

# Lab 4 - Results: Phasors and AC Power

ECE209: *Fundamentals of Electrical Engineering*

| Name | Student ID | CCID | Lab Section |
|------|------------|------|-------------|
|      |            |      |             |
|      |            |      |             |
|      |            |      |             |

Pre-lab Sign-off: \_\_\_\_\_ Results Sign-off: \_\_\_\_\_

## Function Generator – ( $Z_{OUT}$ )

| Resistor Load – Decade Box |               |                           |    |                       |       |
|----------------------------|---------------|---------------------------|----|-----------------------|-------|
| Resistance - ( $\Omega$ )  | Open          | 100                       | 50 | 20                    | Short |
| $V_{OUT} - (V^{RMS})$      |               |                           |    |                       |       |
|                            |               | Capacitor Load - $1\mu F$ |    | Inductor Load – 2.5mH |       |
| $f_{@50\Omega}$            | (kHz)         |                           |    |                       |       |
| $V_{OUT}$                  | ( $V^{RMS}$ ) |                           |    |                       |       |
| $f_{VOUT}$                 | (kHz)         |                           |    |                       |       |

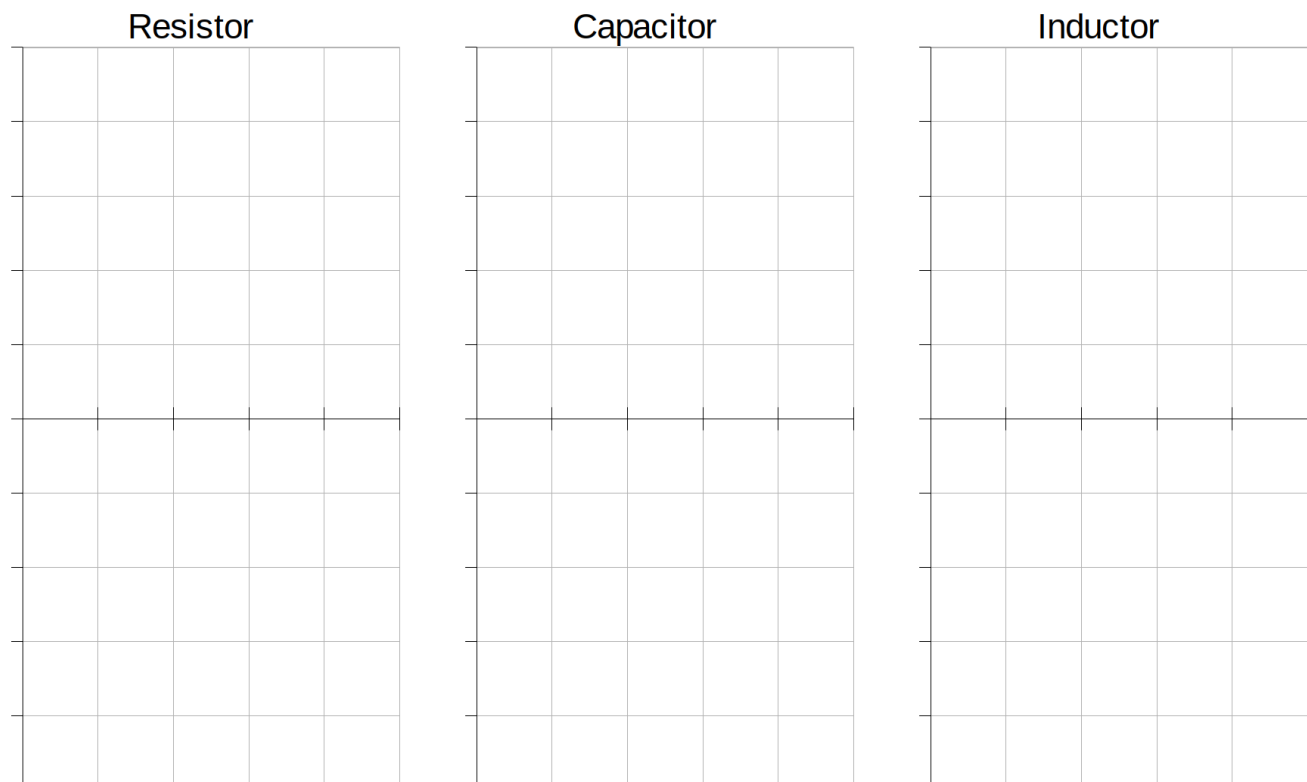
## Scope vs. DMM – ( $RMS$ )

| Attenuation               |               | 1   | 0.707 | 0.5 | 0.25 |
|---------------------------|---------------|-----|-------|-----|------|
| $V_{OUT} - \text{Calc} -$ | ( $V^{RMS}$ ) | -   |       |     |      |
| $V_{OUT} - \text{DMM}$    | ( $V^{RMS}$ ) |     |       |     |      |
| $V_{OUT} - \text{Scope}$  | ( $V^{RMS}$ ) |     |       |     |      |
| f                         | (kHz)         | 1.0 |       |     |      |

## Phasors and AC Power - (RCL)

|                  |                   | Resistor - $200\Omega$ | Capacitor - $1\mu\text{F}$ | Inductor – $2.5\text{mH}$ |
|------------------|-------------------|------------------------|----------------------------|---------------------------|
| f                | (Hz)              | 4.0k                   | 796                        | 12.7k                     |
| Z                | ( $\Omega$ )      |                        |                            |                           |
| Period           | ( $\mu\text{s}$ ) |                        |                            |                           |
| $V_{\text{RMS}}$ | (V)               |                        |                            |                           |
| $I_{\text{RMS}}$ | (mA)              |                        |                            |                           |
| $t_{V-I}$        | ( $\mu\text{s}$ ) |                        |                            |                           |
| I (lead/lag) V   | (lead/lag)        |                        |                            |                           |
| $\theta$         | ( $^\circ$ )      |                        |                            |                           |
| Z                | ( $\Omega$ )      |                        |                            |                           |
| S                | (mVA)             |                        |                            |                           |
| Q                | (mVAR)            |                        |                            |                           |
| P                | (mW)              |                        |                            |                           |

## Phasor Diagrams – Resistor, Capacitor, Inductor



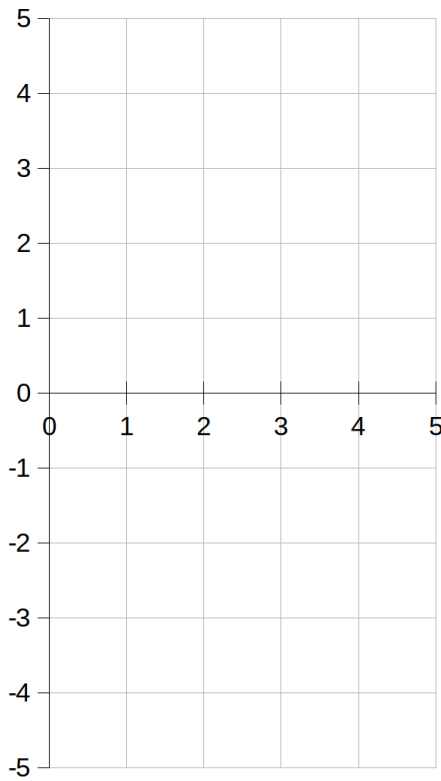
**Series RLC Circuit – (KVL)**

| $f_s$                     | (kHz)         | 1.80 | 3.20 | 4.60 |
|---------------------------|---------------|------|------|------|
| Z                         | ( $\Omega$ )  |      |      |      |
| $t_s$                     | ( $\mu s$ )   |      |      |      |
| $V_R$                     | ( $V^{RMS}$ ) |      |      |      |
| $I_s = (V_R \div 100)$    | (mA)          |      |      |      |
| $V_s$                     | ( $V^{RMS}$ ) |      |      |      |
| $t_{R-S}$                 | ( $\mu s$ )   |      |      |      |
| $V_s$ angle - $\theta$    | ( $^\circ$ )  |      |      |      |
| $V_{RL}$                  | ( $V^{RMS}$ ) |      |      |      |
| $t_{R-RL}$                | ( $\mu s$ )   |      |      |      |
| $V_{RL}$ angle - $\delta$ | ( $^\circ$ )  |      |      |      |
| $V_L$                     | ( $V^{RMS}$ ) |      |      |      |
| $V_L$ angle - $\alpha$    | ( $^\circ$ )  |      |      |      |
| $V_C$                     | ( $V^{RMS}$ ) |      |      |      |
| $V_C$ angle - $\beta$     | ( $^\circ$ )  |      |      |      |
| Z                         | ( $\Omega$ )  |      |      |      |
| S                         | (mVA)         |      |      |      |
| Q                         | (mVAR)        |      |      |      |
| $P_s$                     | (mW)          |      |      |      |
| $P_R$                     | (mW)          |      |      |      |
| $P_{LC(loss)}$            | (mW)          |      |      |      |

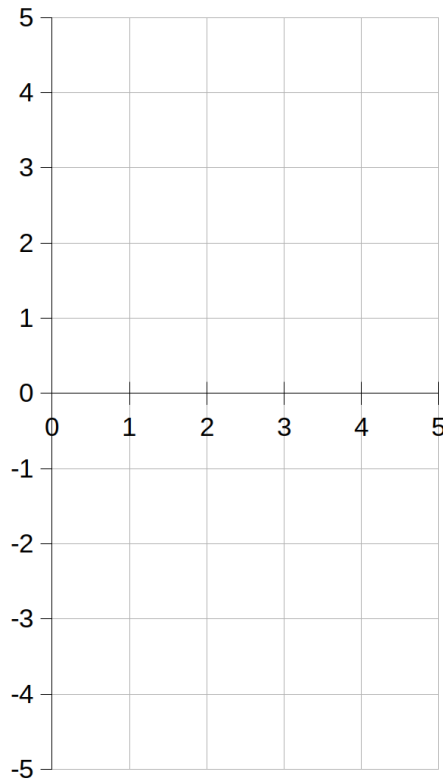
## Series RCL Circuit - *Graphs*

**Phasor Diagram** -  $V_R(ref)$ ,  $V_S$ ,  $V_{RL}$ ,  $V_L$ ,  $V_C$

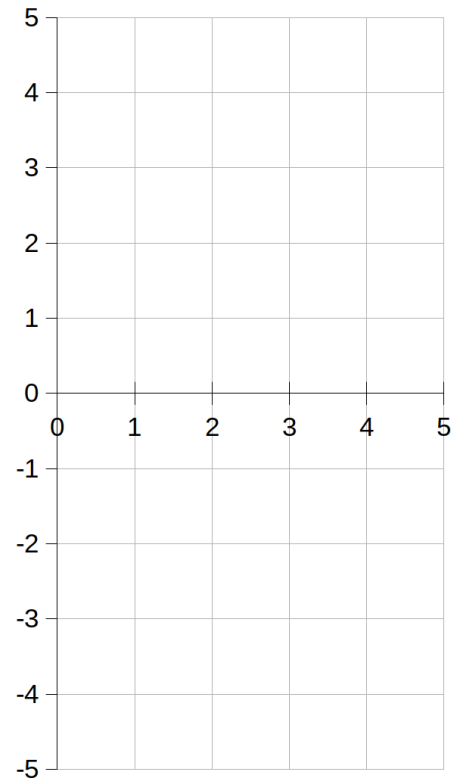
1.8 kHz



3.2 kHz

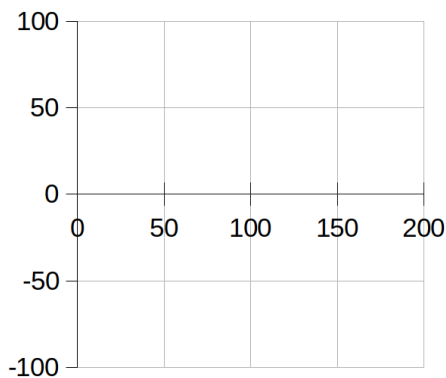


4.6 kHz

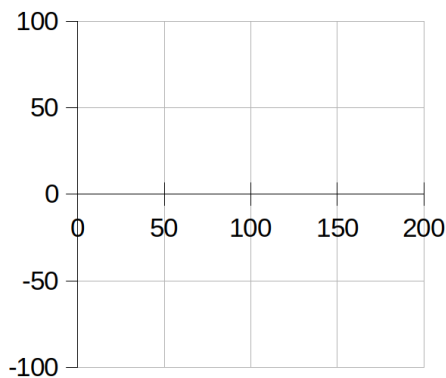


**Power Triangle** –  $S$ ,  $Q$ ,  $P_s$

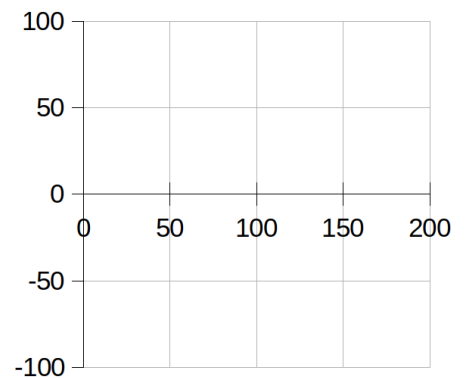
1.8 kHz



3.2 kHz



4.6 kHz

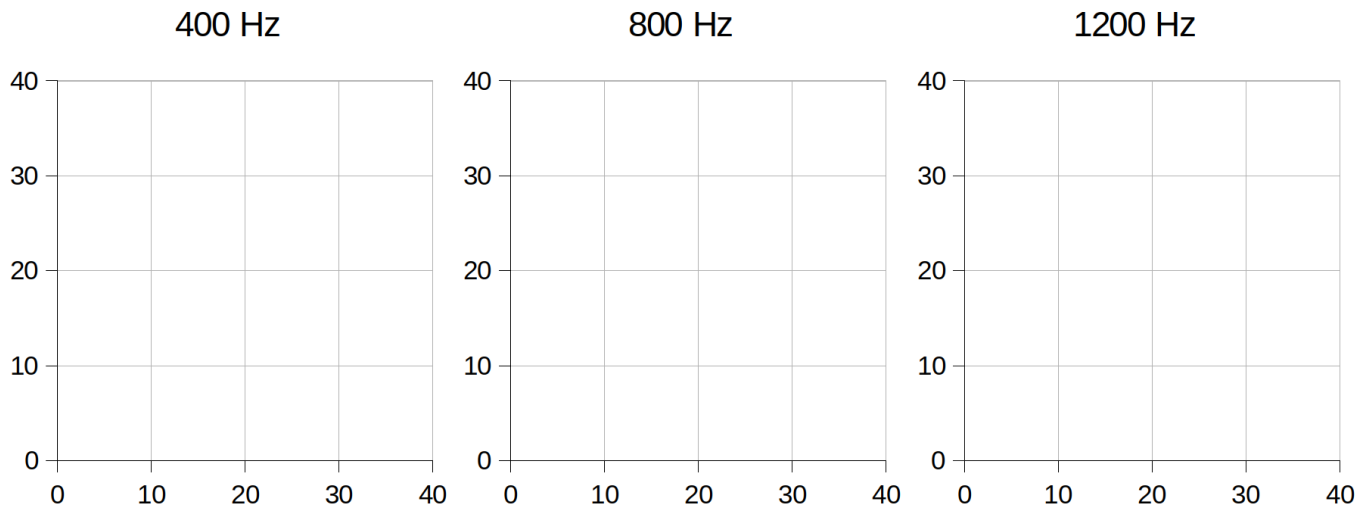


**Parallel RC Circuit – (KCL)**

| $f_s$                  | (Hz)          | 400 | 800 | 1.20 k |
|------------------------|---------------|-----|-----|--------|
| Z                      | ( $\Omega$ )  |     |     |        |
| $t_s$                  | ( $\mu s$ )   |     |     |        |
| $V_R$                  | ( $V^{RMS}$ ) |     |     |        |
| $I_R$                  | (mA)          |     |     |        |
| $I_C$                  | (mA)          |     |     |        |
| $t_{R-C}$              | ( $\mu s$ )   |     |     |        |
| $I_C$ angle - $\delta$ | ( $^\circ$ )  |     |     |        |
| $I_s$                  | (mA)          |     |     |        |
| $t_{R-S}$              | ( $\mu s$ )   |     |     |        |
| $I_s$ angle - $\theta$ | ( $^\circ$ )  |     |     |        |
| Z                      | ( $\Omega$ )  |     |     |        |
| S                      | (mVA)         |     |     |        |
| Q                      | (mVAR)        |     |     |        |
| P                      | (mW)          |     |     |        |

## Parallel RC Circuit - *Graphs*

### Phasor Diagram – $I_R(\text{ref})$ , $I_C$ , $I_S$



### Power Triangle – $S$ , $Q$ , $P$

