



PiezoWave<sup>®</sup>

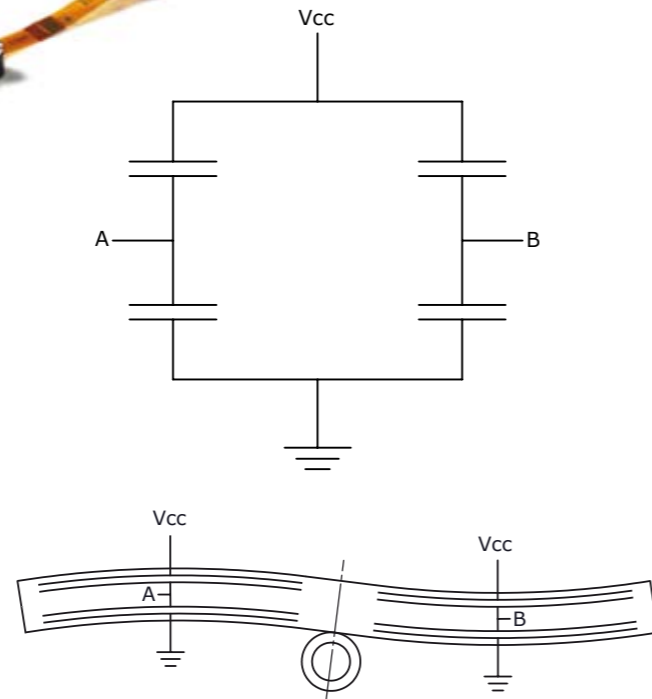
## GENERAL TECHNOLOGY

Originally developed for applications inside handheld consumer electronic devices such as mobile phones, the PiezoWave® motor is now integrated into many more applications, including medical technology applications, electromechanical door locks, advanced toys and cameras. The simple design of the PiezoWave® facilitates mass volume manufacturing at very low cost, and straightforward integration into other products.

The PiezoWave® motor is an ultrasonic linear piezo-electric motor with an extremely small cross-section. It is based on surface assembly of components on a flexible printed circuit board. The simple and robust design, in addition to outstanding cost, size, and low power consumption, makes PiezoWave® an ideal choice for demanding applications. You'll soon discover that what these small compact ceramic elements can do is nothing short of astonishing.

For more detailed descriptions on how to adapt the PiezoWave® technology please see separate application notes.

Actual size of a PiezoWave® motor.



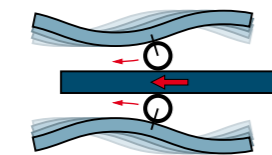
## PRINCIPLE OF MOTION

Each segment of the piezo element can be controlled separately. Typically two 90° phase-shifted sinusoidal signals are applied to the A and B phase electrodes. An applied voltage will introduce a strain in the piezo ceramic material in-between the electrodes. By alternating the voltage at a high frequency the element can be brought into resonance. The phase relationship between the two signals will determine the movement direction of the drive rod.

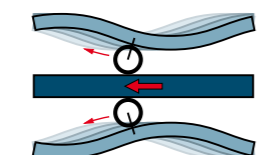
The PiezoWave® motor is friction based, meaning the motion is transferred by contact friction between drive pads and drive rod. For each time the drive pads nudge the drive rod there is a small movement – the average step length is about 1 µm. The drive frequency is close to 100 kHz making the drive rod move very fast at full speed. Because the PiezoWave® holding force is transferred by friction, there is no need to keep the motor electrically activated in order to hold its position. Should the drive rod be subjected to a large impact force, the drive rod will slide and the motor will not be damaged. Consequently, the PiezoWave® motor is very durable.

### This is how a PiezoWave® motor moves

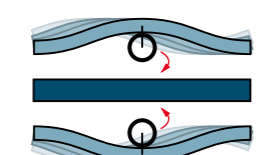
**1** The motor consists of two piezo elements, each with a drive pad attached. When activated, the piezo elements and the drive pads move, which in turn cause the drive rod (the dark blue part with a red arrow) to move.



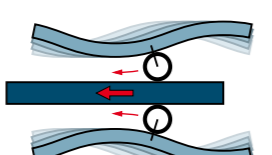
**2** When the first motion cycle is complete, the drive pads have moved as far to the left as possible.



**3** The drive pads are then lifted from the drive rod surface to allow the piezo elements to reposition.

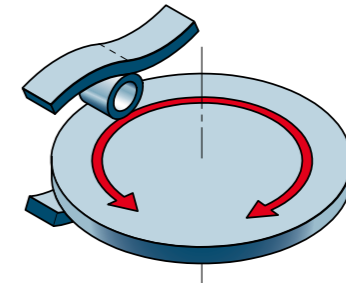
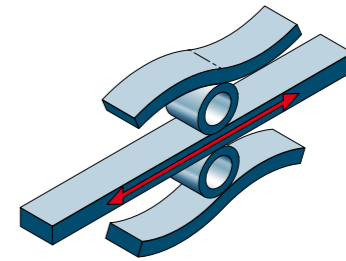


**4** Recommencing the motion, the motor can continue pushing the drive rod to the left.



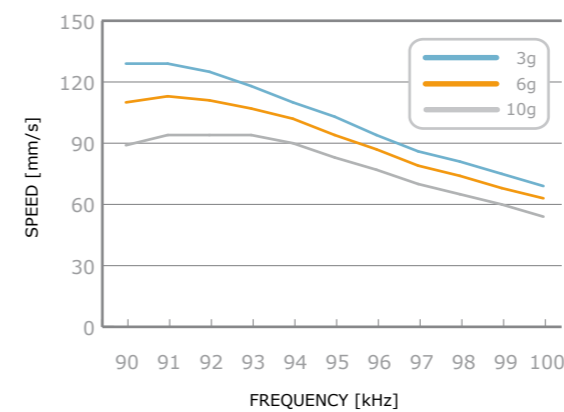
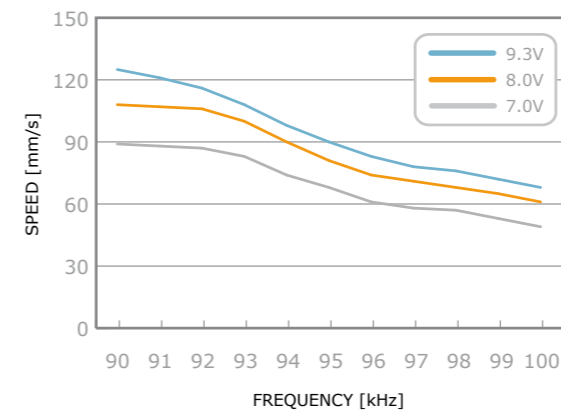
## LINEAR MOVEMENT?

Even though the PiezoWave® motor performs a linear movement, the technology can easily be tailored to create a rotating motion – simply replace the drive rod with a rotating disc and the advantages of the PiezoWave® technology can be utilized for rotating dynamics. This is one example of how the mechanics around the PiezoWave® elements can be modified to meet customer needs.



## OPERATING AREA

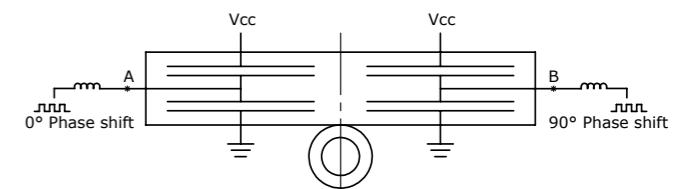
The PiezoWave® motor has a wide operating range and long lifetime. Designed for high tech applications, it is reliable, precise, and insensitive to major changes in temperature. Wear surfaces are made of alumina, a hard and durable ceramic material that will ensure reliable operation.



## DRIVE CONTROL ELECTRONICS

The most straightforward way of driving the motor is to send a pulse train via an inductor to the piezo element phase electrodes. This creates an LC circuit and sinusoidal voltage across the piezo element. The direction of motion depend on the phase shift between the phase signals A and B.

Compared to conventional electromagnetic motors, the PiezoWave® motor has the great advantage of not consuming energy while withstanding a holding force. The PiezoWave® motor only consumes energy when moving the drive rod. The overall energy consumption is kept low by using resonant drive electronics.



## SENSORS

If your mechanical system requires very accurate positioning, we propose an additional integrated sensor system. For example, IR photo detectors can be surface mounted on the PiezoWave® flexible printed circuit board. The photo sensor can detect the position of the drive rod or act as a limit switch.

## DEMO KIT

Reading about it is one thing, testing is another. To really get the feel for what PiezoWave® technology can do for you and your customers, contact us. We'd be more than happy to show how you can benefit from our piezo motor technology.

PiezoWave® demo kits are also available for you to order online.

We have a team of engineers ready to tailor the PiezoWave® technology to your applications. We can easily make your products smaller, faster, easier to control and adjust, lighter in weight, and more reliable and durable. Realizing the full motion potential of your application is our business.



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