University of Rochester

Electrical and Computer Engineering

Circuits and Signals

Lab 1

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Abstract

This lab required measurements for the difference between a source voltage and the voltage across components in two circuits. The two circuits were RL and RC circuits, in series, in both orders. Measurements were made across both the reactive components and the resistor when resistance was changed as well as when frequency was changed. The relationships found show that both frequency and resistance have an effect on amplitude and phase shift, respectively, on the output across the components of a circuit. The amplitude of the source voltage was always held constant.

Series RL Circuit

Measurements were made with an oscilloscope across the resistor of the circuit described in figure 2a in order to find the phase shift between VS and VR while resistance changed. Resistors were switched with different values, 10kΩ, 18kΩ, and 27kΩ, and the phase shifts were recorded for each.

|  |  |  |
| --- | --- | --- |
| Resistance (kΩ) | Experimental Phase Shift | Theoretical Phase Shift |
| 10 | 57.6˚ | 57.5˚ |
| 18 | 39.6˚ | 41.1˚ |
| 27 | 28.8˚ | 30.2˚ |

The results of the measurements were rather accurate. Any discrepancies are most likely due to the imperfections of the resistors, which are rated at ±5% their marked values. Any error due to the measurement equipment is negligible.

Then, measurements were made across the resistor modeled after the same circuit with an oscilloscope in order to find the peak amplitude **|VR|** while frequency changed (resistance was held constant). The function generator was set to 5kHz, 10kHz, 20kHz, 30kHz, and 50kHz, and measurements were made at each frequency.

Then, the positions of the inductor and the resistor were switched, and measurements were made across the inductor with the oscilloscope in order to find the peak amplitude **|VL|** while frequency was changed. Frequency was set to the same values as the measurements made for **|VR|**.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Frequency  (kHz) | Resistor (18kΩ) | | Inductor (100mH) | |
| **|VR|** | **|VR|**/Vm | **|VL|** | **|VL|**/Vm |
| **5** | 10.6 | 2.12 | 2.44 | .488 |
| **10** | 10.3 | 2.06 | 2.44 | .488 |
| **20** | 9.0 | 1.8 | 2.48 | .496 |
| **30** | 7.8 | 1.56 | 2.52 | .504 |
| **50** | 5.4 | 1.08 | 2.60 | .52 |

Series RC Circuit

Measurements were made with an oscilloscope across the resistor of the circuit described in figure 2b in order to find the phase shift between VS and VR while resistance changed. Resistors were switched with different values, 1.5kΩ, 4.7kΩ, and 15kΩ, and the phase shifts were recorded for each.

|  |  |  |
| --- | --- | --- |
| Resistance (kΩ) | Experimental Phase Shift | Theoretical Phase Shift |
| 1.5 | -77˚ | -76.74 |
| 4.7 | -57˚ | -53.56 |
| 15 | -22˚ | -22.99 |

The results of the measurements were rather accurate. Any discrepancies are most likely due to the imperfections of the resistors, which are rated at ±5% their marked values. Any error due to the measurement equipment is negligible.

Then, measurements were made across the resistor modeled after the same circuit with an oscilloscope in order to find the peak amplitude **|VR|** while frequency changed (resistance was held constant). The function generator was set to 5kHz, 10kHz, 20kHz, 30kHz, and 50kHz, and measurements were made at each frequency.

Then, the positions of the capacitor and the resistor were switched, and measurements were made across the capacitor with the oscilloscope in order to find the peak amplitude **|VC|** while frequency was changed. Frequency was set to the same values as the measurements made for **|VR|**.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Frequency  (kHz) | Resistor (4.7kΩ) | | Capacitor (.001µH) | |
| **|VR|** | **|VR|**/Vm | **|VC|** | **|VC|**/Vm |
| **5** | 10.8 | 2.16 | 1.64 | .328 |
| **10** | 10.6 | 2.12 | 3.12 | .624 |
| **20** | 9.4 | 1.88 | 5.44 | 1.09 |
| **30** | 8.2 | 1.64 | 6.88 | 1.15 |
| **50** | 5.76 | 1.15 | 9.00 | 1.8 |