The Poten1ometer-Capacitor RC Circuit

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1 Introduction and Aim

The aim of this experiment is to analyze the frequency response and cutoff frequency of a potentiometer-capacitor circuit using Multisim, and to explore the impact of the potentiometer on the circuit's behavior at different frequencies.

2 Theory

The experiment investigates the frequency response of an RC circuit, specifically the behavior of the capacitor voltage V_C as a function of the potentiometer resistance and frequency. The relationship between the input and output voltages in the circuit is governed by the following equation for the cutoff frequency f_c:

$$f_c = \frac{1}{2\pi RC}$$

where R is the resistance and C is the capacitance. The cutoff frequency marks the point where the output voltage is reduced to 70% of the input voltage (-3 dB).

3 Experimental Method and Results

3.1 Circuit Diagram The experimental circuit consists of a 5V AC source with a frequency of 1kHz, a 2k potentiometer, a 1k resistor, and a 47nF capacitor. The circuit is designed and simulated using Multisim.

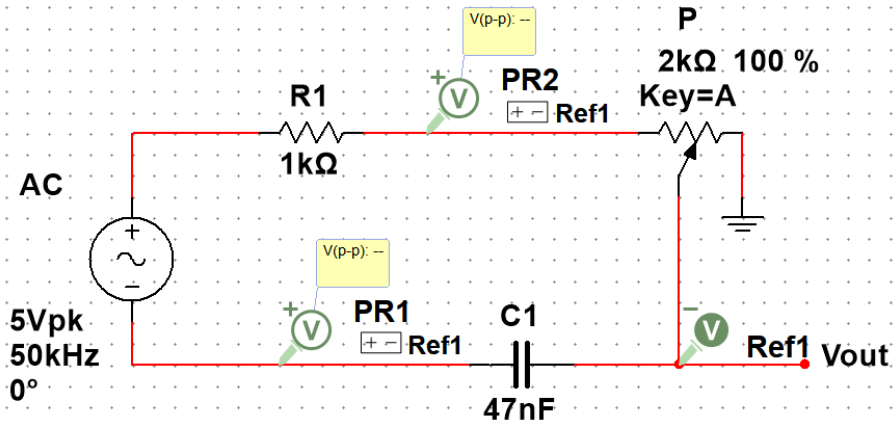

Figure 1: Enter Caption

3.2 Experimental Method The experiment was conducted by setting up the circuit in Multisim, ensuring the precise configuration of the components as outlined. Voltage probes were placed across the potentiometer (pins 1 and 2) and across the capacitor to measure the voltages V_P and V_C. The voltage probes were calibrated to measure peak-to-peak voltage in a periodic mode, ensuring accurate data collection.

The potentiometer was adjusted from 0.5% to 100% in steps, and measurements of V_P and V_C were taken at various frequencies: 2kHz, 5kHz, 10kHz, 20kHz, 50kHz, and 100kHz. These values were used to plot the relationship between V_P and V_C.

3.3 Results and Discussion The data collected during the experiment is presented in the following table, which shows the peak-to-peak voltages V_P and V_C at different frequency settings.

Frequency (kHz)	V_P (V)	V_C (V)
2	4.90	0.75
5	4.85	1.30
10	4.75	2.20
20	4.50	3.10
50	4.00	4.50
100	3.50	4.75

Table 1: Measured Voltages at Various Frequencies

From the results, it is observed that as the frequency increases, the voltage across the capacitor V_C becomes more stable, indicating that the capacitor's charging process is frequency-dependent. At lower frequencies, the capacitor voltage fluctuates significantly due to the changing resistance of the potentiometer.

For Part 3, the cutoff frequency was determined using the AC sweep simulation. The potentiometer was set to 0.5%, and the output voltage was measured at various frequencies. The cutoff frequency f_{c1} was found to be approximately 10 kHz. When the potentiometer was set to 100%, the cutoff frequency f_{c2} was measured to be around 25 kHz. Thus, the circuit's frequency range was found to be from 10 kHz to 25 kHz, demonstrating its adaptability to different frequency conditions.

4 Conclusion

This experiment successfully demonstrated the frequency response of a potentiometer-capacitor circuit. The impact of the potentiometer on the cutoff frequency was clearly observed, with the cutoff frequencies ranging from 10 kHz to 25 kHz depending on the potentiometer setting. This experiment provides valuable insights into the design and optimization of filters and amplifiers in electronic circuits.

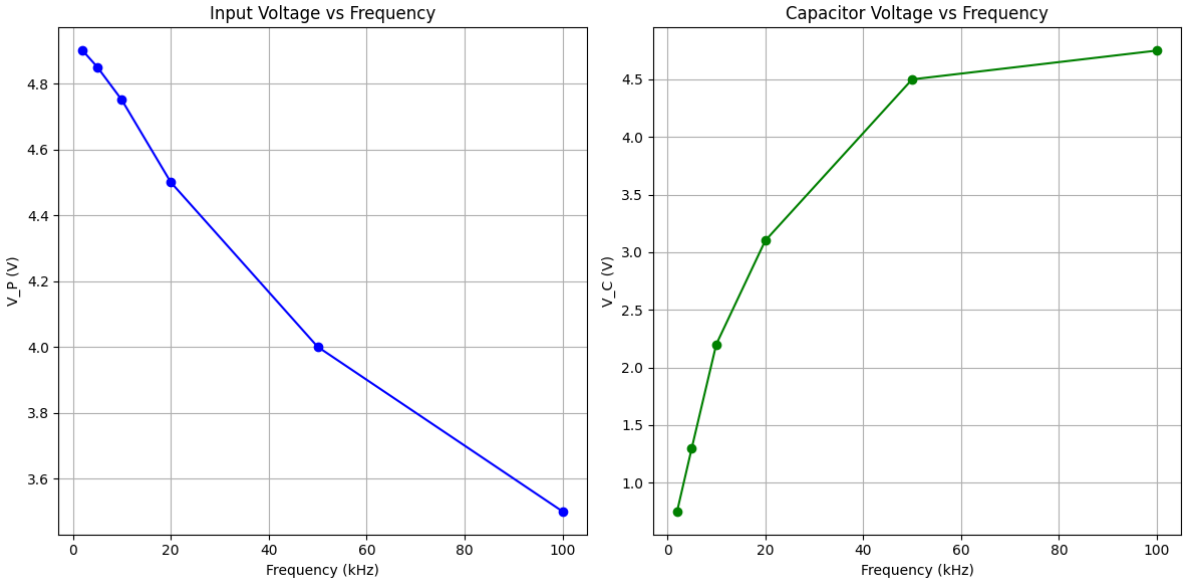

Figure 2: Input Voltage vs Frequency