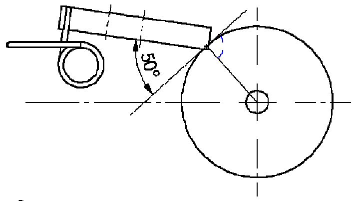
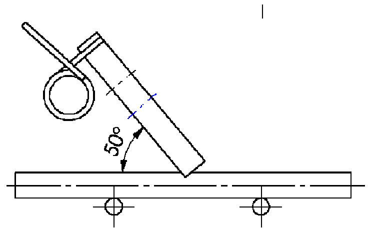
Design Guide X15G

Motor Mounting Angle

The angle between the stator and the rotor impacts motor performance. The angle is measured with respect to the longitudinal pushrod axis in the linear motor configuration or with respect to the wheel tangent in the rotary motor configuration. For the Elliptec Motor X15G, the motor mounting angle should be 50° for equally good forward and backward performance. The angle deviation should be no more than +/-1°.

A reduction of the mounting angle enhances backward performance and torque while reducing forward performance. A steeper angle has the opposite effect. This may be a convenient feature for applications where unequal forward and backward motions are needed[1].





Material Selection

The rotor material and its surface quality are essential for the performance of piezoelectric motors. The material should be selected along Elliptec's empirical guidelines.

Not every material is suitable! Suitable materials should be sufficiently stiff (high Young's modulus) and temperature-stable to support the static spring preload and the driving forces.

Suggested Materials:

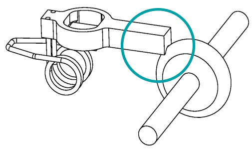
- PF7595 from Bakelite: www.bakelite.de
- IXEF1032 from Solvay (60% glass fiber): www.solvay.com
- Thermosetting plastics with a 15%-graphit- and 30%-pulverised coal content (e.g. PF7595)
- Thermosetting plastics with a glass fiber content > 50% (e.g. IXEF1032)

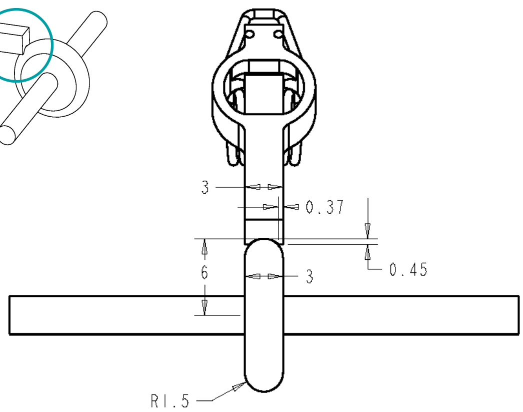
Elliptec provides individual samples upon request.

Point of Contact

A spring maintains the contact between the resonator and the rotor. At the point of contact, friction forces are generated that move the rotor forward or backward.

The contacting portion of the stator has a dented shape, which creates a formfitting contact with the rotor surface if the rotor has a matching rounded shape with a 1.5mm radius. If this radius is larger, the motor contact occurs at the edges of the dent, which increases wear and reduces performance.





Note:

- Burrs on the rotor surface reduce motor performance and increase tip wear.
- The contact actually improves initially after a brief running time.

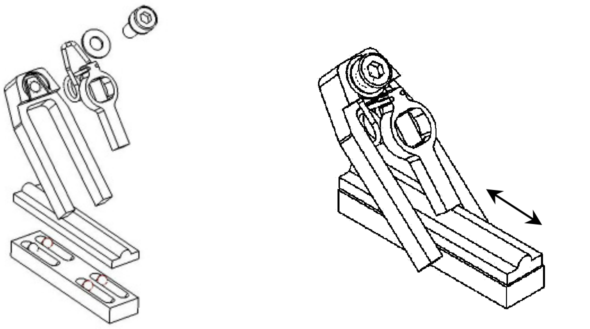
[1] In these cases however, the motor Tipp geometry needs to be appropriately modified in order to provide secure rotor-stator contact. The motor may not function at very steep or very shallow mounting angles.

Bearings

A common source for poor performance is unnecessarily large friction in the rotor bearing.
The spring holds the motor tip against the rod or the wheel with a force of up to 4N. The rotor bearing should be designed to support this load with minimal friction.

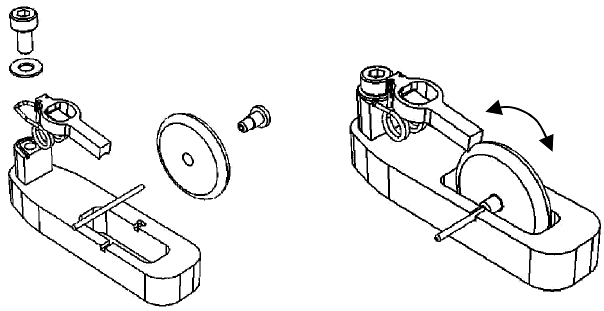
Linear Bearings

A suitable linear bearing for a pushrod may have a fairly simple design.
Roller bearings are recommended, but even 4 balls (e.g. plastics) can be used in low-cost applications.
Due to relatively high friction, sliding bearings are not recommended (with the exception of multi-motor configurations).



Rotary Bearings

The resulting torque and speed depend on the wheel diameter.
The friction losses depend on the wheel material, the wheel diameter, and the diameter of the wheel axle.
Rule of thumb: the diameter of the wheel axle should be no more than one twentieth of the wheel diameter. We recommend a Ø1mm axle for Ø15mm- Ø30mm wheels.
Ball bearings may be used as well.



Operating Frequencies

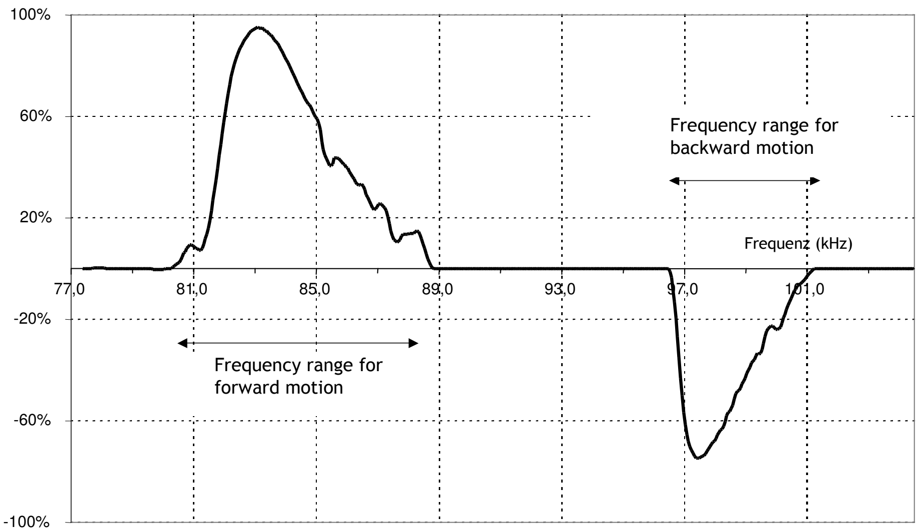
Individual motors have slightly different frequencies of operation for the forward and backward motions due to manufacturing tolerances. The graph below shows a typical velocity vs. frequency plot.

In most cases, it is recommended to cycle through several discrete frequencies within a given range of operation. This fast frequency switching creates a smooth motion of the rotor.

Achieving optimal motor speed requires searching for the optimal frequency of operation. Elliptec offers the necessary control software for free.

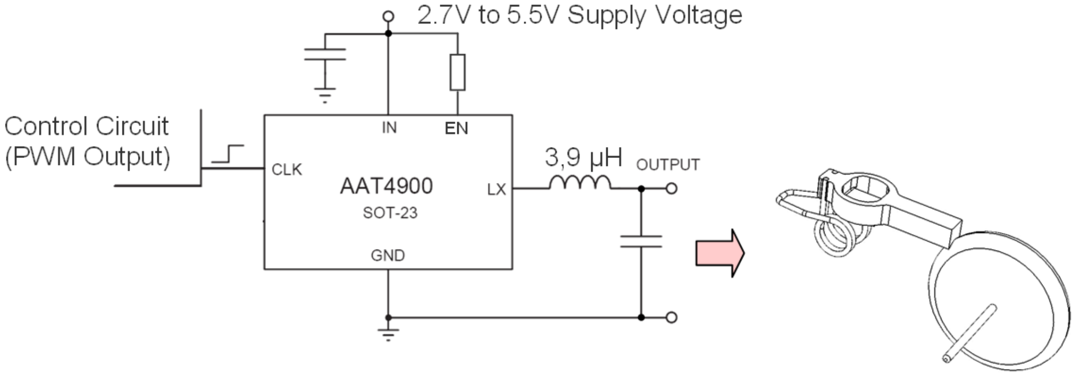
You select the control method:

- External sensors (switches, hall sensors, photoelectric barriers, etc.)
- Electric feedback (requires the analog/digital-converter of the microcontroller and a low-pass filter)



Motor Driver Electronics

A microcontroller cannot supply a sufficient electric motor current so that a driver circuit is needed. In a 5Volt system, a simple driver is provided by the integrated halfbridge AAT4900 from Analogic Tech together with inductivity:



You may obtain a Driver-Starter-Kit (AAT4900 and inductivity 3,9µH) from Elliptec. Further details and circuit diagrams for inexpensive single-transistor drivers and for other supply voltages are furnished upon request.

Summary of Keydata

Operating voltage:	6 - 8 VDC
Temperature:	-40°C bis +85°C
Frequency for forward motion:	75 – 90 kHz
Frequency for backward motion:	95 – 110 kHz
Motor mounting angle:	50° +/-1°
Linear speed:	~ 100 mm/s (recommended operating point)
Linear force:	~ 0,2 N (recommended operating point)

Appendix

Trademarks

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Attention

The preloaded software and hardware is not suitable for climate tests, please contact Elliptec when required.

For further information please visit our website at www.elliptec.com

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