Matthew Spencer – Spring 2018

E190AK Lab 1: Near Field Probes

Familiarize Yourself with the RF Lab

Find and record the location of each of the equipment listed below. Note that you need to return your equipment to the place you found it when you clean the lab.

1. The short SMA cables drawer
2. The SMA-BNC drawer
3. The power supply
4. The multimeter
5. The near field probes.

We will use the spectrum analyzer and function generator that are currently on the bench to analyze the output of the near field probes in this lab.

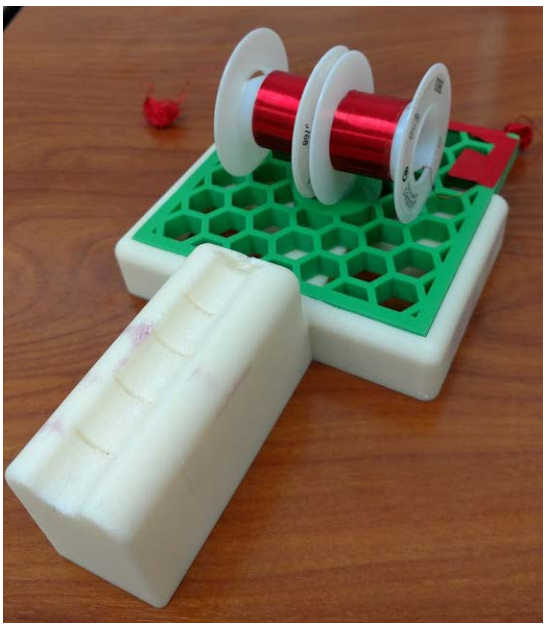
1. Turn on both devices.
2. Set the output of the function generator to -50dBm (https://en.wikipedia.org/wiki/DBm) at 4MHz and connect the output to the input of the spectrum analyzer. NOTE THAT THE OUTPUT NEEDS TO BE NEGATIVE 50 dBm, NOT POSITIVE 50 dBm.
3. Set the center frequency of the spectrum analyzer to 2MHz and the center frequency to 4MHz.
4. Record the measured spectrum.

Calibrate the Near Field Probes

Use the Helmholtz coil and the parallel plate setup pictured in Figure 1 to calibrate your near field probes so that you have a relationship between observed voltage and measured field. Replicate the calibration curve on pages 2 and 3 of the probe datasheet, which is linked below. You are expected to calculate the field induced in the coil in order to take this calibration, but you may use outside references to figure out that calculation (hint: consider the Biot-Savart law). Note that the coil has 75 turns on each side. Follow the instructions below when you are setting up your first experiment.

1. Connect your SMA probe to the pre-amplifier that is in the SMA probe box and Power the pre-amplifier from USB.
2. Use the function generator and an SMA-BNC adapter to energize the Helmholtz coil. and put your probe into it.
3. Measure the Helmholtz coil with the probe and use the AC mode of the multimeter to ensure that it is not creating levels of output voltage that will damage the spectrum analyzer.
4. Connect it to the spectrum analyzer and proceed with data collection.

https://www.tekbox.net/images/documents/testequipment/tbps01/TBPS01_TBWA2_Manual.pdf



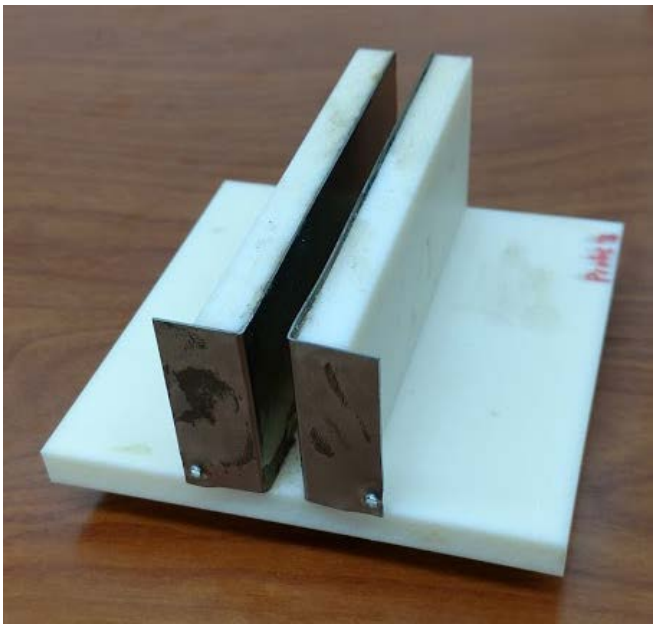


Fig 1

Measure Field around an “Infinite” Wire

Use your calibrated probes and the function generator to measure the field distribution around the long wire on this board. Compare your measured results to theory. You are expected to calculate the theoretical field distribution around the wire, and you may use outside reference to help you do so.

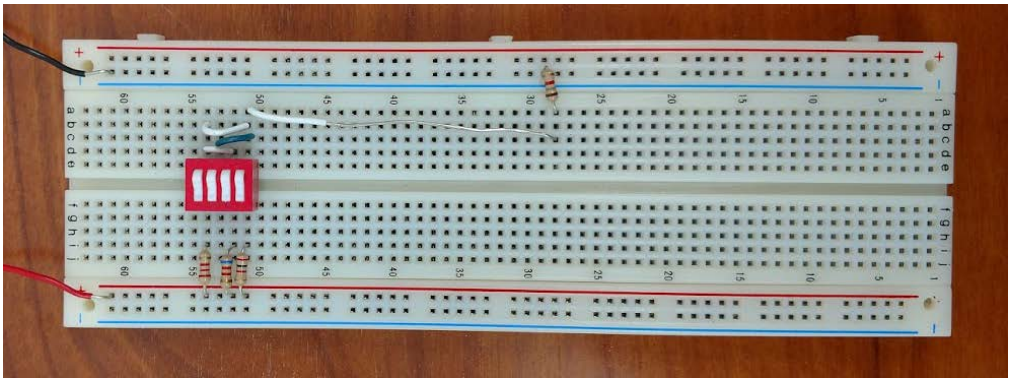


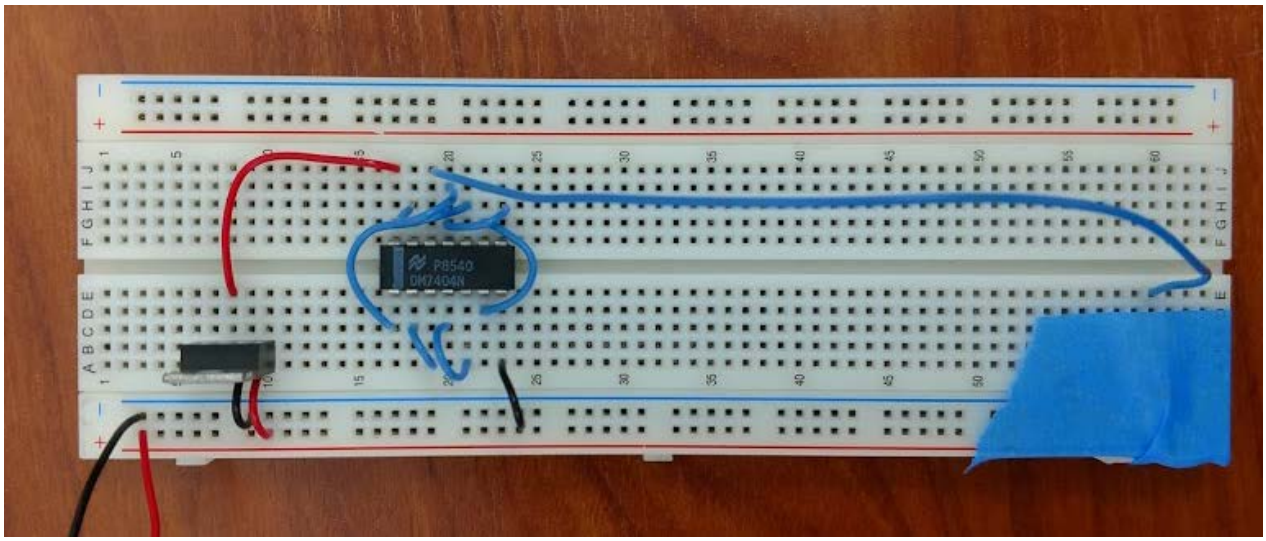
Fig 2

Measure EMC in an Example Circuit

Find the test circuit pictured in Figure 3. It is comprised of a voltage regulator, a ring oscillator, a buffering inverter and a load resistor as shown in the schematic in Figure 3. It should be powered with at least 7V. Inspect the circuit with your sniffer probes and use your measurements to answer the following questions.

1. What nodes emit strong B fields? What nodes emit strong E fields? Why?
2. What is the frequency of the ring oscillator? Are there other frequency components in your measured spectrum? Why?

3. Use your measurements to determine the value of the load resistor (which is currently hidden by tape).



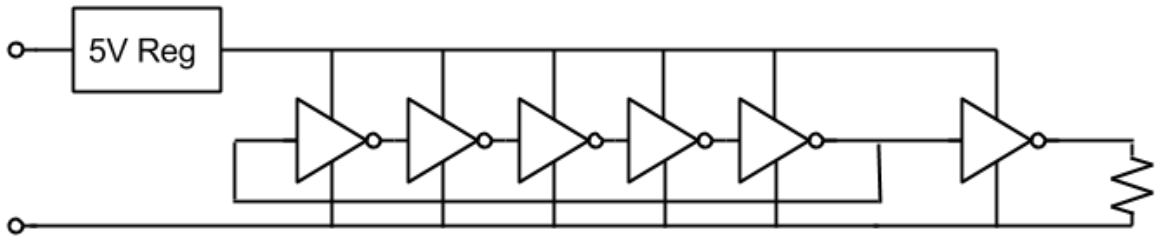


Fig 3