OSCILLATORS

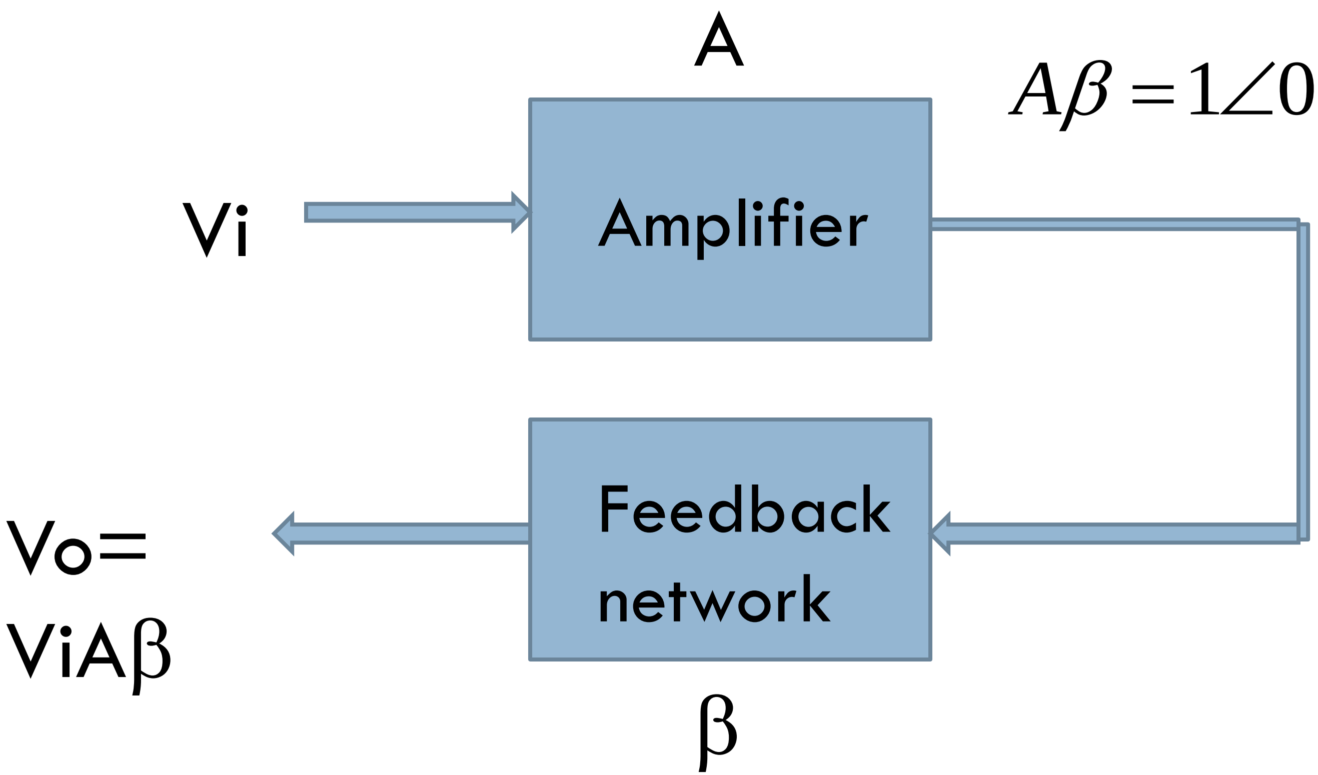
Lecture 5

Oscillator

- Oscillator is a circuit that produces a time varying waveform using the d.c. input
- Sinusoidal oscillator

$$Condition\ \ for\ oscillation$$

$$A\beta = 1\angle 0$$

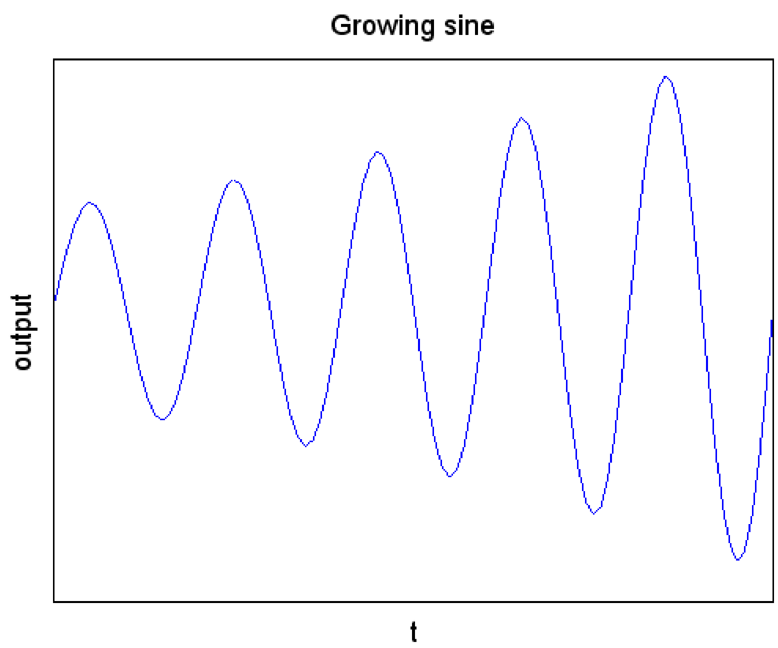


Loop gain

- $A\beta$ is called a loop gain.

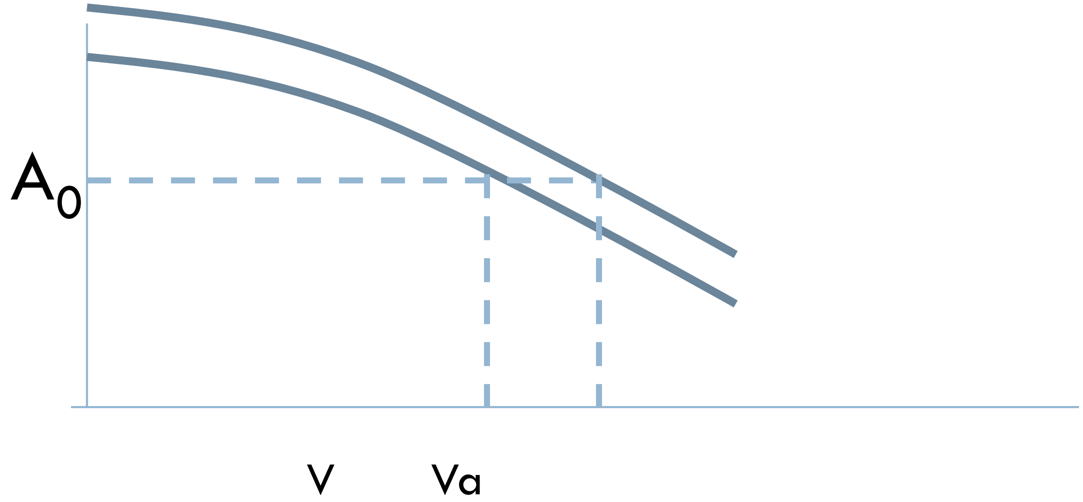
  It is kept slightly higher than 1

  So initially the oscillations grow

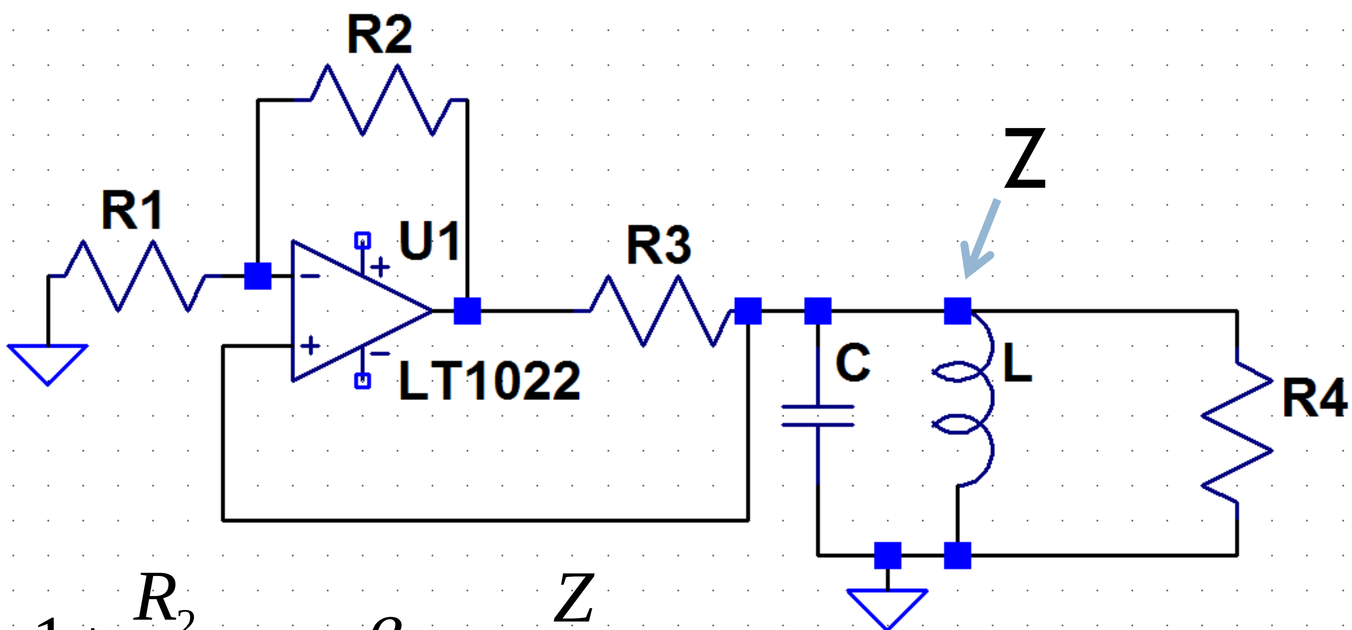


Amplitude stabilization

- Due to non-linearity in the circuit A falls as amplitude increases
- The amplitude stabilizes when $A\beta$ becomes unity
- The frequency of oscillations is the frequency at which the phase shift becomes zero.
- $A_0\beta = 1$



L-C oscillator



$$A = 1 + \frac{R_2}{R_1} \qquad \beta = \frac{Z}{R_3 + Z}$$

Note that A has an angle of zero and β has zero angle at resonance so the Barkhausen criterion is satisfied and the circuit oscillates at resonant frequency

Minimum gain requirement

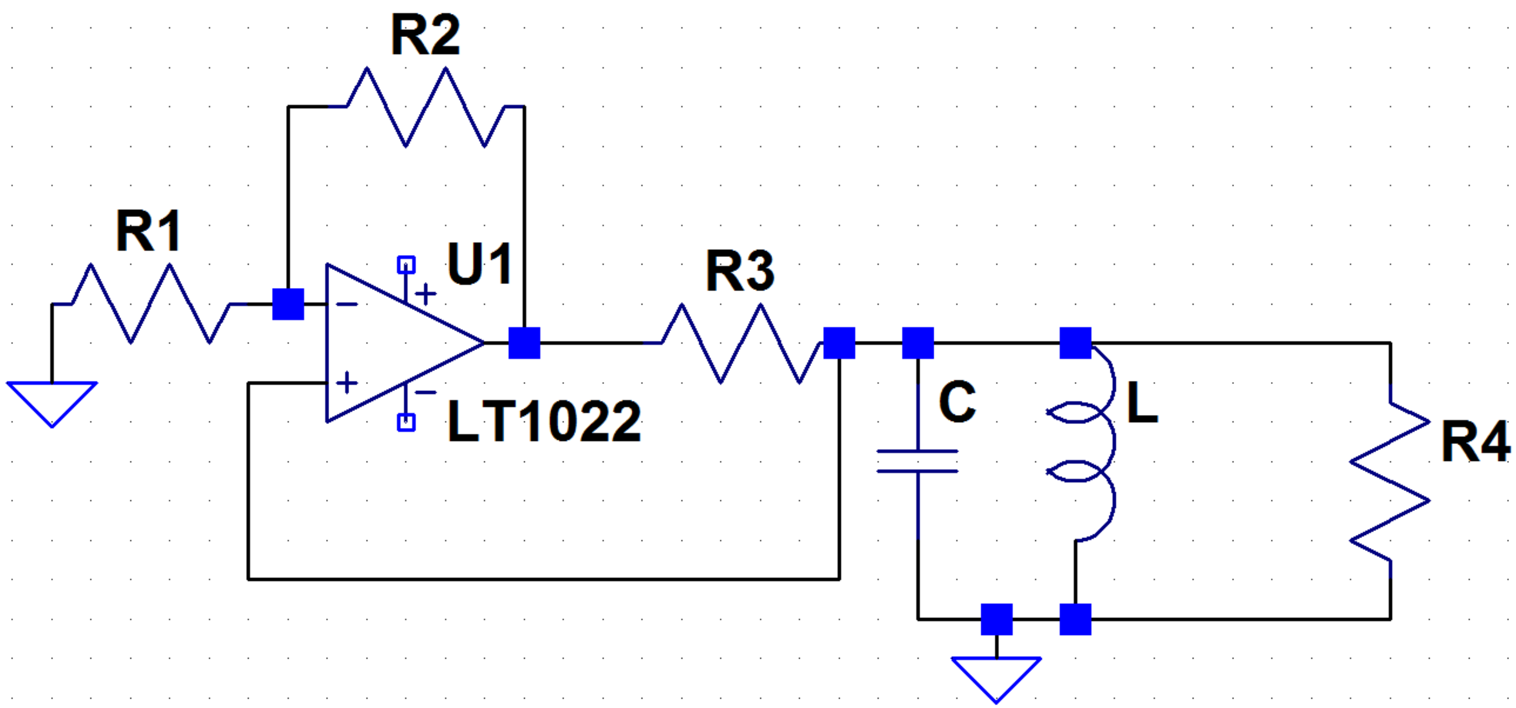
$$A_{\min}\beta = 1 : At \ resonance$$

$$A_{\min} = \frac{1}{\beta} = \frac{R_3 + R_4}{R_4}$$

$$Frequency \ of \ oscillations$$

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

Problem



R3 = R4

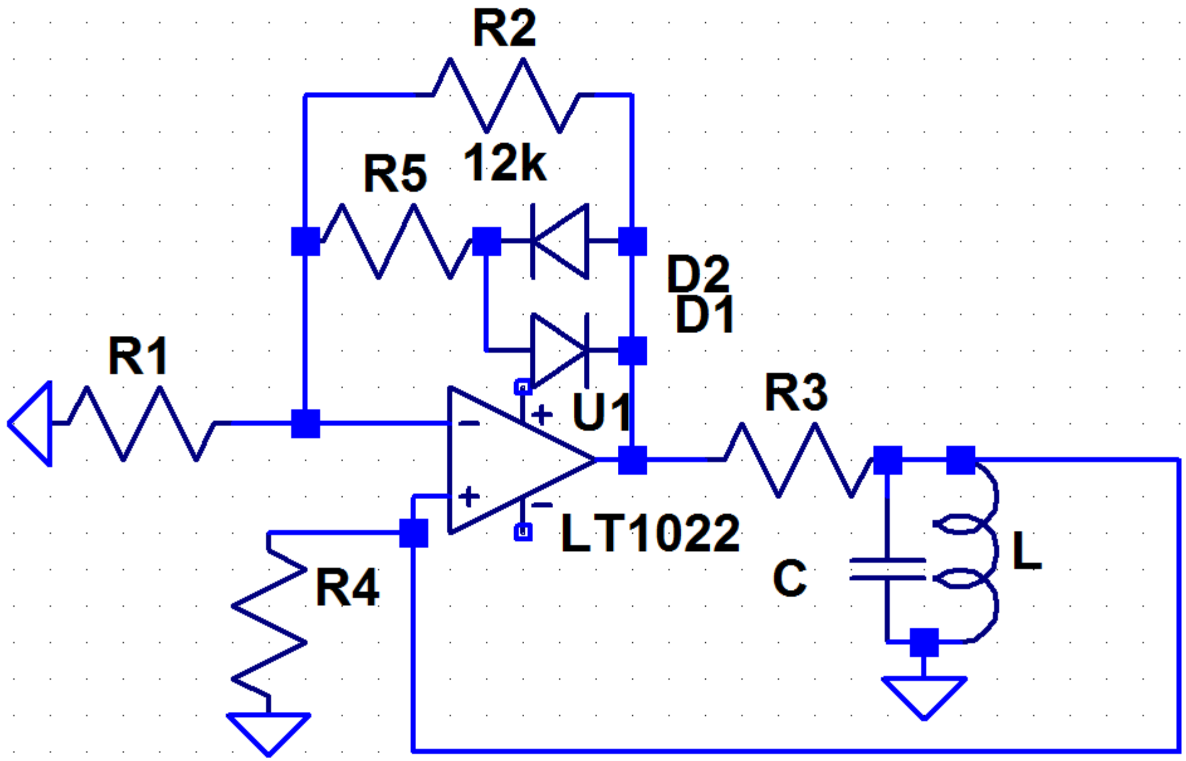
Find the ratio of R2 to R1 to satisfy Barkhausen criterion

L =100 μH and C = 100 pF

Find the frequency of oscillations

Answers

Amplitude limiting in oscillators

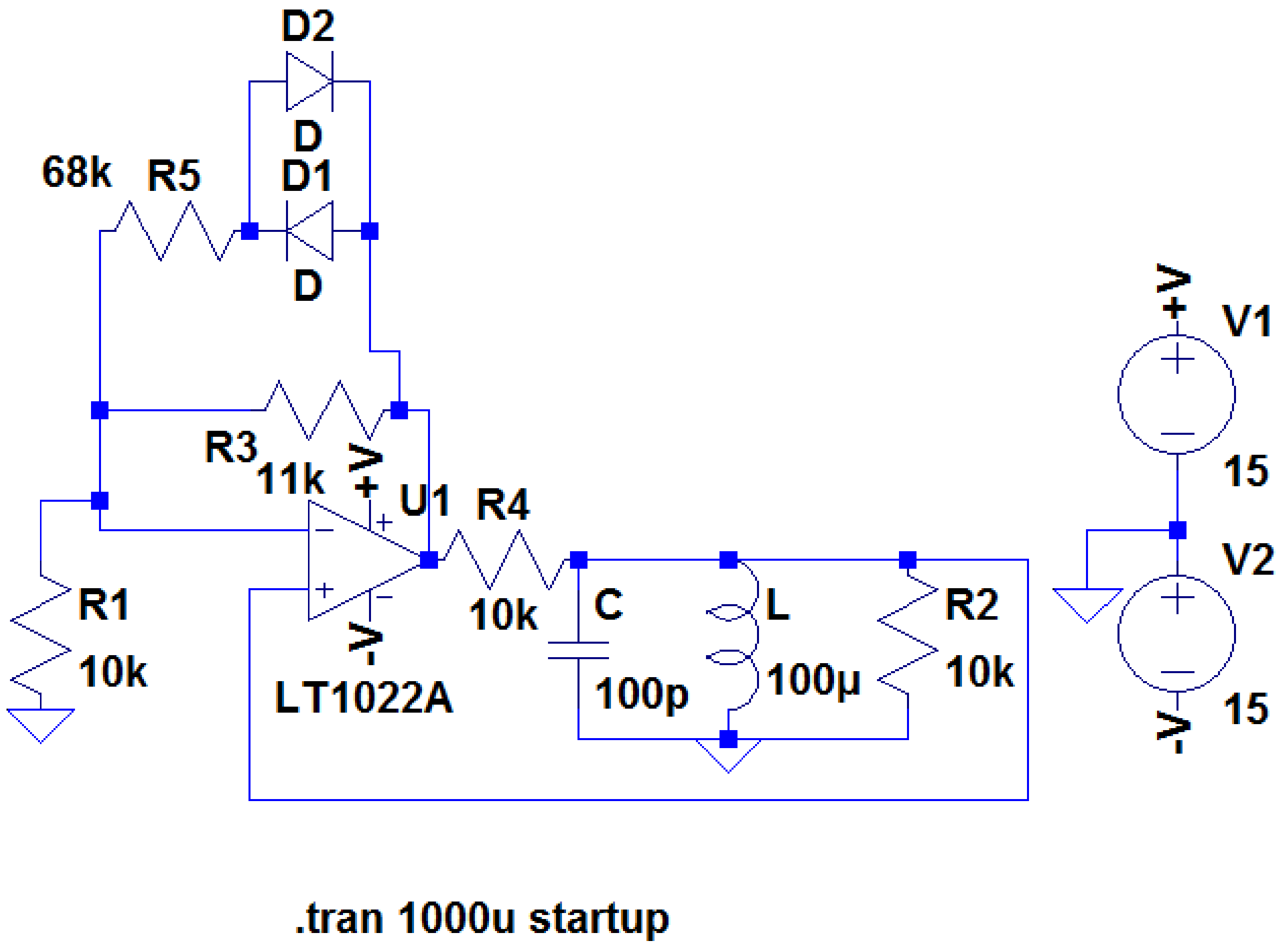


Design the above circuit for oscillating at 1.59 MHz. Diodes used are for limiting amplitude. Chose A slightly greater than Amin. And chose R5 much larger than R2 to keep distortion low.

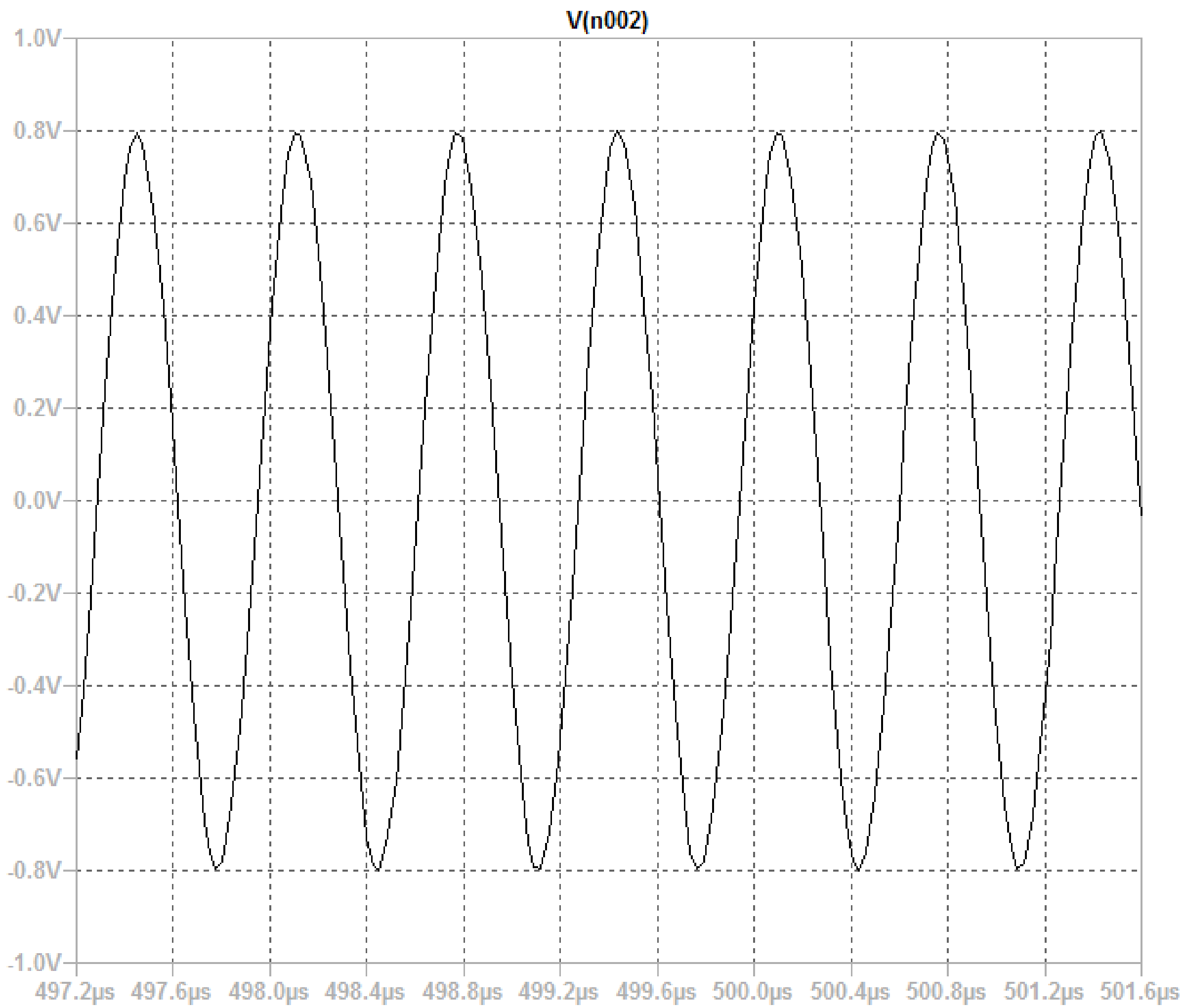
Problem

- Build an oscillator circuit using a series resonant circuit

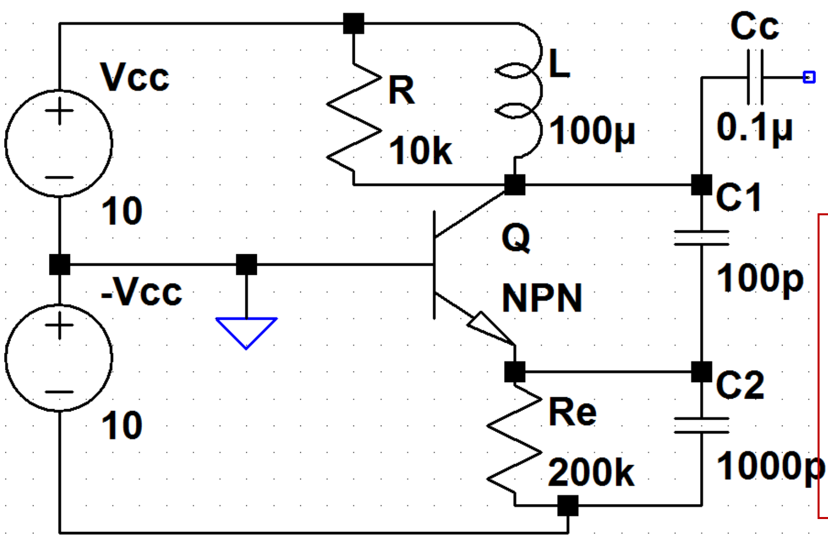
Oscillator with amplitude limiting



Output waveform



An RF oscillator circuit



$$Frequency\ of\ oscillations\ is$$

$$f_0 = \frac{1}{\sqrt{LC}} \quad where\ \ C = \frac{C_1 C_2}{C_1 + C_2}$$

Common base amplifier

C1 and C2 form the feedback circuit

Amplifier gain can be controlled by R