Matthew Spencer – Spring 2018

# E190AK Design Project 2: Receiver

Design a receiver using Mini Circuits modules in the RF lab which can decode the message being sent from the transmitter in the RF lab. The transmitter has 17dBm of Output Power and modest (6dBi) directionality. The output is frequency shift keyed: 0 bits are transmitted at 2.256 GHz and 1 bits are transmitted at 2.296 GHz. The transmitter repeats a message is continuously at a bit rate of 10kbps. Each message begins with a pilot frame that consists of the bits 010101. The remaining bits represent ASCII encoded characters.

Your receiver may use any architecture that you see fit, but your report should include a careful analysis of the receiver's expected performance. In particular, you should have analytical predications and experimental confirmation of its system temperature, IIP2 and IIP3. You should supplement this with a spreadsheet showing the voltage noise power and power of distortion products at each stage. A link budget will help you predict the behavior of the first stage. Be sure your report also includes the decoded message.

We have purchased Teensy 3.2 Microcontrollers to act as the samplers for your receiver. These are programmed with the Arduino IDE. The `matlablogging.m` and `matlablogging.ino` files on the E80 Lab 2 page are easy ways to log received data. The maximum data rate that I've achieved with these programs is ~100 kSa/s, but I think you can use some fancy footwork with ADC interrupts to increase that speed. You don't need to play those tricks to build a working receiver.

You must achieve a minimum receive range of 10ft and you must demonstrate your receiver working at a range of 10ft. You may demonstrate functionality at other ranges, and the longest ranged receiver will receive extra credit.

A few odds and ends:

- Our supply of modules is more limited than I would like. Share them gracefully.
- We have a modest budget to order additional modules. Be sure to get your orders in by Monday of the week this lab is due because we use two day shipping.
- You may use a spectrum analyzer or oscilloscope for debugging, but not to decode the message.
- You may use power supplies to generate reference voltages.
- For full credit, you need to use VCOs for frequency synthesis. You may use signal generators for frequency synthesis, but will receive a grade penalty for doing so.
- Beware of blocker signals from Wi-Fi at 2.4-2.4835 GHz.

Helpful links:

- https://sites.google.com/g.hmc.edu/e80/lab-2
- https://www.arduino.cc/en/Main/Software
- https://www.minicircuits.com/