Students must complete all details except the faculty use part.

Title

Analysis of RLC parallel circuit and verification of KCL in AC circuits.

Objectives

The objectives of this experiment are -

1) To determine phase relationship between I_L and I_C in a RLC Parallel circuit.
2) Draw the complete vector diagram for a RLC parallel circuit.
3) Verification of KCL in AC circuits.

Theory

In ac circuits, admittance Y is equal to $1/Z$. The unit of admittance in SI system is Siemens. Admittance is a measure of how well an ac circuit will allow current to flow in the circuit. The larger its value, the heavier the current flow for the same applied potential. The total admittance of a circuit can also be found by finding the sum of parallel admittances.

The equation is like as follows

$$Y_T = Y_1 + Y_2 + Y_3 + \ldots + Y_n$$

since $Y = \frac{1}{Z}$

$$\frac{1}{Z_T} = \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3} + \ldots \frac{1}{Z_n}$$

The reciprocal of reactance ($1/X$) is called susceptance and is a measure of how susceptible an element is to the passage of current through it.

For inductor,

$$Y_L = \frac{1}{Z_L} = \frac{1}{X_L \angle 90^\circ} = \frac{1}{X_L} \angle -90^\circ$$

For capacitor,

$$Y_C = \frac{1}{Z_C} = \frac{1}{X_C \angle -90^\circ} = \frac{1}{X_C} \angle 90^\circ$$

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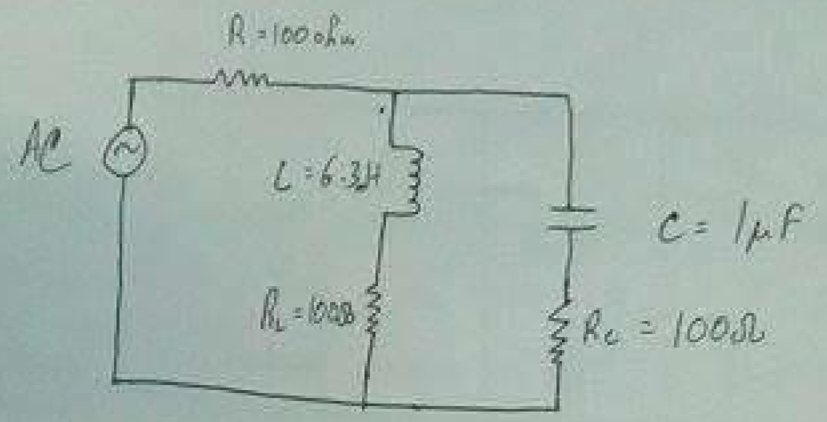

Fig: RLC parallel circuit

In the circuit above the total Current I will divide into I_L and I_c in the parallel branches. Applying KCL $I = I_L + I_c$.

Apparatus

1. Oscilloscope
2. Function generator
3. Resistor : 100 Ω (3)
4. Inductor : 6.3 mH
5. Capacitor : 1 μF
6. Connecting wire
7. Bread board

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Results

f/kHz	E	I_L	θ_L	I_C	θ_C	I_L+I_C	I
1	10_{p-p}	0.050	-28.8°	6.91×10^{-3}	50.4°	0.0691	
2	10_{p-p}	0.020	-36°	0.020	36°	0.040	
4	10_{p-p}	7.58×10^{-3}	-28.8	0.05	28.8°	0.05[illegible]	

Calculations:

For 1 kHz

$V_L = 2\,V_{p-p}\angle -28.8$

$X_L = 2\pi f L = 2\pi(1\times10^{3})(6.3\times10^{-3}) = 39.58\,\Omega$

$I_L = \frac{V_L}{X_L} = \frac{2}{39.58}\angle -28.8 = 0.050A\angle -28.8^\circ$

$V_C = 1.1\,V_{p-p}\angle 50.4$

$X_C = \frac{1}{2\pi f C} = 159.15\,\Omega$

$I_C = \frac{V_C}{X_C} = \frac{1.1}{159.15}\angle 50.4 = 6.91\times10^{-3}A\angle 50.4$

For 2 kHz:

$V_L = 1.6\,V_{p-p}\angle -36$

$V_C = 1.6_{p-p}V\angle 36$

$I_L = \frac{V_L}{X_L} = \frac{1.6\angle -36}{2\pi f L} = \frac{1.6}{2\pi(2\times10^{3})(6.3\times10^{-3})}\angle -36 = 0.0202A\angle -36$

$I_C = \frac{V_C}{X_C} = \frac{1.6\angle 36}{1/2\pi f C} = \frac{1.6\angle 36}{1/2\pi\times(2\times10^{3})\times(1\times10^{-6})} = 0.0201A\angle 36$

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For 4kHz:

$I_L = \frac{V_L}{X_L}$ $\quad I_C = \frac{V_C}{X_C}$

$V_L = 1.2V_{p-p} \angle -28.8$

$V_C = 2V_{p-p} \angle 28.8$

$X_L = 2\pi(4\times10^3)(6.3\times10^{-3}) = 158.3\,\Omega$

$X_C = \left\{2\pi(4\times10^3)(1\times10^{-6})\right\}^{-1} = 40\,\Omega$

$I_L = \frac{1.2\angle -28.8}{158.3} = 7.58\times10^{-3}A\angle -28.8^\circ$

$I_C = \frac{2\angle 28.8}{40.0} = 0.05A\angle 28.8^\circ$