ECE 182 Lab #5 Real and Reactive Power
Day of Submission: 10/03/2025
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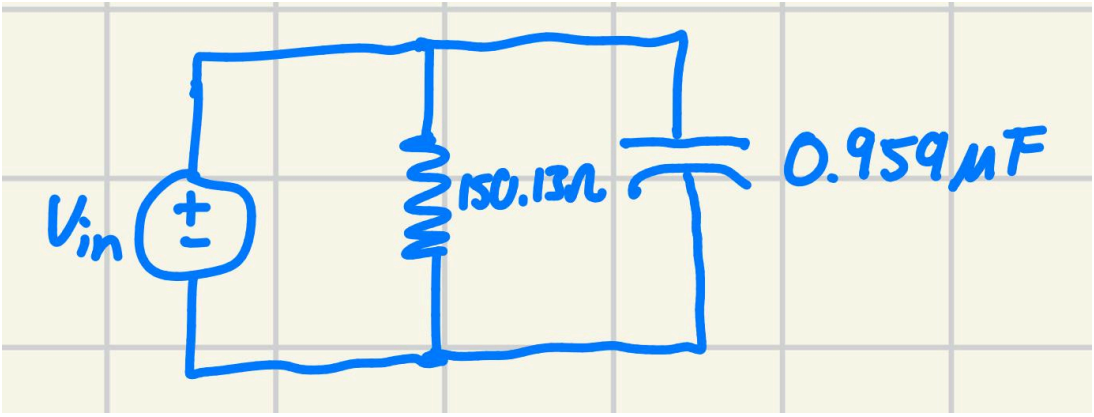
Circuit and Schematic



Theoretical vs Experimental

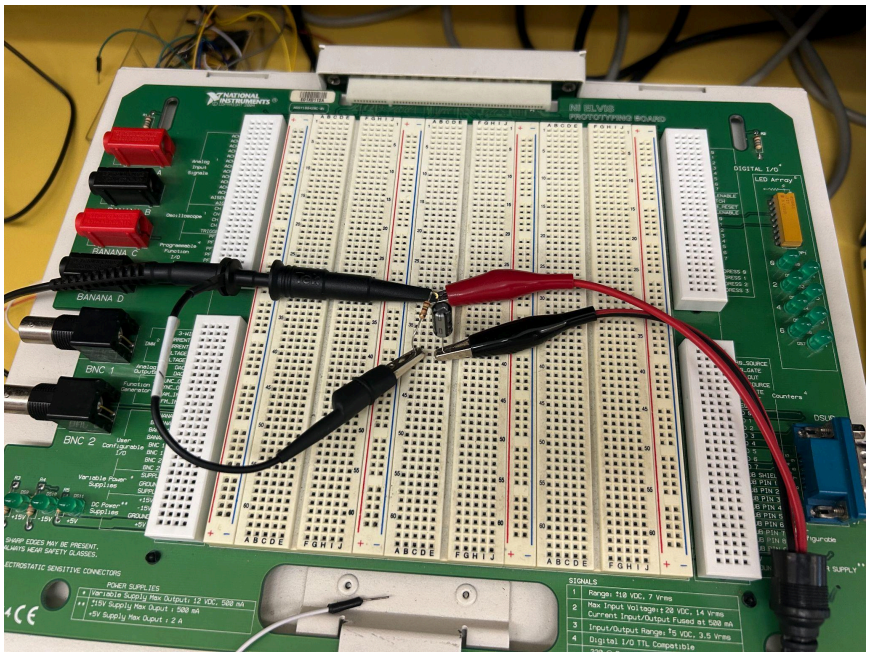
- R1: 150 ohms vs 150.13 ohms
- C1: 1 microfarad vs 0.959 microfarad
- IR: 6.66 mA vs 1.31 mA
- IC: 3.012 mA vs 0.08mA

Equations for Theoretical Basis

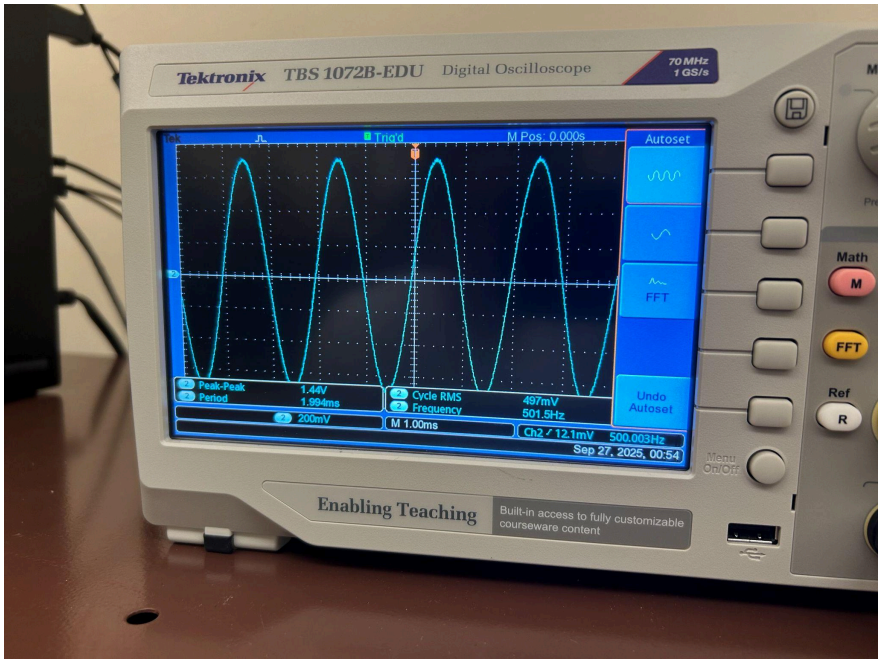
There are multiple equations, so they will be included in the calculations section.

Results and Calculations

Circuit on breadboard

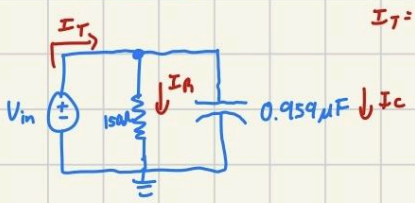


Output Waveform



Calculations

Lab 5



$I_T = I_R + I_C$

$V_{in} = 1V \Rightarrow 500Hz$ $\quad \omega = 2\pi f$ $\quad \omega = 2\pi(500)$ $\quad \omega = 1000\pi$

$V(t) = V_m \cos(\omega t + \phi)$

$V(t) = 1V \cos(1000\pi t + 0)$

$V(t) = 1V \cos(1000\pi t)$

$V_L = 1\angle 0°$

$I_R = \frac{V_{in} - 0}{Z_R}$ $\quad I_C = \frac{V_{in} - 0}{Z_C}$

$I_R = \frac{1\angle 0°}{150.13}$ $\quad I_C = \frac{1\angle 0°}{-j331.92}$

$I_R = \frac{1\angle 0°}{150.13\angle 0°}$ $\quad I_C = \frac{1\angle 0°}{331.92\angle -90°}$

$I_R = 6.66\angle 0°\,mA$ $\quad I_C = 3.012\angle 90°\,mA$

$V_R = I_R \cdot 150.13\angle 0°$

$V_R = 6.66mA\angle 0° \cdot 150.13\angle 0°$

$V_R = 0.99V\angle 0°$

$V_C = I_C \cdot 331.92\angle -90°$

$V_C = 3.012mA\angle 90° \cdot 331.92\angle -90°$

$V_C = 0.99V\angle 0°$

$I_R\angle 0° = 6.66mA\angle 0°$

$I_C\angle 0° = 3.012mA\angle 90°$

$(6.66 + j0) + (0 + j3.012) = 6.66 + j3.012mA$

$|I_T| = \sqrt{(6.66)^2 + (3.012)^2} = 7.30$ $\quad \angle I_T = \tan^{-1}\left(\frac{3.012mA}{6.66mA}\right) = 24.33°$

$I_T = 7.30mA\angle 24.33°$

measured: $R_1 = 150.13\,ohm$

measured: $C_1 = 0.959\mu F$

measured: $I_R = 1.31mA$

measured: $I_C = 0.08mA$

$Z_T = \frac{V}{I_T} = \frac{1\angle 0°}{7.30mA\angle 24.33°} = 136.99\Omega\angle -24.33°$

Real Power: $P = V \cdot I_T \cdot \cos(\theta)$

$P = 1V \cdot 7.30mA \cdot \cos(-24.33)$

$P = 6.65mW$

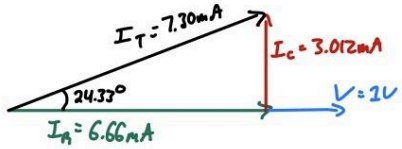
Reactive Power: $P = V \cdot I_T \cdot \sin(\theta)$

$P = 1V \cdot 7.30mA \cdot \sin(-24.33)$

$P = -3.00mW$

$V_L\angle 0$	$I_R\angle \vartheta$	$I_C\angle \delta$	$I_L\angle \varphi$	Real power	Reactive power
$1V\angle 0°$	$6.66mA\angle 0°$	$3.012mA\angle 90°$	$7.30mA\angle 24.33°$	$P = 6.65mW$	$P = -3.00mW$

Phasor diagram



Summary

In this lab, we analyzed the real and reactive power of an RC load using both theoretical calculations and experimental results. The results showed deviations between the expected and measured values, this is largely due to the component tolerances/error. The phasor diagram and current measurements confirmed the angular relationships between voltage, resistor current, and capacitor current. Overall, the experiment successfully demonstrated the concepts of real and reactive power in AC circuits and highlighted the differences between theoretical and experimental data.