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# NASA TECH BRIEF

*Goddard Space Flight Center*



## Piezoelectric Relay

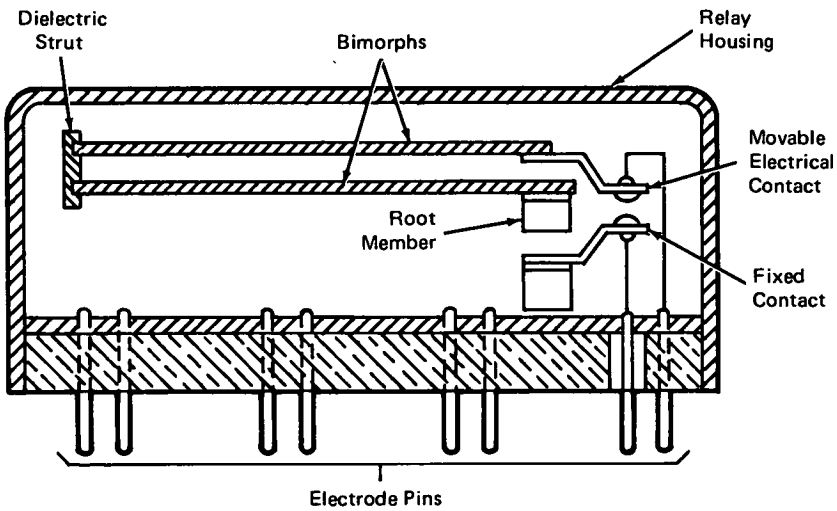
Assemblies of two or more piezoelectric plates are called bimorphs. Typically bimorphs include two abutting piezoelectric plates which are polarized so that one plate expands and the other contracts in response to an electric field applied through the plate thickness.

Bimorphs are used in the electrostatic relay to move the contacts in response to an actuating electric field. A typical relay contains a single bimorph which is rigidly attached on one end while its contact end is allowed to move freely. The longer the bimorph, the greater the movement (due to the same field), and therefore the greater the sensitivity. However, a relatively long bimorph, cantilivered from one rigidly-held end is vulnerable to shock and vibration.

New bimorph configurations have been developed which have reduced sensitivity to shock and vibration and yet respond to weak electric fields. As shown in the illustration, two bimorphs, in a folded-over configuration, provide the sum of their individual movements, simulating a bimorph of double length.

Both of these equal-length bimorphs are mounted so that they are substantially parallel along the horizontal plane when no field is applied. On the left, as shown, the bimorphs are rigidly connected by a dielectric strut. On the opposite end, the lower bimorph is fixed to the relay housing through a root member. The contact end of the upper bimorph is free.

When a dc potential is applied to any pair of the electrode pins, an electric field is formed which actuates both bimorphs. As a result, the bimorphs bend and the upper bimorph closes the electrical connection. In effect, the pair of bimorphs moves the contact a distance approximately twice that of the movement derived from an individual bimorph. This obviates the use of long bimorphs, making the electrostatic relays mechanically reliable. Additional increases in effective bimorph length are made by using several pairs of such bimorph assemblies.




Piezoelectric Relay

(continued overleaf)

When several bimorph assemblies are used, vibration hardening is achieved with an identical pair of bimorphs placed below the pair (not shown in the figure) operating in phase opposition to the upper pair and carrying the lower contact. The upper and lower pairs are tuned mechanically to the same natural frequency, and hence, in a vibration environment both pairs move identically preserving the contact separation.

**Note:**

Requests for further information may be directed to:

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**Patent status:**

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

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