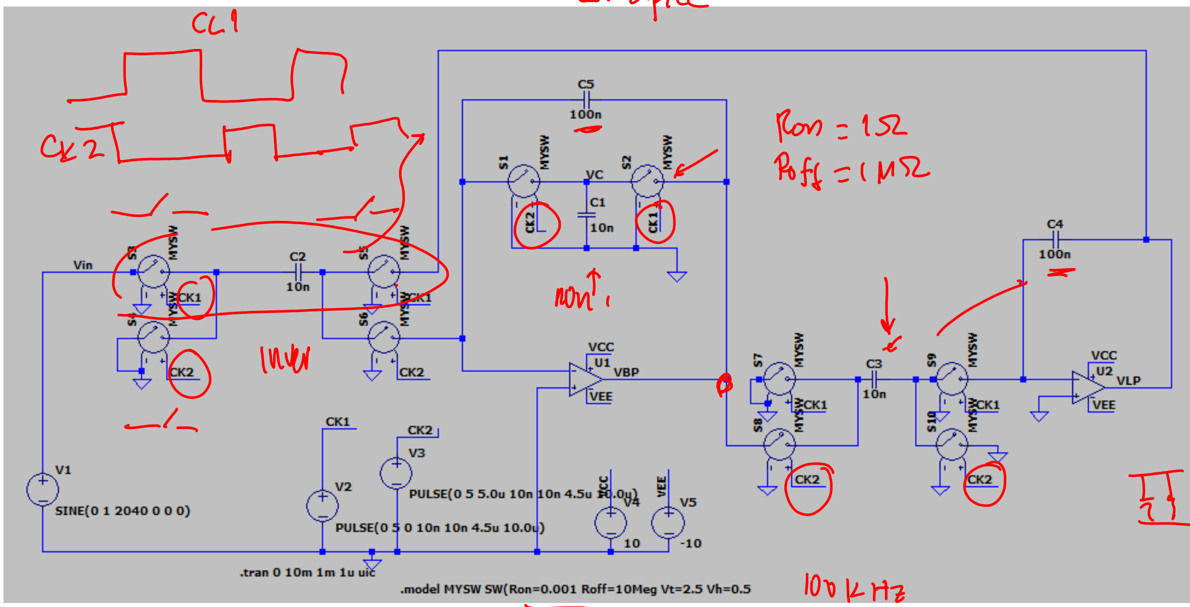
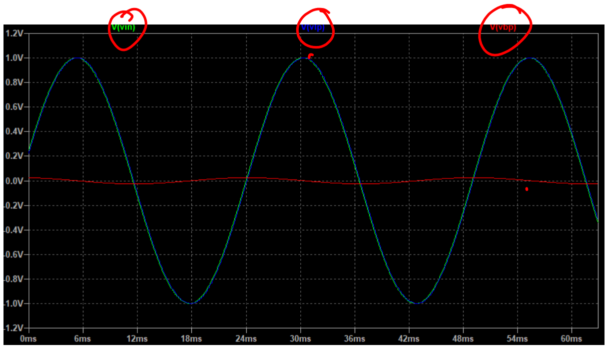
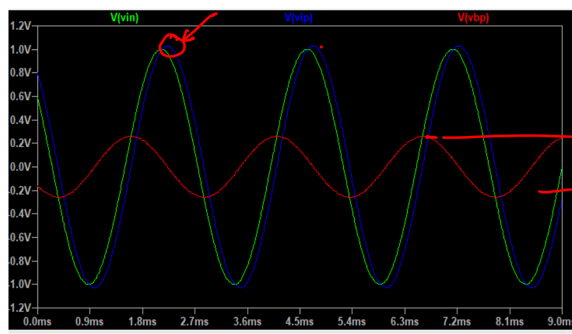
Lecture 18 - Signal Generators 2

Wednesday, October 25, 2023 5:38 PM

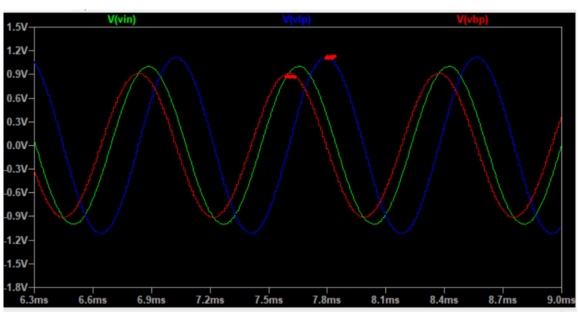
LTSpice

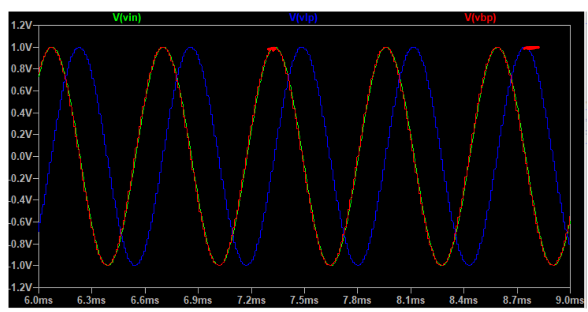




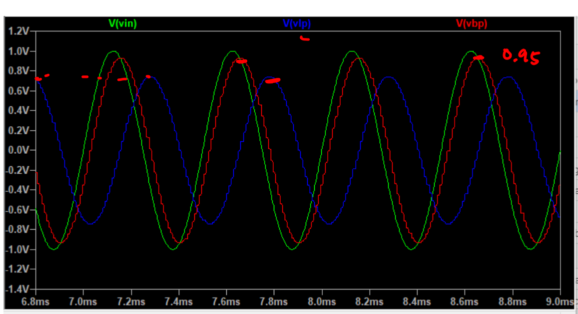


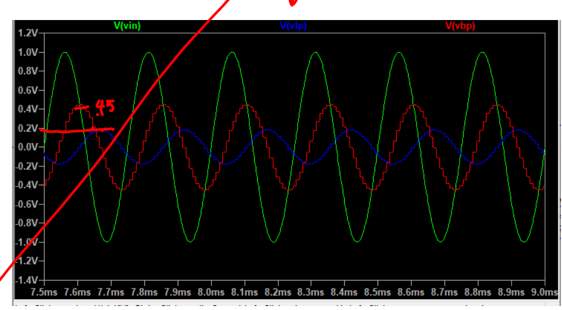
Input - 40Hz 400Hz



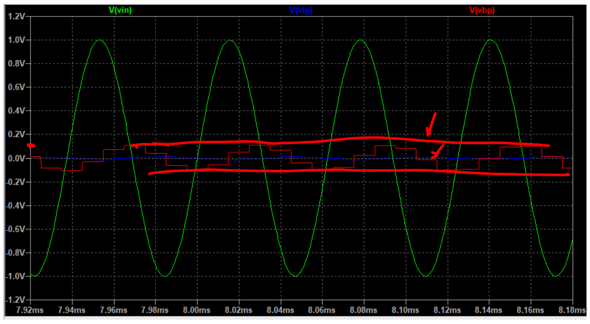


1.3KHz 1.59KHz

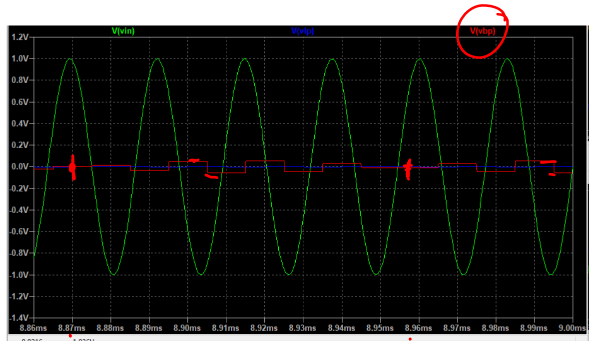




2KHz 4KHz

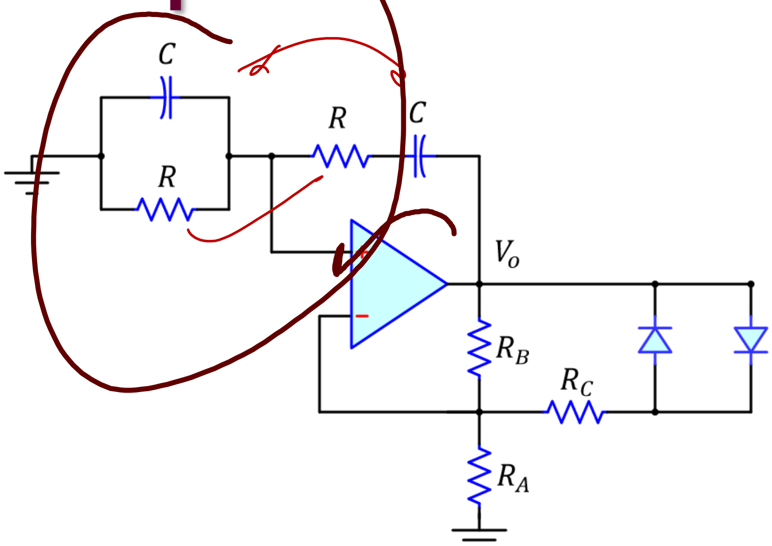


16KHz



44KHz 50 100 KHz

Wien-Bridge Oscillator



For $T(j\omega_0 > 1)$,

$$A = \frac{V_o}{V_p} = 1 + \frac{R_B}{R_A}$$

$$V_p = \frac{Z_p}{Z_p + Z_s} V_o = \frac{\frac{R}{1+sRC}}{\frac{R}{1+sRC} + \frac{1+sRC}{sC}} =$$

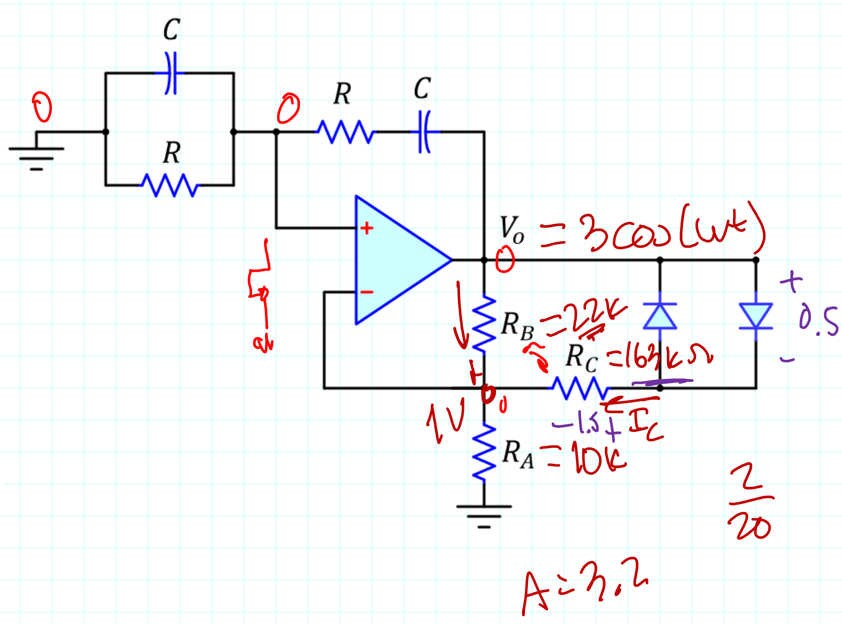
$$B(j\omega) = \frac{V_p}{V_o} = \frac{s/\omega_o}{s^2 + 3\frac{s}{\omega_o} + \omega_o^2}, whe$$

$$T(j\omega) = \frac{1 + \frac{R_B}{R_A}}{s^2 + 3\frac{s}{\omega_o} + \omega_o^2}$$

At resonant frequency $|T(j\omega_o)|$

Therefore, for sustained oscillations, $\frac{R_B}{R_A}$ >

Wien-Bridge Oscillator

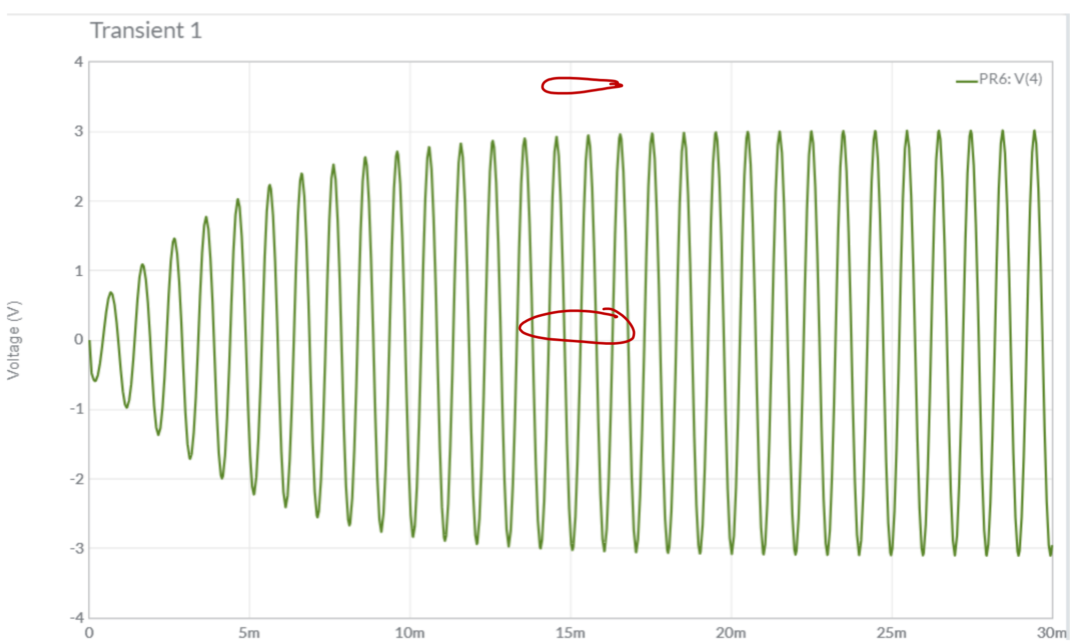


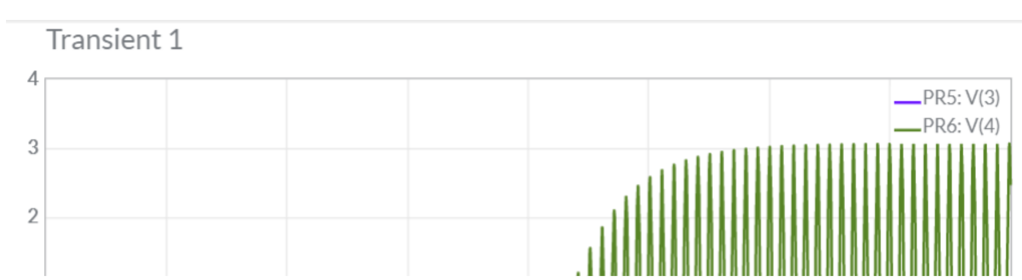
Design an oscillator such that it produ

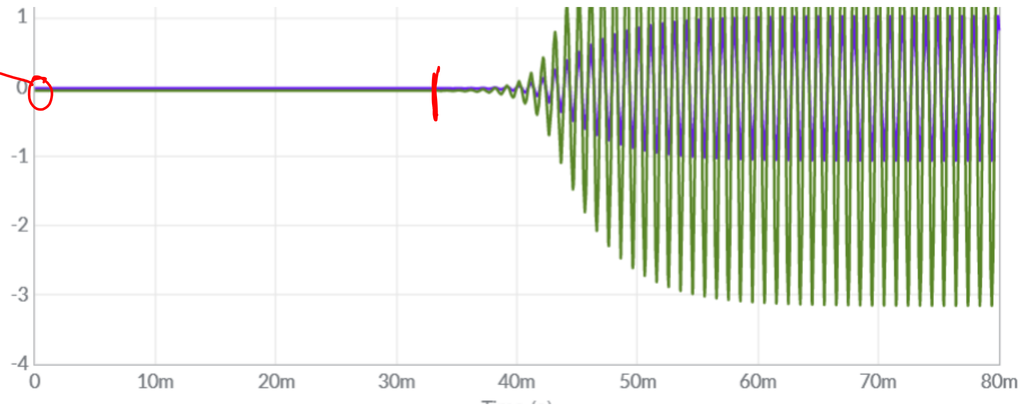
$V_o = 3\cos(\omega t)$, *and* $\omega = 1KHz$

- For sustained oscillations, $\frac{R_B}{R_A} > 2$
- Example:
- Let $R_B = 22k\Omega$ *and* $R_A = 10k\Omega$, (
- At the peak value we want to redu therefore:
- $I_B = \frac{2V}{22k\Omega}$, must fall to $I_B = \frac{2V}{20k\Omega}$ c circuit is added
- $I_C = \frac{2V}{22k\Omega} - \frac{2V}{20k\Omega} = 9.09\mu A$
- Use diode equation with $I_0 = 1 \times$
- $I_D = I_0 e^{\frac{V_D}{V_T}} \Rightarrow V_D = V_T \ln\left(\frac{9.09mA}{I_0}\right)$
- $R_C = \frac{2-0.515}{9.091\mu A} = 163k\Omega$

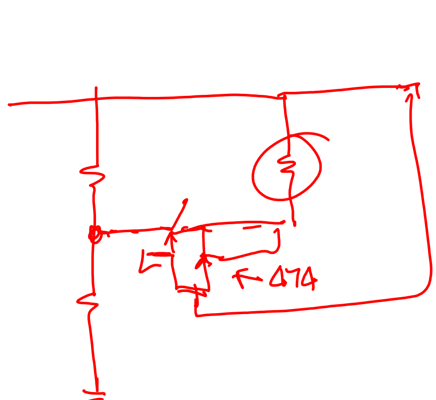
Make sure V_T is determined according to the simulation temperature

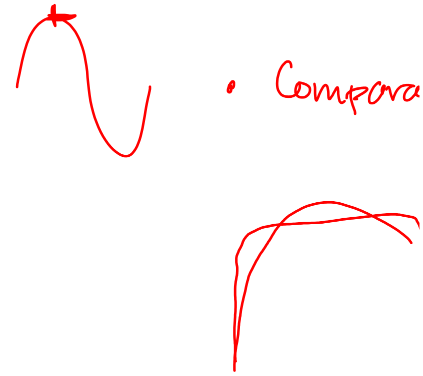






0.000000001
0.000000001?





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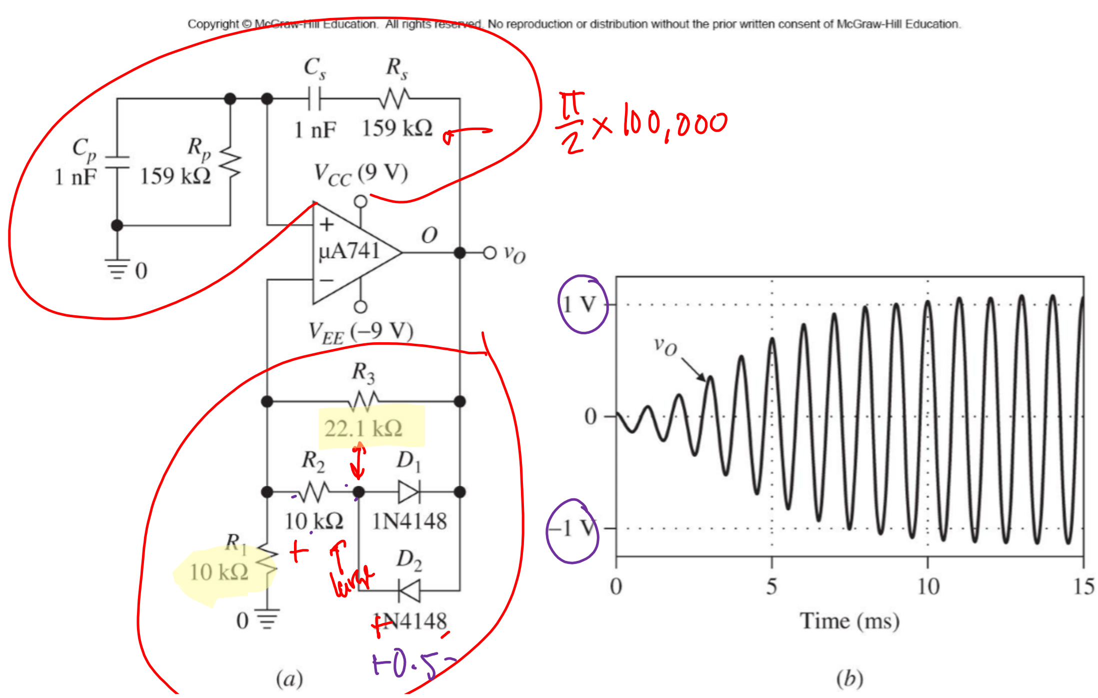
Wien-Bridge Oscillator



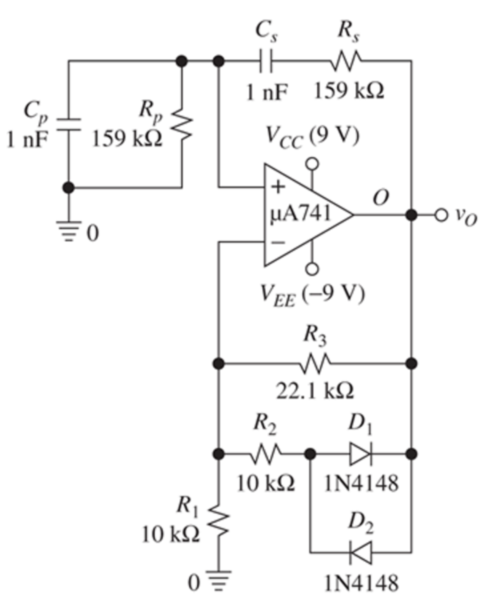
$\frac{\pi}{2} \times 100{,}000$

Sine Wave Generators

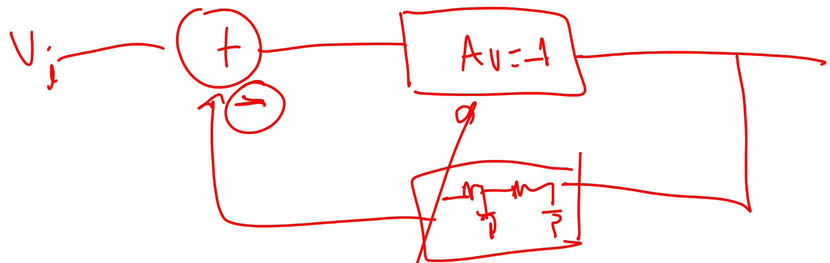
- Oscillation accuracy and stability
  - Affected by quality of passive components and op amp dynamics
- Good choices for elements in the positive feedback network
  - Polycarbonate capacitors and thin-film resistors
- Use trimmers for exact adjustment of f_0

Amplitud control

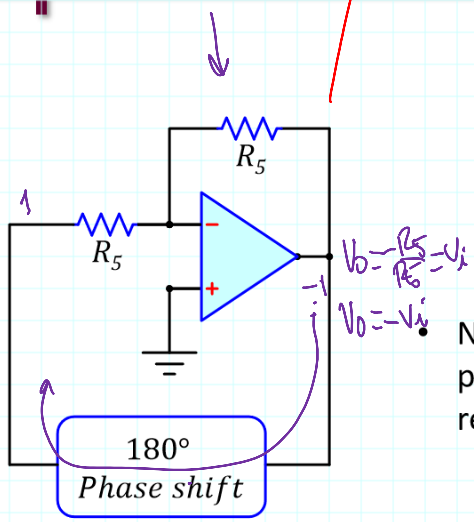
Sine Wave Generators

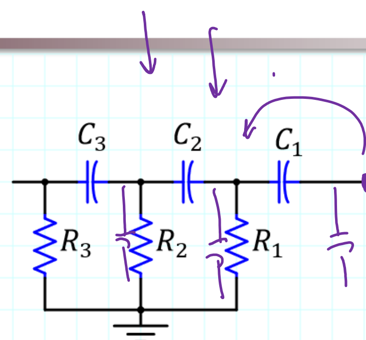


- FET-input op amps used to minimiz bias-current errors
- Quadrature oscillators
  - Can make an oscillator out of any sec filter
  - Dual-integrator-loop type filters are g candidates
    - Provide two oscillations with rela shift of 90 degrees

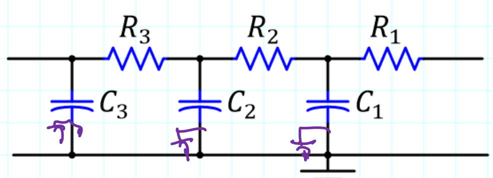


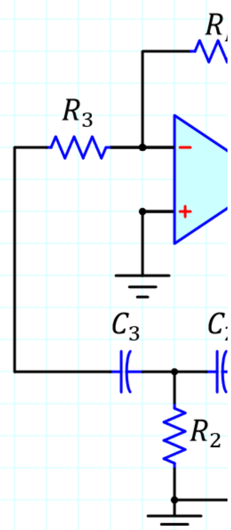
Phase Shift Oscillator





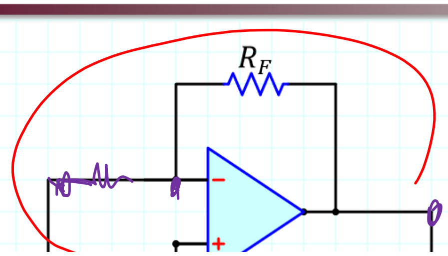
- Notice that each RC stage loads the previous one, this effect can be reduced by choosing:
  - $R_3 = 10R_2 = 100R_1$, and
  - $C_1 = 10C_2 = 100C_3$

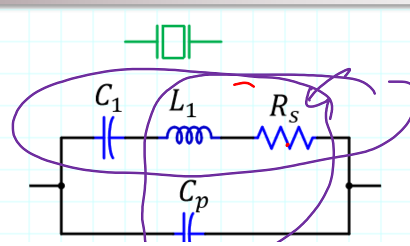




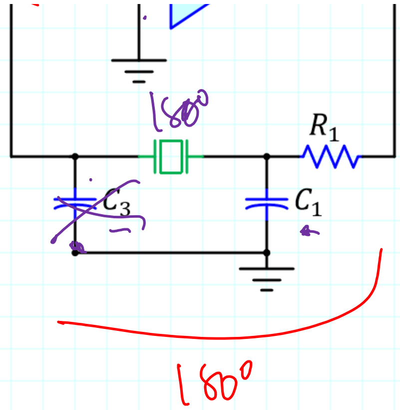
Crystal Oscillator

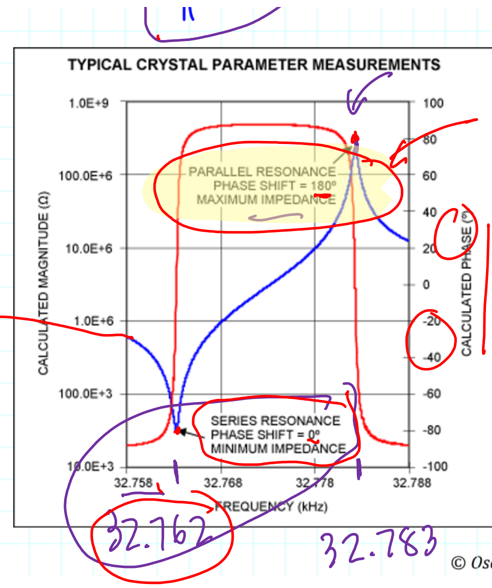
Watch crystal





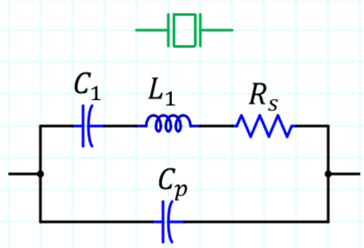
Series R
Parallel





[Max

Crystal Oscillator



Series Resonan
Parallel Resonar