EE 206

Lab 2: *Oscilloscopes and Function Generators*

Objectives: To learn the basic operations of an *oscilloscope* and of a *function generator.*

Equipment Needed: Breadboard, CADET, function generator, multimeter, oscilloscope

Parts List: 2.0 kΩ and 10.0 kΩ resistors from Lab kit

Introduction

An *oscilloscope* is used to measure and display signals. The oscilloscope can display the waveform of any dc or varying signal. It can also be used to measure the amplitude, frequency, and time period of any periodic signal.

A *function generator* (also called a "*signal generator*") is used to produce a time-varying signal with various characteristics.

Part I: Measuring dc Voltage using the Oscilloscope

1. Review the oscilloscope manual in the lab to become familiar with the operation and controls of the oscilloscope.
2. Set the CH 1 VOLTS/DIV setting of the oscilloscope to 2 V.
3. Connect CH 1 to the 1.3 – 15 V dc supply of the CADET. **Note**: one lead of the oscilloscope probe is *always* ground. Always be **sure** that this ground corresponds to the ground of the CADET.
4. Measure this supply voltage using both the oscilloscope and the multimeter. Observe the effect of varying the dc voltage and varying the VOLTS/DIV setting on the oscilloscope. Record at least five different voltage observations that differ by at least 2.0 V. Compare the readings you obtain from the oscilloscope and from the multimeter.

Part II: Operating a Function Generator

1. Review the function generator manual in the lab to become familiar with the operation and controls of the function generator.
2. Connect CH 1 of the oscilloscope to the OUTPUT of the function generator.
3. Adjust the settings of the function generator to produce a 5.0 V peak-to-peak (pp) sinusoidal wave with a frequency of 3.0 kHz.
4. Adjust the oscilloscope so that you have between two and four periods of the waveform visible on the screen. Sketch the waveform seen on the oscilloscope screen. Record the peak-to-peak (pp) voltage and time period of the waveform using the oscilloscope. Measure the voltage using the multimeter.
5. Configure the function generator to output a 5.0 Vpp square wave at a frequency of 1.7 kHz. Repeat step 4 for this waveform. **Note**: most multimeters are only designed to measure dc

and sine waves (and then only to measure something called the *rms* value). Multimeters also are much more limited in the range of frequencies for which they can correctly measure voltages. At higher frequencies the values given by a multimeter can vary significantly from the values determined by an oscilloscope.

6. Observe and describe other signal waveforms that can be produced by the signal generator.

Part III: ac Measurements

1. Construct the circuit shown in Fig. 1. Use R1 = 10.0 kΩ and R2 = 2.0 kΩ for the passive components. Use the function generator to supply an input voltage Vin with a magnitude of 5.0 Vpp and a 2.0 kHz frequency square wave.

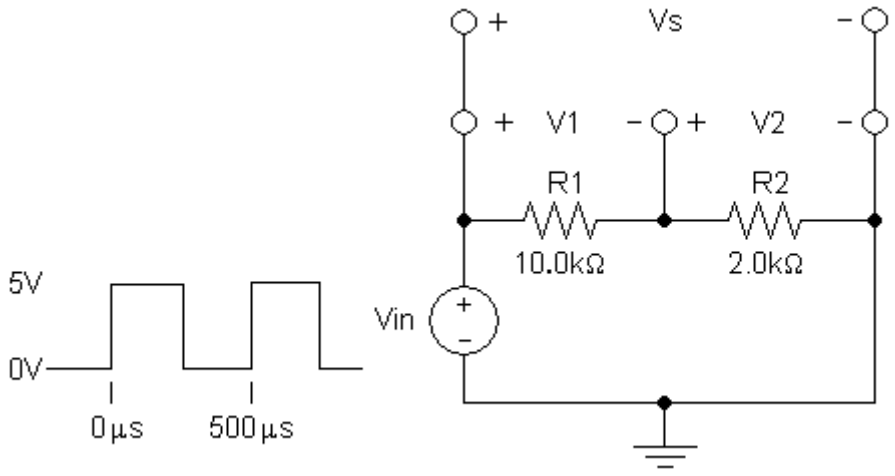

Figure 1: Test Circuit

2. Use the oscilloscope to display the voltages Vin and V2 (use both oscilloscope channels). Measure the magnitudes of both voltages with both the oscilloscope and the multimeter. Determine the frequency of the voltages using the oscilloscope. Sketch the waveforms of Vin and V2, as seen on the oscilloscope. **Note**: it is not possible to directly measure or display a voltage like V1 in this circuit with an oscilloscope. It is necessary to use the *channel math* feature of the oscilloscope, due to the fact that one lead of the oscilloscope probe is connected to ground while neither end of V1 is ground.

Report:

1. Discuss the differences of making measurements with an oscilloscope versus a multimeter. In your opinion, which device is more accurate? Which one is more precise? Which one is easier to use? Explain.
2. In a situation like that which occurs in Part III, explain the process that must be used to display voltage V1 with an oscilloscope. Be specific.