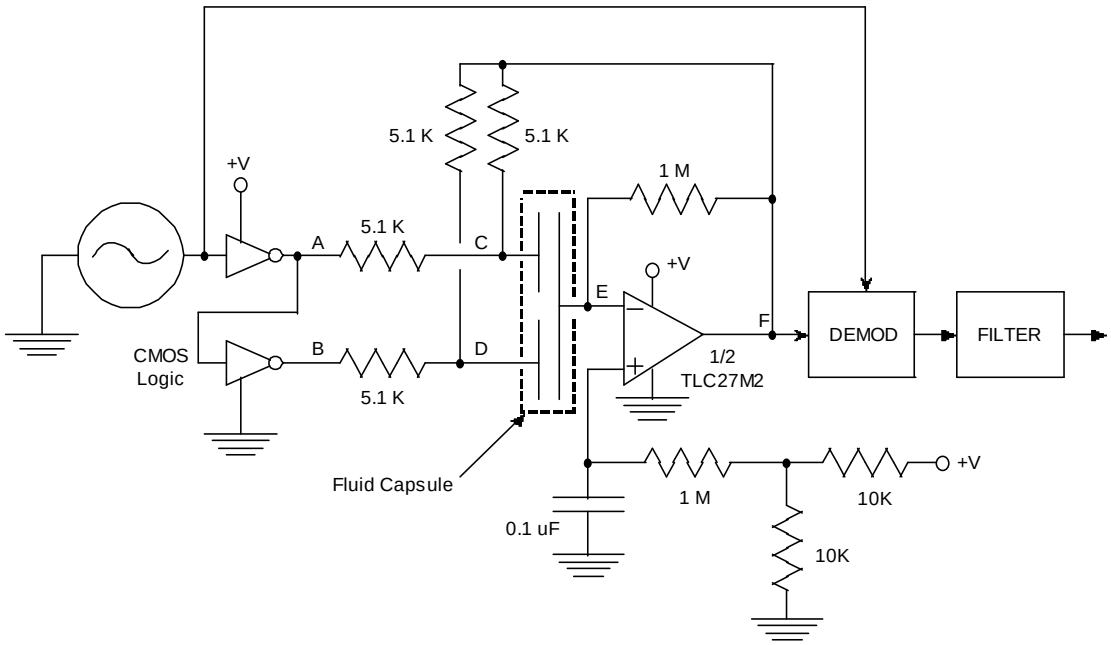
# Useful Design 002:

## Ratiometric Liquid Level Sensor

**The circuit below provides an output voltage proportional to the impedance ratio in a fluid capsule.**

The capsule is described later, but is generally a structure of closely spaces plates with a shared fluid medium. The medium may be a capacitive dielectric fluid or a resistive fluid

Signals “A” and “B” are equal but have opposite phase. If the impedance between “C” and “E” vs. “D” and “E” are the same, “E” will have a flat signal and so will “F”. If the “D” and “E” path dominates, “F” will have the same signal as “A”. “F” will then have an AC signal proportional to the ratio of the impedance on the plates. Demodulating signal “F” and filtering the result will then give a DC voltage output proportional to the impedance ratio in the capsule.




Overall, attention must be paid to the layout. Stray capacitance will produce bias and affect linearity. Protect and shield the op amp input from coupling to the oscillator and the op amp output.

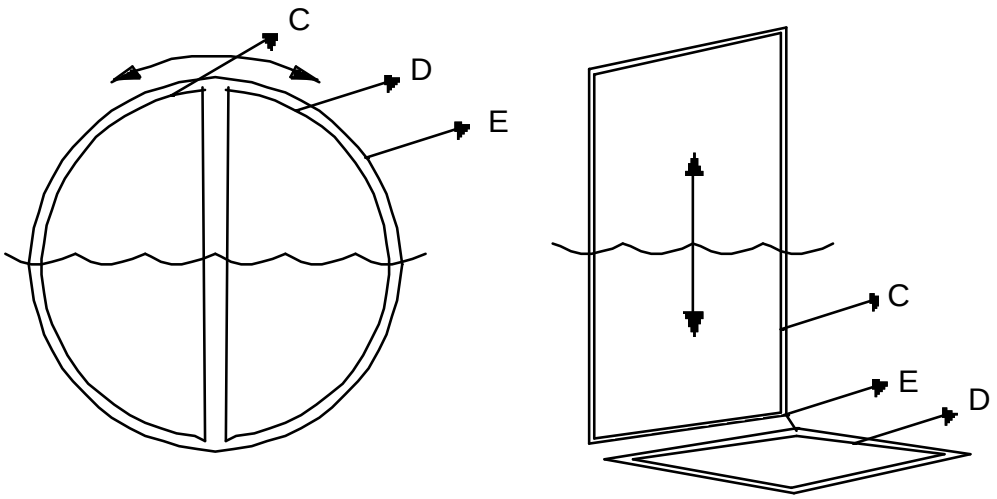
**The capsule part of this fluid level sensor has many possible configurations for a wide variety of applications.**

One obvious application is a liquid pendulum as shown below. Two “D” shaped electrodes over a circular plate with a thin (not too thin) spacing can give a linear output

for angle displacements. Too thin makes a large meniscus that will affect linearity and will produce fluid drag that will reduce bandwidth. Too wide reduces sensitivity.

Because it is ratiometric, this circuit will provide high accuracy over a wide temperature range without exotic fluids. Isopropyl alcohol works fine, but 50% deionized water and 50% isopropyl alcohol works better.

There are several plate arrangements that would work for fluid level measurement. The preferred arrangement is shown below. The plate area may be configured irregularly to accommodate irregular fluid containers. Spacing and plate area would have to be optimized for the fluid to be measured because some fluids are poor conductors or have a low dielectric constant.




Liquid Pendulum  Liquid Level Sensor

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