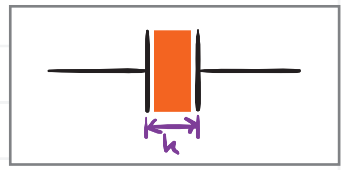
Capacitive sensors

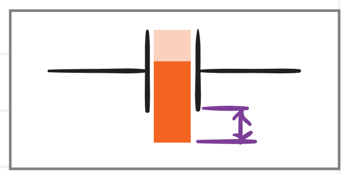
A capacitive sensor uses changes in capacitance to indicate changes in its environment. Recall that a capacitor stores energy in an electric field between two conducting plates separated by an insulating medium. The capacitance is

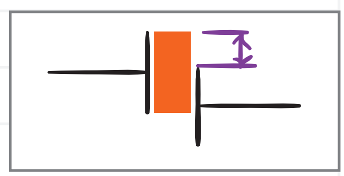
where

ε_0 is the permittivity of free space ($\varepsilon_0 = 8.85e{-12}$ F/m),
ε is the relative permittivity of the insulator,
A_{cp} is the plate area, and
h is the plate separation.

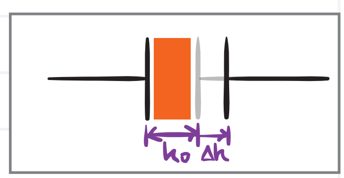


ε can be varied by arranging the capacitor such that the insulating medium is laterally displaced (partially outside the plates) such that the effective relative permittivity between the plates varies.





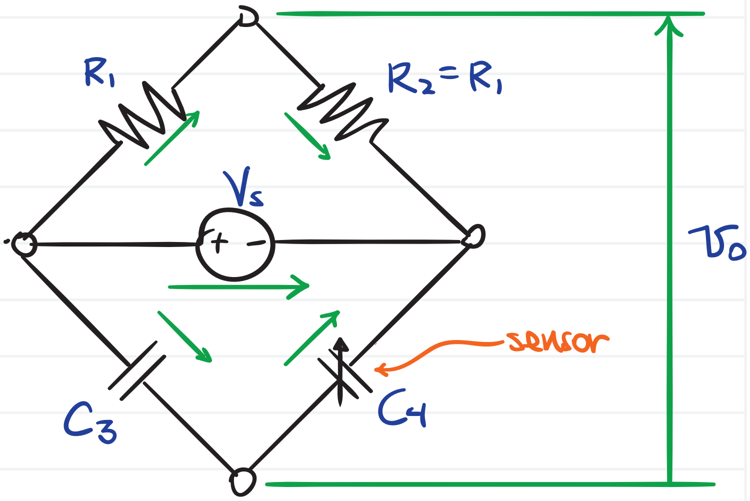
h can be varied directly. This is the most common type of capacitive sensor, called a variable spacing capacitive sensor. If ε and A_{cp} are constant, changes in h are related to changes in capacitance by



where C_0 + h_0 are a reference capacitance + a reference spacing.

Capacitive (variable spacing) displacement indicator

Capacitive displacement sensors are used with wheatstone bridge transducers to measure small displacements.



If $\Delta C << C_o$, $v_o = V_s\left(\frac{\Delta C}{4C_o}\right) = -V_s \frac{\Delta h}{4h_o}$. This implies

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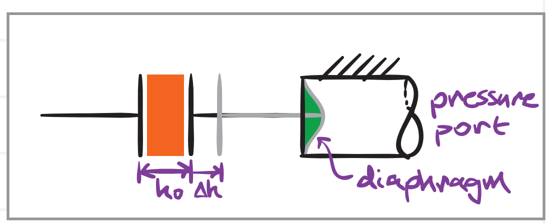
Capacitive (variable spacing) pressure transducer

With one plate fixed and the other responding to changes in pressure $\Delta p = p - p_o$,



When used with the capacitive wheatstone bridge above, $\left(\frac{\Delta C}{C_o} = 4\frac{v_o}{V_s}\right)$

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