device, a mounting aid, or non-magnetic spacers!

37) Attach the centering aid to the outer body. Be careful not to squeeze, kink, or excessively bend the leads.

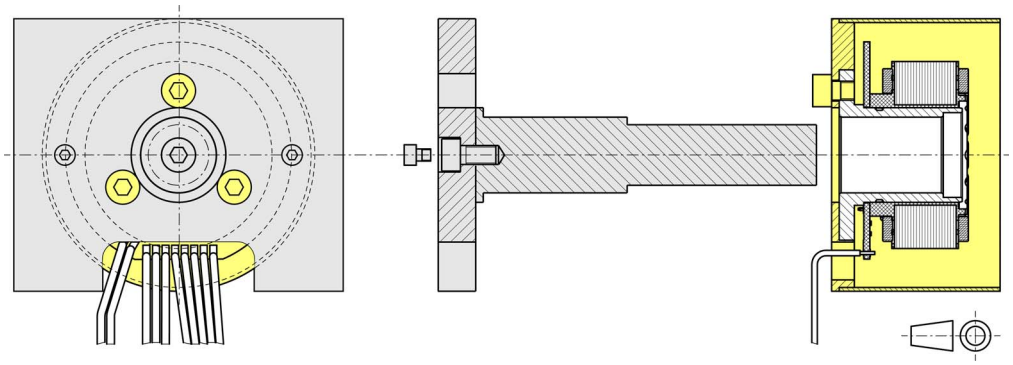


Figure 3-14 Centering aid at outer body/stator

38) Attach the centering aid to the shaft.

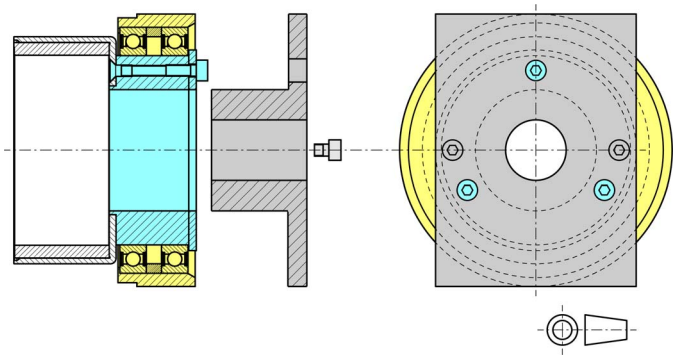


Figure 3-15 Centering aid at shaft/rotor

39) Place the two centering aids in position and mount them to the mounting fixture (not shown).

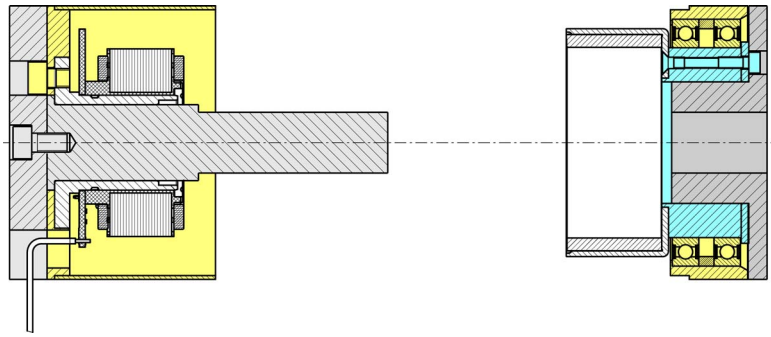


Figure 3-16 Mounting the centering aids

Protect hands and fingers
Put on well-fitting, cut-resistant protective gloves.

40) Slowly move the two centering aids in axial direction towards each other. Thereby observe the following:
   – Make sure that the parts do not tilt or hook. Pay special attention to the bearings.
   – Be aware that while approaching the two parts, rotor and stator will all of a sudden magnetically attract each other in a forceful manner. Therefore, hold against the axially moving part at all times (➔Figure 3-17).

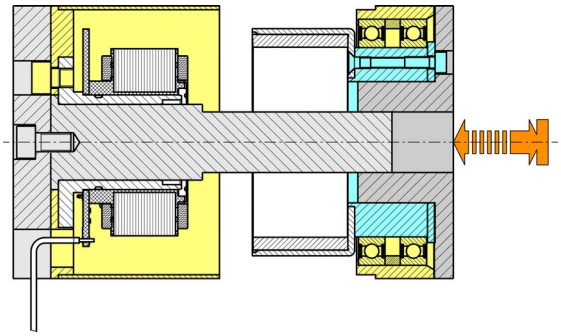


Figure 3-17 Joining stator and rotor

   – Continue until the rotor completely lays in the stator (➔Figure 3-18).

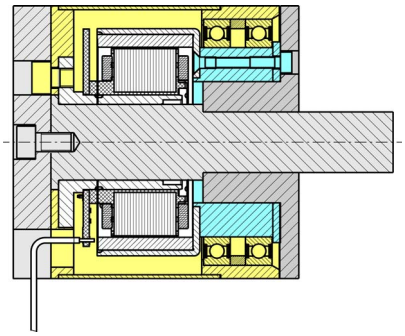


Figure 3-18 Final position stator/rotor

41) Make sure that rotor and stator are correctly aligned and verify the motor length (➔Figure 3-19; mounting dimension **LM**).

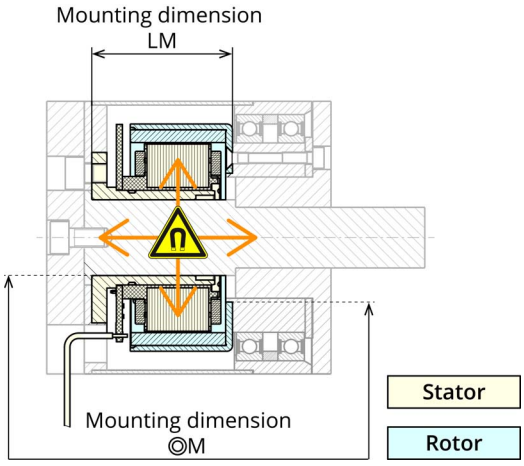


Figure 3-19 Verification of stator and rotor position

42) Carefully loosen the fixations on both centering aids and remove them.

43) Verify the motor length and concentricity(➔Figure 3-19; mounting dimensions **LM** and ◎**M**).

3.5 Electrical Installation

3.5.1 Connections

Electrical Interface—possible permanent damage

- *Handle connections and cables with special care!*
- *Do not kink cable, do not bend around small radii, do not route around sharp edges!*
- *Do not apply tensile stress, use strain relief!*

MOTOR PLUGS

By default, the connection cables are equipped with the following plugs.

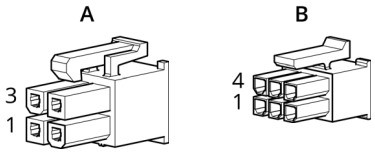


Figure 3-20 Motor plugs

Plug	Manufacturer	Type
A	Molex	Molex Mini-Fit Jr., 4 pole (39-01-2040)
B	Molex	Molex Micro-Fit 3.0, 6 pole (430-25-0600)

Table 3-10 Motor plugs – Specifications

Plug	Pin	Signal	Description
A	1	Winding 1	Motor winding 1
	2	Winding 2	Motor winding 2
	3	Winding 3	Motor winding 3
	4	—	not connected
B	1	Hall sensor 1	Hall sensor 1 output
	2	Hall sensor 2	Hall sensor 2 output
	3	Hall sensor 3	Hall sensor 3 output
	4	GND	Ground
	5	+4.5…+24 VDC	Nominal voltage
	6	—	not connected

Table 3-11 Motor plugs – Pin assignment

NTC THERMISTOR

Wire	Signal	Description
violet	NTC	Thermistor
violet	NTC	Thermistor

Table 3-12 NTC thermistor – Wire assignment

3.5.2 Hall Sensors

The angular rotor position is determined by means of three built-in digital Hall sensors.These are offset by 120°e to one another and deliver six different signal combinations per rotor pole pair.

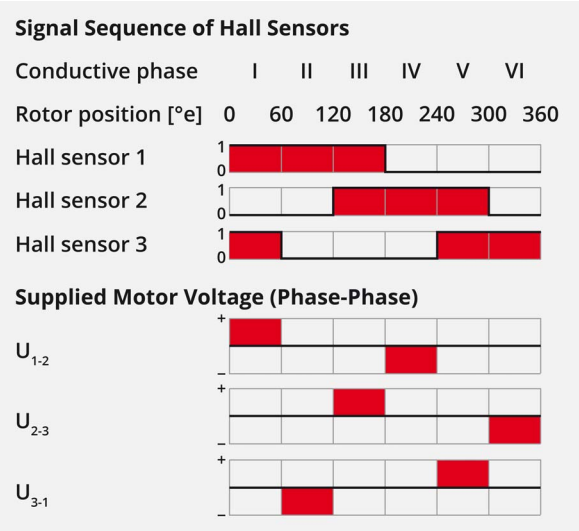


Figure 3-21 Hall sensors – Block commutation

3.5.3 Temperature Sensor

The «EC frameless» is equipped with two temperature sensors based on the NTC thermistor principle (NTC; Negative Temperature Coefficient). Thereby, a negative temperature coefficient is used, which is associated with a decreasing electrical resistance as the temperature increases.

The NTC thermistors are connected in parallel and positioned underneath two motor windings on the motor PCB. They have no direct contact with the motor windings. This leads to a delay of the temperature measurement and to higher thermal resistance (lower measured temperature). For this reason, temperature monitoring is primarely suitable for continuous operation, whereby the actual temperature measurement depends on the mounting conditions and requires testing. The NTC thermistor does not perform linear. The respective temperature can be calculated using the following parameters (find the corresponding values in the data sheet; ➔Appendix as of page 30), provided that both NTC thermistors have the same temperature (the same resistance):

Motionless, permanently energized motor
If the rotor does not turn while the same two windings are permanently energized, no uniform heating takes place in the motor. As a result, the thermistors do not have the same temperature. In this case, the formula can only serve as an approximation.

$$T(R) = \frac{1}{\frac{\ln\left(\frac{R}{R_{25}}\right)}{beta} + \frac{1}{T_{25}}}[K]$$

$$T_{25} = 298.15[K]$$

$beta$	Constant (temperature coefficient) optimized for the operating range of the motor
R_{25}	Nominal resistance at standard temperature T_{25}
T_{25}	Standard temperature of 25 °C (298.15 K)

4 MAINTENANCE

4.1 Periodic Inspection

The «EC frameless» as a whole and its individual parts are maintenance-free.

Outer body, motor shaft, and bearings are customer-made parts. For their maintenance and repair consult the relevant instructions. Thereby observe the following:

If you perform maintenance on outer body, motor shaft, and bearings:

- Before you start: Be aware of the necessary safety precautions (➔page 5) and strictly follow the general rules (➔page 9).
- Verify the correct position of the motor before re-commissioning. Specially important are the mounting dimensions **LM** and ◎**M** (➔page 11).

4.2 Storage

Observe all safety aspects (➔"About the Safety Precautions" on page 5) and the stated environmental conditions (➔"Technical Data" on page 7).

Physically separate the storage location to prevent all persons who possibly may suffer impairment caused by strong magnetic fields from approaching the device and force them to stay clear in a safe distance of at least two (2) meters. Put up warning signs stating STRONG MAGNETIC FIELDS.

4.3 Decommissioning & Dismantling

Dismantling follows basically the Installation in reverse order (➔chapter "3.4 Mechanical Installation" on page 14). Be aware of the necessary safety precautions (➔page 5) and strictly follow the general rules (➔page 9).

4.4 Disposal

In no case dispose used components with normal domestic waste.

Dispose used components only via official collection sites or a certified recycling company. Draw to attention that the high magnetic forces produced by the device constitute an imminent hazard to persons wearing a cardiac pacemaker or metal implants.

DECLARATION OF INCORPORATION

Declaration of Incorporation of partly completed Machinery according to EU Directive 2006/42/EC, Annex II 1B.

Manufacturer	maxon motor ag Brünigstrasse 220 CH-6072 Sachseln Switzerland	
Authorized representative to compile the relevant technical documentation	maxon motor ag Brünigstrasse 220 CH-6072 Sachseln Switzerland	
Product	EC frameless	Direct current electric motor, comprising stator, rotor, and connector cables

The manufacturer declares that the aforementioned product is considered partly completed machinery complying with all essential requirements of EC Directive 2006/42/EC (Directive on Machinery). It is intended, exclusively, to be incorporated into machinery or partly completed machinery and therefore does not yet meet all requirements of the Directive on Machinery.

Applied harmonized standards: EN ISO 12100:2010

The special technical documentation according to Annex VII, Part B has been prepared and will be made available to the national authorities at their request.

The product must not be put into service until the machinery into which the aforementioned product is to be incorporated has been declared in conformity with the provisions of the Directive on Machinery.

Sachseln, April 17, 2018, on behalf of the manufacturer

Eugen Elmiger
CEO maxon motor Group

Dr. Ulrich Claessen
CTO Director Research & Development
Member of the Executive Committee

LIST OF FIGURES

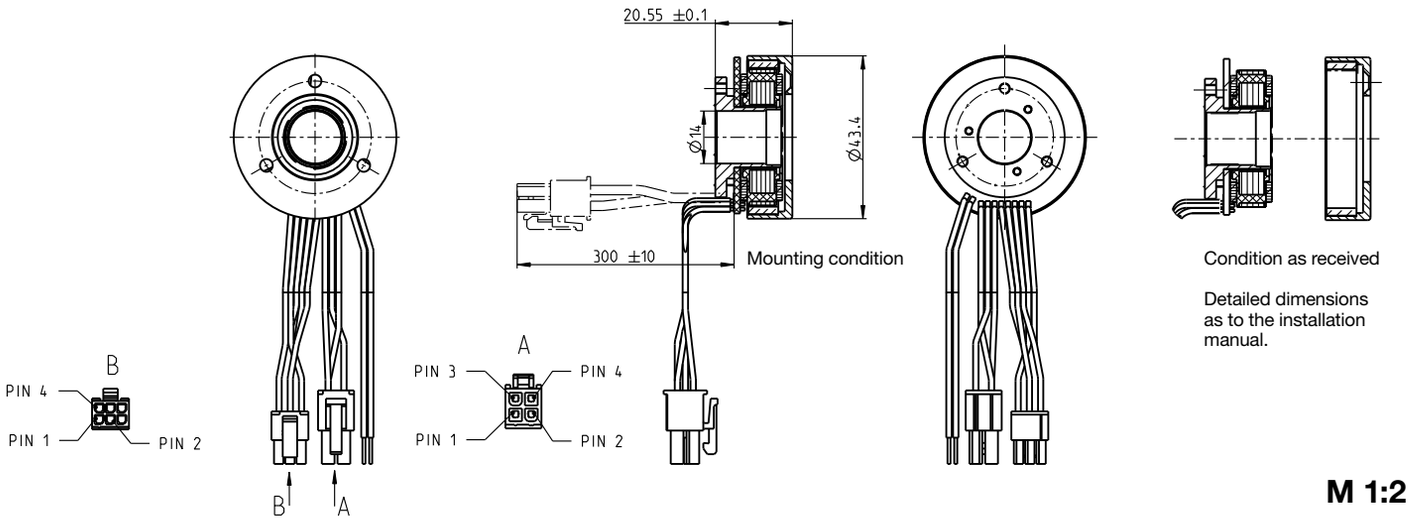
maxon

LIST OF TABLES

INDEX

APPENDIX

EC frameless 45 flat ∅43.4 mm, brushless, 30 Watt



M 1:2

Stock program
Standard program
Special program (on request)

Part Numbers

	with Hall sensors	548273	574536	574537	574538
Motor Data					
	Values at nominal voltage				
1	Nominal voltage	V	12	18	24	36
2	No load speed	rpm	4360	4890	4360	4750
3	No load current	mA	163	129	81.4	61.6
4	Nominal speed	rpm	2910	3510	2930	3290
5	Nominal torque (max. continuous torque)	mNm	54.9	57.8	54.7	66
6	Nominal current (max. continuous current)	A	2.02	1.63	1.01	0.847
7	Stall torque	mNm	247	295	251	378
8	Stall current	A	9.69	8.61	4.93	5.35
9	Max. efficiency	%	76.3	77.5	76.5	80.1
	Characteristics					
10	Terminal resistance phase to phase	Ω	1.24	2.09	4.87	6.73
11	Terminal inductance phase to phase	mH	0.56	0.697	2.24	4.29
12	Torque constant	mNm/A	25.5	34.3	51	70.6
13	Speed constant	rpm/V	374	278	187	135
14	Speed/torque gradient	rpm/mNm	18.2	17	17.9	12.9
15	Mechanical time constant	ms	28.6	30.8	28.1	20.2
16	Rotor inertia	gcm²	150	150	150	150

Specifications

	Thermal data	
17	Thermal resistance housing-ambient	6.73 K/W
18	Thermal resistance winding-housing	3.92 K/W
19	Thermal time constant winding	11.4 s
20	Thermal time constant motor	296 s
21	Ambient temperature	-40…+100°C
22	Max. winding temperature	+125°C
	Mechanical data	
23	Max. speed	10000 rpm
	Other specifications	
29	Number of pole pairs	8
30	Number of phases	3
31	Weight of motor	89 g
	Weight of rotor	35 g
	Weight of stator	54 g

Values listed in the table are nominal.

Connection motor (Cable AWG 18)

red	Motor winding 1	Pin 1
black	Motor winding 2	Pin 2
white	Motor winding 3	Pin 3
	N.C.	Pin 4

Connector	**Part number**
Molex	39-01-2040

Connection sensors (Cable AWG 24)

yellow	Hall sensor 1	Pin 1
brown	Hall sensor 2	Pin 2
grey	Hall sensor 3	Pin 3
blue	GND	Pin 4
green	V_{Hall} 4.5…24 VDC	Pin 5
	N.C.	Pin 6

Connector	**Part number**
Molex	430-25-0600

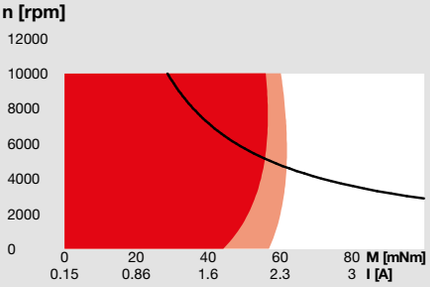
Wiring diagram for Hall sensors see p. 43

Connection NTC (Cable AWG 24)

pink	NTC
blue	NTC

Resistance 25°C: 5 kOhm ±1%, beta (25–85°C): 3490 K

Operating Range



Comments

Continuous operation: In observation of above listed thermal resistance (lines 17 and 18) the maximum permissible winding temperature will be reached during continuous operation at 25°C ambient = Thermal limit.

Continuous operation with reduced thermal resistance R_{th2} 50%.

Short term operation: The motor may be briefly over-loaded (recurring).

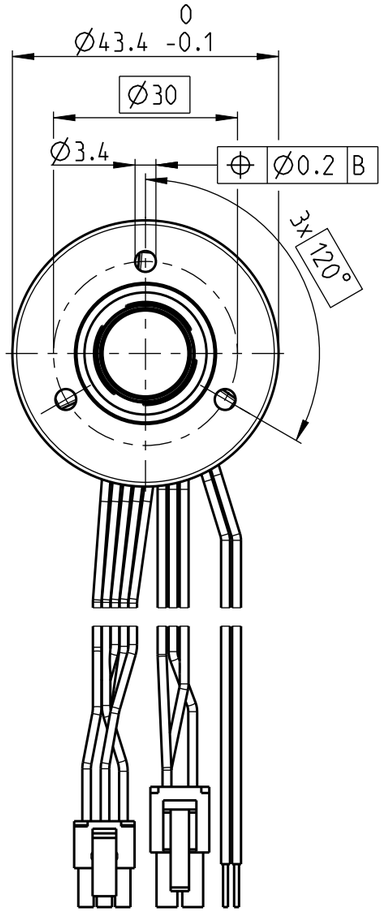
Assigned power ratin

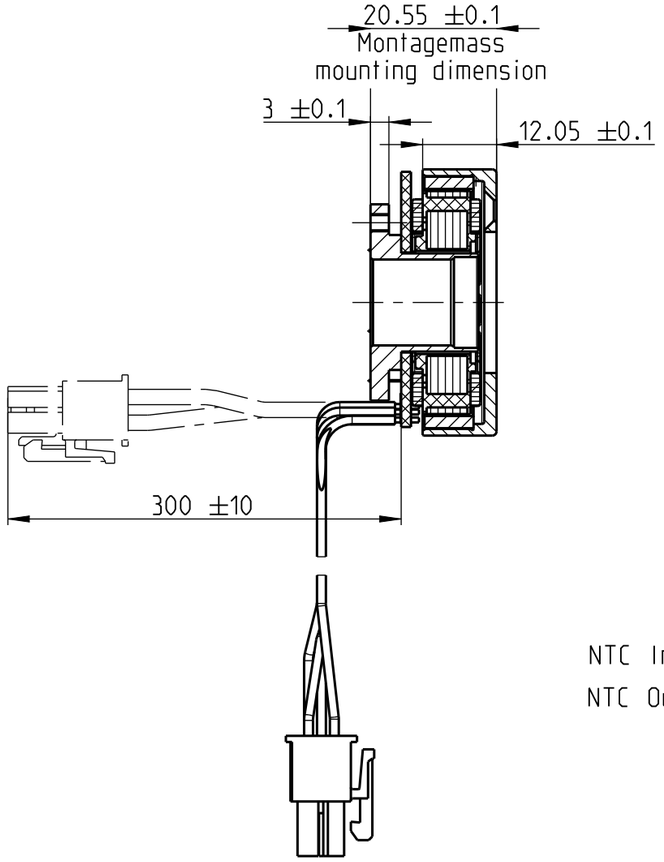
maxon Modular System

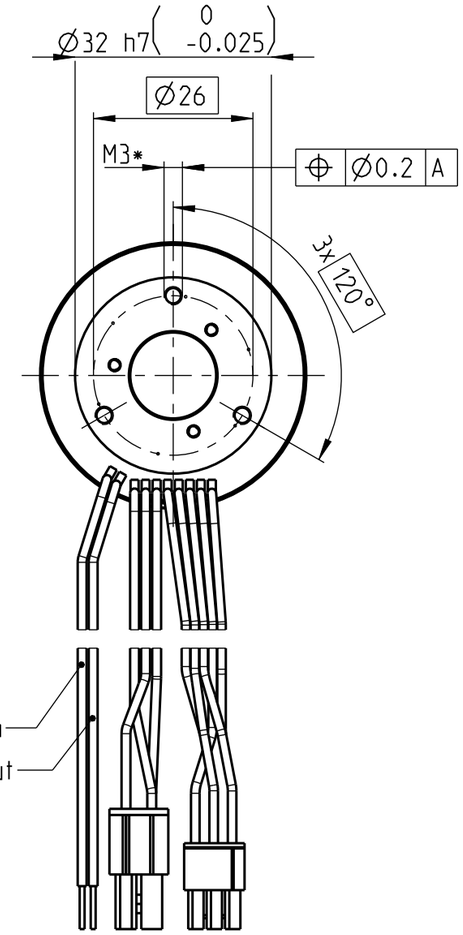
Overview on page 29–33

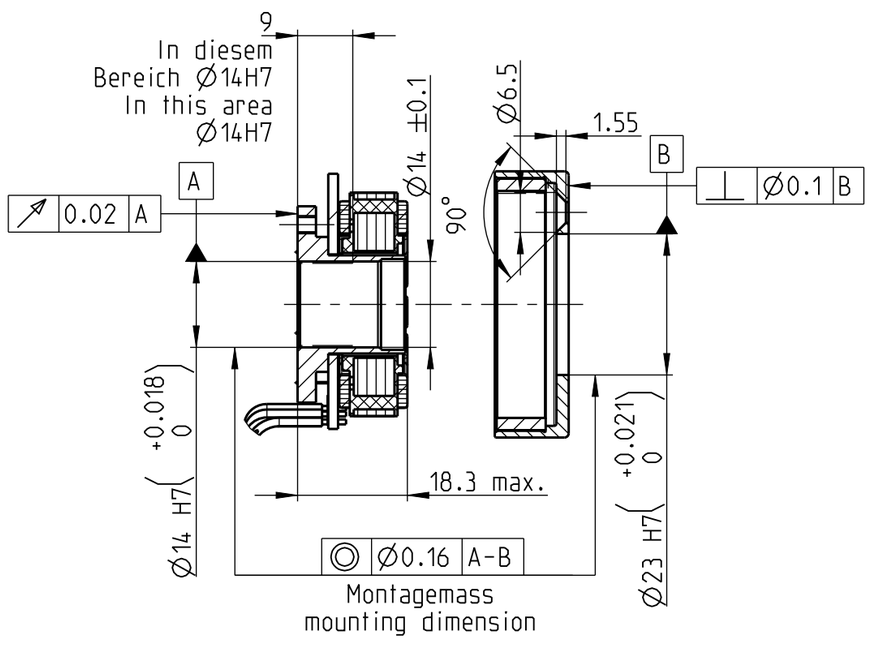
Recommended Electronics:

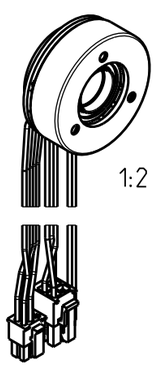
Notes	Page **32**
ESCON Module 24/2	426
ESCON 36/3 EC	427
ESCON Mod. 50/4 EC-S	427
ESCON Module 50/5	427
ESCON 50/5	428
DEC Module 24/2	430
DEC Module 50/5	430
EPOS2 24/2	434
EPOS2 Module 36/2	434
EPOS2 24/5, 50/5	435
EPOS2 P 24/5	438
EPOS4 Mod./CB 24/1.5	441
EPOS4 Module/CB 50/5	442
MAXPOS 50/5	447



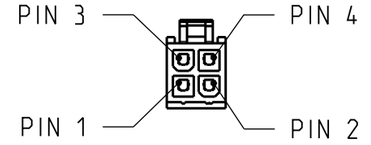








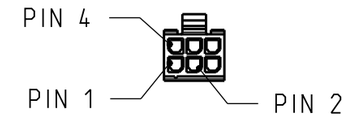
A



Steckertyp / connector typ	
Fabrikat manufacturer	Artikel Nummer part number
Molex	39-01-2040

Steckerbelegung / PIN allocation	
PIN 1	Wicklung 1 / winding 1
PIN 2	Wicklung 2 / winding 2
PIN 3	Wicklung 3 / winding 3
PIN 4	Not connected

B



Steckertyp / connector typ	
Fabrikat manufacturer	Artikel Nummer part number
Molex	43025-0600

Steckerbelegung / PIN allocation	
PIN 1	Hallsensor 1 / hall sensor 1
PIN 2	Hallsensor 2 / hall sensor 2
PIN 3	Hallsensor 3 / hall sensor 3
PIN 4	GND
PIN 5	+4.5...24 V DC
PIN 6	Not connected

* Durchgangsgewinde:
maximale Einschraubtiefe 3.0mm
* Through thread:
maximum depth for screws 3.0mm

Achtung: Rotor und Stator
werden getrennt angeliefert
Attention: rotor and stator
delivered seperated

maxon EC Frameless EC45 fl. BL Y 30W 0WE A

Artikel Nr./part no. | Fertigprodukt/finished product | Basis Nr./basic no.

Tolerierung tolerancing	Allgemeintoleranzen general tolerances	Gewindetoleranzen screw thread tolerances	Geometrische Tolerierung geometrical tolerancing	Oberflaechen surfaces	Kanten edges	N/A N/A
ISO 8015	ISO 2768-m	ISO 965-1	ISO 1101	N/A	N/A	N/A

Bezeichnung/title

Massbild

EC45 flach

CO: 679881	Datum/date	Name/name	Massstab/scale: 1:1	Modell/model
Erstellt/created	27.07.2016	MMAGGAN	Blatt/sheet: A3/1/1	3585865
Geaendert/modified	09.11.2018	MMAGGAN	Masseinheit dimension unit: mm	Projektionsmethoden projection methods: ISO 5456-1
Freigabe/release	20.11.2018	MMAGMALU		

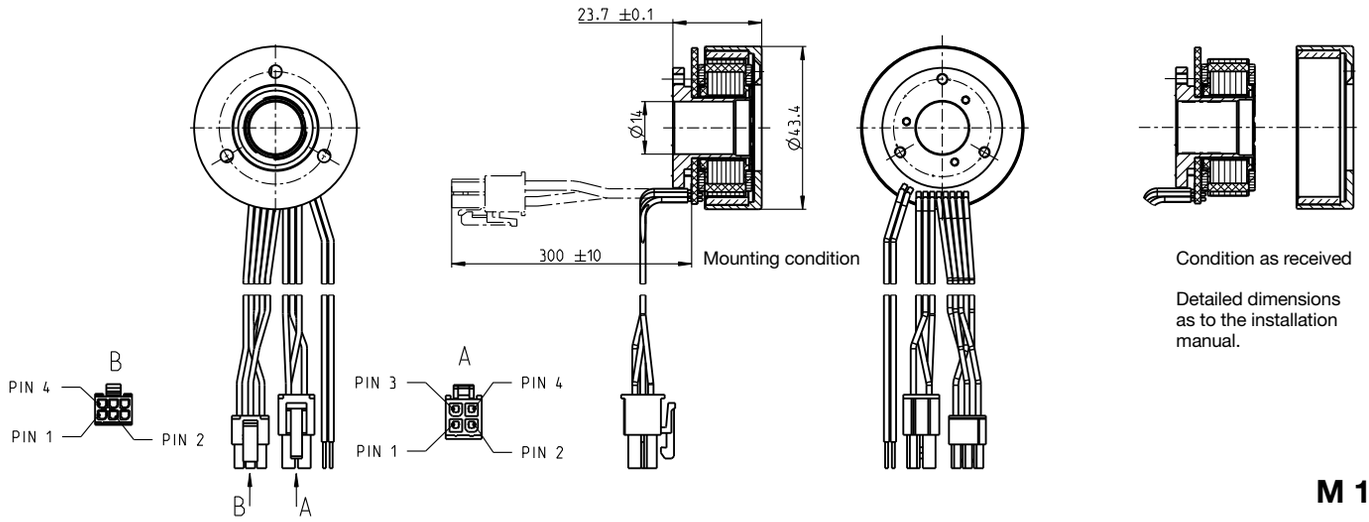
Artikel-Nr./part-no. | Revision revision

Dokument-Nr./document-no.: 3585877 | Revision revision: 03

maxon motor
driven by precision

www.maxonmotor.com

EC frameless 45 flat ∅43.4 mm, brushless, 50 Watt



M 1:1

Stock program
Standard program
Special program (on request)

Part Numbers

	with Hall sensors	543631	574402	574403	574404
Motor Data					
	Values at nominal voltage				
1	Nominal voltage	V	18	24	24	36
2	No load speed	rpm	6720	6710	4730	3360
3	No load current	mA	247	185	106	42.3
4	Nominal speed	rpm	5190	5240	3480	2360
5	Nominal torque (max. continuous torque)	mNm	97.1	83.4	69.6	90.5
6	Nominal current (max. continuous current)	A	3.52	2.33	1.41	0.828
7	Stall torque	mNm	975	780	402	484
8	Stall current	A	38.8	23.3	8.47	4.81
9	Max. efficiency	%	85	83.3	79.3	82.4
	Characteristics					
10	Terminal resistance phase to phase	Ω	0.464	1.03	2.83	7.48
11	Terminal inductance phase to phase	mH	0.322	0.572	1.15	5.15
12	Torque constant	mNm/A	25.1	33.5	47.5	101
13	Speed constant	rpm/V	380	285	201	95
14	Speed/torque gradient	rpm/mNm	7.02	8.77	12	7.07
15	Mechanical time constant	ms	13.6	17	23.3	13.7
16	Rotor inertia	gcm²	185	185	185	185

Specifications

	Thermal data	
17	Thermal resistance housing-ambient	4.53 K/W
18	Thermal resistance winding-housing	4.75 K/W
19	Thermal time constant winding	17.7 s
20	Thermal time constant motor	227 s
21	Ambient temperature	-40…+100°C
22	Max. winding temperature	+125°C
	Mechanical data	
23	Max. speed	10000 rpm
	Other specifications	
29	Number of pole pairs	8
30	Number of phases	3
31	Weight of motor	110 g
	Weight of rotor	41 g
	Weight of stator	69 g

Values listed in the table are nominal.

Connection motor (Cable AWG 18)

red	Motor winding 1	Pin 1
black	Motor winding 2	Pin 2
white	Motor winding 3	Pin 3
	N.C.	Pin 4

Connector	**Part number**
Molex	39-01-2040

Connection sensors (Cable AWG 24)

yellow	Hall sensor 1	Pin 1
brown	Hall sensor 2	Pin 2
grey	Hall sensor 3	Pin 3
blue	GND	Pin 4
green	V_{Hall} 4.5…24 VDC	Pin 5
	N.C.	Pin 6

Connector	**Part number**
Molex	430-25-0600

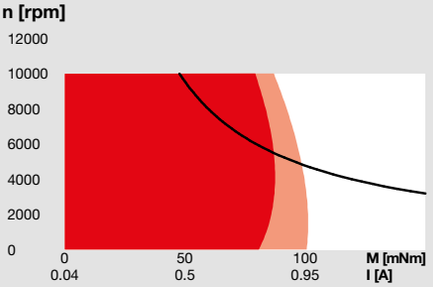
Wiring diagram for Hall sensors see p. 43

Connection NTC (Cable AWG 24)

pink	NTC
blue	NTC

Resistance 25°C: 5 kOhm ±1%, beta (25–85°C): 3490 K

Operating Range



Comments

Continuous operation: In observation of above listed thermal resistance (lines 17 and 18) the maximum permissible winding temperature will be reached during continuous operation at 25°C ambient = Thermal limit.

Continuous operation with reduced thermal resistance R_{th2} 50%.

Short term operation: The motor may be briefly overloaded (recurring).

Assigned power ratin

maxon Modular System

Overview on page 29–33

Recommended Electronics:

Notes	Page **32**
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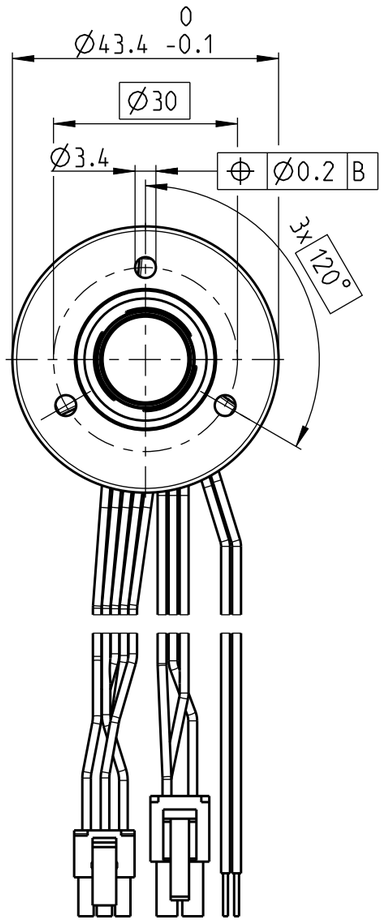
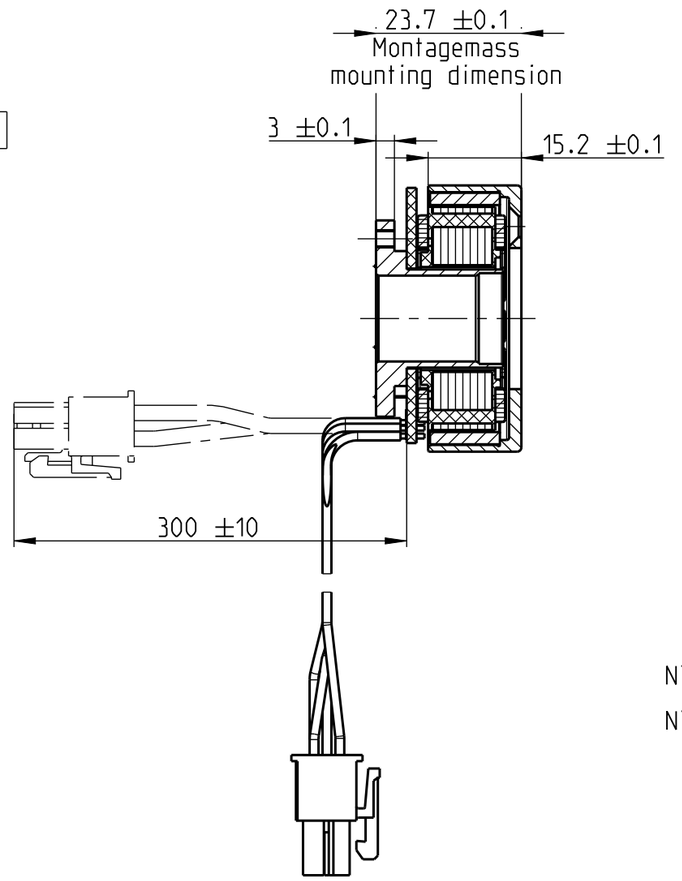
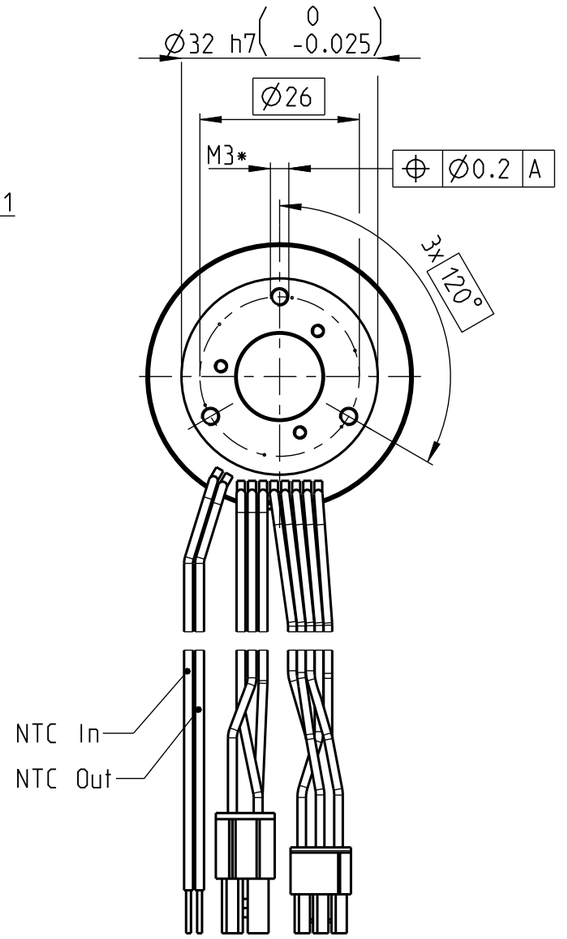
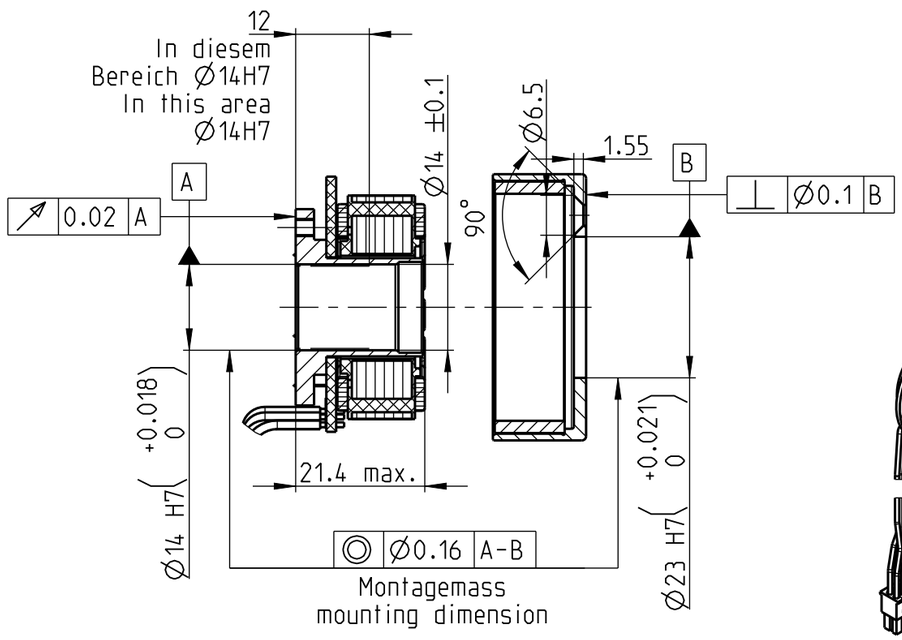
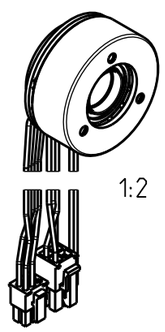
ESCON 36/3 EC	427
ESCON Mod. 50/4 EC-S	427
ESCON Module 50/5	427
ESCON 50/5	428
DEC Module 24/2	430
DEC Module 50/5	430
EPOS2 24/2	434
EPOS2 Module 36/2	434
EPOS2 24/5, 50/5	435
EPOS2 P 24/5	438
EPOS4 Mod./CB 24/1.5	441
EPOS4 Module/CB 50/5	442
MAXPOS 50/5	447



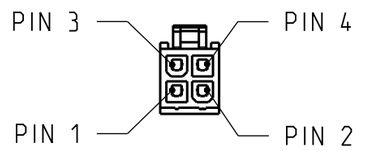








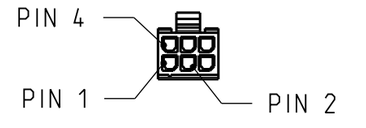
A



Steckertyp / connector typ	
Fabrikat manufacturer	Artikel Nummer part number
Molex	39-01-2040

Steckerbelegung / PIN allocation	
PIN 1	Wicklung 1 / winding 1
PIN 2	Wicklung 2 / winding 2
PIN 3	Wicklung 3 / winding 3
PIN 4	Not connected

B



Steckertyp / connector typ	
Fabrikat manufacturer	Artikel Nummer part number
Molex	43025-0600

Steckerbelegung / PIN allocation	
PIN 1	Hallsensor 1 / hall sensor 1
PIN 2	Hallsensor 2 / hall sensor 2
PIN 3	Hallsensor 3 / hall sensor 3
PIN 4	GND
PIN 5	+4.5...24 V DC
PIN 6	Not connected

* Durchgangsgewinde:
maximale Einschraubtiefe 3.0mm
* Through thread:
maximum depth for screws 3.0mm

Achtung: Rotor und Stator
werden getrennt angeliefert
Attention: rotor and stator
delivered sperated

maxon EC Frameless EC45 fl. BL Y 50W 0WE A

Artikel Nr./part no. | Fertigprodukt/finished product | Basis Nr./basic no.

Tolerierung tolerancing	Allgemeintoleranzen general tolerances	Gewindetoleranzen screw thread tolerances	Geometrische Tolerierung geometrical tolerancing	Oberflaechen surfaces	Kanten edges	N/A N/A
ISO 8015	ISO 2768-m	ISO 965-1	ISO 1101	N/A	N/A	N/A

Bezeichnung/title

Massbild

EC45 flach

CO: 679881	Datum/date	Name/name	Massstab/scale:	1:1	Modell/model
Erstellt/created	09.05.2016	MMAGDARS	Blatt/sheet:	A3/1/1	3411893
Geaendert/modified	09.11.2018	MMAGGAN	Masseinheit dimension unit	Projektionsmethoden projection methods	
Freigabe/release	20.11.2018	MMAGMALU	mm	ISO 5456-1	

Artikel-Nr./part-no. | Revision revision

Dokument-Nr./document-no.: 3411892 | Revision revision: 04

maxon motor
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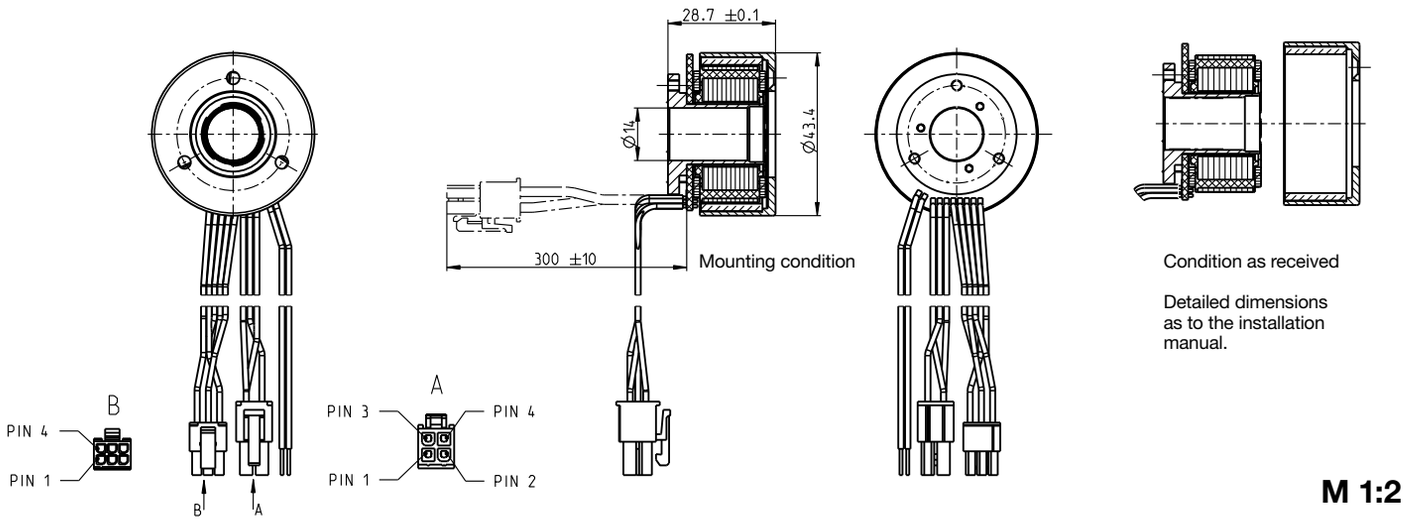
EC frameless 45 flat ∅43.4 mm, brushless, 70 Watt



M 1:2

Stock program
Standard program
Special program (on request)

Part Numbers

	with Hall sensors	548270	574035	574036	574037
Motor Data					
	Values at nominal voltage				
1	Nominal voltage	V	24	30	36	48
2	No load speed	rpm	6110	6230	6330	3440
3	No load current	mA	234	194	166	48.1
4	Nominal speed	rpm	4860	4990	5080	2540
5	Nominal torque (max. continuous torque)	mNm	128	112	108	134
6	Nominal current (max. continuous current)	A	3.21	2.36	1.93	0.936
7	Stall torque	mNm	1460	1170	1100	915
8	Stall current	A	39.5	25.8	20.7	6.97
9	Max. efficiency	%	85.4	83.7	83.2	84.3
	Characteristics					
10	Terminal resistance phase to phase	Ω	0.608	1.16	1.74	6.89
11	Terminal inductance phase to phase	mH	0.463	0.691	0.966	5.85
12	Torque constant	mNm/A	36.9	45.1	53.3	131
13	Speed constant	rpm/V	259	212	179	72.7
14	Speed/torque gradient	rpm/mNm	4.26	5.44	5.85	3.82
15	Mechanical time constant	ms	10.7	13.7	14.7	9.6
16	Rotor inertia	gcm²	240	240	240	240

Specifications

Thermal data

17	Thermal resistance housing-ambient	3.56 K/W
18	Thermal resistance winding-housing	4.1 K/W
19	Thermal time constant winding	29.6 s
20	Thermal time constant motor	178 s
21	Ambient temperature	-40…+100°C
22	Max. winding temperature	+125°C

Mechanical data

23	Max. speed	10000 rpm

Other specifications

29	Number of pole pairs	8
30	Number of phases	3
31	Weight of motor	143 g
	Weight of rotor	51 g
	Weight of stator	92 g

Values listed in the table are nominal.

Connection motor (Cable AWG 18)

red	Motor winding 1	Pin 1
black	Motor winding 2	Pin 2
white	Motor winding 3	Pin 3
	N.C.	Pin 4

Connector	**Part number**
Molex	39-01-2040

Connection sensors (Cable AWG 24)

yellow	Hall sensor 1	Pin 1
brown	Hall sensor 2	Pin 2
grey	Hall sensor 3	Pin 3
blue	GND	Pin 4
green	V_{Hall} 4.5…24 VDC	Pin 5
	N.C.	Pin 6

Connector	**Part number**
Molex	430-25-0600

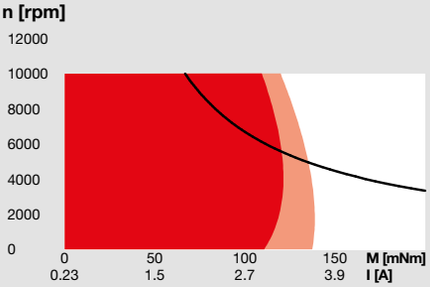
Wiring diagram for Hall sensors see p. 43

Connection NTC (Cable AWG 24)

pink	NTC
blue	NTC

Resistance 25°C: 5 kOhm ±1%, beta (25–85°C): 3490 K

Operating Range



Comments

Continuous operation: In observation of above listed thermal resistance (lines 17 and 18) the maximum permissible winding temperature will be reached during continuous operation at 25°C ambient = Thermal limit.

Continuous operation with reduced thermal resistance R_{th2} 50%.

Short term operation: The motor may be briefly over-loaded (recurring).

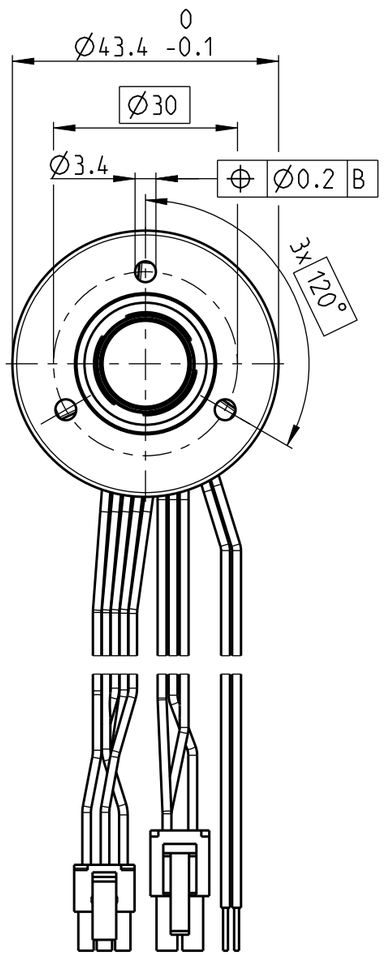
Assigned power ratin

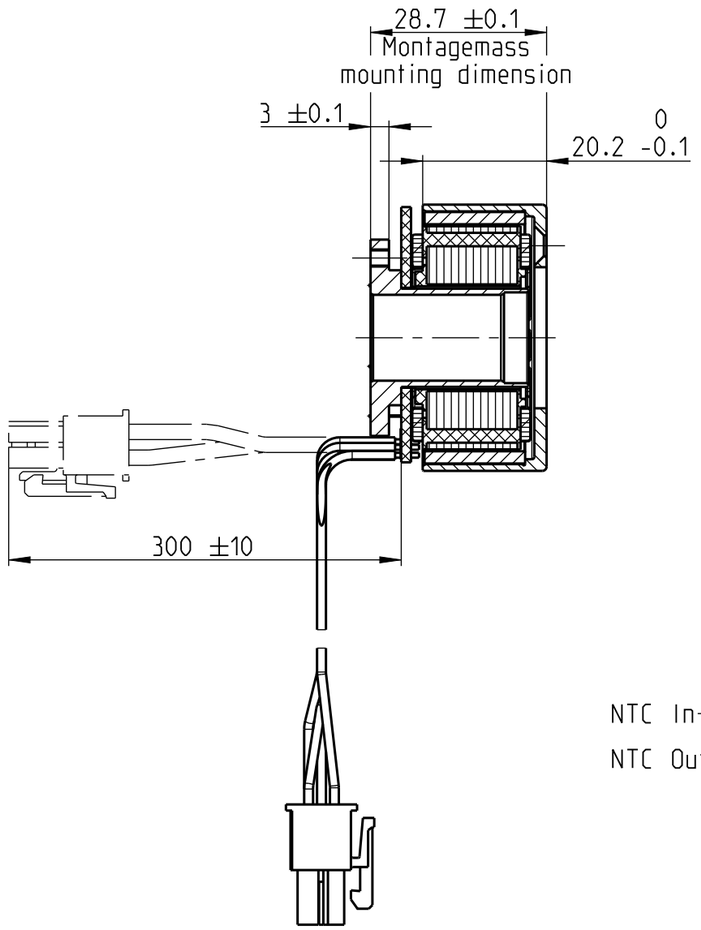
maxon Modular System

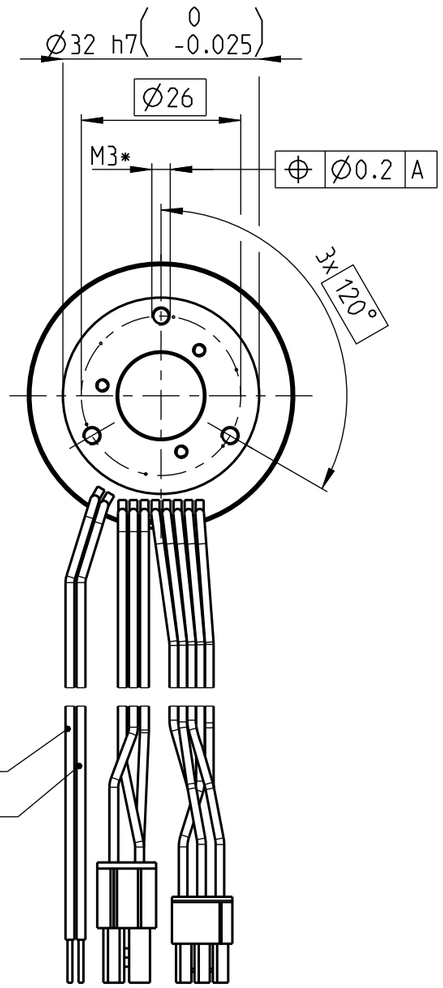
Overview on page 29–33

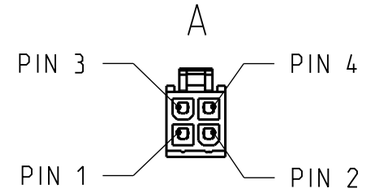
Recommended Electronics:

Notes	Page **32**
ESCON 36/3 EC	427
ESCON Mod. 50/4 EC-S	427
ESCON Module 50/5	427
ESCON 50/5	428
DEC Module 50/5	430
EPOS2 Module 36/2	434
EPOS2 24/5, 50/5	435
EPOS2 P 24/5	438
EPOS4 Module/CB 50/5	442
MAXPOS 50/5	447



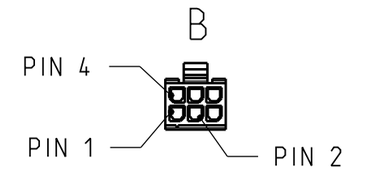






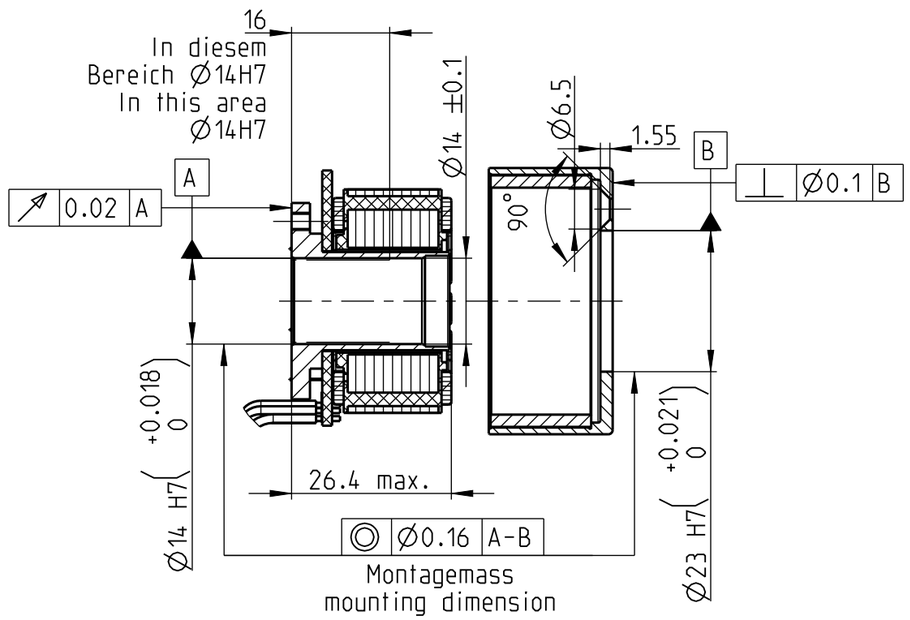
Steckertyp / connector typ	
Fabrikat manufacturer	Artikel Nummer part number
Molex	39-01-2040

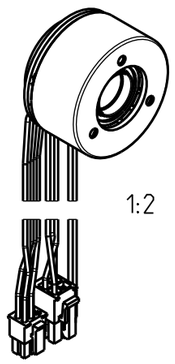
Steckerbelegung / PIN allocation	
PIN 1	Wicklung 1 / winding 1
PIN 2	Wicklung 2 / winding 2
PIN 3	Wicklung 3 / winding 3
PIN 4	Not connected



Steckertyp / connector typ	
Fabrikat manufacturer	Artikel Nummer part number
Molex	43025-0600

Steckerbelegung / PIN allocation	
PIN 1	Hallsensor 1 / hall sensor 1
PIN 2	Hallsensor 2 / hall sensor 2
PIN 3	Hallsensor 3 / hall sensor 3
PIN 4	GND
PIN 5	+4.5...24 V DC
PIN 6	Not connected





* Durchgangsgewinde:
maximale Einschraubtiefe 3.0mm
* Through thread:
maximum depth for screws 3.0mm

Achtung: Rotor und Stator
werden getrennt angeliefert
Attention: rotor and stator
delivered sperated

	maxon EC Frameless EC45 fl. BL Y 70W 0WE A	
Artikel Nr./part no.	Fertigprodukt/finished product	Basis Nr./basic no.

Tolerierung tolerancing	Allgemeintoleranzen general tolerances	Gewindetoleranzen screw thread tolerances	Geometrische Tolerierung geometrical tolerancing	Oberflaechen surfaces	Kanten edges	N/A N/A
ISO 8015	ISO 2768-m	ISO 965-1	ISO 1101	N/A	N/A	N/A

Bezeichnung/title	CO: 679881	Datum/date	Name/name	Massstab/scale:	1:1	Modell/model
Massbild	Erstellt/created	27.07.2016	MMAGGAN	Blatt/sheet:	A3/1/1	3585821
EC45 flach	Geaendert/modified	09.11.2018	MMAGGAN	Masseinheit dimension unit	Projektionsmethoden projection methods	
	Freigabe/release	20.11.2018	MMAGMALU	mm	ISO 5456-1	

Artikel-Nr./part-no.	Revision revision	Dokument-Nr./document-no.	Revision revision
		3585833	05

maxon motor
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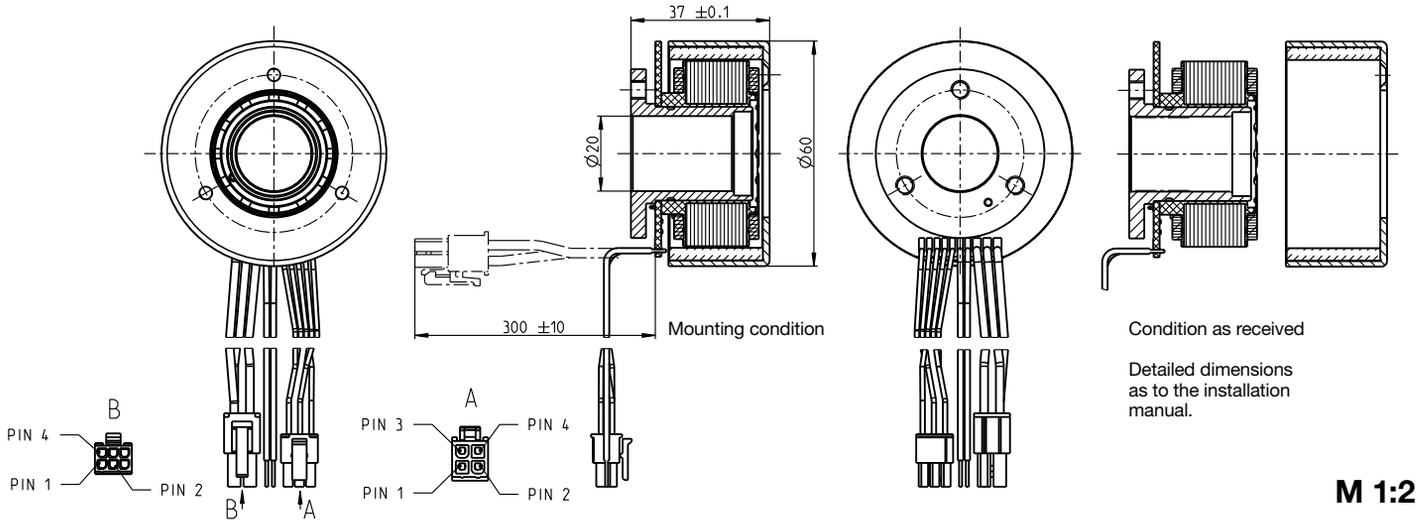
EC frameless 60 flat ∅60 mm, brushless, 100 Watt



M 1:2

Stock program
Standard program
Special program (on request)

Part Numbers

	with Hall sensors	550153	542002	550154
Motor Data				
	Values at nominal voltage			
1	Nominal voltage	V	12	24	48
2	No load speed	rpm	3710	4250	3970
3	No load current	mA	671	419	187
4	Nominal speed	rpm	3170	3740	3490
5	Nominal torque (max. continuous torque)	mNm	279	289	319
6	Nominal current (max. continuous current)	A	9.25	5.47	2.78
7	Stall torque	mNm	2850	4180	5010
8	Stall current	A	93.5	78.2	43.8
9	Max. efficiency	%	84	86	88
	Characteristics				
10	Terminal resistance phase to phase	Ω	0.128	0.307	1.1
11	Terminal inductance phase to phase	mH	0.062	0.188	0.864
12	Torque constant	mNm/A	30.5	53.4	114
13	Speed constant	rpm/V	313	179	83.4
14	Speed/torque gradient	rpm/mNm	1.32	1.03	0.798
15	Mechanical time constant	ms	17.2	13.4	10.4
16	Rotor inertia	gcm²	1246	1246	1246

Specifications

	Thermal data	
17	Thermal resistance housing-ambient	2.5 K/W
18	Thermal resistance winding-housing	3.8 K/W
19	Thermal time constant winding	40 s
20	Thermal time constant motor	89.9 s
21	Ambient temperature	-40…+100°C
22	Max. winding temperature	+125°C
	Mechanical data	
23	Max. speed	6000 rpm
	Other specifications	
29	Number of pole pairs	7
30	Number of phases	3
31	Weight of motor	333 g
	Weight of rotor	160 g
	Weight of stator	173 g

Values listed in the table are nominal.

Connection motor (Cable AWG 18)

red	Motor winding 1	Pin 1
black	Motor winding 2	Pin 2
white	Motor winding 3	Pin 3
	N.C.	Pin 4

Connector	**Part number**
Molex	39-01-2040

Connection sensors (Cable AWG 24)

yellow	Hall sensor 1	Pin 1
brown	Hall sensor 2	Pin 2
grey	Hall sensor 3	Pin 3
blue	GND	Pin 4
green	V_{Hall} 4.5…24 VDC	Pin 5
	N.C.	Pin 6

Connector	**Part number**
Molex	430-25-0600

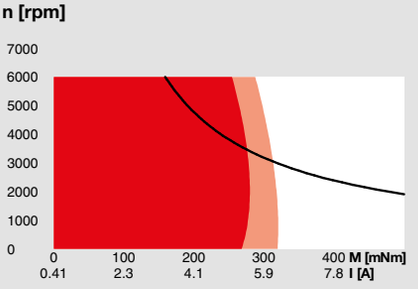
Wiring diagram for Hall sensors see p. 43

Connection NTC (Cable AWG 24)

pink	NTC
blue	NTC

Resistance 25°C: 5 kOhm ±1%, beta (25–85°C): 3490 K

Operating Range



Comments

Continuous operation: In observation of above listed thermal resistance (lines 17 and 18) the maximum permissible winding temperature will be reached during continuous operation at 25°C ambient = Thermal limit.

Continuous operation with reduced thermal resistance R_{th2} 50%.

Short term operation: The motor may be briefly over-loaded (recurring).

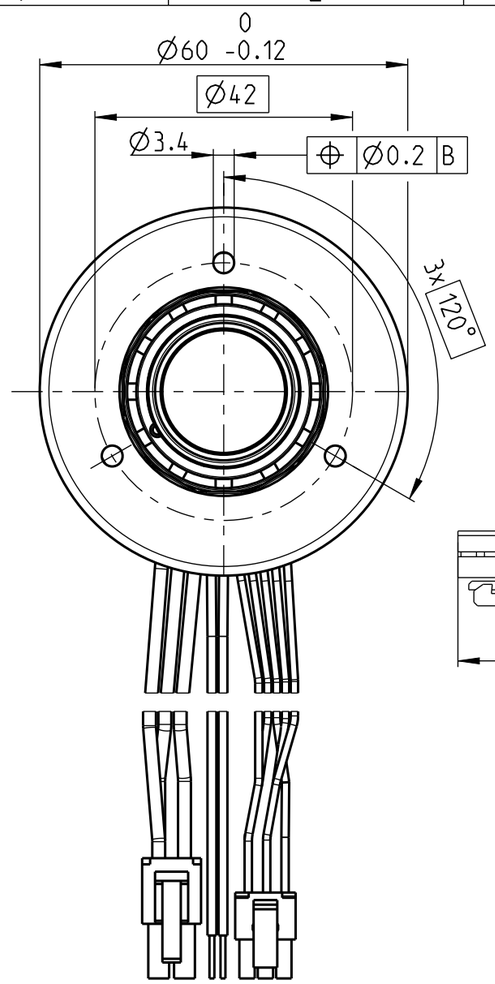
Assigned power ratin

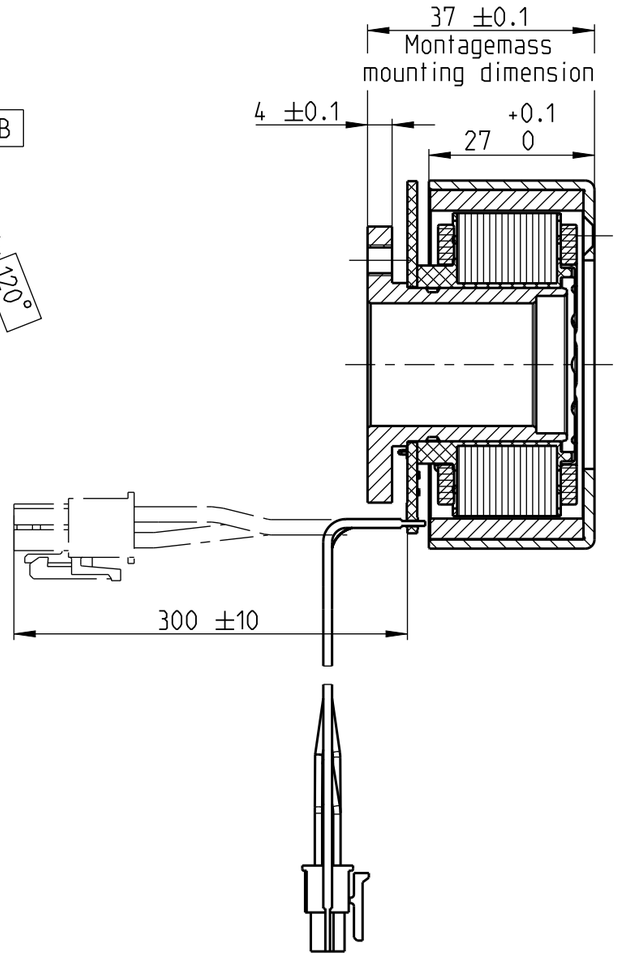
maxon Modular System

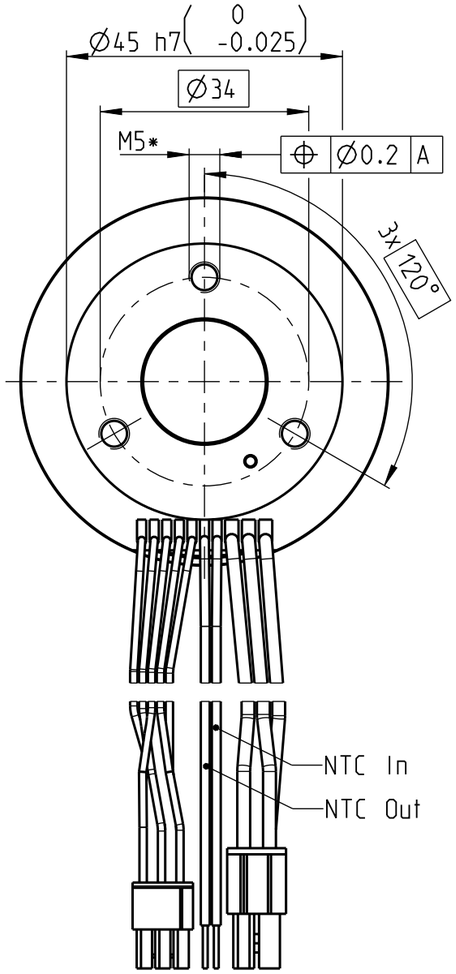
Overview on page 29–33

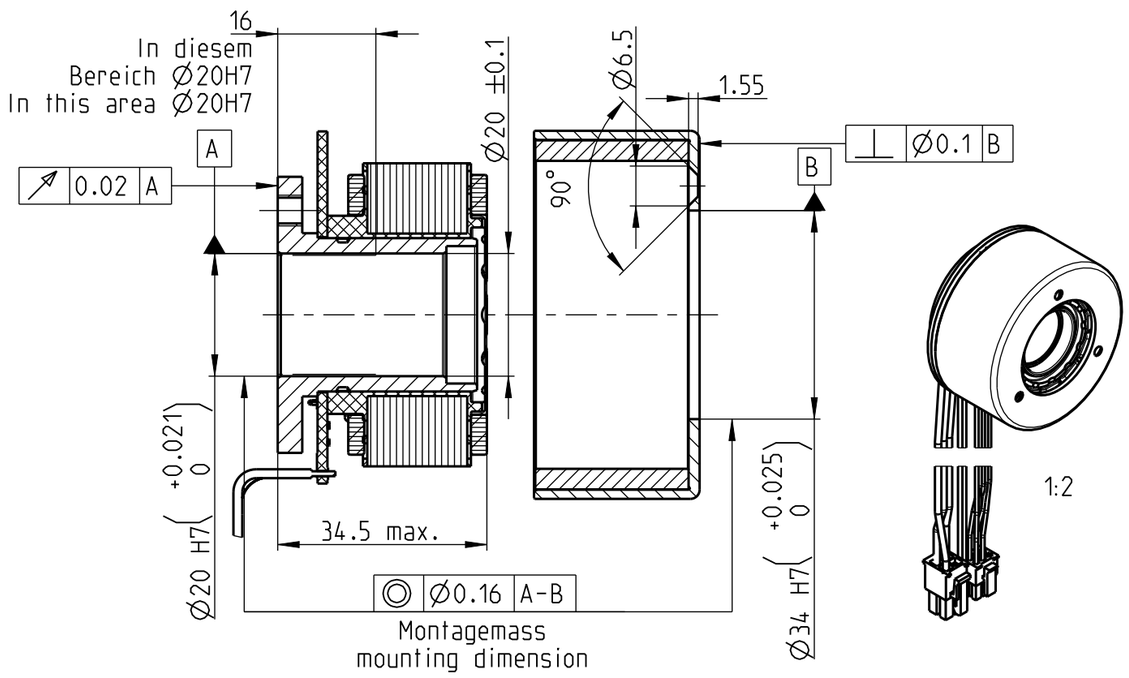
Recommended Electronics:

Notes	Page **32**
ESCON Mod. 50/4 EC-S	427
ESCON Module 50/5	427
ESCON 50/5	428
ESCON 70/10	428
DEC Module 50/5	430
EPOS2 24/5	435
EPOS2 50/5	435
EPOS2 70/10	435
EPOS2 P 24/5	438
EPOS4 Module 50/8	443
EPOS4 Comp. 50/8 CAN	443
MAXPOS 50/5	447









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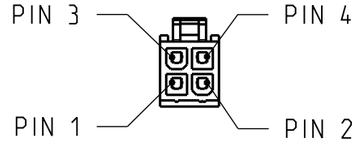
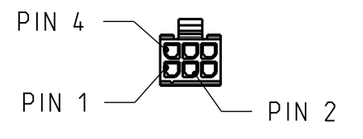


Steckertyp / connector typ	
Fabrikat manufacturer	Artikel Nummer part number
Molex	39-01-2040

Steckerbelegung / PIN allocation	
PIN 1	Wicklung 1 / winding 1
PIN 2	Wicklung 2 / winding 2
PIN 3	Wicklung 3 / winding 3
PIN 4	Not connected

B



Steckertyp / connector typ	
Fabrikat manufacturer	Artikel Nummer part number
Molex	43025-0600

Steckerbelegung / PIN allocation	
PIN 1	Hallsensor 1 / hall sensor 1
PIN 2	Hallsensor 2 / hall sensor 2
PIN 3	Hallsensor 3 / hall sensor 3
PIN 4	GND
PIN 5	+4.5...24 V DC
PIN 6	Not connected

* Durchgangsgewinde:
maximale Einschraubtiefe 4.0mm
* Through thread:
maximum depth for screws 4.0mm

Achtung: Rotor und Stator
werden getrennt angeliefert
Attention: rotor and stator
delivered sperated

maxon EC Frameless EC60 fl. BL Y 100W 0WE A

Artikel Nr./part no. | Fertigprodukt/finished product | Basis Nr./basic no.

Tolerierung tolerancing	Allgemeintoleranzen general tolerances	Gewindetoleranzen screw thread tolerances	Geometrische Tolerierung geometrical tolerancing	Oberflaechen surfaces	Kanten edges	N/A N/A
ISO 8015	ISO 2768-m	ISO 965-1	ISO 1101	N/A	N/A	N/A

Bezeichnung/title

Massbild

EC60 flach

CO: 679881	Datum/date	Name/name	Massstab/scale: 1:1	Modell/model
Erstellt/created	24.03.2016	MMAGGAN	Blatt/sheet: A3/1/1	3322946
Geaendert/modified	09.11.2018	MMAGGAN	Massseinheit dimension unit: mm	Projektionsmethoden projection methods: ISO 5456-1
Freigabe/release	20.11.2018	MMAGMALU		

Artikel-Nr./part-no. | Revision revision

Dokument-Nr./document-no.: 3322945 | Revision revision: 03

maxon motor
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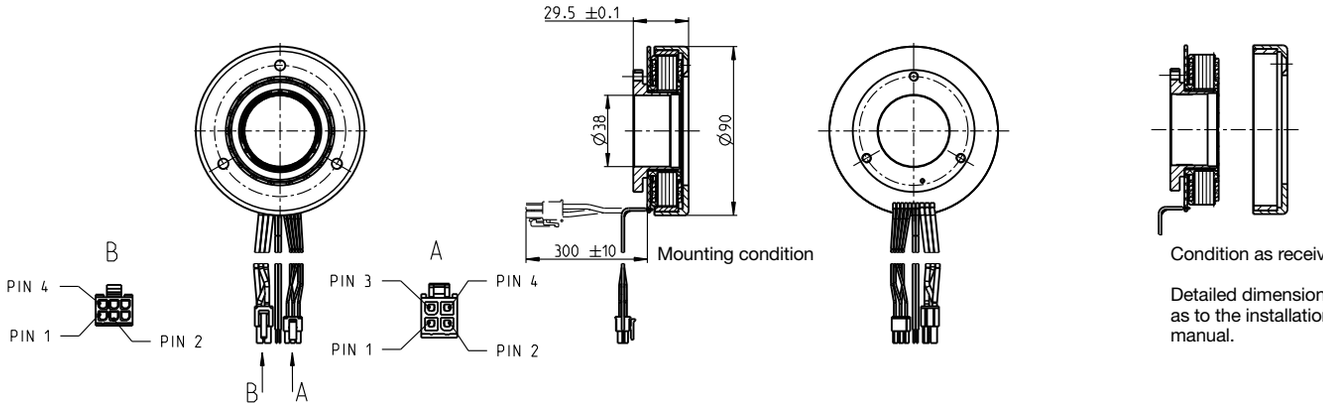
EC frameless 90 flat ∅90 mm, brushless, 160 Watt



M 1:4

Stock program
Standard program
Special program (on request)

Part Numbers

	with Hall sensors	588847	543673	581301	581302
Motor Data					
	Values at nominal voltage				
1	Nominal voltage	V	12	24	36	60
2	No load speed	rpm	3150	3160	3070	2600
3	No load current	mA	1310	657	419	196
4	Nominal speed	rpm	2610	2670	2600	2170
5	Nominal torque (max. continuous torque)	mNm	477	475	470	477
6	Nominal current (max. continuous current)	A	13.1	6.52	4.18	2.14
7	Stall torque	mNm	5980	7770	7810	6780
8	Stall current	A	168	109	70.9	31.2
9	Max. efficiency	%	83.3	85.3	85.4	85
	Characteristics					
10	Terminal resistance phase to phase	Ω	0.0715	0.22	0.508	1.92
11	Terminal inductance phase to phase	mH	0.0644	0.258	0.616	2.39
12	Torque constant	mNm/A	35.6	71.3	110	217
13	Speed constant	rpm/V	268	134	86.7	44
14	Speed/torque gradient	rpm/mNm	0.538	0.414	0.4	0.39
15	Mechanical time constant	ms	20	15.5	15	14.7
16	Rotor inertia	gcm²	3398	3398	3398	3398

Specifications

	Thermal data	
17	Thermal resistance housing-ambient	1.7 K/W
18	Thermal resistance winding-housing	3.75 K/W
19	Thermal time constant winding	67.9 s
20	Thermal time constant motor	252 s
21	Ambient temperature	-40…+100°C
22	Max. winding temperature	+125°C
	Mechanical data	
23	Max. speed	5000 rpm
	Other specifications	
29	Number of pole pairs	11
30	Number of phases	3
31	Weight of motor	490 g
	Weight of rotor	195 g
	Weight of stator	295 g

Values listed in the table are nominal.

Connection motor (Cable AWG 18)

red	Motor winding 1	Pin 1
black	Motor winding 2	Pin 2
white	Motor winding 3	Pin 3
	N.C.	Pin 4

Connector	**Part number**
Molex	39-01-2040

Connection sensors (Cable AWG 24)

yellow	Hall sensor 1	Pin 1
brown	Hall sensor 2	Pin 2
grey	Hall sensor 3	Pin 3
blue	GND	Pin 4
green	V_{Hall} 4.5…24 VDC	Pin 5
	N.C.	Pin 6

Connector	**Part number**
Molex	430-25-0600

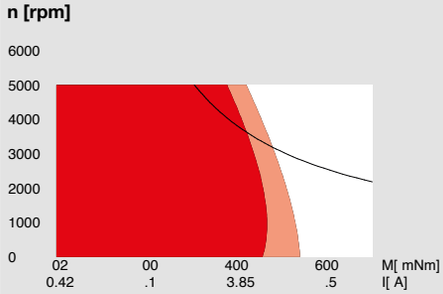
Wiring diagram for Hall sensors see p. 43

Connection NTC (Cable AWG 24)

pink	NTC
blue	NTC

Resistance 25°C: 5 kOhm ±1%, beta (25–85°C): 3490 K

Operating Range



Comments

Continuous operation: In observation of above listed thermal resistance (lines 17 and 18) the maximum permissible winding temperature will be reached during continuous operation at 25°C ambient = Thermal limit.

Continuous operation with reduced thermal resistance R_{th2} 50%.

Short term operation: The motor may be briefly over-loaded (recurring).

Assigned power ratin

maxon Modular System

Overview on page 29–33

Recommended Electronics:

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ESCON Mod. 50/4 EC-S	427
ESCON Module 50/5	427
ESCON 50/5	428
ESCON 70/10	428
DEC Module 50/5	430
EPOS2 24/5	435
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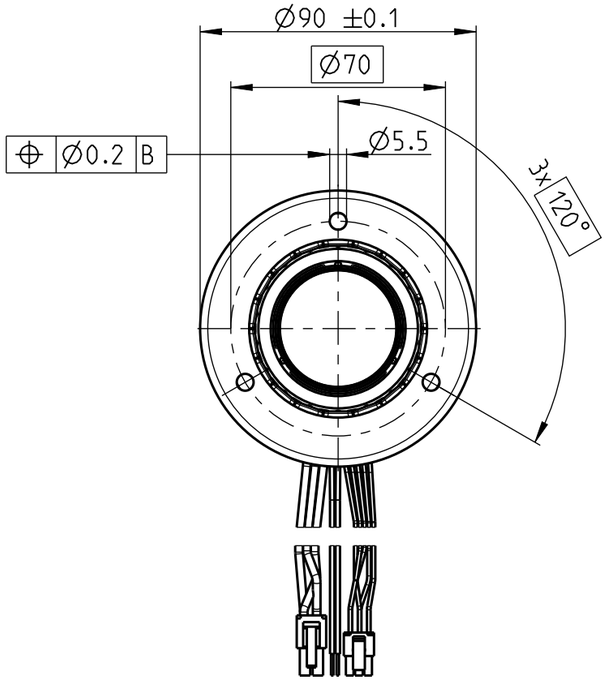
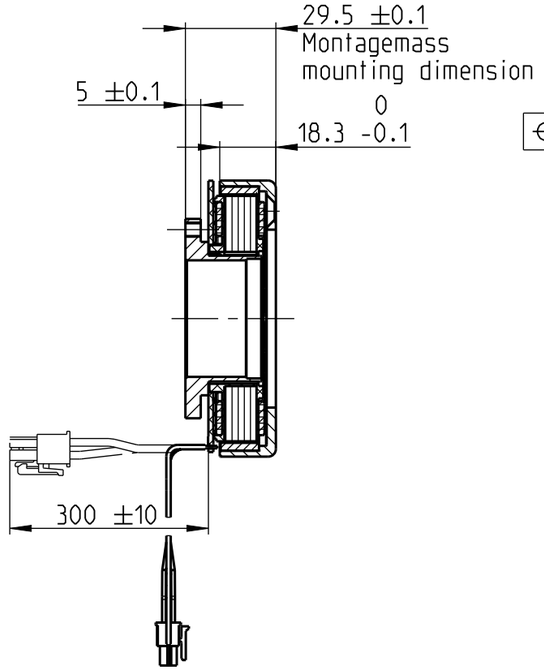
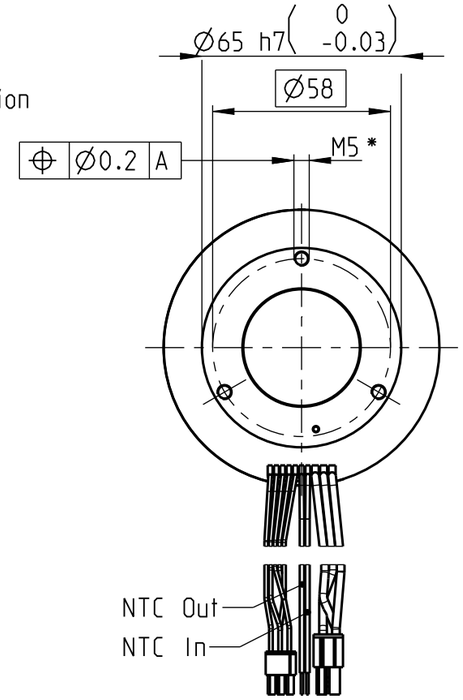
EPOS2 70/10	435
EPOS2 P 24/5	438
EPOS4 Module 50/8	443
EPOS4 Comp. 50/8 CAN	443
MAXPOS 50/5	447







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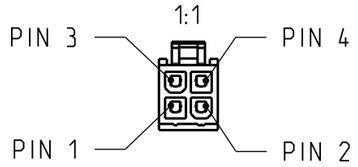
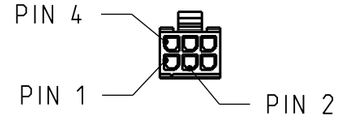


Steckertyp / connector typ	
Fabrikat manufacturer	Artikel Nummer part number
Molex	39-01-2040

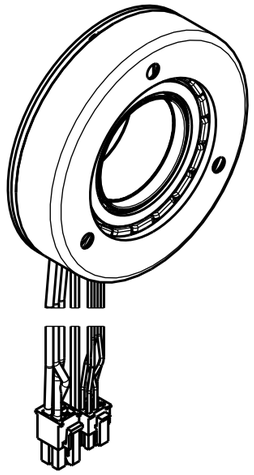
Steckerbelegung / PIN allocation	
PIN 1	Wicklung 1 / winding 1
PIN 2	Wicklung 2 / winding 2
PIN 3	Wicklung 3 / winding 3
PIN 4	Not connected

B
1:1



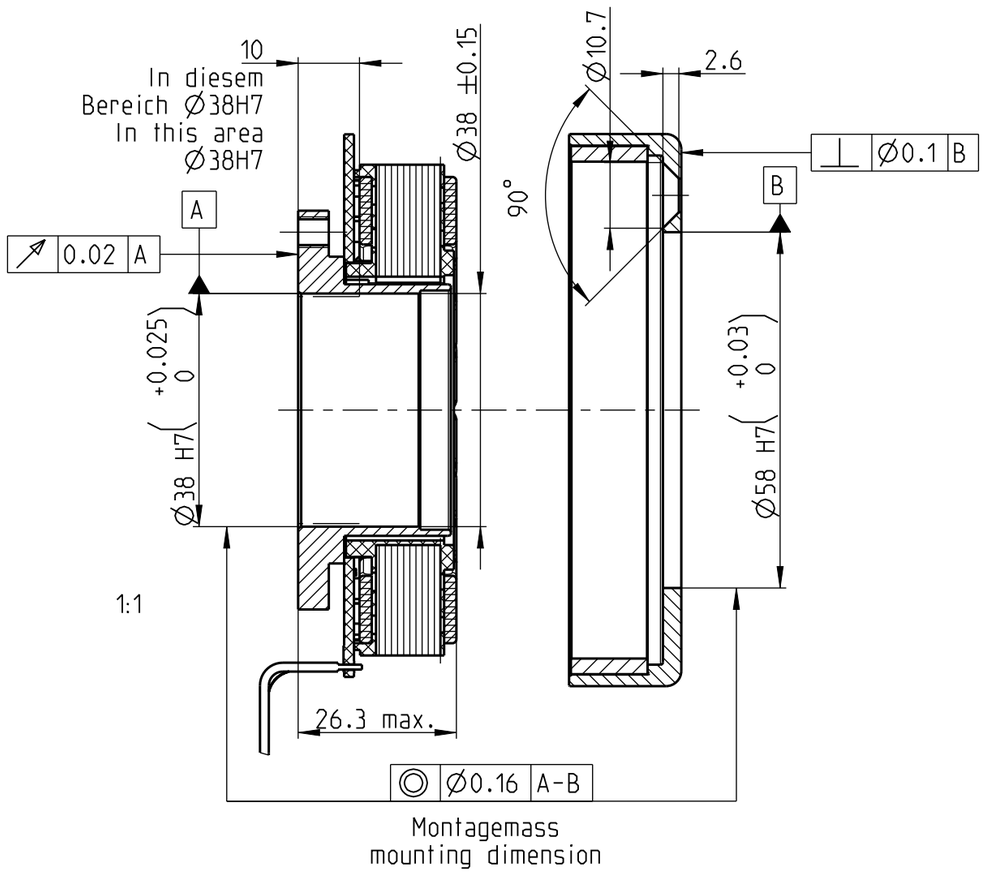
Steckertyp / connector typ	
Fabrikat manufacturer	Artikel Nummer part number
Molex	43025-0600

Steckerbelegung / PIN allocation	
PIN 1	Hallsensor 1 / hall sensor 1
PIN 2	Hallsensor 2 / hall sensor 2
PIN 3	Hallsensor 3 / hall sensor 3
PIN 4	GND
PIN 5	+4.5...24 V DC
PIN 6	Not connected



* Durchgangsgewinde:
maximale Einschraubtiefe 5.0mm
* Through thread:
maximum depth for screws 5.0mm

Achtung: Rotor und Stator
werden getrennt angeliefert
Attention: rotor and stator
delivered sperated



Montagemass
mounting dimension

maxon Frameless EC90 fl. BL D 160W OWE A

Artikel Nr./part no. | Fertigprodukt/finished product | Basis Nr./basic no.

Tolerierung tolerancing	Allgemeintoleranzen general tolerances	Gewindetoleranzen screw thread tolerances	Geometrische Tolerierung geometrical tolerancing	Oberflaechen surfaces	Kanten edges	N/A N/A
ISO 8015	ISO 2768-m	ISO 965-1	ISO 1101	N/A	N/A	N/A

Bezeichnung/title

Massbild

EC90 flach

CO: 679881	Datum/date	Name/name	Massstab/scale: 1:2	Modell/model
Erstellt/created	07.06.2016	MMAGDARS	Blatt/sheet: A3/1/1	3471637
Geaendert/modified	09.11.2018	MMAGGAN	Masseinheit dimension unit: mm	Projektionsmethoden projection methods: ISO 5456-1
Freigabe/release	20.11.2018	MMAGMALU		

Artikel-Nr./part-no. | Revision revision

Dokument-Nr./document-no.: 3471636 | Revision revision: 04

maxon motor
driven by precision

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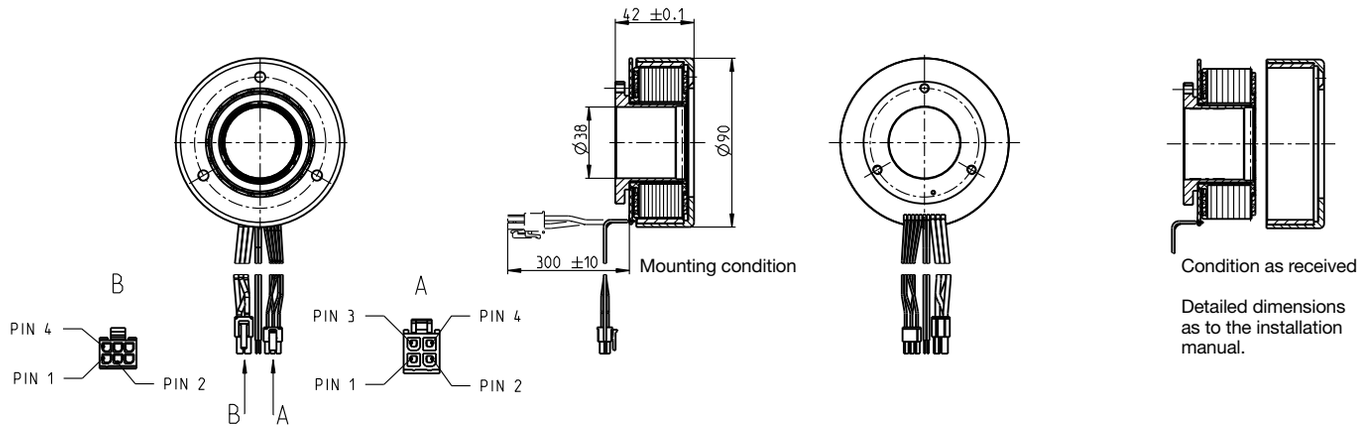
EC frameless 90 flat ∅90 mm, brushless, 260 Watt



M 1:4

Stock program
Standard program
Special program (on request)

Part Numbers

	with Hall sensors	588849	542099	581294	581295
Motor Data					
	Values at nominal voltage				
1	Nominal voltage V	18	30	48	60
2	No load speed rpm	2110	2120	1990	2020
3	No load current mA	831	502	285	232
4	Nominal speed rpm	1810	1820	1700	1730
5	Nominal torque (max. continuous torque) mNm	1030	992	968	968
6	Nominal current (max. continuous current) A	12.4	7.24	4.16	3.37
7	Stall torque mNm	15700	15100	13500	13700
8	Stall current A	195	113	59.5	48.8
9	Max. efficiency %	87.6	87.3	86.8	86.9
	Characteristics				
10	Terminal resistance phase to phase Ω	0.0923	0.266	0.807	1.23
11	Terminal inductance phase to phase mH	0.12	0.334	0.964	1.47
12	Torque constant mNm/A	80.7	134	228	281
13	Speed constant rpm/V	118	71.4	42	34
14	Speed/torque gradient rpm/mNm	0.135	0.142	0.149	0.149
15	Mechanical time constant ms	7.59	7.88	8.26	8.25
16	Rotor inertia gcm²	5301	5301	5301	5301

Specifications

Thermal data

17	Thermal resistance housing-ambient	1.36 K/W
18	Thermal resistance winding-housing	1.82 K/W
19	Thermal time constant winding	54.6 s
20	Thermal time constant motor	202 s
21	Ambient temperature	-40…+100°C
22	Max. winding temperature	+125°C

Mechanical data

23	Max. speed	5000 rpm

Other specifications

29	Number of pole pairs	11
30	Number of phases	3
31	Weight of motor	814 g
	Weight of rotor	292 g
	Weight of stator	522 g

Values listed in the table are nominal.

Connection motor (Cable AWG 18)

red	Motor winding 1	Pin 1
black	Motor winding 2	Pin 2
white	Motor winding 3	Pin 3
	N.C.	Pin 4

Connector	**Part number**
Molex	39-01-2040

Connection sensors (Cable AWG 24)

yellow	Hall sensor 1	Pin 1
brown	Hall sensor 2	Pin 2
grey	Hall sensor 3	Pin 3
blue	GND	Pin 4
green	V_{Hall} 4.5…24 VDC	Pin 5
	N.C.	Pin 6

Connector	**Part number**
Molex	430-25-0600

Wiring diagram for Hall sensors see p. 43

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pink	NTC
blue	NTC

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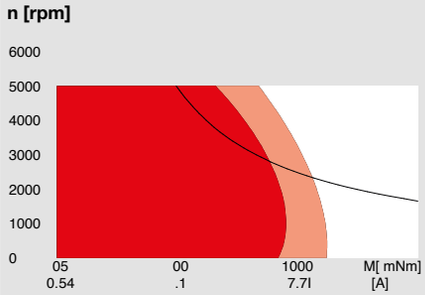

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maxon Modular System

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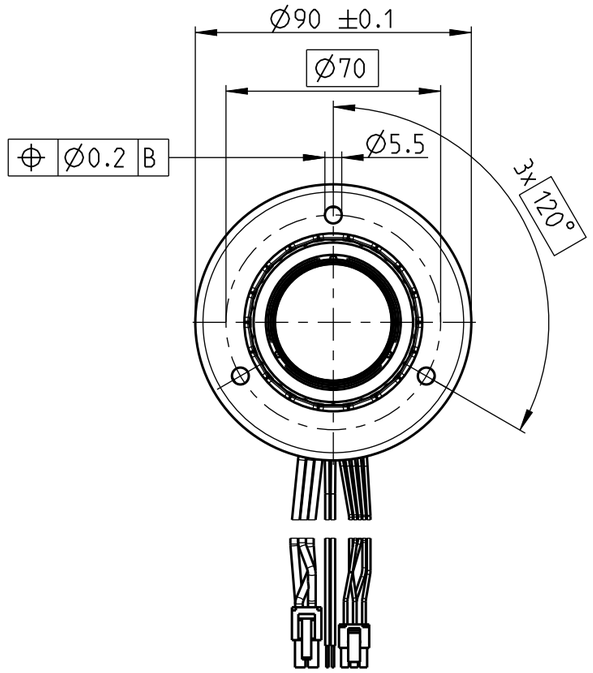

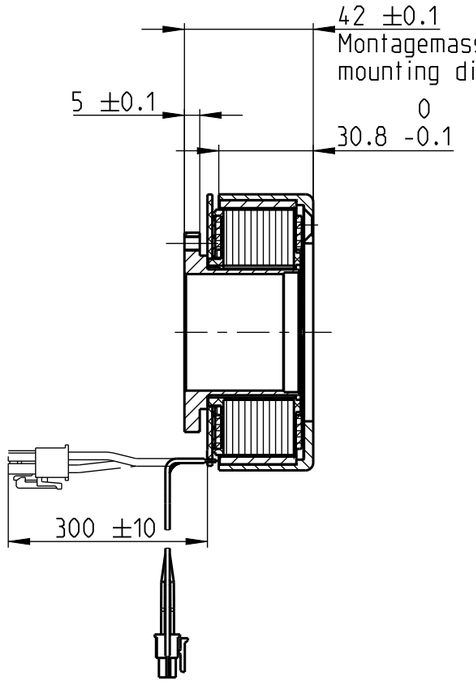

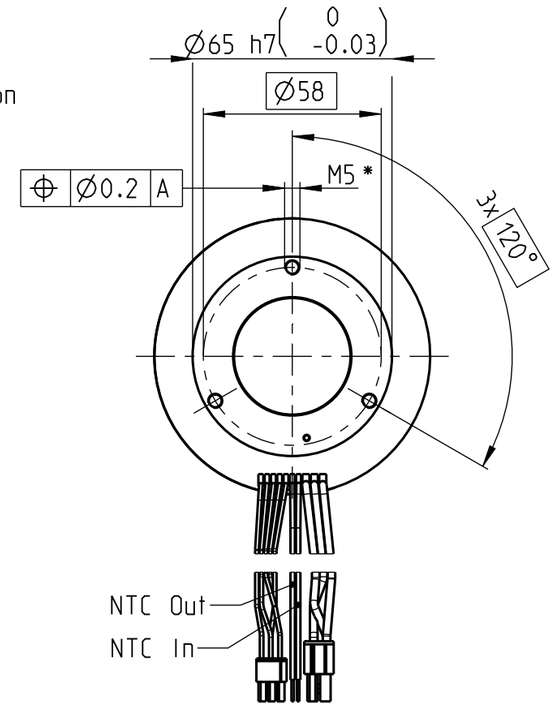

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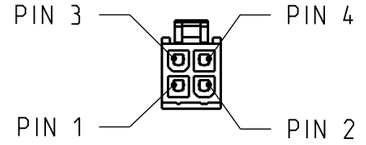

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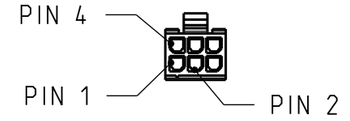

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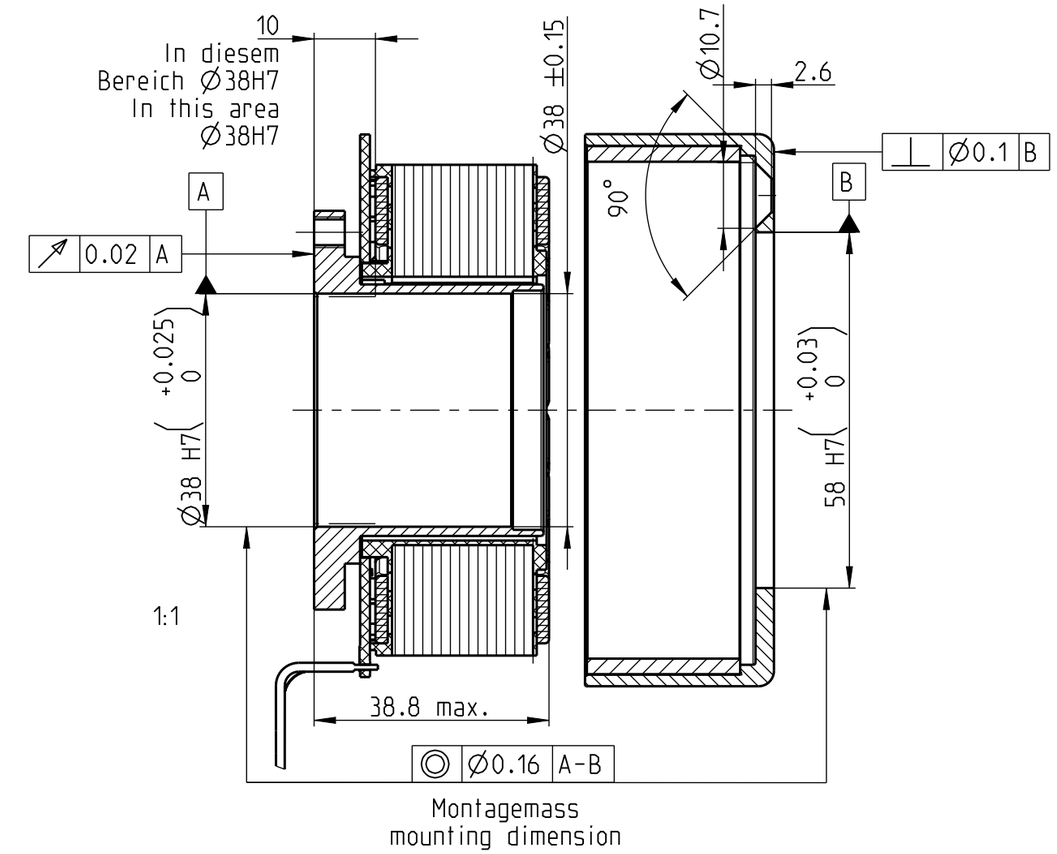

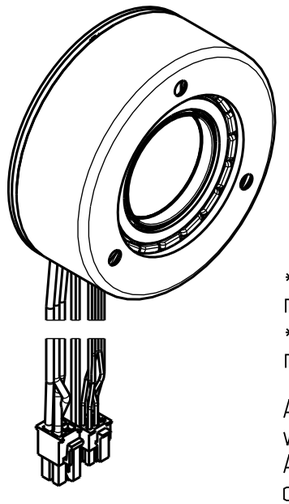

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Bezeichnung/title	CO: 679881	Datum/date	Name/name	Massstab/scale: 1:2	Modell/model
Massbild	Erstellt/created	01.04.2016	MMAGGAN	Blatt/sheet: A3/1/1	3335879
EC90 flach	Geaendert/modified	09.11.2018	MMAGGAN	Masseinheit dimension unit: mm	Projektionsmethoden projection methods: ISO 5456-1
	Freigabe/release	20.11.2018	MMAGMALU		

Artikel-Nr./part-no.	Revision revision	Dokument-Nr./document-no.	Revision revision
		3335880	04

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