Product Information «DC & EC Drives up to Ø10 mm»

1 Installation

The purpose of the present document is to familiarize you with the safe and adequate installation and commissioning of maxon motors with a diameter less than 10 mm. 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.

Until completion of the installation, individual components can be permanently damaged by improper handling. Therefore, handle the components with particular care. **Observe the following information before proceeding**.

Electrostatic Sensitive Device (ESD)
- *Wear electrically conductive working clothes.*
- *Comply with ESD protective measures.*

Electrical Interface – possible permanent Damage
- *Handle connection cables with special care! – Do not kink! Do not bend! Do not route around sharp edges! Do not strain!*
- *Ribbon cable: If necessary, maintain a bending radius of at least 10 mm.*
- *Flexprint: If necessary, maintain a bending radius of at least tenfold Flexprint thickness. For detailed information see design specification «IPC-2223; Sectional Design Standard for Flexible Printed Boards».*

2 Mounting

Possible irreversible Damage of the Motor
- *Press fit connections at the motor shaft: Do not apply any axial load to the motor shaft (➔Figure 1).*
- *Fixation of the motor: We recommend to use either center thread or centering collar (➔Figure 2).*

2.1 Driving Elements

In order to mount driving elements (such as pinion, coupling) by means of a press fit, you will need to prop up the motor shaft. Bracing the flanges or the casing will result in irreversible damage of the motor. The same applies accordingly for motor/gearbox combinations.

Find details on maximal permissible static force for press fits here:
- *Motors: maxon catalog, line 27.*
- *Gears: maxon catalog, section “Technical Data”*

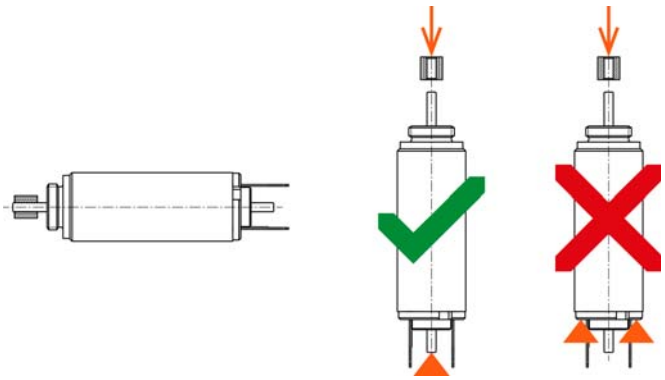

Figure 1 Assembly of Driving Elements

2.2 Fixation

Find details on maximal permissible axial and radial loads here:
- *Motors: maxon catalog, lines 26, 27, and 28.*
- *Gears: maxon catalog, section "Technical Data"*

Basically, fixation at the periphery (at the outer diameter) is possible. **In order to prevent irreversible damages, we recommend one of the following mounting methods** (➔Figure 2):

A Center thread

B Radial clamping at the centering collar

C Bonding at the abutting face in combination with radial clamping at the centering collar (➔"B")

D Abutting face fastening threads

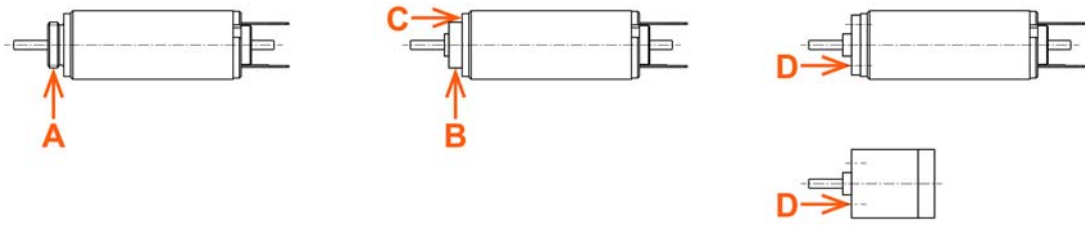

Figure 2 Mounting Methods

Notes
- *Preferably, mount **motor/gearbox combinations** at the abutting face fastening thread (➔"D").*
- *The **EC 9.2 flat** features an aluminum protective cover. You must not use it to radially mount the motor!*
- *The **EC 10 flat** features an open design and is therefore vulnerable in respect to contamination and penetration of foreign objects. Likewise, particles can be magnetically draws by the motor magnets. Foreign objects or particles can cause irritating noise or may lead to complete failure of the unit!*

3 Electrical Connections

Find details on pin assignment in the maxon catalog, section "Specifications".

3.1 Solder Termination

Possible irreversible Damage of the Motor
- *For connection by Flexprint observe the information on ➔page 1.*
- *The motors **RE 6** and **RE 8** can be irreversibly damaged when directly connecting the terminals by means of solder joint. Exercise special care and make sure to protect the motor parts from overheat.*

3.2 Motor Chokes

maxon's motors ≤10mm possess very low inductance. In order to prevent excessive heating of the motor caused by acting current ripple, most maxon motor controllers feature additional motor chokes. If you operate the motor with a controller with pulse width modulation (PWM), you may be required to provide external inductance. Use the following approximation formulas to define the maximum current ripple within the PWM cycle and the size of an additionally required motor choke.

PARAMETER

ΔI_{PPmax}	Maximal current ripple
f_{pwm}	Pulse width modulation frequency [kHz]
I_{cont}	System continuous current [A]
L_{ext}	Required additional inductance of external motor choke [H]
L_{int}	Internal inductance of controller [H] (for details on circuitry ➔Figure 3)
L_{mot}	Terminal inductance of motor (➔maxon catalog, section Motor Data, line 11) [H]
L_{tot}	Total inductance [H]
V_{cc}	Nominal operating voltage $+V_{CC}$ [V]

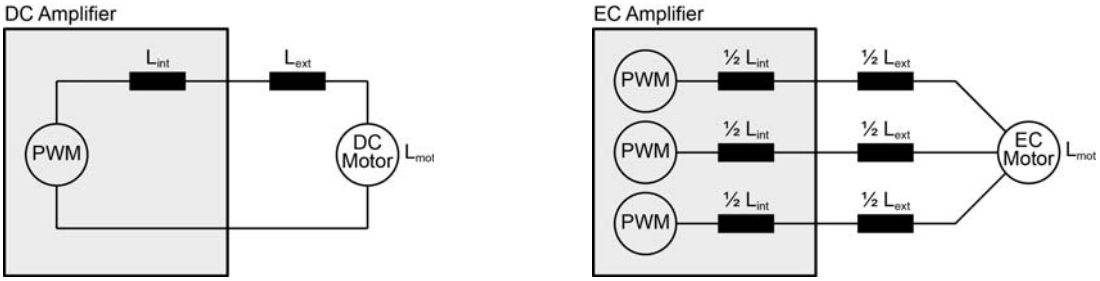

Figure 3 Motor Chokes Circuitry

Note
All values in SI units.
Check out our Support & Service Desk for additional information: http://support.maxonmotor.com

Current Ripple			
PWM Scheme	**1 Quadrant**	**2 Level (4 Quadrant)**	**3 Level (4 Quadrant)**
Max. current ripple (peak-to-peak measurement)	$\Delta I_{PPmax} = \frac{V_{CC}}{4 \cdot L_{tot} \cdot f_{pwm}}$	$\Delta I_{PPmax} = \frac{V_{CC}}{2 \cdot L_{tot} \cdot f_{pwm}}$	$\Delta I_{PPmax} = \frac{V_{CC}}{4 \cdot L_{tot} \cdot f_{pwm}}$
Max. current ripple occurs at…	Motor voltage $= \frac{V_{CC}}{2}$	Motor voltage = 0 V (standstill)	Motor voltage $= \pm\frac{V_{CC}}{2}$
Evaluation L_{tot}	$L_{tot} = L_{int} + (0.3 \ldots 0.8 \cdot L_{mot}) + L_{ext}$ *Remark: The in fact motor inductance for a rectangular PWM excitation is only about 30…80% of the value "L_{mot}" stated in the maxon catalog (at 1 kHz, sinusoidal).*		

Table 1 Current Ripple

RESULT

With a resulting current ripple $\Delta I_{PPmax} \leq 1.5 \cdot I_{cont}$, the motor may be operated without additional chokes up to approximately 90% of the value I_{cont} stated in the maxon catalog.

With a resulting current ripple $\Delta I_{PPmax} > 1.5 \cdot I_{cont}$, an external inductance as to below notation is recommended.

Calculation of additional Motor Choke	
1 Quadrant / 3 Level (4 Quadrant)	**2 Level (4 Quadrant)**
$L_{ext} = \frac{V_{CC}}{6 \cdot I_{cont} \cdot f_{pwm}} - (L_{int} - (0.3 \cdot L_{mot}))$	$L_{ext} = \frac{V_{CC}}{3 \cdot I_{cont} \cdot f_{pwm}} - (L_{int} - (0.3 \cdot L_{mot}))$

Table 2 External Inductance

RESULT

With $L_{ext} \leq 0$, no additional choke will be required.

With $L_{ext} > 0$, an external inductance as to below details is recommended.