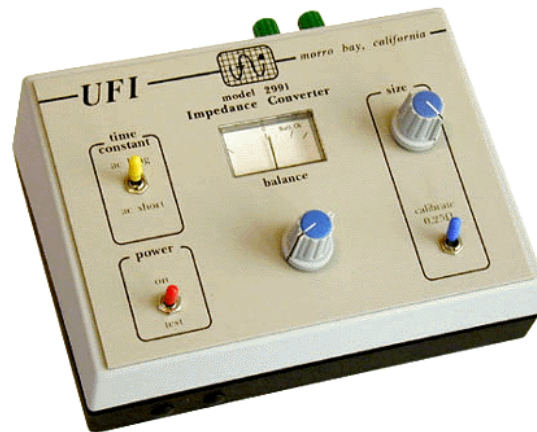


# The Model 2991 Impedance Converter and physical transducers

## Overview

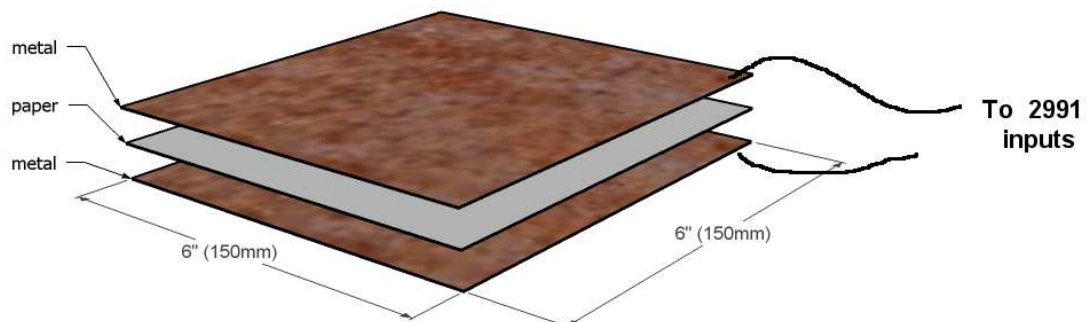


The user manual for the Model 2991 Impedance Converter covers several of the main applications for the unit. These include

- respiration measurement
- pulse plethysmography
- psycho-galvanic reflex measurement
- use as a strain gauge

The Model 2991 is a very versatile instrument, however: any device which changes its resistance, capacitance, or inductance is a potential transducer. This technical note discusses several more of the many ways the Model 2991 can be used.

## Displacement/tension measurement



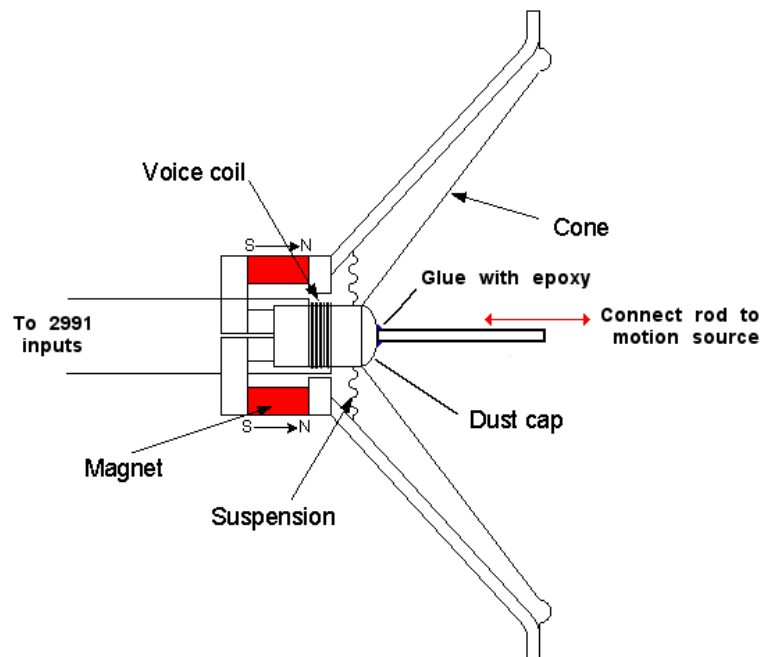
Two metal sheets, each about 6" x 6" (15cm x 15cm) and separated by a piece of paper, make a functional "quick and dirty" capacitor for displacement or tension measurements.

## Torque/rotational displacement

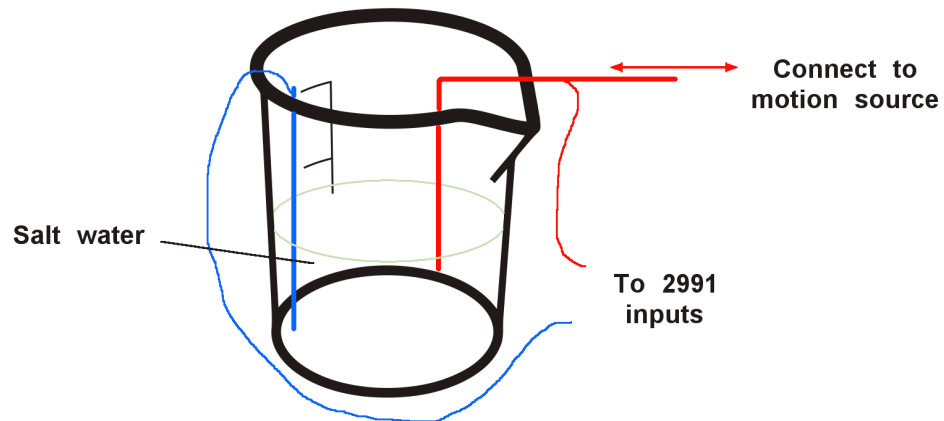


An ordinary 365pF variable capacitor, of the type once used to tune AM (medium-wave) radio receivers, may be used to measure torque or rotational displacement. Simply couple the rotating shaft of the capacitor to the rotating device to be measured. The Model 2991 is sensitive to a capacitance range between about 200pF and 1,000pF.

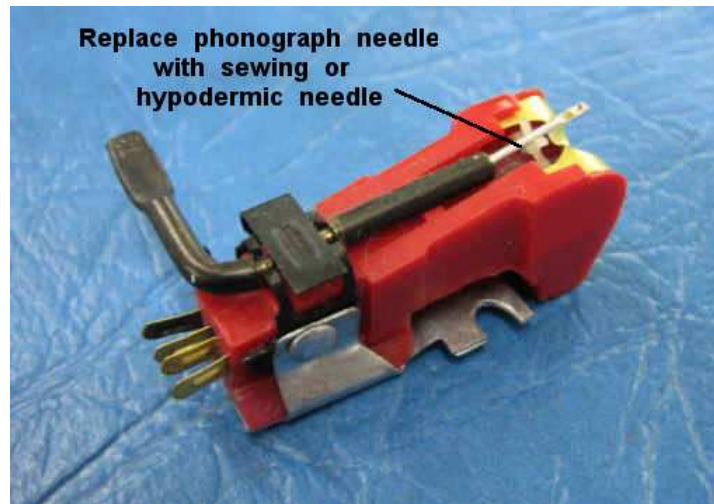
## Linear displacement



To measure small amounts of linear displacement (up to a few millimeters), connect the Model 2991 to the voice coil terminals of an inexpensive loudspeaker. Then glue one end of a rigid stick or rod to the center of the loudspeaker (the domed paper or plastic dust cap). Attach the other end to the moving object to be monitored. This transducer gives excellent results in measuring linear displacement due to the change in voice coil inductance.

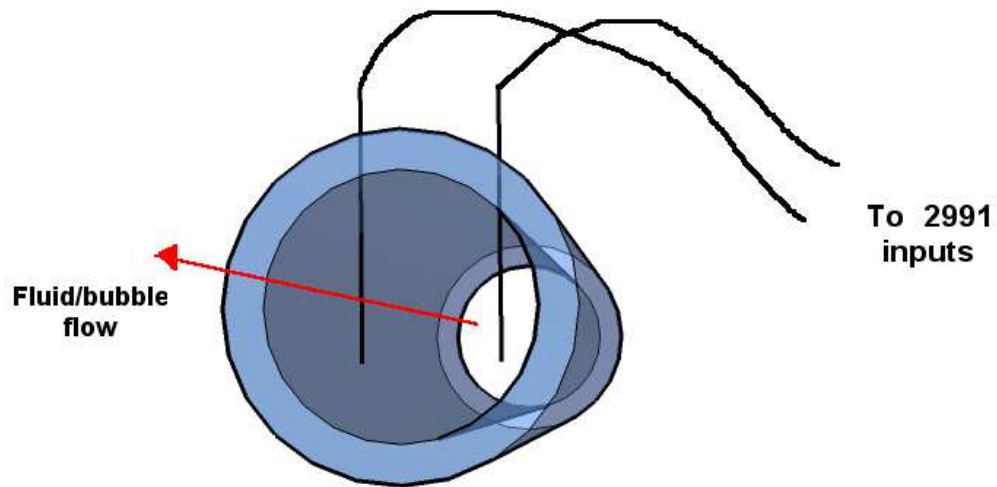


Other linear displacement transducers have been made with two stiff wires suspended in a beaker filled with salt water. One wire (blue above) is fixed; the other (red) is attached to the moving object. Start with just a pinch of table salt, and add until the resistance between the wires at maximum distance is no more than about 2000 ohms.

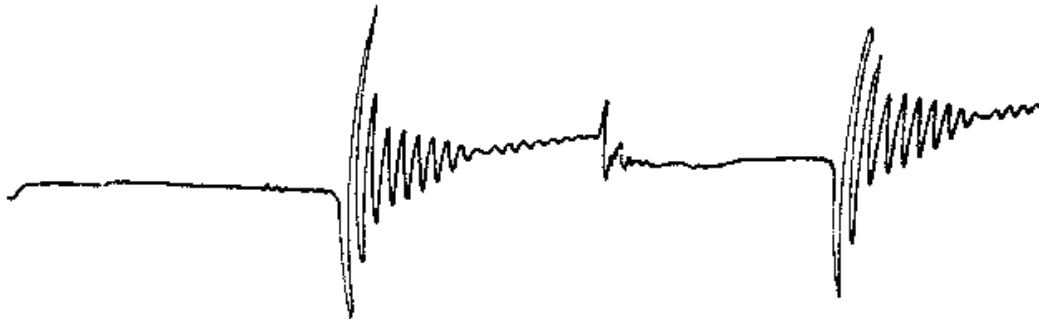


You can make an exceptionally sensitive displacement transducer using a crystal or ceramic phonograph cartridge; these are still widely available from sources on the web for about \$20. In place of the phonograph needle, which is a replaceable component, insert a 2- to 3-inch (50 – 75mm) sewing or hypodermic needle. Attach the end of the needle to the object to be monitored. You may need to experiment to determine which cartridge output terminals give the best signal out to the Model 2991.

## Bubble sensing



To use the Model 2991 as a bubble sensor, arrange two needle electrodes across from one another in the fluid stream. (If the stream flows through soft plastic tubing, you can just push the needles through the tubing.) Any bubble passing between the electrodes will cause an impedance change that can be detected by the Model 2991.



Damped oscillations recorded with two needle electrodes, separated by about 0.25" (6mm), that projected into a saline stream flowing at a constant rate. Damped oscillations were recorded from the Model 2991 output when the flow was stopped abruptly with a pair of hemostats.