PRECISION ACOUSTICS

Transducer product selector

Precision Acoustics Ltd (PA) is pleased to offer a wide range of transducers. PA does not have a catalogue of "standard" transducers; instead each transducer we supply is custom made and bespoke to the client's requirements. This document introduces the different transducer types and provides a summary of the customisations that each model offers.

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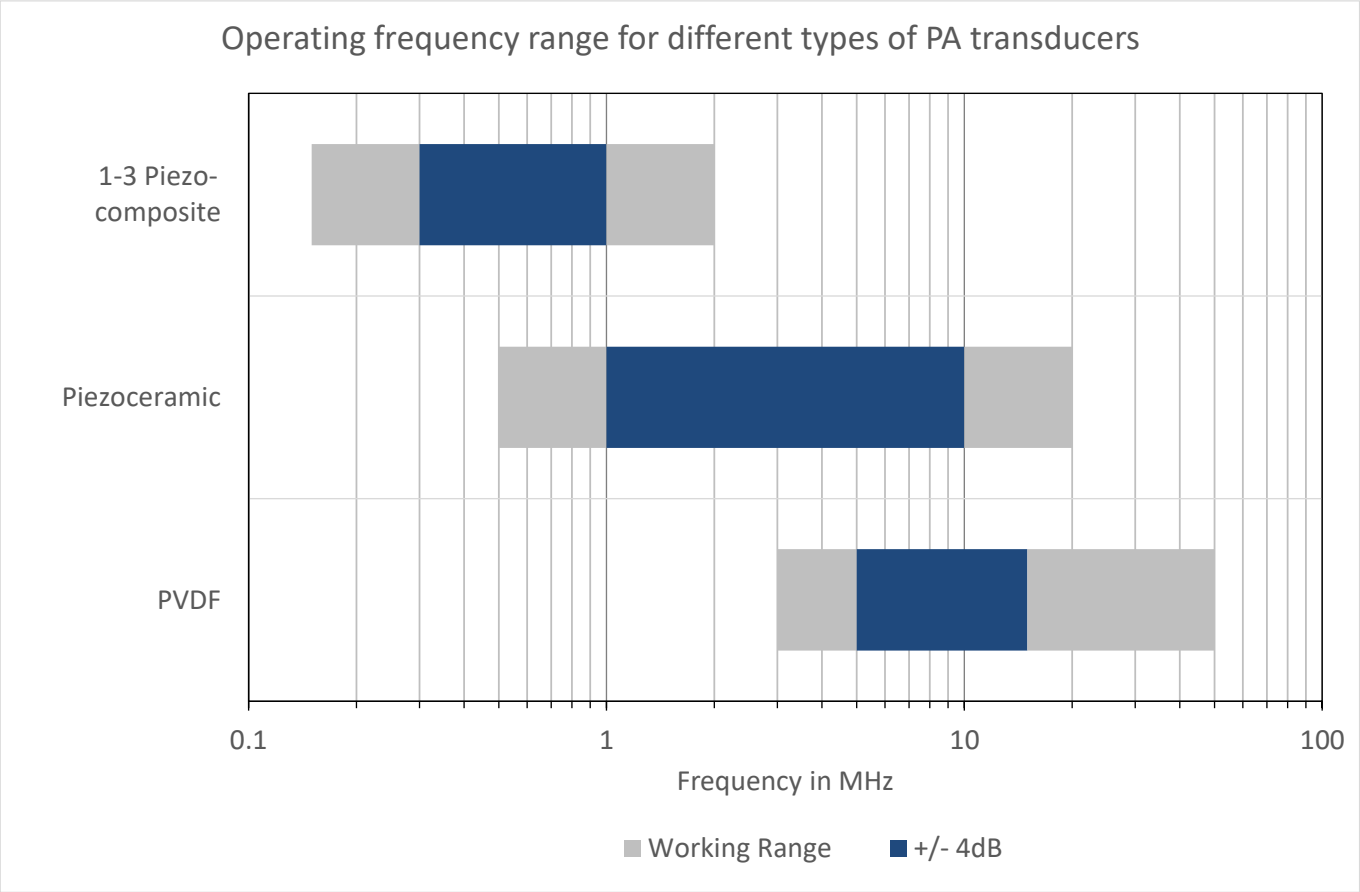
SPECIFYING A TRANSDUCER

Centre frequency

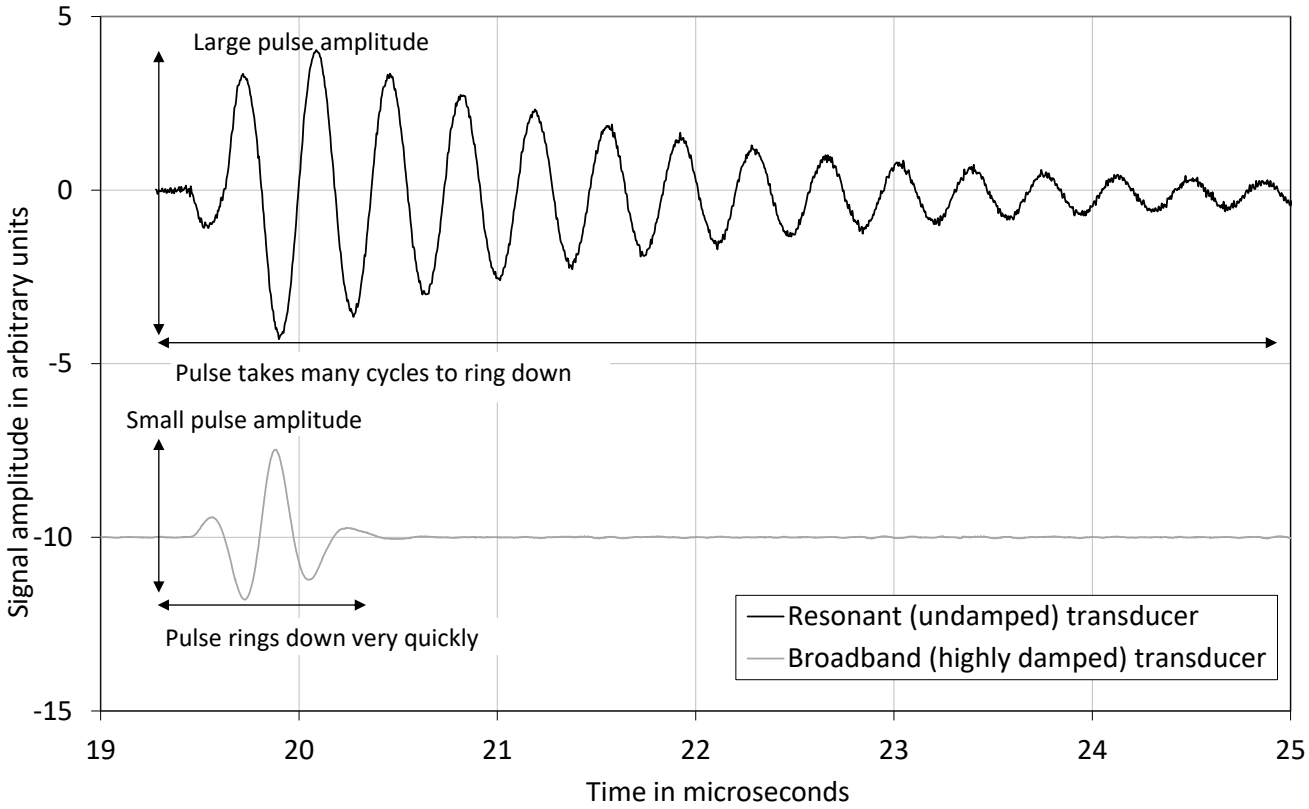
The most important concern when choosing a transducer is its operating frequency since this imposes constraints on what piezo-electric material can be used to construct the transducer. As is shown in the chart below, it impractical to make the very lowest frequency transducers from any material other than 1-3 piezo-composite. Similarly, PVDF is the only viable choice for the highest frequency transducers.



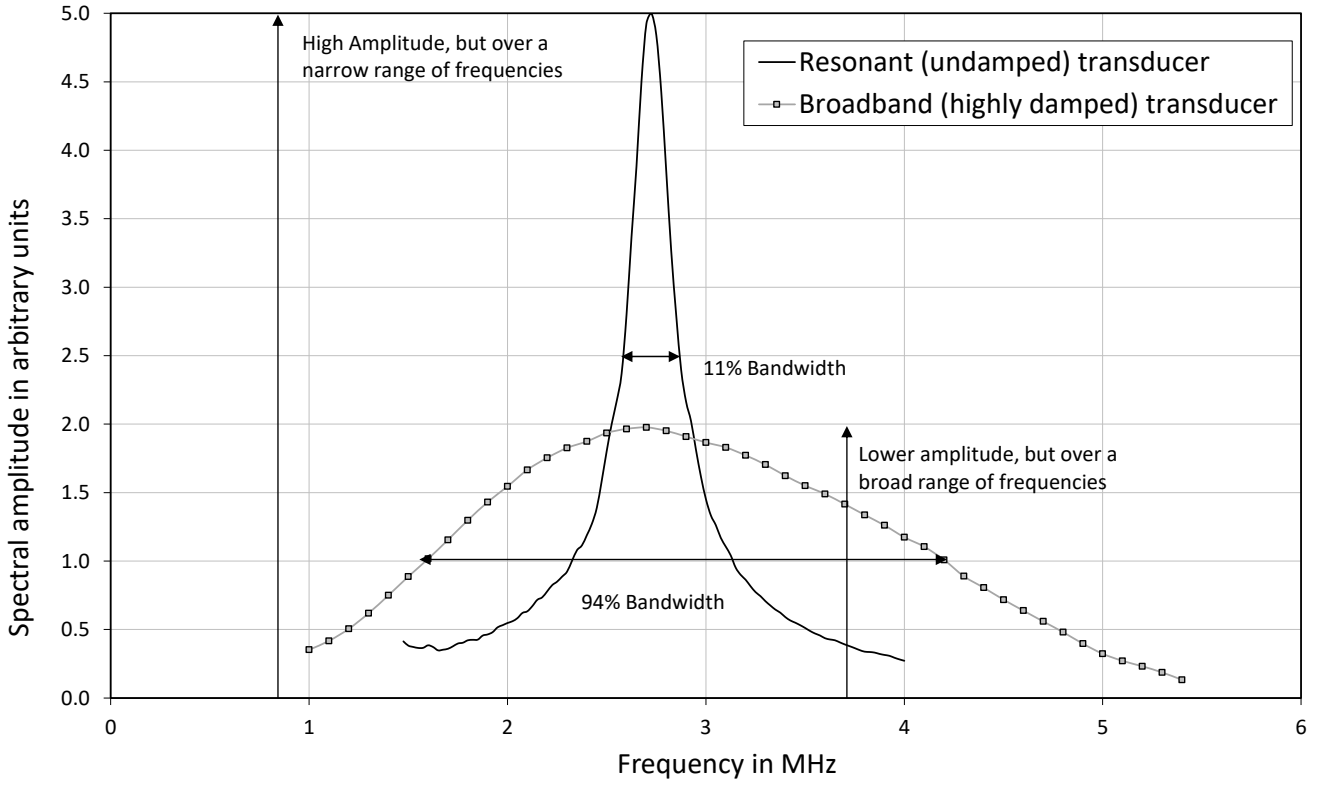
Bandwidth and damping

The second consideration when specifying a transducer is the required bandwidth. All piezo-electric transducers are resonant devices. The performance of a resonant device is significantly affected by how much damping is applied as can be seen in the graph below. The description that follows will consider the two extreme conditions of very low, and very high damping. However, Precision Acoustics Ltd is able to produce transducers with damping anywhere between these two limits.

An undamped (or resonant) transducer will produce a large amplitude signal but may take many cycles to "ring-up" and "ring-down". This means undamped transducers are well suited to applications when high amplitude/power ultrasonic signals are required. Therapeutic ultrasonic routinely uses resonant transducers. However the long pulse duration of these devices means they are unsuitable for imaging applications. Highly damped transducers have a much lower peak amplitude but a very short pulse length. This yields much better axial resolution and thus ensures that damped transducers are widely used within imaging applications such as diagnostic ultrasound and non-destructive testing.



An undamped (or resonant) transducer will produce a large output very close to its resonant frequency, but the amplitude of its response will decrease significantly away from the centre frequency. In contrast a highly damped transducer will produce a much lower output, but is capable of driving at a range of frequencies either side of the centre frequency.



1-3 PIEZO-COMPOSITE TRANSDUCERS

Unfocussed

- Centre frequency: 0.15 MHz to 1.0 MHz
- Bandwidth: 25 % to 55% of centre frequency
- Active element diameter: 20 mm to 67 mm
- Output impedance: 50 Ω (± 10%)

PIEZO-CERAMIC TRANSDUCERS

Unfocussed

Piezo-ceramic are low to moderate internal damping designed for immersion use. As such transducers can be made within following ranges

- Centre frequency: 0.5 MHz to 10 MHz
- Bandwidth: 10 % to 65% of centre frequency
- Active element diameter: 5 mm to 60 mm
- Output impedance: 50 Ω (± 10%)
- Termination: wide range of options including bare flying lead, UHF, BNC, SMA, TNC, Lemo
- Output power: up to 120 W

Spherical (point) focussed

In addition to the above information, spherically focussed devices typically have focal depths in the range 15 mm to 100 mm but will vary depending on current stock levels.

HIFU

High intensity focussed ultrasound (HIFU) sources are entirely undamped devices designed to produce maximum possible output.

- Centre frequency: 0.66, 1.0, 1.5, 2.5, 2.5 and 5.0 MHz
- Bandwidth: 10 % of centre frequency
- Output impedance: 50 Ω (± 10%)
- Focal intensity: > 1.5 kW/cm^2 (frequency > 1 MHz)

PVDF TRANSDUCERS

Unfocussed

Spherical (point) or Cylindrical (line) focussed

Central aperture transducers

PVDF has very high levels of internal damping and lends itself to very broadband transducers that can be made within following ranges

- Centre frequency: 5 MHz to 50 MHz
  The diameter of a PVDF transducer can affect the maximum achievable centre frequency. Also the attenuation coefficient of water becomes significant at high frequencies. Therefore high frequency transducers may only be possible when the diameter is small and tightly focussed
- Bandwidth: 40 % to 110% of centre frequency
- Active element diameter: 1 mm to 60 mm
- Output Impedance: variable
- Focal lengths: 3mm to 200 mm
- Termination: wide range of options including bare flying lead, UHF, BNC, SMA, TNC, MCX, Lemo

Some applications require optical fibre access to the acoustic centre (either to introduce laser light or to allow optical sensing). Focussed or unfocussed PVDF sensors can be made with central apertures as small as 500 µm.

For focussed transducers, the concave front face can also be filled and polished to provide a flat front face (as is shown in the image)

This Submersible Preamplifier & DC Coupler provides an indication of the range of transducers that have been produced by Precision Acoustics Ltd. If your transducer requirements lie outside some of the parameters listed within this document, please contact us as there may be a way to accommodate your device specification.

TRANSDUCER DESIGN QUESTIONNAIRE

Whenever contacting Precision Acoustics Ltd to discuss the design of a custom transducer, it will assist the process if you can ensure that you have completed the design questionnaire with as much detail as possible.

Drive Signal Type (e.g. CW, impulse)	
Pulse Width or Burst Length if appropriate	
Drive Signal Amplitude (Volts - peak)	
Mode of Operation (pulse-echo, transmit only)	
Required Acoustic Output at focus or far field position	
Centre Frequency (MHz)	
Required Bandwidth or Q factor	
Diameter of active area (mm)	
Flat or Focussed	
Focal Length (mm)	
Transducers are normally supplied with a BNC output connector but if you require an alternative please indicate it here (e.g. flying lead, UHF)	
Electrical Impedance (Ω)	
Any other design requirements	