University of British Columbia
Electrical and Computer Engineering
ELEC291/ELEC292

Module 5 – Magnitude and Phase Measurement

Introduction

Circuits with sinusoidal sources are very common in the field of electrical engineering. Because of their importance, the analysis of sinusoidal AC circuits is studied with great detail in many university courses. As you probably know, the analysis of AC circuit is greatly simplified by using phasors. Phasors are used to describe constant frequency sinusoidal AC signals in circuits with two scalar quantities: the magnitude of the sine wave and the phase difference of the sine wave with an arbitrary reference. These two scalar quantities are combined into a vector or phasor. In this lab you will design, build, program, and test a microprocessor based AC voltmeter that displays both magnitude and phase.

For this laboratory module you can work with a partner. You and your lab partner need to demonstrate just one circuit and program.

Components Required for this Module

For this laboratory you will need the EFM8 microcontroller board. Also, you'll need C51 and Crosside to compile and download the program to the microcontroller board. Additionally, you may need some signal diodes (such as the 1N4148), a LM339/LM393 comparator IC, or a LM324/LM358 op-amp IC depending on your design.

Laboratory

Design, assemble, and test an AC phasor voltmeter using the EFM8 microcontroller board. The function generators available in the lab can precisely generate two independent sine wave functions via outputs #1 and #2 as needed by this experiment, without any extra circuitry. The two signals must have the same frequency (something around 60Hz should do) with amplitudes that do not exceed the maximum voltage input of the EFM8 board. The phase difference between the signals can be adjusted in the function generator.

The voltmeter should take the two analog inputs: the reference input and the test input. Display, using an LCD, the magnitude of both inputs in volts RMS, and the phase difference between the reference and test signals in degrees, taking care of displaying the correct sign. Optionally, you can also display the frequency of the reference signal in Hz. When you are done, demonstrate the phasor voltmeter to the lab TA.