Capacitor Sensor

theory of capacitive bridge

$$\frac{C1}{C1+C2+\Delta C} = Vo^{+} \qquad (1)$$

$$\frac{C1}{C1+C2-\Delta C} = Vo^{-} \qquad (2)$$

equation 1 minus equation 2

$$\frac{2*C1*\Delta C}{(C1+C2+\Delta C)(C1+C2-\Delta C)} \qquad (3)$$

If C1 is much larger then C2 and ΔC then equation 3 can approximate down to

$$\frac{2*\Delta C}{C1} \qquad (4)$$

This was then used in an AC manner since a DC value would have no way to get across the capacitor. So then the basics of this is that you will have equation 4 as a transfer function with an input sin wave, then you multiply it with the input, and you have a DC component and a higher AC component, then you just low pass filter the signal in order to get just the DC and feed that back.

$$\sin(\omega t) \qquad (5)$$

$$\frac{1}{2}A + \frac{1}{2}A * \sin(2\omega t) \qquad (6)$$

where A is just equation 4, and if the sin wave is larger than 1, there would be another scale factor.

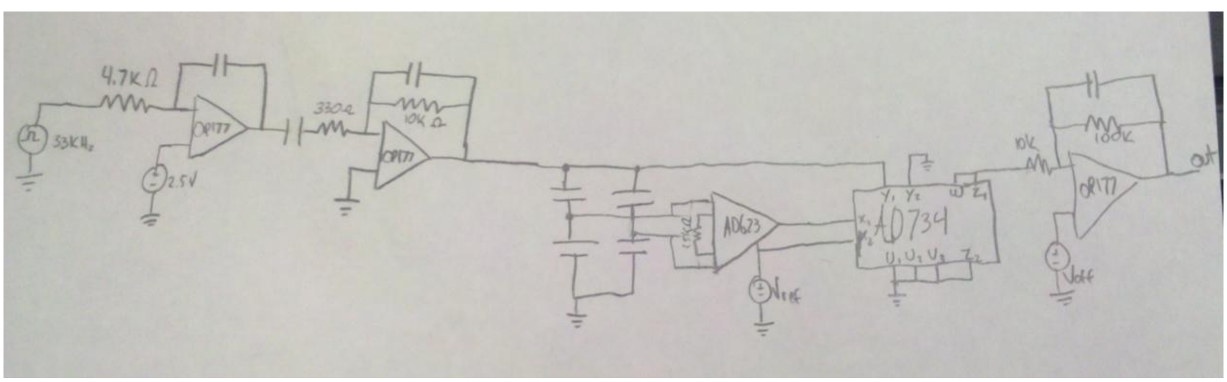

figure 1.1 Sensor circuit with capacitor bridge.

AD623 was used due to its high common mode rejection in the order of 100 dB. The circuitry on the left was used to convert a square wave (ordered the wrong part) to a sin wave. And the right was just a simple low pass filter with a 100 gain.

Suggestion for future work

use an inductive sensor, talk to the ITT customer, he has experience with it, and can help you figure out how to use it. The capacitor sensor has issues with actually creating a low C2 and high ΔC values. We were able to create some plates on the mount, for the C2 side, where it would be grounded, but then trying to find a way to mount the second capacitive plate in a way that would keep it from moving was an issue, and we ended up creating a very large C2 value on the order of 0.2 nF.