Stony Brook University

EEO335

Spring 2024

Radio-Frequency Communications Project - ABET

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Copy of Original Assignment

Assignment 7 - Radio-Frequency Communications Project - ABET

This Assignment aims at verifying and expanding, with design, simulations and measurements, your creativity and your knowledge and understanding of radio-frequency circuits.

This is a Project: you must design and build your circuit starting from specifications and constraints.

Please document each step with snapshots, pictures, and your observations. Also, please include a short video with audio to demonstrate proper operation.

1) Using the simulator, design and simulate a FM transmitter in the 90-100 MHz frequency band composed of one signal amplifier circuit followed by one oscillator circuit (**40pts**):

- voltage supply: +9V
- for the amplifier use one BJT 2N3904 to provide ~x10 signal amplification without next-stage load
- for the oscillator use one BJT 2N3904, one ~0.1uH inductor and two ~5-20 pF capacitors
- use a ~0.1uF to couple the input signal to the amplifier
- use a ~0.1uF to couple the amplifier to the oscillator
- simulate the oscillator
- try to apply a low-frequency signal (you may need to use a small "Max Timestep")

2) Prepare an experimental plan to demonstrate your transmitter *(ABET PI-61)*

3) Build the circuit at (1) and experimentally demonstrate the transmission of a song generated from the jack line of your cell phone or your desktop/laptop into the circuit at(1) to a FM receiver (e.g. car) (**160pts**) *(ABET PI-62)*

Helpful hints:

- use a 9V battery
- for the oscillator
    - use capacitors in series to achieve small values, and/or use adjustable capacitors
    - use/build an air coil inductor and adjust it to achieve the desired frequency
- for the antenna
    - use a ~12 long inch wire
    - AC-couple the antenna to the circuit
- filter the supply with tens to hundreds of µF
- place the FM transmitter close to your FM radio
- patiently tune the circuit and your FM radio until you receive the signal

Overview

In this lab we design and built a frequency modulation transmitter with front end amplifier. The input signal is wirelesly transmitted to an FM radio receiver tuned near 100 mHz. The simulation and experiment are quite close, but the transmit frequency differs by $\approx$ 6 MHz. When considering temperature effects, part tolerance, commercial FM receiver frequency display, and other factors, the resulting transmitter is acceptably close in performance to the ideal simulation.

1 Using the simulator, design and simulate a FM transmitter in the 90-100 MHz frequency band composed of one signal amplifier circuit followed by one oscillator circuit.

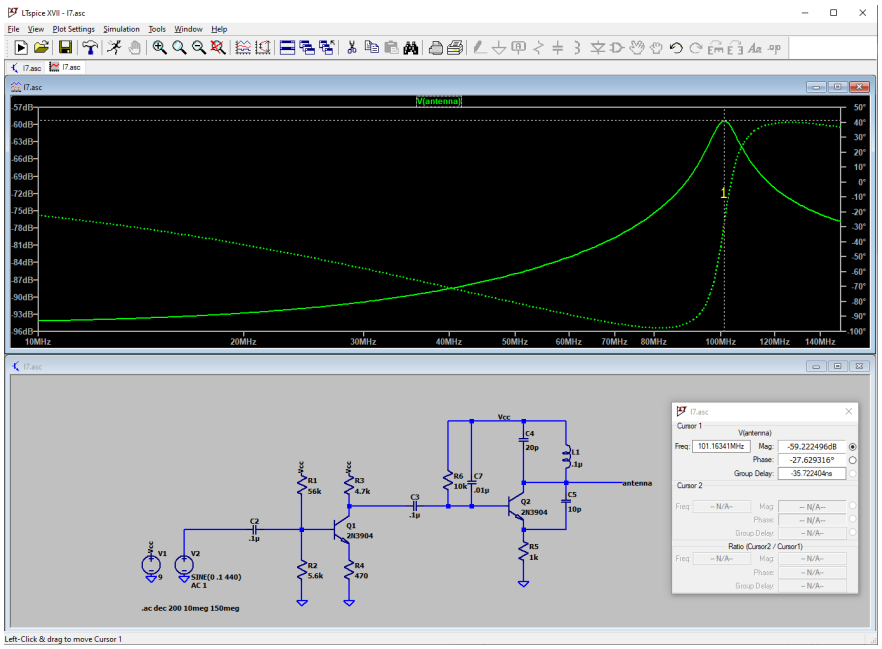

Figure 1: An FM transmitter circuit was designed that meets the target performance and within the design constraints. Simulation reveals the circuit has a resonant frequency of $\approx$ 101 MHz

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2 Prepare an experimental plan to demonstrate your transmitter

1. Build the circuit from the simulation on a breadboard.
2. Connect an audio source to the input of the amplifier at C2.
3. Play a distinctive song on the audio source.
4. Turn ON the FM transmitter and slowly sweep the tuning dial from 90 MHz to 100 MHz
5. When the song transmitted is heard, stop tuning and read the tuner frequency.

3 Build the circuit at (1) and experimentally demonstrate the transmission of a song generated from the jack line of your cell phone or your desktop/laptop into the circuit at(1) to a FM receiver (e.g. car)

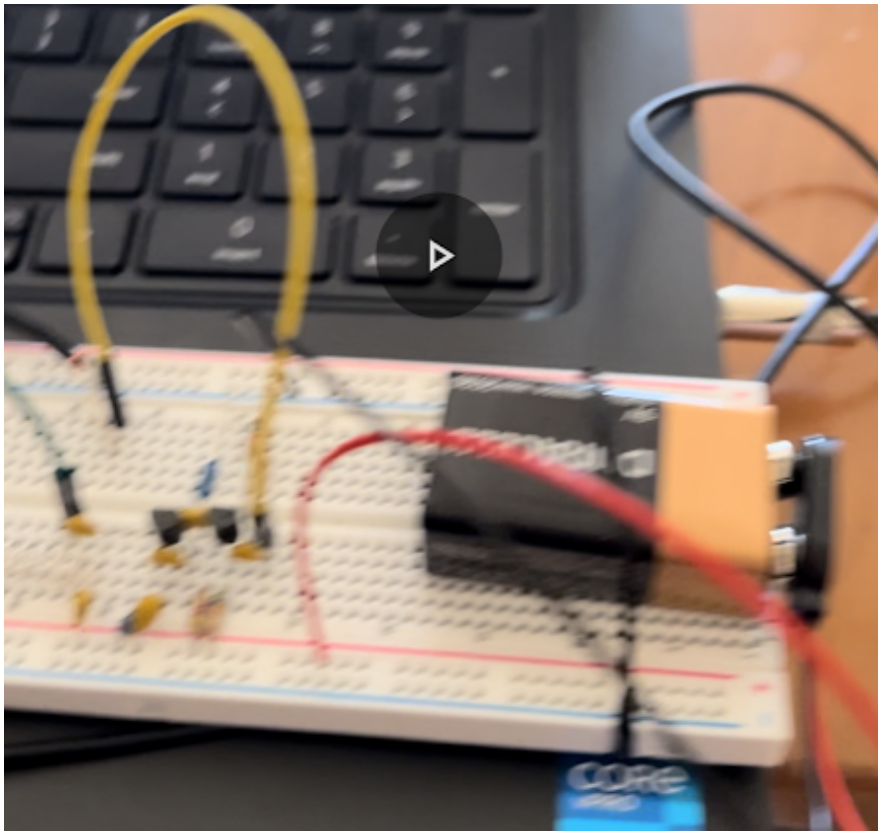

Figure 2: An FM transmitter circuit transmitting classical music to an FM receiver.

Figure 3: FM receiver tuned to $\approx 94\,\mathrm{MHz}$

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