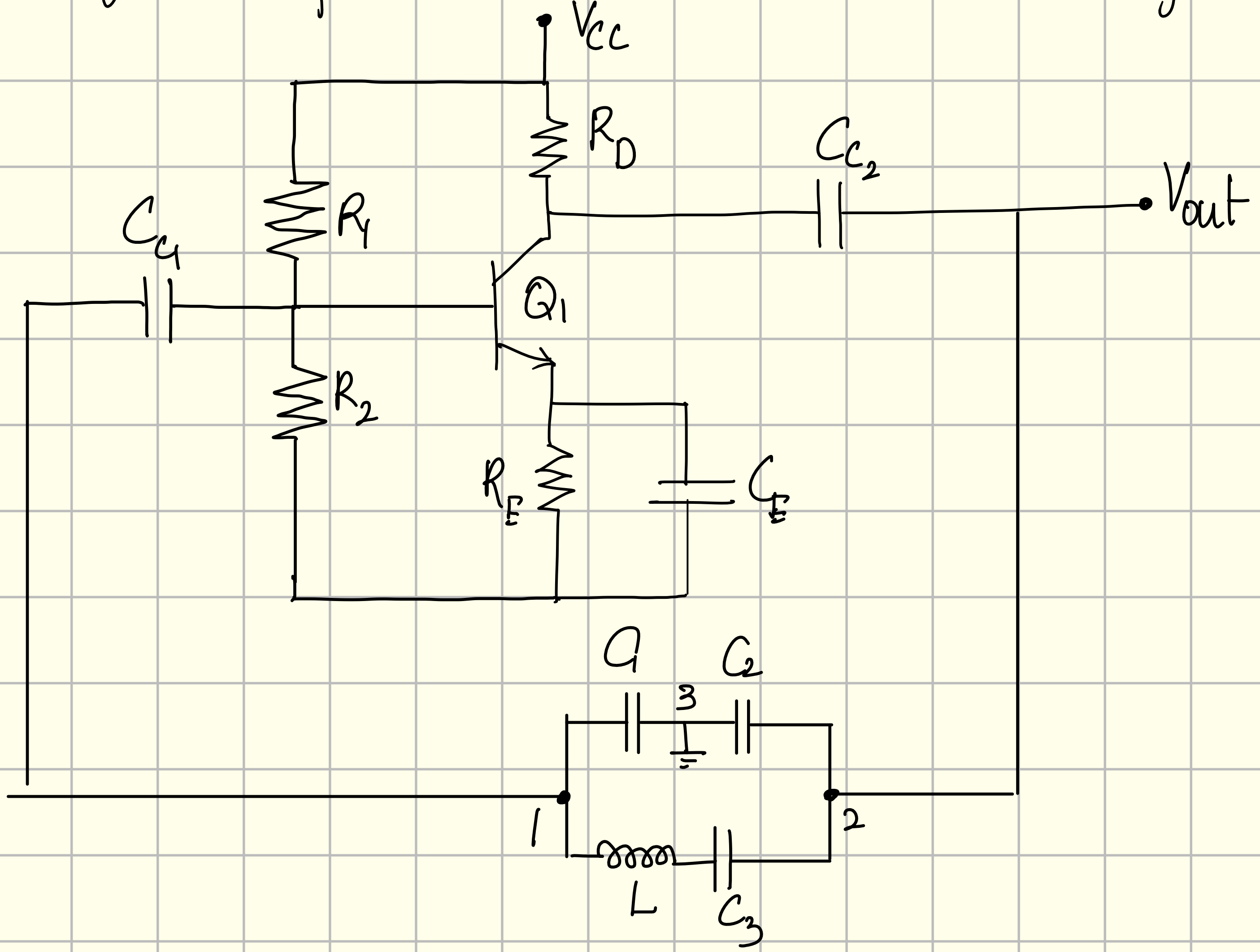
Clapp Oscillator

- much like Colpitt's oscillator with the capacitive voltage divider producing the feedback signal.

- Gives much better stability compared to Colpitt's oscillator.
- The capacitors C_1 and C_2 provide the feedback to input of the amplifier which is a BJT in C-E configuration.



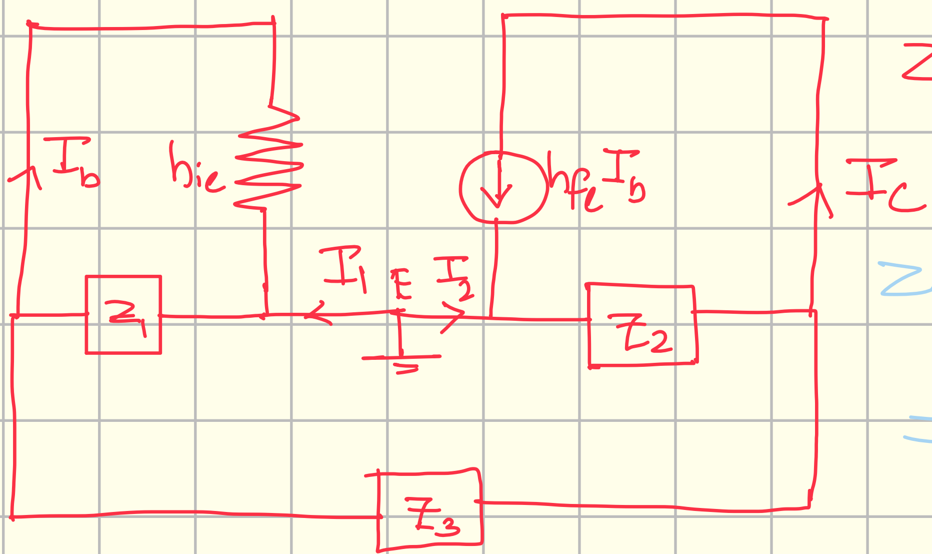
- So in the feedback network, the potential at 2 gets inverted when it reaches point 1 due to the fact its grounded at point 3. This introduces a 180° phase shift which gets added to the 180° phase shift of the inverting amplifier to produce a total phase shift of 360°.

- Total $C = \dfrac{1}{\frac{1}{C_1}+\frac{1}{C_2}+\frac{1}{C_3}}$, the C_3 used is a very small value so that $\frac{1}{C_3} >> \frac{1}{C_1}$ and $\frac{1}{C_2}$ which get affected by the parasitic capacitances of the BJT so adding C_3 provides stability to the circuit

$$f = \frac{1}{2\pi\sqrt{LC_3}}$$

- In high frequency oscillators, a HF choke is used in place of R_c which provides a high impedance without dissipating power which provides good output voltage swing. It reduces static power loss and improves Q factor of the oscillator for a purer sine wave.

Equivalent circuit of LC Oscillator



$Z' \rightarrow$ parallel combination of h_{ie} and Z_1

$$Z' = \frac{Z_1 h_{ie}}{Z_1 + h_{ie}}$$

• Now $Z_L \rightarrow$ the load impedance. This is obtained by z' in series with Z_3 which is parallel to Z_2.

$$Z_L = \frac{(z'+z_3)\, z_2}{z'+z_3+z_2} \quad \text{or} \quad \frac{1}{Z_L} = \frac{1}{Z_2} + \frac{1}{z'+Z_3}$$

$$\frac{1}{Z_L} = \frac{1}{Z_2} + \frac{1}{\frac{Z_1 h_{ie}}{Z_1+h_{ie}} + Z_3}$$

$$Z_L = \frac{1}{Z_2} + \frac{1}{\frac{Z_1 h_{ie} + Z_3(Z_1+h_{ie})}{Z_1+h_{ie}}} = \frac{1}{Z_2} + \frac{Z_1+h_{ie}}{Z_1 h_{ie} + Z_3 Z_1 + Z_3 h_{ie}}$$

Voltage gain without feedback: $A_V = \frac{-h_{fe} Z_L}{h_{ie}}$

• for the feedback network, output voltage across Z_2 and input voltage across Z'.

$$\beta = \frac{z'}{z'+z_3} = \frac{Z_1 h_{ie}}{h_{ie}(Z_1+Z_3) + Z_1 Z_3}$$

$\boxed{A_V \beta = 1} \rightarrow$ Barkhausen's criteria

$$\frac{-h_{fe}}{h_{ie}} \times Z_L \times \frac{Z_1 h_{ie}}{h_{ie}(Z_1+Z_3)+Z_1 Z_3} = 1$$

Simplifying this equation -:

$$\boxed{h_{ie}(Z_1+Z_2+Z_3)+Z_1Z_2(1+h_{fe})+Z_2Z_3=0}$$ *

↳ Characteristic equation of oscillator

* pretty sweet.