EE430 - Electromagnetism
Project 1: FM Pirate Radio Station
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Introduction:

Objectives:

Design a Colpitts oscillator-based FM transmitter capable of transmitting an audio signal within the frequency range of 88 MHz to 108 MHz. The transmitter's power output should be carefully controlled to ensure that the signal does not extend beyond a 30-foot range for the receiver.

Materials:

Component	Schematic Name	Expected Value	Unit	Actual value	Unit	Percent Error
Capacitor	C1	10	pF	10.2	pF	2.0
Capacitor	C2	0.1	uF	0.11	uF	9.1
Capacitor	C3	0.1	uF	0.11	uF	9.1
Capacitor	C4	0.1	uF	0.1	uF	0.0
Inductor	L1	-	-	65	nH	-
Resistor	R1	27	KΩ	26.8	KΩ	0.7
Resistor	R2	10	KΩ	9.9	KΩ	1.0
Resistor	R3	390	Ω	389	Ω	0.3
Transistor	Q1	-	-	-	-	-

Procedure:

The circuit required an inductor with a low value of inductance. This component could be made by hand by wrapping a wire with a few turns. My inductance happened to have a value of ~65 nH. After finding the value for the inductor, we could apply the formula for the center oscillation frequency of the colpitts oscillator, the circuit was then simulated in LTSpice to verify the circuit behaves as it should.

Calculations:

$$f = \frac{1}{2\pi\sqrt{L\frac{C_1 * C_2}{C_1 + C_2}}}$$

$$f = \frac{1}{2\pi\sqrt{65nH\frac{0.1uF * 50pF}{0.1uF + 50pF}}}$$

$$f = 88.31\ MHz$$

Simulation:

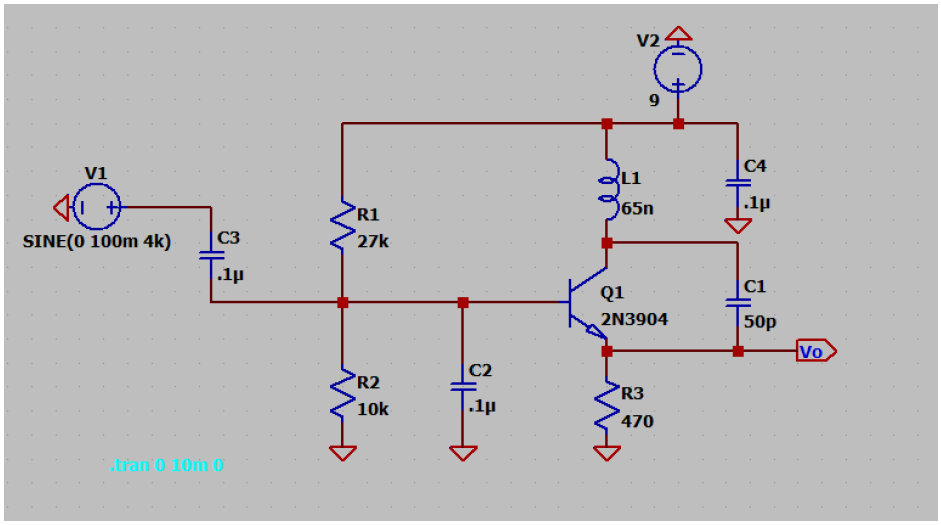

Fig. 1

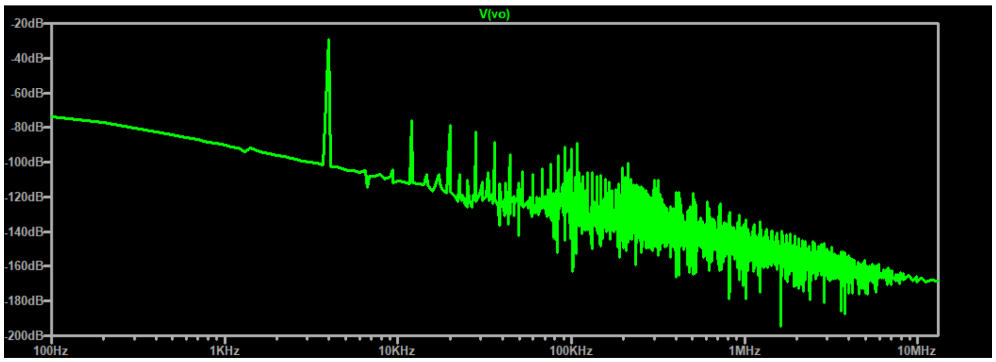

Fig. 2

Measurements:

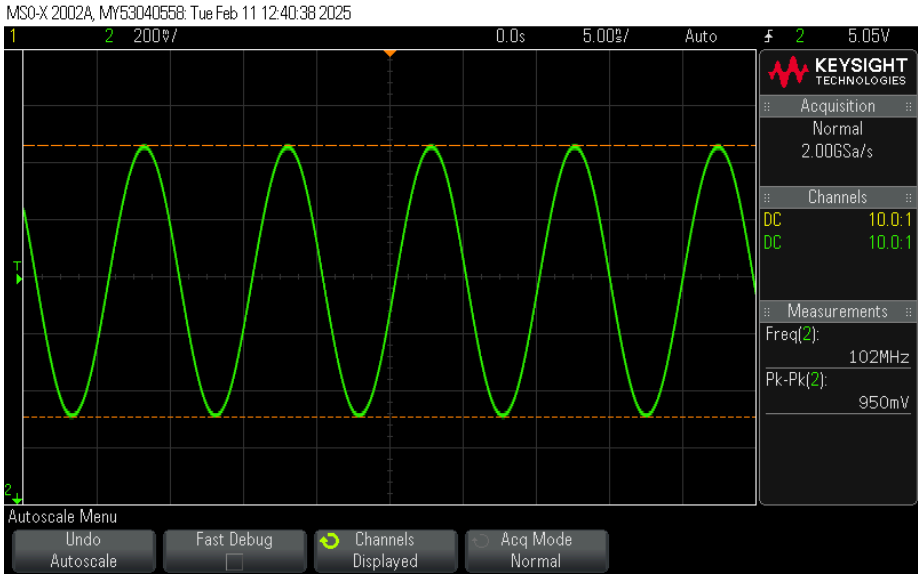

Fig. 3

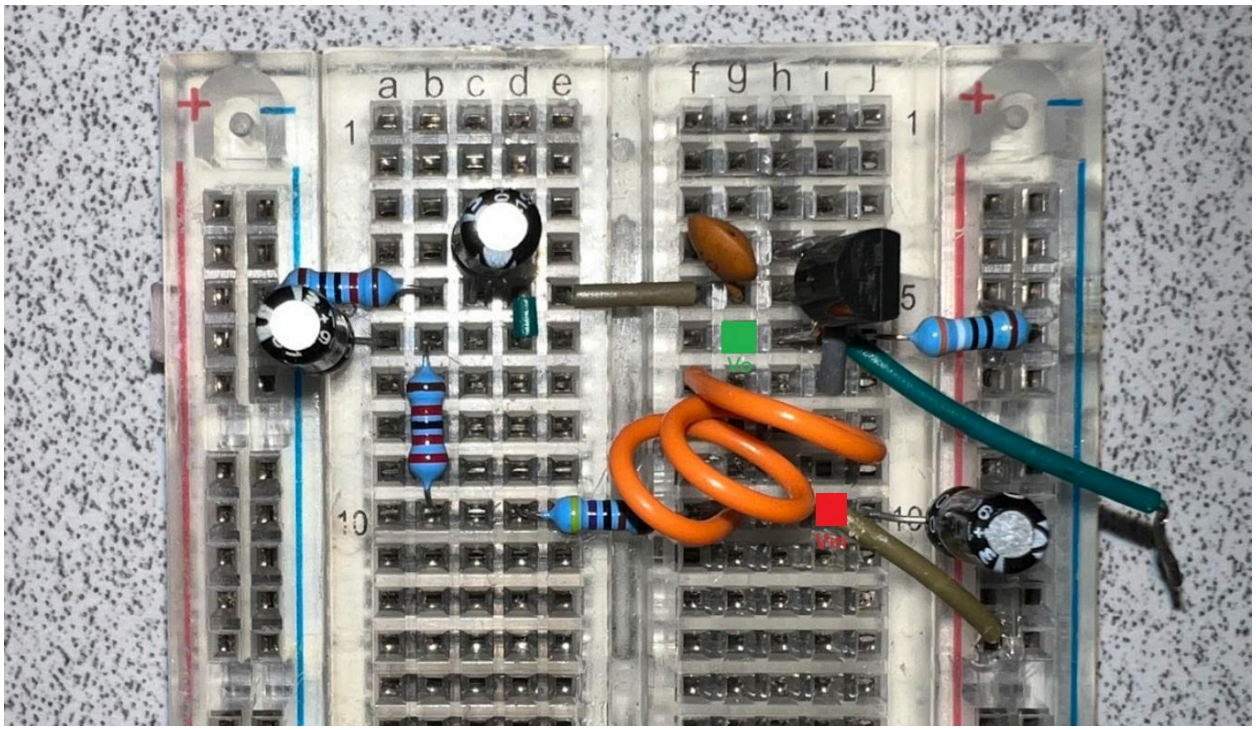

Fig. 4

Conclusion:

This project provided valuable hands-on experience in working with high-frequency circuits on a breadboard, enhancing my understanding and practical skills in this area. I found that due to the parasitic inductance and capacitance of the breadboard, it severely affected the output frequency which deviated significantly from the calculated

frequency. The value for C1 had to be changed significantly to broadcast a frequency between 88 MHz to 108 MHz. The initially calculated value for C1 had to be changed from 50 pF to ~10 pF due to the parasitic effects of the breadboard. Although the project presented challenges and occasional frustrations, the successful outcome ultimately justified the rigorous and sometimes painful troubleshooting process.