AC CIRCUITS : RC CIRCUIT

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1. Aim

1. To study current voltage relationships
2. To study variation of reactance of the capacitor with frequency of the AC source hence determine the capacitance value
3. To draw the phasor diagram and hence determine the loss factor of capacitor

2. Theory

The RC circuit consists of a Capacitor and a Resistor connected in series supplied by a AC power supply in form of a Function Generator. As the applies signal is sinusoidal the current in each element is also sinusoidal, but are not in phase.A series combination of a resistor R and capacitor C if connected to AC source of angular frequency and RMS voltage V, the RMS current flowing in the circuit is given by $I = V_R/R$, where V_R is the voltage across the resistor. If V_C is the RMS voltage across the capacitor, then $V_C = Z_C I$ also $C = 1/(2\pi f X_C)$.

The voltageacrosss an ideal capacitor lags the current by 90^o, but naturally there are losses in the dielectric between the capacitor plates and a small deviation in angle occurs δ, called loss angle. Loss Factor is defined as $D = \tan\delta$. δ can be got by drawing a phasor diagram.

3. Procedure

As said earlier connect the circuit with a Capacitor and a Variable Resistance Box in series suplied by a AC source, here a Function Generator. We can observe theoutputt voltage across the whole circuit andacrosss the Resistor in the two channels of an oscilloscope. We fix a value of input frequency and vary resistance. We note down the V and V_R. We do the same for various frequencies of input signal. From this we can get the V-I relationships, determine the Reactance of the Capacitor.

4. Observations and Results

S.No	V	Voltage across resistor V_R	Resistance R Ω
frequency=1.1kHz			
1	0.69	0.03	0
2	0.73	0.18	1
3	0.79	0.32	2
4	0.86	0.46	3
5	0.96	0.61	4
6	1.04	0.73	5
frequency = 1.814kHz			
1	0.44	0.03	0
2	0.5	0.19	1
3	0.59	0.33	2
4	0.68	0.47	3
5	0.8	0.61	4
6	0.92	0.74	5
frequency=2.395kHz			
1	0.35	0.03	0
2	0.42	0.18	1
3	0.53	0.32	2
4	0.64	0.45	3
5	0.76	0.60	4
6	0.84	0.72	5
frequency=3.574kHz			
1	0.26	0.03	0
2	0.36	0.18	1
3	0.48	0.32	2
4	0.60	0.46	3
5	0.72	0.61	4
6	0.84	0.74	5

We can see that the Voltage increases as Resistance increases. The relationship is linear between V and I in each component. From the above data Z_C can be calculated and the Capacitance is found to be $C = 31.2\mu F$.