Electronic Devices and Circuits

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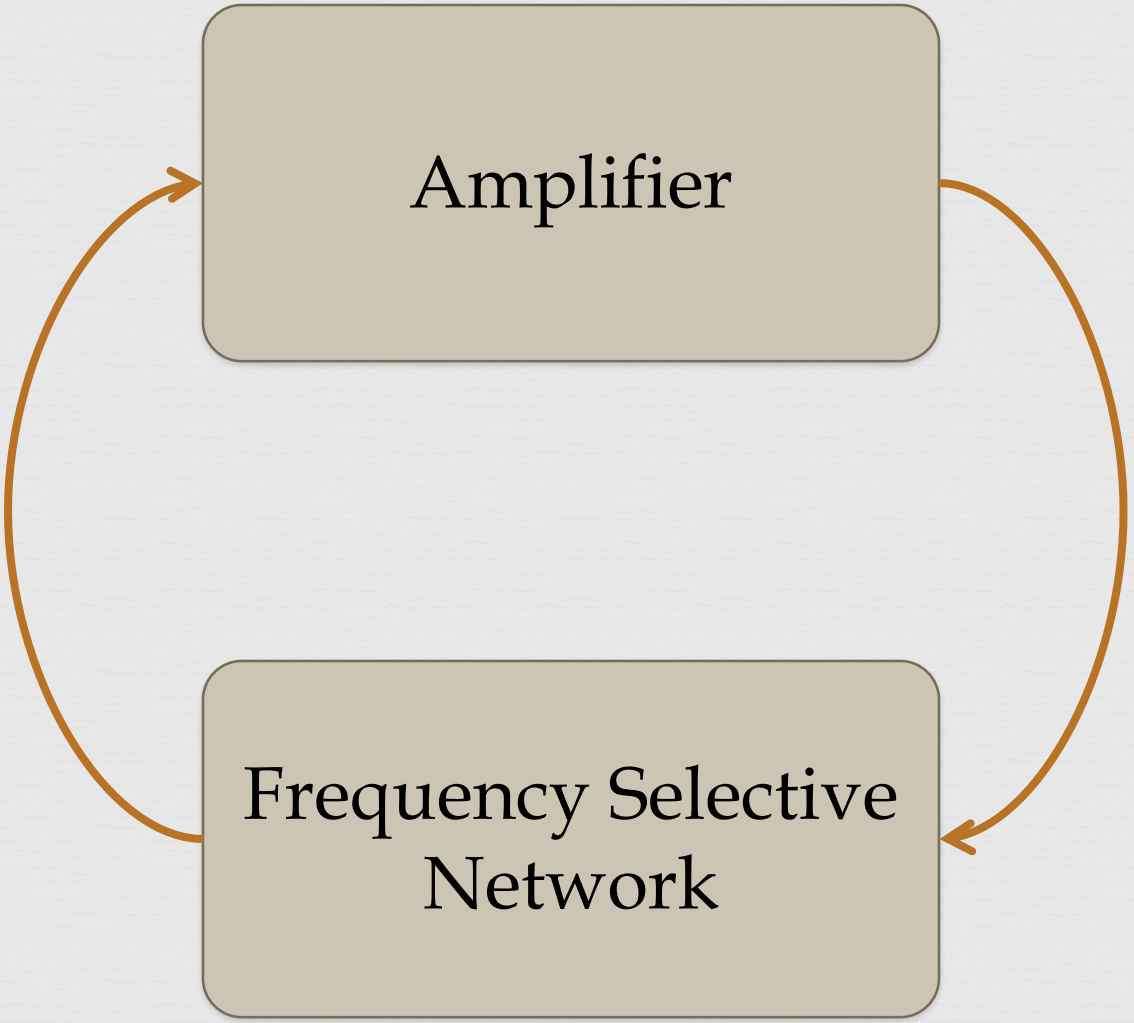
Introduction

Problem

- Design a Wien bridge oscillator to provide 18 KHz frequency.
- Use MULTSIM to simulate your oscillator.
- Modify oscillator for amplitude stabilization.
- Implement you design on PCB and test your circuit.

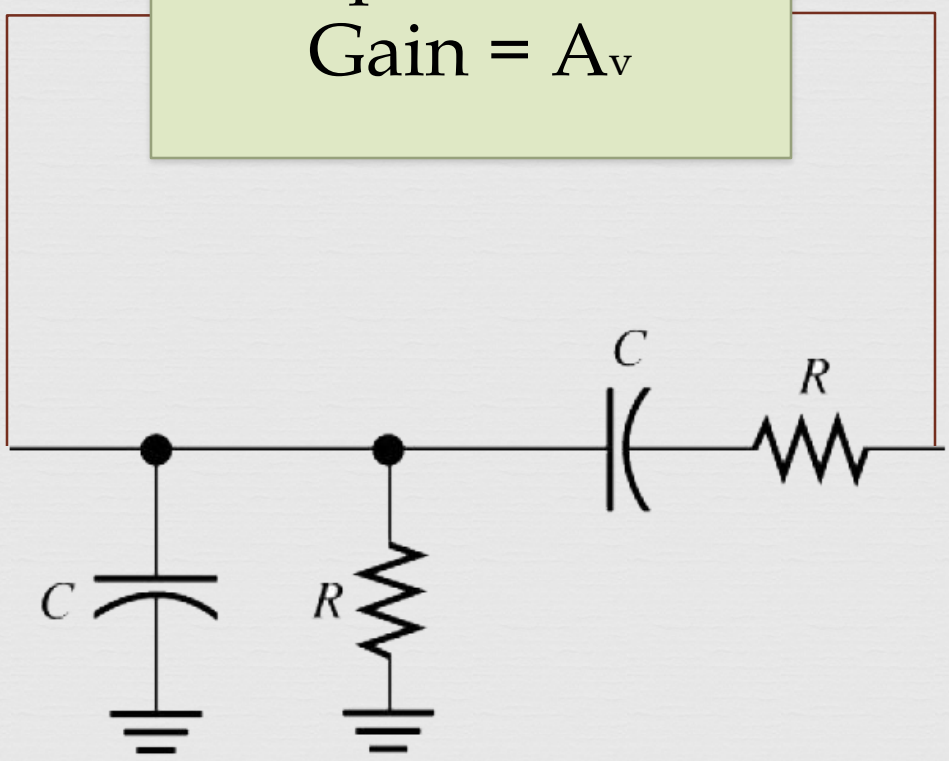
Designing the Circuit

Oscillators



Oscillators

Amplifier with
Gain = A_v



$$\omega = \frac{1}{RC}$$

Finding Resistor Values

$$\omega = \frac{1}{RC} \quad \Rightarrow \quad f = \frac{1}{2\pi RC} \quad \Rightarrow \quad R = \frac{1}{2\pi f C}$$

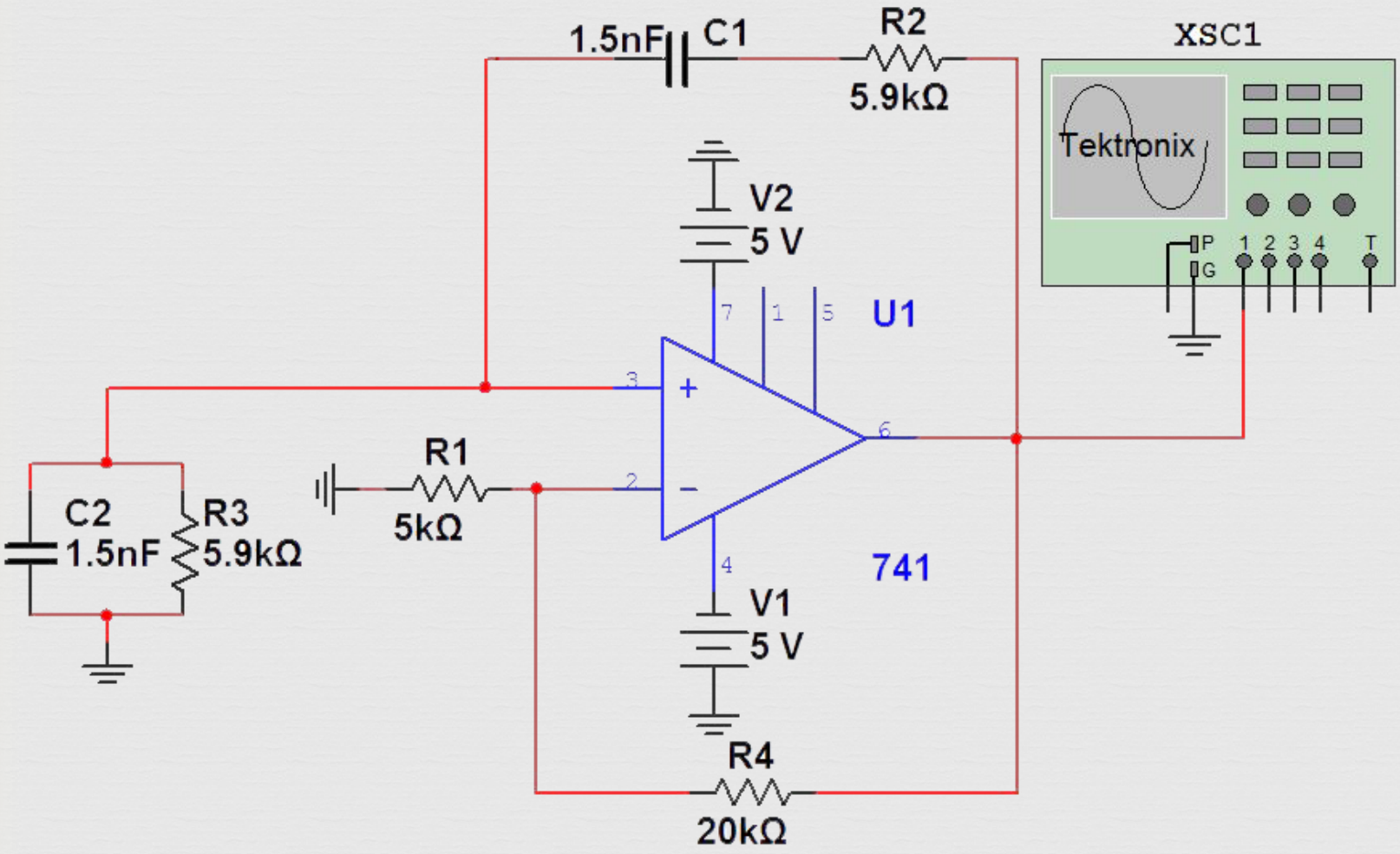
$$R = \frac{1}{2\pi \times 1.5 \times 10^{-9} \times 18 \times 10^{3}}$$

f = 18 KHz
C = 1.5 nF

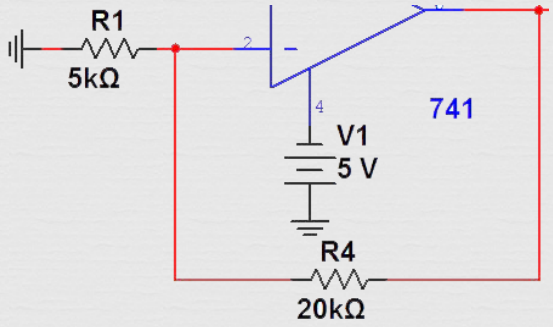
$$R \approx 5.9\ K\Omega$$

Simulation

Setting the Environment



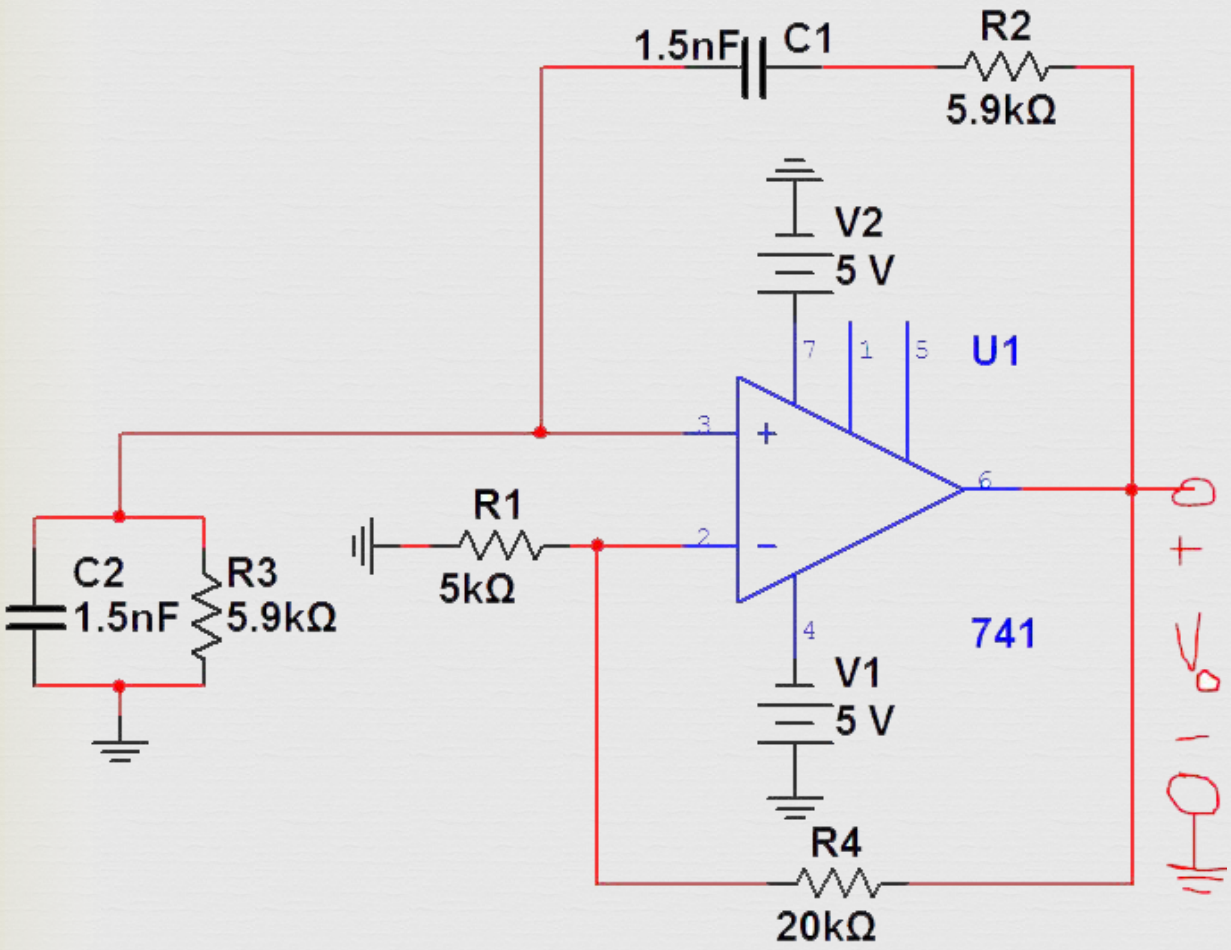
Finding the Right Gain



$$A_V = \frac{R4 + R1}{R1}$$

S.No.	R1	R4	Gain	Oscillation
1	5K	5K	2	No Oscillation
2	5K	10K	3	No Oscillation
3	5K	15K	4	Oscillation Present
4	5K	20K	5	Oscillation Present

Wien Bridge Oscillator

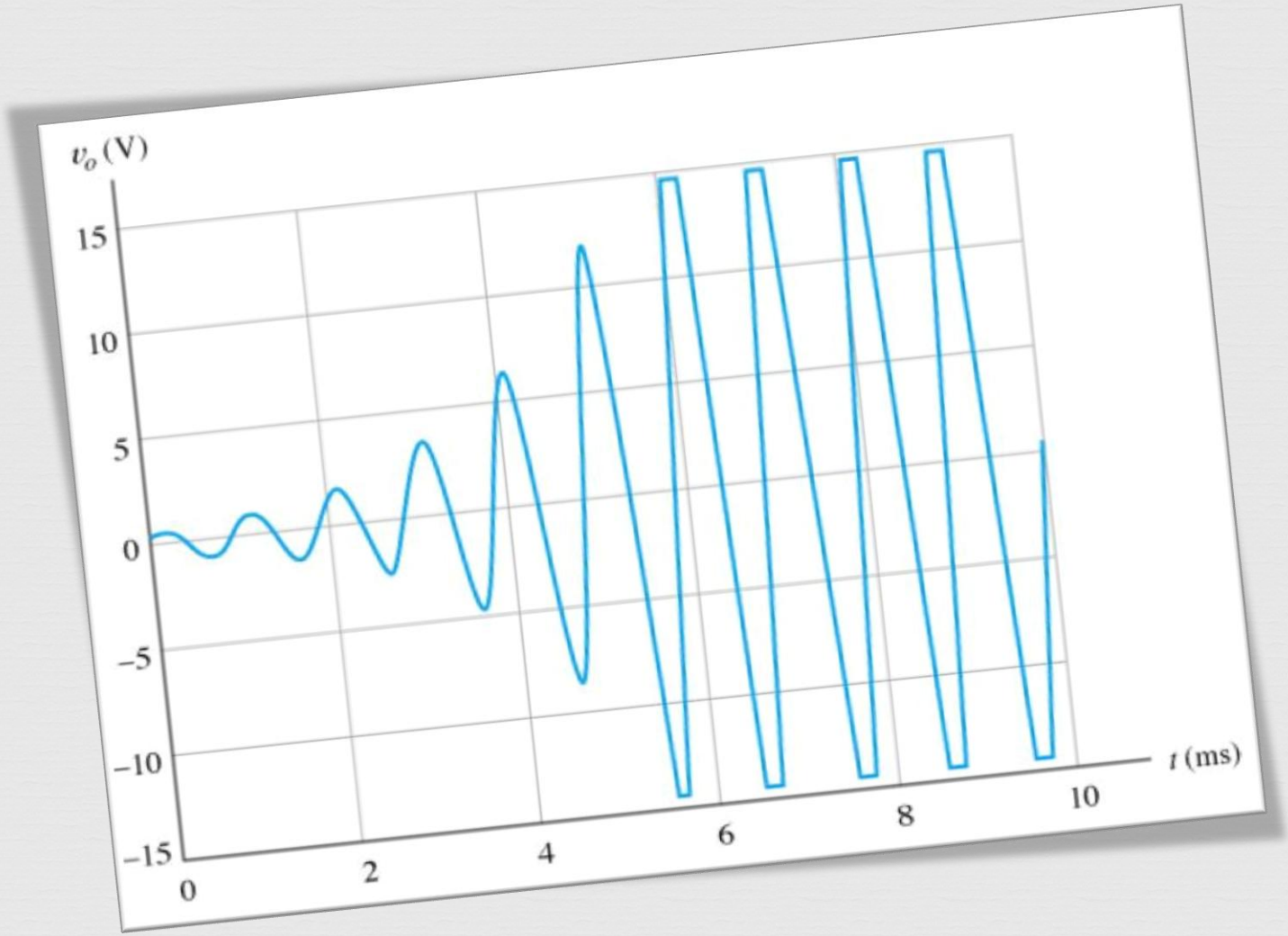


$$A_v = \frac{R4 + R1}{R1}$$

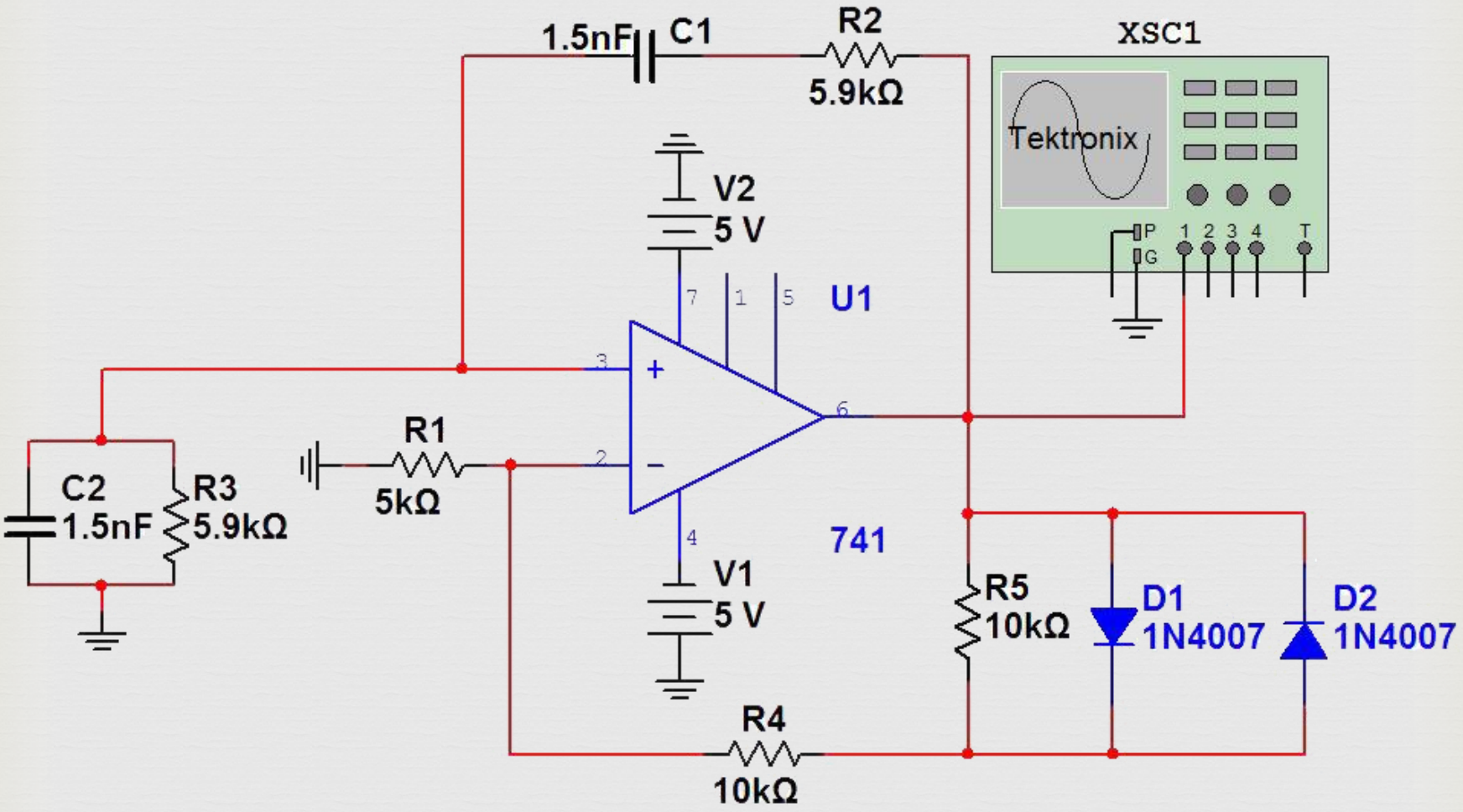
$$A_v = \frac{25}{5} = 5$$

Amplitude Stabilization

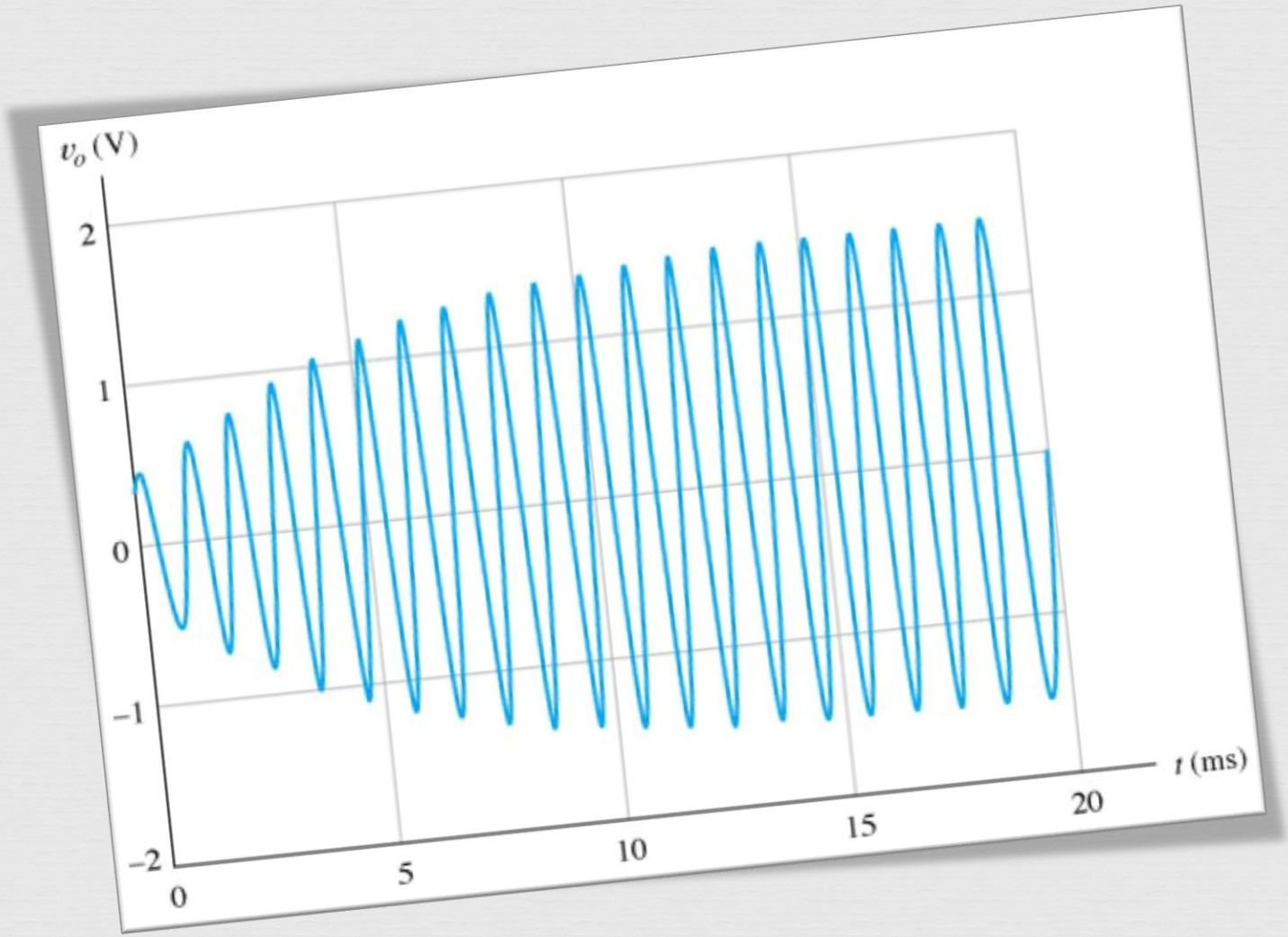
Amplitude Problem



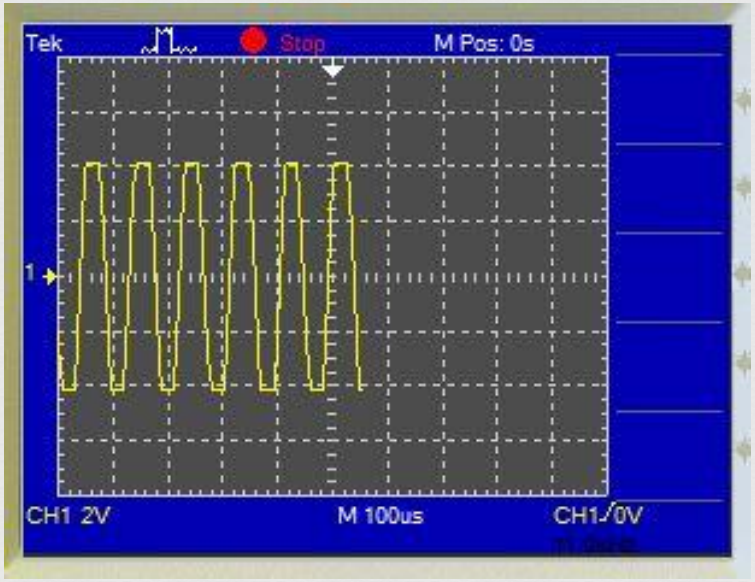
Possible Solution



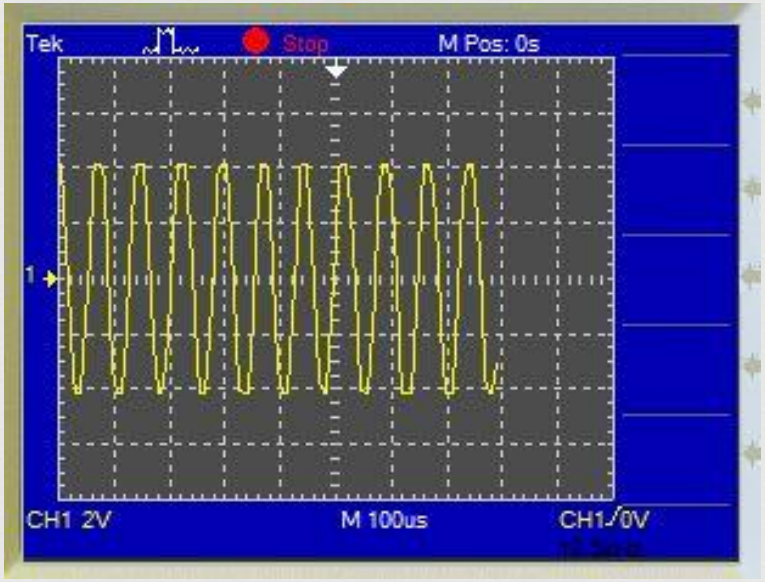
Possible Solution



Solution Result



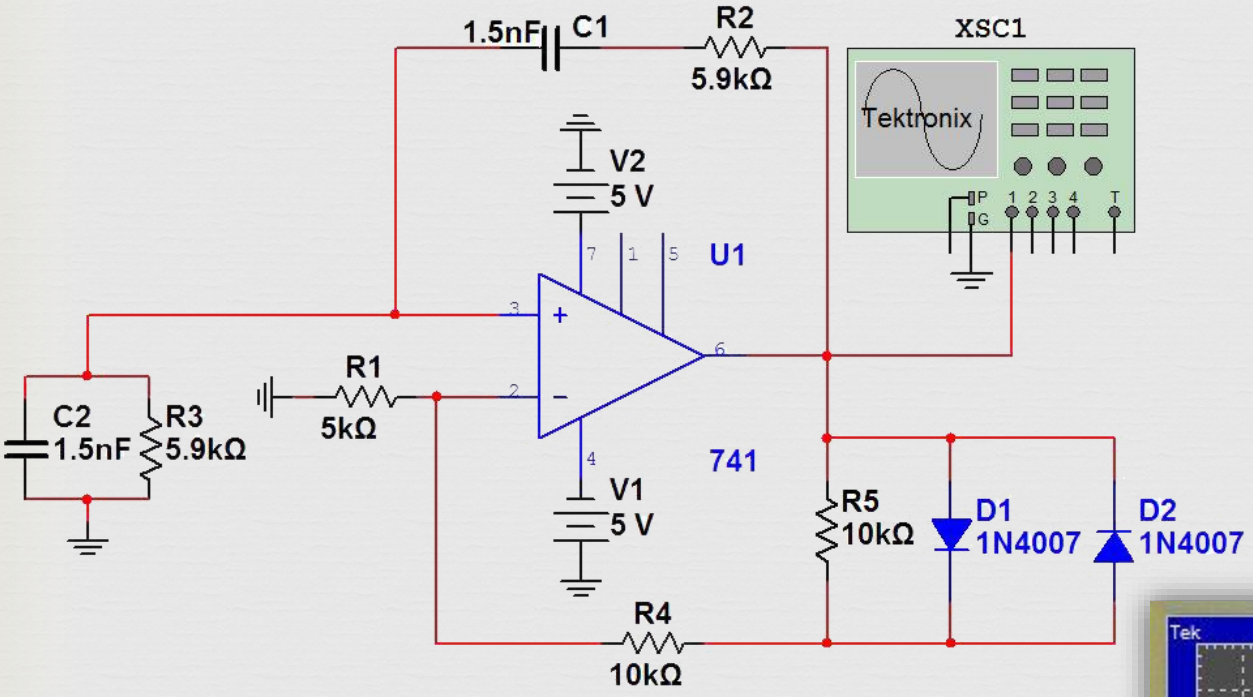
Before
(without diodes)

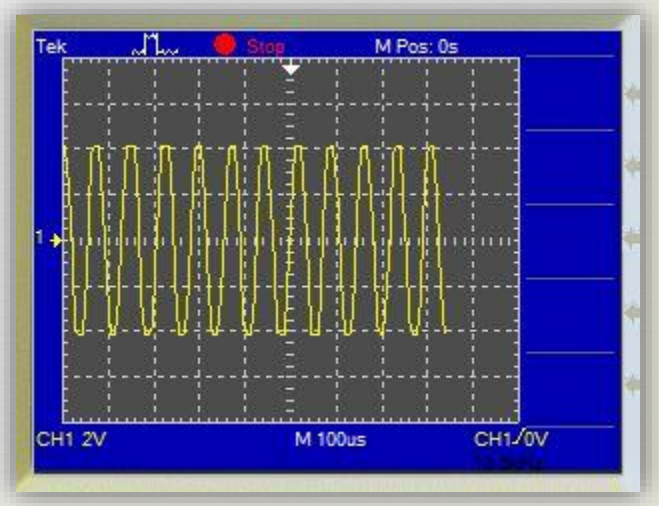


After
(with diodes)

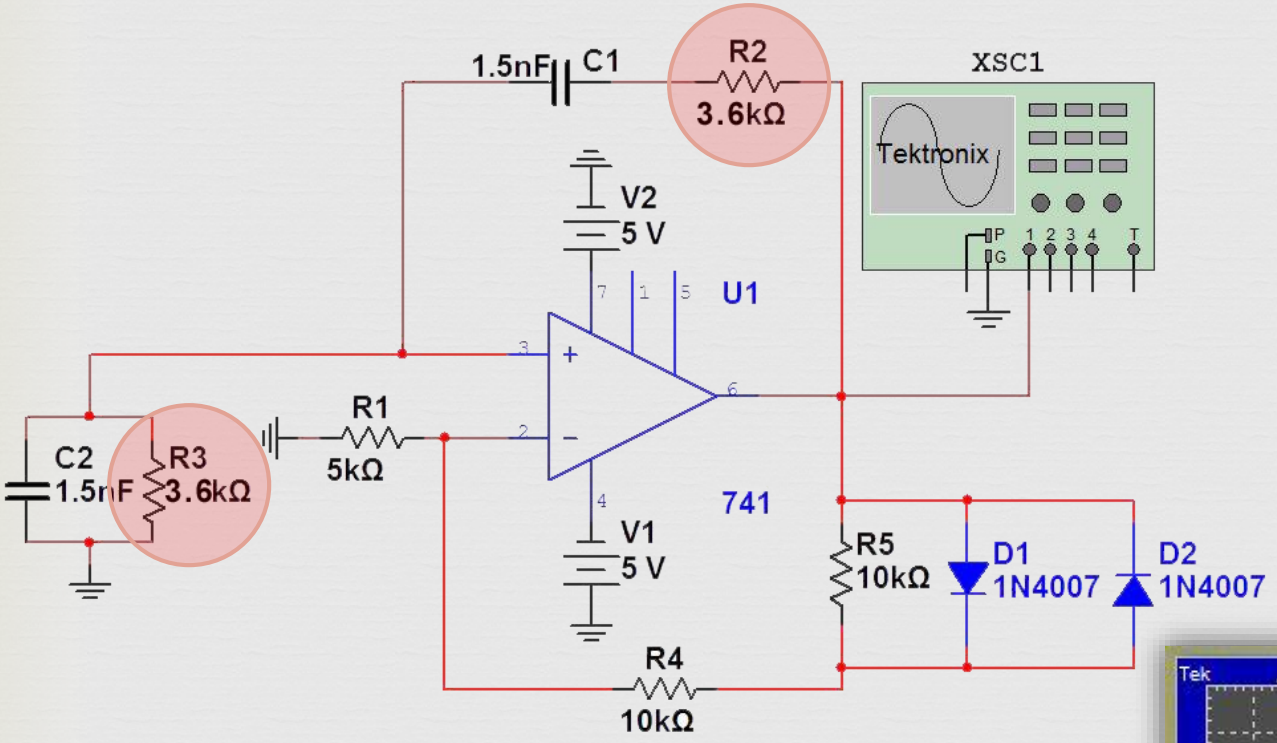
Problems Faced

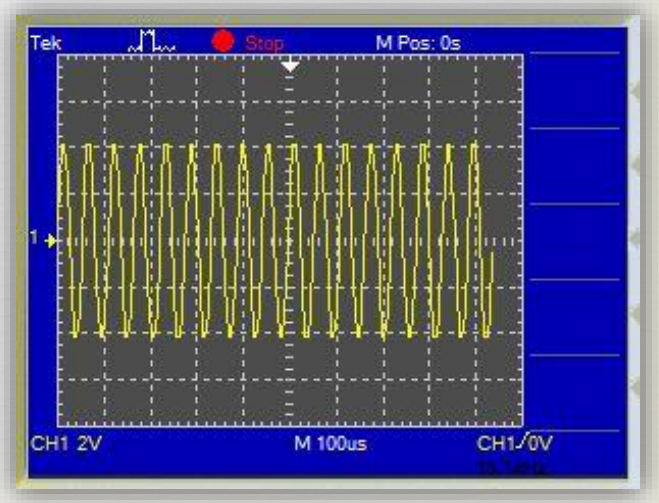
Frequency Problem





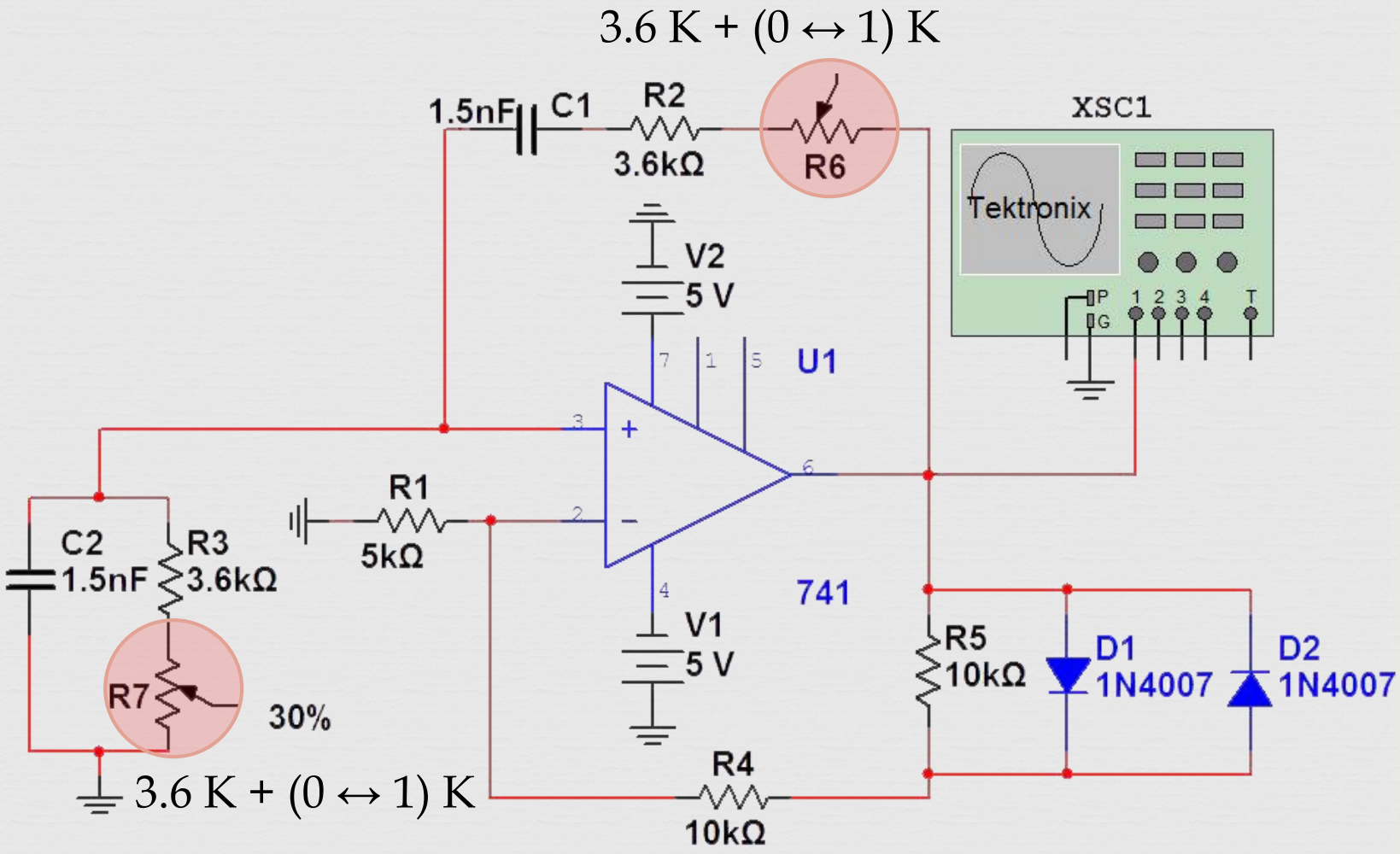
Frequency Solution



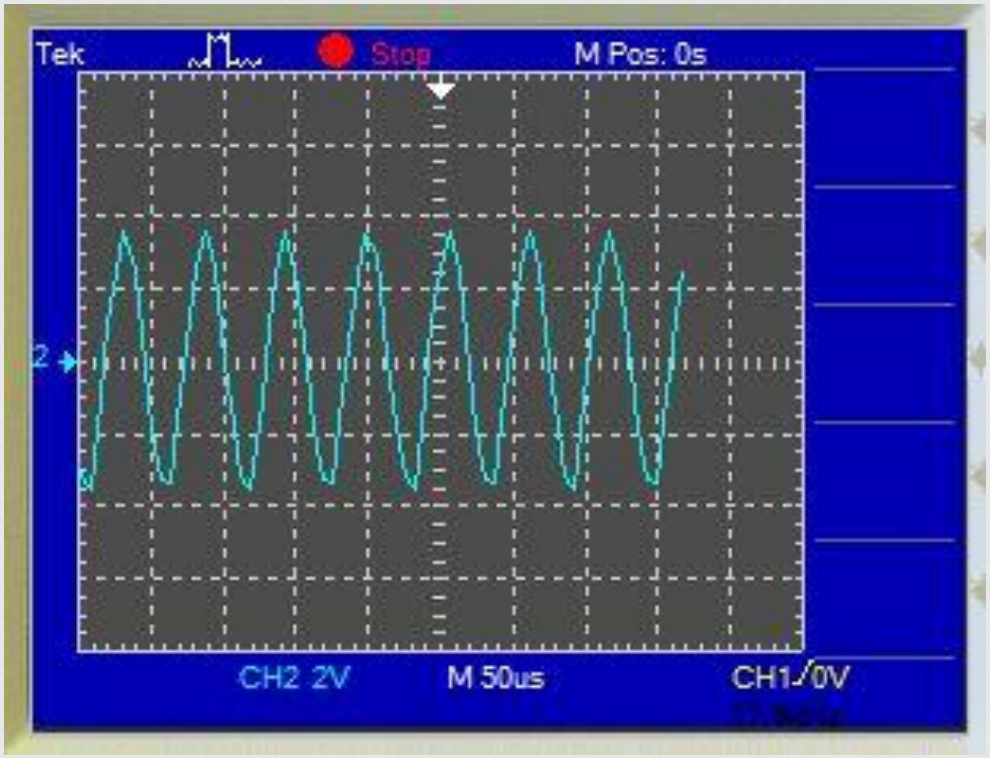


PCB and Testing

Final Circuit

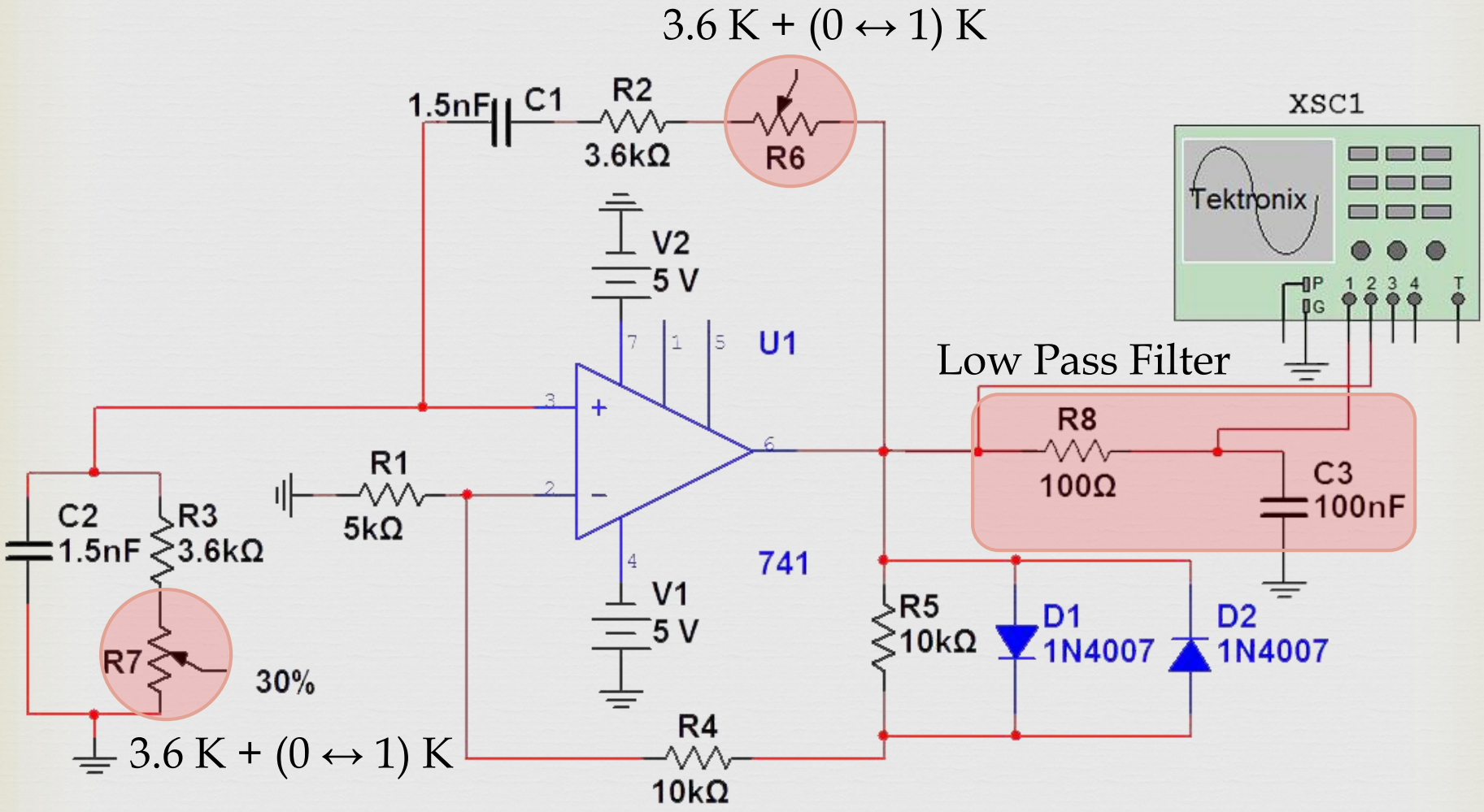


Final Circuit

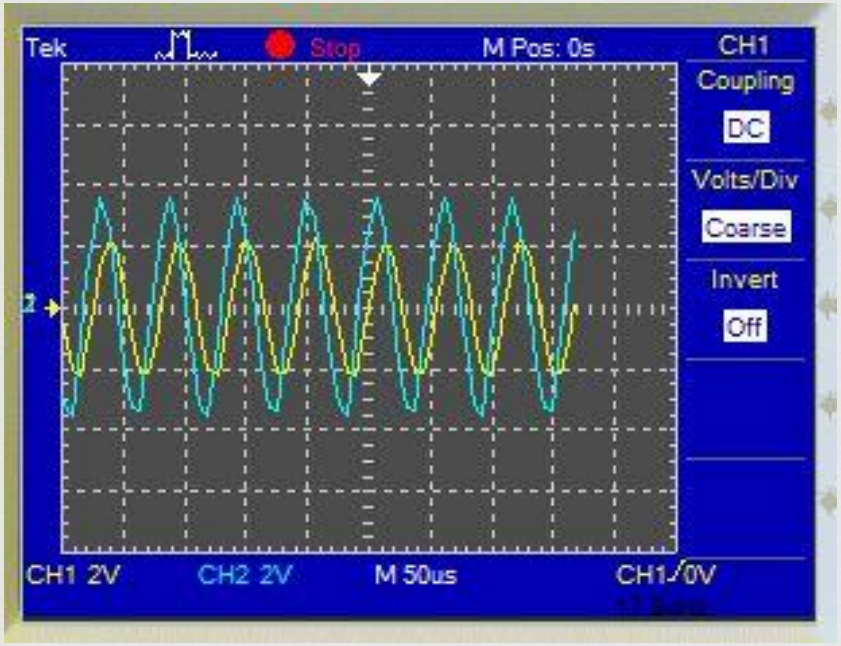


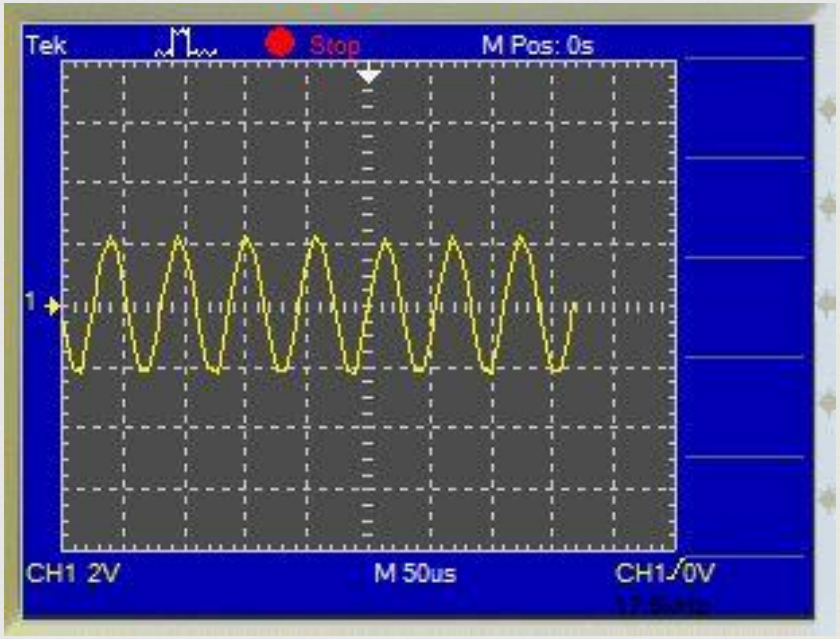
Oscilloscope Resulting Waveform

Going Further…



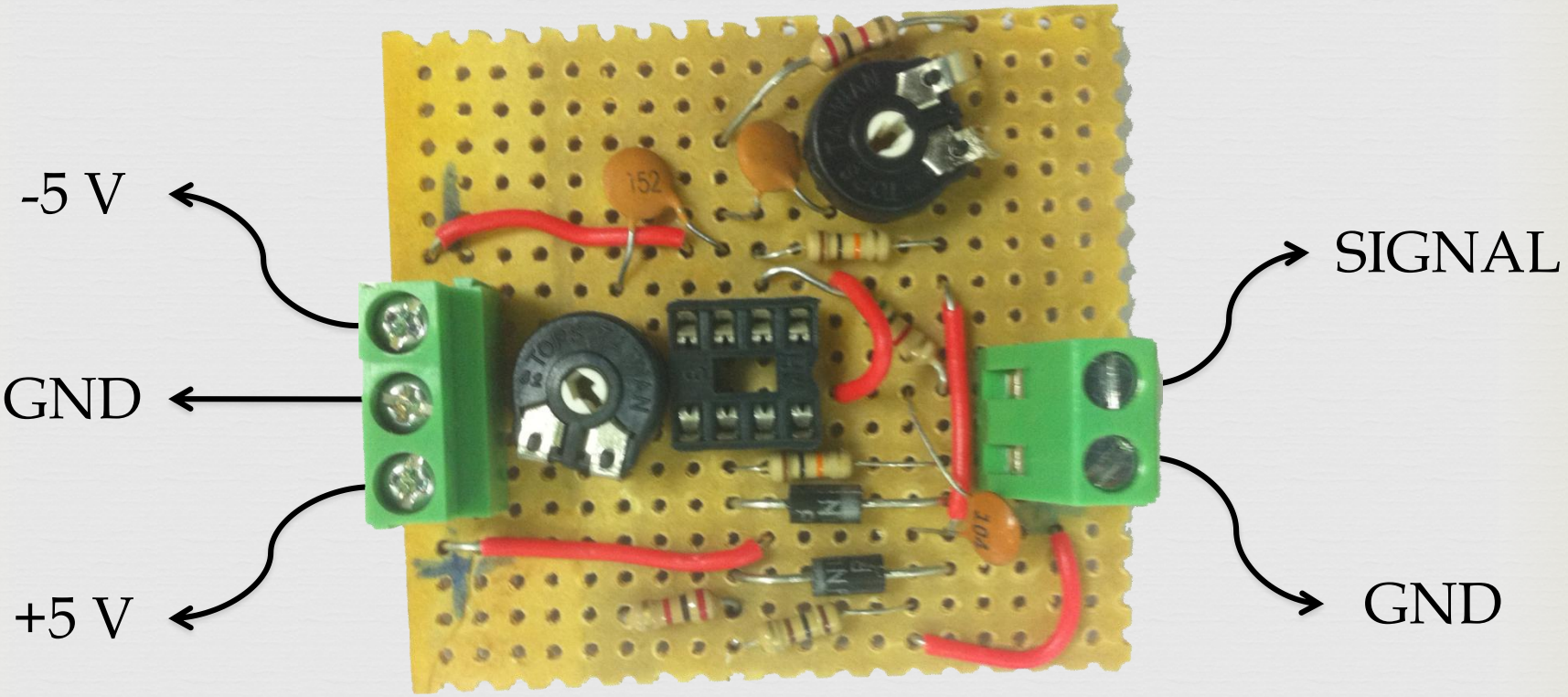
Going Further…





Blue – without low pass
Yellow – with low pass

PCB



Video Demo

Conclusion

- Low pass filter can remove the harsh edges but it consumes power from the signal.
- RC circuit as a frequency filter is good but not accurate enough, for high accuracies we can use crystal oscillator.
- Wien bridge oscillator frequency depends on the input voltage.

- MULTISIM simulates close to real components and takes into account some probabilities.
- Amplifier gain should be above 3 for an oscillation to happen.
- Distortion happens if the input voltages (-V and +V) are not equal.

Thank You