

BEE 233 Circuits

Fall 2015

Lab 1: Using the laboratory instruments

1 Objectives

The purpose of this lab is to familiarize you with using our laboratory instruments, the multimeter, power supplies, the function generator and the oscilloscope. The objective is that when you're asked on a future lab to set V_{in} equal to some specific function, amplitude, offset and frequency, then take a screenshot of V_{out} with suitable on-screen measurements, that you can do it reliably.

It is perfectly okay if this is your first time using the lab instruments and you need help.

2 The instruments

Here the instruments you'll encounter in our Discovery and Beardslee EE labs. Not all our benches have exactly the same equipment. We have the same Tektronix scopes and function generators everywhere but the power supplies and multimeters differ between Discovery and Beardslee.

1. Keithley 2110 multimeter (Discovery 264 only)
2. Tektronix DMM4020 multimeter (Beardslee 220 only)
3. Tektronix PWS 4205 programmable power supply (Beardslee 220 only)
4. RSR HY3002-3 triple output power supply (Discovery 264 only)
5. Keithley 2230-30-1 power supply (all of Beardslee 220, half of Discovery 264)
6. Tektronix AFG3022B arbitrary function generator (all benches all labs)
7. Tektronix MSO3012 dual channel oscilloscope (all benches all labs)

Since this lab meets in Discovery, you will be using the instruments we have there.

3 Resistance and voltage measurements

This section asks that you verify that you know how to use the multimeter and the power supplies. If you are at a bench that does not have a Keithley supply, you will need to go to one that does have one to complete that part.

1. Measure the resistance of the five $1\text{ K}\Omega$ resistors in your parts kit. Do the measured values remain stable or do they change over time as you try to measure them?
2. Calculate the percentage errors. What is the average value and the average of the absolute values of the percentage errors?
3. With Keithley 2230-30-1 supply set for 5 V, what is the measured output?
4. With the RSR HY3002-3 supply set for 5 V, what is the measured output?

4 RSR HY3002-3 power supply current limit

This section asks that you verify that you know how current limit is and how it behaves.

1. Without a load, set the master for 10 V with the current knob fully clockwise.
2. Turn the supply off and connect it to a 1 K Ω resistor in series with the DMM set to measure current.
3. Turn the supply on and record the current measurement.
4. Turn the current knob counter-clockwise.
5. Explain what you observe.

5 RSR HY3002-3 power supply series mode

This section asks that you verify that you know what it means to use a power supply in series mode.

1. Put it in series mode.
2. Set the master to 5 V.
3. As you adjust the master, what happens to the slave?
4. Measure the voltage between black on the slave and red on the master and between red on the slave and black on the master.
5. Explain what series mode does.

6 Using the function generator and oscilloscope

This section asks that you verify that you know how to use the function generator and oscilloscope

1. With the function generator set for High Z output and connected directly to the oscilloscope without any load, capture oscilloscope screenshots of the following waveforms. Adjust the voltages as precisely as you can.
 - a. Sine wave of 5.0 V_{pp} at 20 KHz and 1.0 V DC offset with measurements of V_{pp}, frequency and mean.
 - b. Square wave (a pulse) of 2.0 V_{pp} at 100 KHz, 80% duty cycle with measurements of V_{pp} and frequency and cursors to measure the duty cycle.
2. With the function generator set a for 400 mV_{pp} sine wave at 100 Hz, capture oscilloscope screenshots of the output for the four combinations of a 51 Ω or 27 K Ω load and the function generator set for either High Z or 50 Ω output.
3. Calculate the function generator output resistance.

7 Your reports

Your reports should be submitted via Canvas as PDFs as described in the rubric.