Experiment 6: Measuring fluorescent lamp circuit and improving the circuit power factor

1. Purpose

a) Study the relationship between voltage phaser and current phaser in Sinusoidal steady-state AC circuit.

b) Know the mechanism of fluorescent lamp circuit, and master the method to connect fluorescent wires.

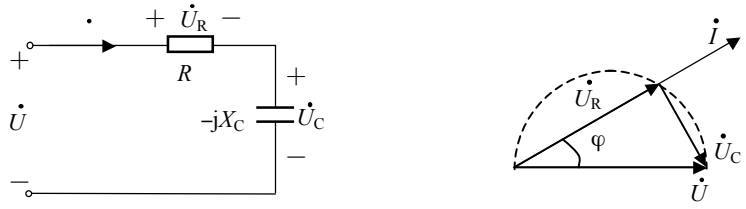
c) Know the meaning and method of improving circuit power factor.

2. Contents and Steps

A. RC phase shift circuit

a) Assemble two parallel incandescent bulbs (220V, 15W) and 4.7μf/450V capacitors into a circuit, as shown in Figure 3-8-1a. The handle of self-coupling voltage regulator should be set to zero before connecting to the power. Steadily increase the regulator output to 220V, after connecting power. Measure the values of U, U_R, U_C by the Voltmeter, and record the experimental data in table 3-8-1.

b) Use only one bulb，repeat the experiment a)，and record the experimental data in table 3-8-1。



(a) Series *RC* Circuit (b) Vector diagram

Figure 3-8-1 RC phase-shifting circuit.

Table 3-8-1 The data of verifying voltage triangular relationship of sinusoidal steady-state circuit

Number of incandescent lamps	Measured value			Calculated values	
	U (V)	U_R (V)	U_C (V)	U (V)	φ
2					
1					

B．Fluorescent lamp circuit and the improvement of power factor

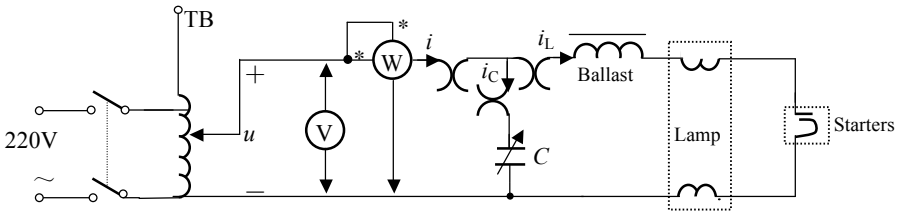


Fig 3-8-2 The experimental fluorescent lamp circuit and the improvement of power factor.

Connect the electric elements (switch off capacitor, i.e., the capacitor is not connected to the circuit), as shown in Figure 3-8-2, put the self-coupling voltage regulator in front of the power，the handle should be set to zero. Increase the regulator output to 220V gradually, after connecting power. Observe the situation and phenomenon of the fluorescent lamp's starting.

a) Measure the current I, voltage U, power P and the power factor cosφ, the ballast voltage U_L, the lamp voltage U_A, the ballast power P_L and the and the power factor $\cos\varphi_L$, under the situation of no parallel capacitor, record the experimental data in table 3-8-2。

Table3-8-2 The data of measuring the fluorescent lamp circuit

	P(W)	cosφ	P_L(W)	$\cos\varphi_L$	I(A)	U(V)	U_L(V)	U_A(V)
Normal operating values								

b) Parallelly connect a capacitor C with different values of capacitance, as shown in table 3-8-3，Increase the power factor steadily until the circuit turns to be capacitive。Measure the total power P, voltage U, current I, and power factor cosφ of the load, and lamp current I_L, the capacitor current I_C, for different values of C, record the experimental data in table 3-8-3.

Table 3-8-3 The data of relationships between luorescent lamp circuit power factor and the capatance of the parallelly connected capacitor

Capacitance value (μf)	P (W)	U (V)	I (A)	I_L (A)	I_C (A)	cosφ
0						
1						
2.2						
3.2						
4.7						
5.7						
6.9						

3. Questions

(1) In daily life, when there is no starter in the fluorescent, people often use a wire to connect both ends of a starter, then quickly disconnect to lighten the fluorescent; or lighten more than one fluorescent of the same type with only one starter, why?

(2) In order to improve the power factor of circuit, we often connect the inductive load with a capacitor in parallel, which means we add a new current branch, then does the total current of the circuit increase or decrease? And do the current and power on inductive element change?

(3) Why do we use the parallel, but not the series, capacitor method to improve the power factor of the circuit? Do the larger capacitance of the capacitor help us to get better result?

4. Writing Your Report

(1) Complete the calculation in the Table 3-8-1。

(2) Plot the voltage phasor diagram according to the data in Table 3-8-1 to verify the KVL of phasor form.

(3) Select data from the table 3-8-2 with nonzero parallelly connected capacitor C, plot the current phasor diagram, and verify the KCL of phasor form.

(4) Draw the relationship between the power factor and the parallelly connected capacitor C, $\cos\varphi = f(C)$.

(5) Answer the questions.