Piezoflex™ Polymer Transducers

Innovative piezoelectric polymer material exclusively from AIRMAR

Piezoflex™ polymer is an advance in PVDF transducer materials. Expand your transducer capabilities with our high performance, broadband, piezoelectric polymer. Learn how Airmar works with you to create your own shapes, tailor the beam patterns to your specifications and ultimately design the perfect polymer hydrophone for your application!

broadband

AIRMAR®
TECHNOLOGY CORPORATION

Flexibility of PVDF opens opportunities for many applications where conformal shapes are desired. Shown here is a curved wrist band. Shaped PVDF hydrophones possess the same piezoelectric sensitivity as flat sheet material yet permanently retain their shape to meet the needs of your applications.

Efficient Transducer Assembly and Excellent Performance with Piezoflex™ Polymer Sensors

Piezoflex™ piezoelectric polymer enables you to create sensors for a wide variety of applications — in air, marine and tactile sensing. This sensing material is manufactured by AIRMAR through a patented process using homopolymer PVDF (polyvinylidene flouride).

Piezoflex polymer simplifies transducer fabrication. Lead wires may be attached by soldering onto copper electrodes. Sensors can operate in a simple hydrostatic mode without needing "pressure release" on one or more sides. Performance is predictable, consistent from unit to unit, and free of unwanted spurious resonance modes.

Piezoflex transducers may have a thin profile and are lightweight — perfect for portable applications such as diver communications. Its flexibility allows you to shape Piezoflex polymer to fit a prescribed contour. And, its physical robustness means Piezoflex sensors can withstand rough handling.

With Piezoflex polymer, you can create a variety of beam shapes by etching precise electrode patterns. You can optimize the beam shape for the space available for the transducer, obtaining the best beamwidth together with the lowest sidelobe levels in the least space. In applications detecting targets near the water surface, you can suppress sidelobe levels to reduce surface clutter. And, with AIRMAR's technology, low sidelobes, which are difficult to achieve with other technologies, are consistently achieved in practice with PVDF. The experimental beam plot exhibits sidelobe levels more the 26 dB below the main beam.

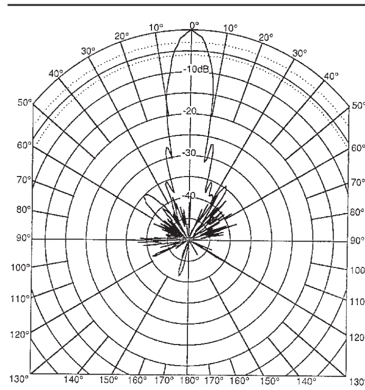
Air transducers, shown above at 250 mm in diameter, can satisfy applications requiring accurate sighting of a target using a very narrow acoustic beam. The large radiating surface attainable with thick PVDF is physically robust and tolerant of adverse environments.

Achieving Narrow Acoustic Beams and Wide Frequency Bandwidth at an Affordable Price

When your acoustic system requires a narrow acoustic beam, Piezoflex transducers provide the advantage of a large radiating surface at low assembly cost. Narrow beams are especially useful for level sensing, bottom mapping, surveying, and multibeam applications. And, Piezoflex sensors can operate over broader bandwidths (steady state to 600 kHz) than many other piezoelectric materials because they operate in a non-resonance mode, ideal for many shallow water applications.

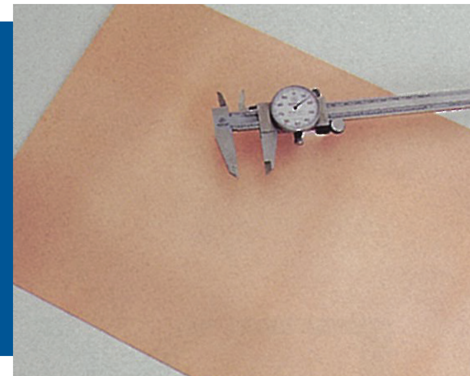
AIRMAR Delivers

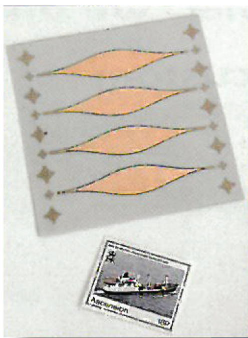
- Efficient transducer assembly
- Lightweight and customizable
- Precise beam patterns
- Low sidelobes
- Wide bandwidth
- Uniform sensitivity



Creating PVDF Products from Sheet Stock to Custom Transducer Assemblies

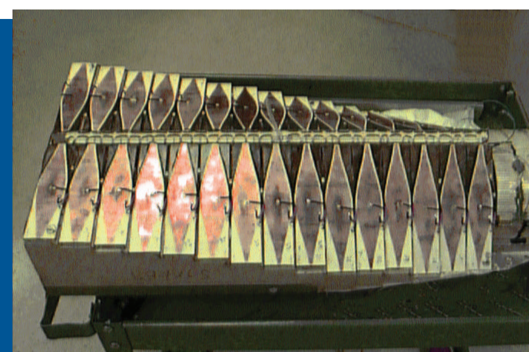
Large sheets of PVDF, shown coated with electroplated copper, typifies the standard size of PVDF in manufacture. Hydrophones with large surface areas can be fabricated from a single piece of PVDF, improving on previous technologies that group smaller elements together. The single sheet ensures uniform piezoelectric properties over the whole acoustic surface, as well as eliminates troublesome seams and gaps.

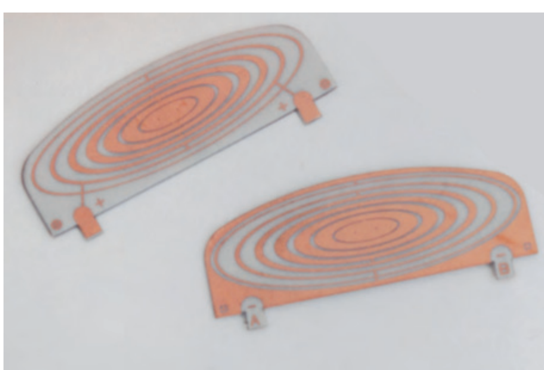




Arrays of elements etched on a single sheet of PVDF embody the intrinsic uniformity of the sheet - providing element responses well matched in amplitude and phase. Elements can be designed for specific beam profiles, and can be created without physically dicing the polymer.

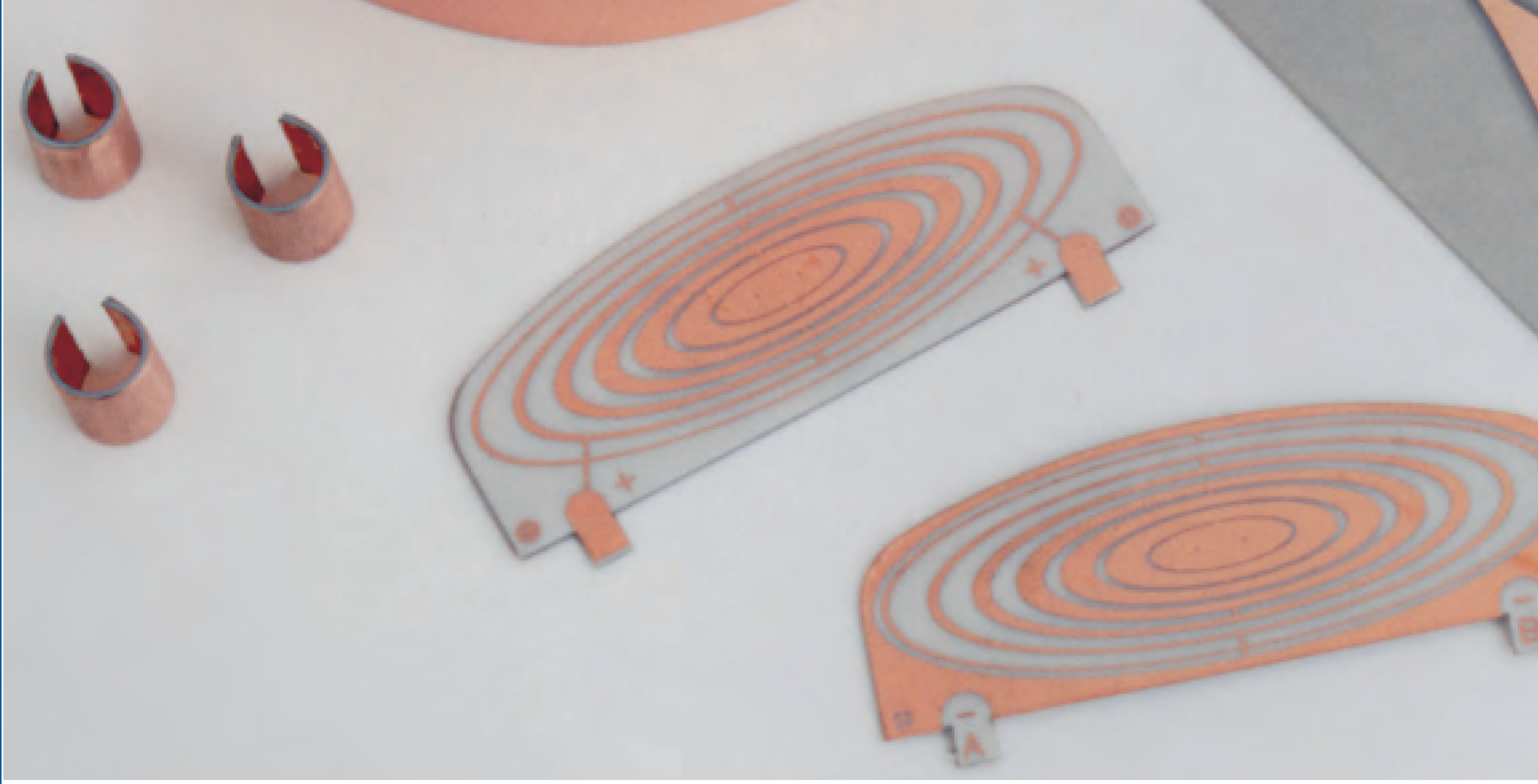
This multibeam transducer, used in swath bathymetry systems, employs individual Piezoflex hydrophones each tilted a few degrees from its neighbor, as shown here. This transducer, with its 30 adjacent beams, enables the survey of a large area of the sea bottom on a single pass of a vessel. The low sidelobes and well-controlled shape of each beam minimize interference between adjacent beams.





Intricate electrode patterns on PVDF, illustrated as a nested set of ellipses in this photo, are created by standard low-cost PCB etching techniques. This pattern produces an elliptical acoustic beam with very low sidelobes in each axis.

Keypads and tactile sensors on PVDF eliminate common problems associated with make/break metal contacts. Piezoflex transducers product a voltage (proportional to the force applied) in an uninterrupted electrical circuit.



Piezoflex Performance Specifications		
PROPERTY	**VALUE**	**NOTES**
Hydrostatic voltage sensitivity (M_o)	-197.2 dB re 1V/μPa	1
Hydrostatic charge sensitivity (d_h)	-18 pC/N	
Charge sensitivity in stretch direction (d_{31})	+14 pC/N	2
Charge sensitivity in orthogonal direction (d_{32})	+2 pC/N	2
Charge sensitivity in thickness direction (d_{33})	-34 pC/N	2
Relative dielectric constant (k′)	7.6	3
Dielectric loss tangent (tan δ)	0.015 at 1kHz	4
Capacitance (C)	130 nF/m² (83 pF/inch²)	
Thickness (t)	0.50 mm (0.020 inches)	
Density (ρ)	1.47×10^3 kg/m³	
Young's modulus ("3" direction) (Y_{33})	900 MPa	5
Maximum exposure temperature (T_{max})	90° C (194° F)	6
Maximum operating pressure (P_{max})	7 MPa (1,000 psi)	7
Maximum drive voltage (V_{max})	±45 kV	8
Frequency (kHz)	Steady State to 600 kHz	

NOTES

1. The term "hydrostatic" indicates that acoustic pressure is exerted on all sides of PVDF (without pressure release or clamping on any side).

2. These tensor coefficients represent charge collected on the electrodes when PVDF is stressed along a single direction. The "1" direction is the process (or so called "stretch") direction. The "2" direction is the in-plane direction orthogonal to the process direction. The "3" direction is the thickness direction. The first subscript indicates that the charge is collected on the large surface area (perpendicular to the "3" direction). The second subscript indicates the direction of the applied stress.

3. Equal to an absolute dielectric constant of 67.2 picoFarads per meter.

4. Loss tangent changes with frequency, gradually increasing as frequency is raised. Contact AIRMAR for detailed graphs.

5. Young's modulus is anistropic. In-plane directions have higher moduli than the thickness "3" direction. In the stretch direction: 2.5 GPa; orthogonal to stretch direction: 2.1 GPa.

6. PVDF can be exposed to this temperature for an indefinite length of time without degradation in properties.

7. In addition, PVDF survives pressure to 14 MPa with 1 dB (permanent) reduction in sensitivity.

8. Dielectric breakdown begins to occur for voltages above 70 kV (150 MV per meter).

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PVDF 4p Brochure_rF 4/11/24

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