PE 18

Power Triangle

(Updated 30 OCT 2008)

A Practical Exercise Name:_____ Section: _____

I. Purpose.

1. Review the computation of the total impedance for AC series/parallel circuits.
2. Review the application of Kirchhoff's current law and the current divider rule to AC series/parallel circuits
3. Introduce the determination of real, reactive and apparent power to a load.

II. Equipment.

Agilent 34401A Digital Multimeter (DMM)
Oscilloscope
Function Generator
220-Ω resistor
1-mH inductor
100-Ω resistor

III. Preparation.

IV. Lab Procedure.

You must **read** and complete each step.

Step One: Real and Reactive Power

☐ Compute the total impedance as seen by the ac power source, e(t) = 5 sin{2 π (20kHz)t}, of the ac series/parallel circuit in Figure 1.

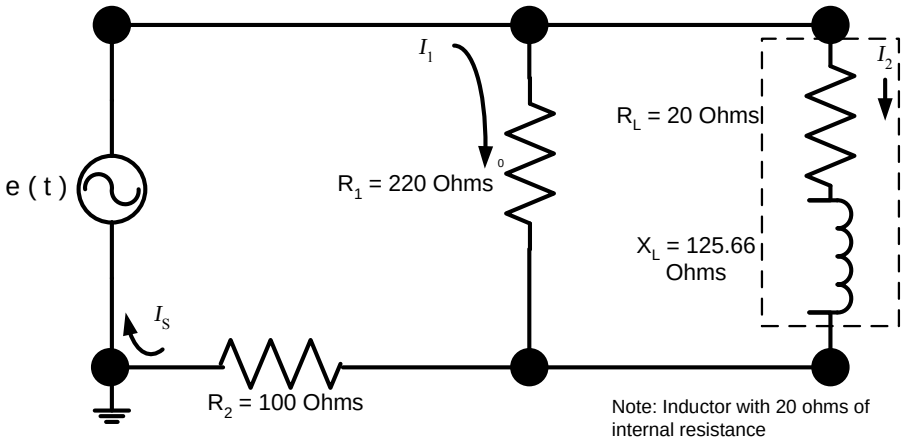

Figure 1

$\mathbf{Z_T}$ = _____

☐ Using Ohm's law and your predicted total impedance ($\mathbf{Z_T}$), calculate the current supplied by the ac power source for e(t) = 5 sin{2 π (20kHz)t}.

$$\boldsymbol{I_S} = \_\_\_\_\_$$

☐ Using the current divider rule calculate each branch current.

$$\boldsymbol{I_1} = \_\_\_\_\_ \quad \boldsymbol{I_2} = \_\_\_\_\_$$

☐ Calculate the real and reactive power of the individual circuit elements in the AC circuit.

$$\mathbf{P_{R1}} = \_\_\_\_\_$$

$$\mathbf{P_{R2}} = \_\_\_\_\_$$

$$\mathbf{P_L} = \_\_\_\_\_$$

$$\mathbf{Q_L} = \_\_\_\_\_$$

Step Two: Power Triangle

☐ Determine the total apparent power (VA) delivered to this circuit.

$$\mathbf{S_T} = \_\_\_\_\_$$

☐ In the space provided below sketch the predicted power triangle.

Is the power factor leading or lagging? _____

Step Three: Construct an AC series/parallel circuit

☐ On a QUAD board construct the ac series/parallel circuit in Figure 1

☐ Set the function generator to be a sine wave with 10 V_{PP} at 20 kHz.

☐ Connect your oscilloscope so that CH 1 will measure the ac voltage source and CH 2 will measure the ac voltage across the 100-Ω resistor.

☐ Use a DMM to measure the output of the function generator. Adjust the function generator amplitude until the DMM displays 3.54 V_{RMS}.

> Note:
> The function generator voltage output decreases when it is attached to a circuit. The voltage indication on the function generator will not match the actual voltage output. You must adjust the function generator output based upon a DMM reading.

☐ Using your oscilloscope, determine the ac voltage across the 100-Ω resistor and express your answer in phasor form.

$$\mathbf{V_{100\Omega}} = \_\_\_\_\_$$

☐ Use your measured value for $\mathbf{V_{100\Omega}}$ to determine $\boldsymbol{I_S}$.

$$\boldsymbol{I_S} = \_\_\_\_\_$$

Step Four: Calculating Real, Reactive, and Apparent power.

☐ Using your actual AC voltage source and the current that you determined in Step 3, calculate the measured real, reactive and apparent power dissipated by the circuit. Note that $S_T=V_{RMS}I_{RMS}$; θ_Z is the angle of your total impedance, as well as the angle between your source voltage and source current; $P_T = V_{RMS}\, I_{RMS} \cos(\theta_Z)$; and $Q_T = V_{RMS}\, I_{RMS} \sin(\theta_Z)$.

P_T = _____

Q_T = _____

S_T = _____