PIEZO BENDERS: GENERAL OVERVIEW AND MOUNTING

Overview

Pierre Curie discovered the piezoelectric effect in 1883. He noted that certain materials, such as quartz crystals, produce a voltage when they are mechanically stressed. Conversely, those materials' shapes are deformed when a voltage is applied to them. As a result, they can be used as transducers, converting electrical signal into mechanical vibration.

Various materials have piezoelectric properties, the most commonly used being Lead Zirconate Titanate (PZT). Modifying the ceramic's chemical composition and manufacturing process can alter performance of the piezo bender.

When the ceramic is attached to a substrate and a charge induced, displacement of the piezo ceramic material becomes amplified at the cost of force.

This is the basis for the Piezo Bender.

Configurations

A piezo ceramic crystal is coated with silver on both sides and glued to a brass, nickel alloy, or stainless steel disk.

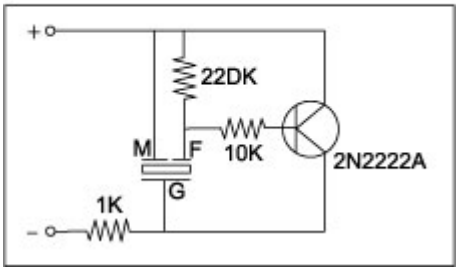
The brass plate is a general-purpose base for commercial and industrial use, where the piezo bender will not be subjected to the environment.

The nickel alloy base is used where the bender will be subjected to the environment. The nickel alloy will resist the corrosive effects of humidity and temperature changes better than brass.

The stainless steel base is used where the bender will be subjected to solvents, corrosive chemicals, underwater and salt-water applications, or in the medical field where chemical interaction cannot be tolerated.

The ceramic can be configured with or without a feedback. The feedback is used in conjunction with an external circuit, see figure 1, to monitor the operation of the piezo bender and adjust the input signal to maintain a consistent output frequency. The resultant effect is an output with higher sound pressure level (dBA) and lower distortion due to frequency drift.

Figure 1
Feedback Current



Mounting

Producing the desired sound output is an important design consideration for a piezo bender. To effectively propagate this sound, correct mounting of the bender along with matching the resonant frequency is two of the most important aspects of bender utilization. A resonating chamber can also be designed and constructed to increase the SPL.

A piezo bender has a resonant frequency where, when mounted properly will result in its highest SPL rating, when the resonant frequency is used.

There are two ways to optimally mount a piezo bender, nodal and edge.

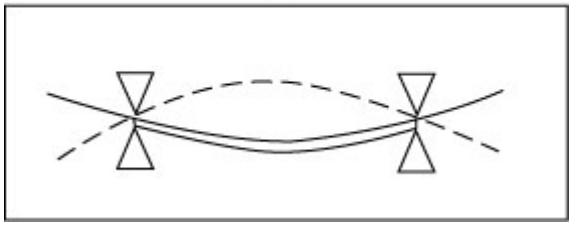
Mounting a piezo bender at its nodal point (circle) results in the lowest bender impedance, a resonating frequency that matches the open-air resonant frequency, narrow bandwidth and highest sound pressure level.

The nodal point is found by multiplying the base diameter by 0.65.

For example: If you have a piezo bender with a 20mm base diameter, the nodal point will be 20 x 0.65 = 13mm. The nodal point will be a circle 13mm in diameter centered on the base.

This will allow free motion of the piezo bender both inside and outside of the mounting point as illustrated in Figure 2.

Figure 2



Mounting a piezoelectric bender at its edge results in higher bender impedance, broader bandwidth, lower sound pressure level than nodal mount, and lower resonating frequency (64% of the open air resonant

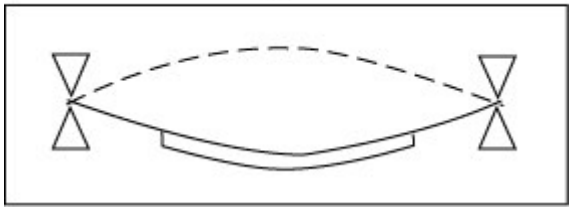
frequency).

For example: a piezo bender with a resonant frequency of 2.0 KHz in open air will have the following resonant frequency when edge mounted:

2000 Hz x 0.64 = 1280 Hz

This will allow the bender to flex in a more restricted fashion than nodal mount, but still produce an acceptable sound pressure level as illustrated in Figure 3.

Figure 3



In using either nodal or edge mounting, an adhesive that when cured remains soft and pliable is necessary for maximum sound pressure level output. A silicone RTV is what is generally used in the audio industry for piezo bender mounting.

The adhesive must be a 360 degree ring to allow even flexion of the bender during operation.

The suggested adhesive bead size is 0.060” (1.5mm) in width and height. This will properly support the bender during operation with minimum surface area of the bender plate secured with adhesive.