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Experiment No.6
R-C parallel Circuit

1. Introduction

In a parallel R-C circuit a pure resistor having resistance in ohms and a pure capacitor of capacitance in Farads are connected in parallel.

2. Objectives

The main Objectives of this lab are: measure the current phasors for a parallel RC circuit and how the current phasors and phase angle are affected by a change in parallel RC circuits.

3. Components

- Function generator
- Oscilloscope
- Resistor
- Capacitor
- Connection wires

4. Theory:

This guide covers Parallel RC Circuit Analysis, of a resistor and capacitor connected in parallel to an AC source, as illustrated in Figure 1, is called a parallel RC circuit. The conditions that exist in RC parallel circuits and the methods used for solving them are quite similar to those used for RL parallel circuits. The voltage is the same value across each parallel branch and provides the basis for expressing any phase differences. The principal difference is one of phase relationship. In a pure capacitor the current leads the voltage by 90 degrees, while in a pure inductor the current lags the voltage by 90 degrees.

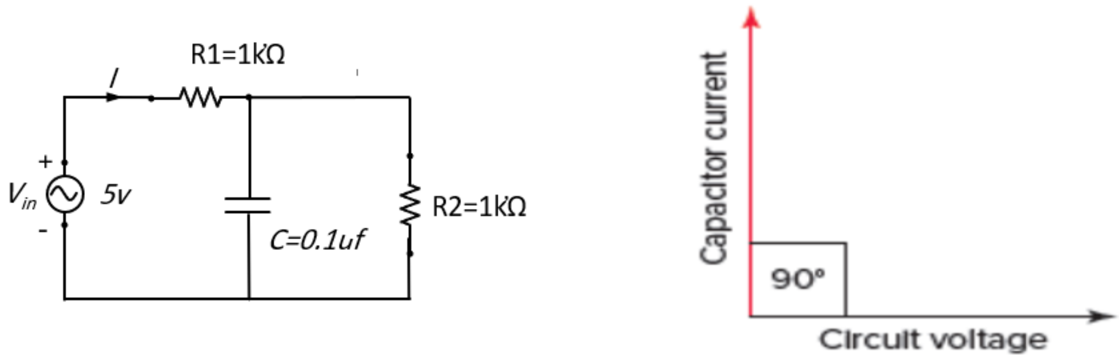

Figure 1 Parallel *RC* circuit.

The **current through the resistor (I_R)** is:

$$I_R = \frac{V}{R}$$

The **Current through the capacitor (I_C)** is:

$$I_C = \frac{V}{X_C}$$

The vector addition of I_R and I_C gives a resultant that represents the total (I_T) use individual branch currents:

$$I_T = \sqrt{{I_R}^2 + {I_C}^2}$$

The **impedance (*Z*)** of a parallel *RC* circuit is similar to that of a parallel *RL* circuit and is summarized as follows:

- Impedance can be calculated directly from the resistance and capacitive reactance values using the equation

$$Z = \frac{RX_C}{\sqrt{R^2 + X_C^2}}$$

- Impedance can be calculated using the Ohm's law equation

$$Z = V_T / I_T$$

- The impedance of a parallel *RC* circuit is always less than the resistance or capacitive reactance of the individual branches.

The relationship between the voltage and currents in a parallel *RC* circuit (θ) is illustrated in the vector (phasor) diagram of Figure **2** and summarized as follows:

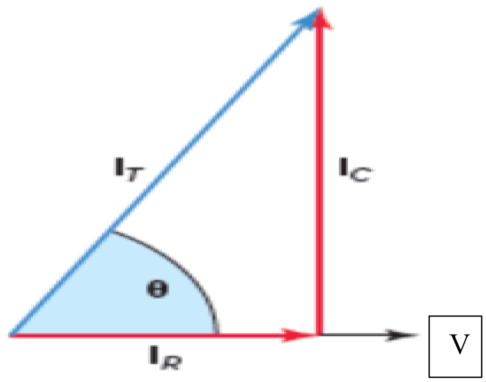

Figure 2 Parallel *RC* circuit (phasor) diagram

In a parallel *RC* circuit, the ***line current leads the applied voltage*** by some phase angle less than 90 degrees but greater than 0 degrees. The exact angle depends on whether the capacitive current or resistive current is greater. If there is ***more capacitive current, the angle will be closer to 90 degrees,*** while if the resistive current is greater, the angle is closer to 0 degrees.

The value of the phase angle can be calculated from the values of the two branch currents using the following equation:

$$\theta = \tan^{-1}\frac{I_C}{I_R}$$

5. Experiment procedure

1- Build, connect the circuit shown in Fig. 1 using a 1kΩ resistor, a 0.1 µf capacitor.

2- Set the input voltage at 5V and frequency at 500Hz………3000Hz.

3- Using the Oscilloscope, read the voltage across the 1kΩ resistor 0.1µf capacitor and I_{R1}, I_{R2}, I_C, I_T, Z_T and θ.

4- Change the input frequency from 500Hz to 1000Hz, 1500Hz, 2000Hz, 2500Hz and 3000Hz.

5- Repeat step 3, measuring the voltage across the 1kΩ resistor 0.1µf capacitor and I_{R1}, I_{R2}, I_C, I_T, Z_T and θ.

6- Write down all the measured and calculated values.

6. Discussion

1- What happens if a resistor and capacitor are in parallel?

2- What is parallel resistor?

3- What is RC in electrical?

4- What are some applications of RC parallel circuits?

5- What does a resistor do in an RC parallel circuit?