FDC2x1y Single-ended sensor: Sensor capacitance vs. sensor frequency

John Miller

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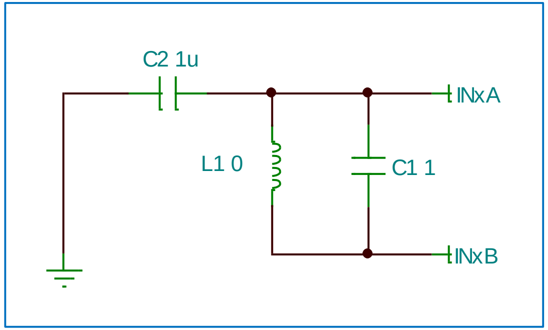
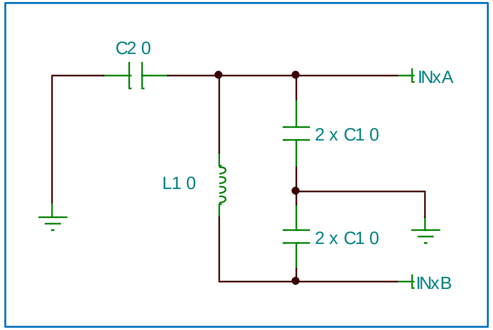
Single-ended sensor

- Goal: determine the relationship between the sensor capacitance (C_2) and the frequency of the larger LC circuit.
- Step 1: Rearrange the single-ended sensor to an equivalent circuit to enable calculations.

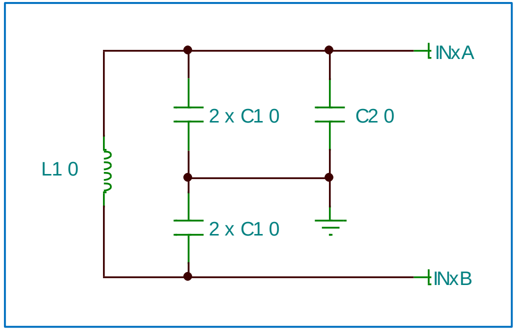
(1) SE sensor from the data sheet



(2) "Split" the on-board capacitance C_1 to have a mid-point GND



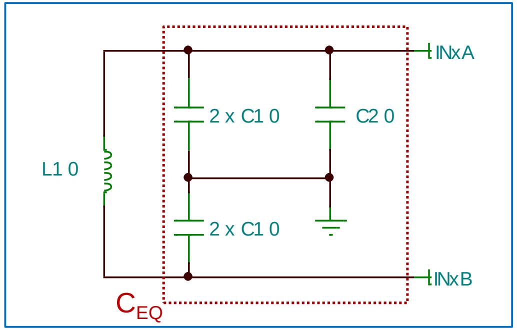
(3a) Move C_2 so it is in parallel with the upper on-board cap.
(3b) Calc the impact of $2 \cdot C_1 + C_2$ on sensor frequency (next slide)



Impact of C2 on SE sensor frequency

- $F_{SENSOR} = \frac{1}{2\pi\sqrt{L_1 C_{EQ}}}$
  - $C_{EQ} = \frac{1}{(2C_1+C_2)} + \frac{1}{2C_1} = \frac{(2C_1+C_2)\cdot(2C_1)}{(4C_1+C_2)} = \left[\frac{1}{L_1\cdot(2\pi\cdot F_{SENSOR})^2}\right]$

$$\rightarrow \quad F_{SENSOR} = \left[\frac{1}{2\pi\sqrt{L_1\cdot\frac{(2C_1+C_2)\cdot(2C_1)}{(4C_1+C_2)}}}\right]$$



- Solving for sensor C_2 as a function of measured F_{SENSOR}:
- $C_2 = 4C_1 \cdot \frac{\left(1-LC_1\cdot(2\pi F_{SENSOR})^2\right)}{(2LC_1\cdot(2\pi F_{SENSOR})^2-1)}$
- Was not able to validate this against the provided data to quantify the effective offset.