Signal Jamming for Wireless Communication Devices

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Submitted
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Abstract

In response to the increasing issue of misuse of communication gadgets during examination, we propose the development of a solution titled 'Signal Jamming for Wireless Communication Devices.' This initiative aims to disable the communication gadgets for restricted communication during college entrance exams and classroom assessments. As time and resources permit, we also plan to extend our efforts to address the jamming of WiFi, GPS and Bluetooth signals, ensuring a comprehensive approach to preserving the integrity of academic environments. The jamming will be achieved using a controlled deployment of signal jammer that can selectively block signal frequencies within specified areas.

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Chapter 1

Introduction

In today's digital age, wireless communication plays a vital role in both personal and professional settings. However, this increasing reliance on wireless technologies presents challenges, especially in academic environments where misuse during exams can compromise integrity.

To address this growing concern, we are working on a project aimed at developing a Signal Jamming System for Wireless Communication Devices. The system will focus on disrupting mobile signals, with plans to extend to Wi-Fi and Bluetooth, creating a controlled environment where communication devices are rendered ineffective during exams.

Our approach combines theoretical design with practical simulation using tools like LTspice. So far, we have successfully developed an oscillator and a noise generator as key components in the jamming system. These modules will play a critical role in the frequency disruption mechanism, laying the foundation for a robust signal jamming solution.

This project not only aims to preserve academic integrity but also provides a step towards creating safer and more controlled communication environments in various sensitive scenarios.

1.1 What is Jamming, a jammer, and its history? :

Jamming is the deliberate blocking of or interference with wireless communications. A signal **jammer** is a device that disrupts a device's connection to its signal source. It can be used to block cell phone signals, Wi-Fi, or other radio signals. It provides an ultimate solution in any area where cellular communications frequently cause nuisance. For example : Security zones, jails, government buildings, military bases, etc.

The concept of signal jamming was pioneered and refined by multiple countries during World War II. Radio Jamming was employed by both the Allies and Axis powers to interfere with enemy communications. The aim was to prevent the enemy from receiving crucial information or coordinating attacks. Radar jamming also emerged as an important military technology. For example, the British developed devices to jam German radar during air raids, helping Allied aircraft evade detection.

1.2 What is the working of a jammer and its components?

It emits radio frequency signals (noise) at the same frequency as the communication system they target. These signals cause interference, leading to dropped connections, slow data transmission, or complete signal loss in the affected area.

Components:

Power Supply : Smaller jamming devices are battery operated. Some look like cell phone and use cell-phone batteries. Stronger devices are plugged into a standard outlet.
Oscillator : Generates the radio signal that will interfere with the cell phone signal.

Antenna : Every jamming device has an antenna to send the signal. Some are contained within an electrical cabinet. On stronger devices, antennas are external to provide longer range and may be tuned for individual frequencies.

1.3 How can we execute signal jamming across multiple frequencies?

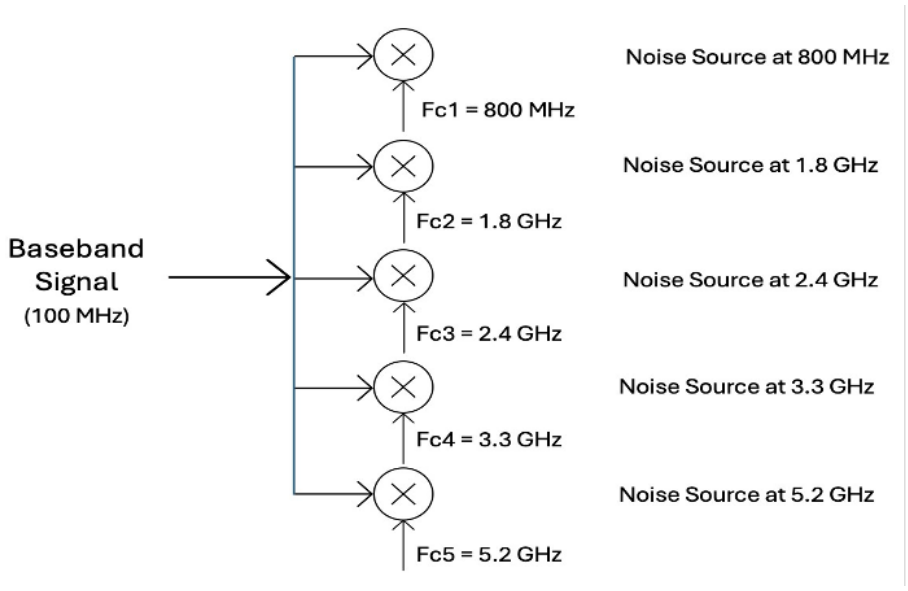

Figure 1.1: Targeting multiple high frequency signals using frequency translation

The jamming system employs mixers to combine the baseband signal with noise generated at specific frequency bands. Each mixer takes the baseband signal and a noise source corresponding to a specific frequency.

By introducing noise at these specific frequencies, the system effectively jams communication across multiple bands simultaneously. This would disrupt devices operating on these frequencies, including mobile networks (800 MHz, 1.8 GHz), Wi-Fi (2.4 GHz, 5.2 GHz), and other wireless communication technologies.

Chapter 2

Literature Survey

This section presents a review of the literature on signal jamming, its applications, and the design considerations for implementing jammers in wireless communication systems.

2.1 Relevant Studies

• **Sharma et al. (2018)** focused on the use of **signal jamming techniques** to prevent unauthorized access in secure environments. Their study highlights the **efficacy of frequency-specific jammers** in blocking mobile communication signals in restricted zones, such as examination halls and sensitive governmental areas.

• **Kim et al. (2020)** investigated **multifrequency jamming systems**, demonstrating their use in blocking signals across **multiple bands** (2G, 3G, 4G, and Wi-Fi). They emphasized the importance of **precision in tuning oscillators and filters** to jam specific frequency bands while avoiding unnecessary disruption of non-targeted frequencies.

• **Rahman et al. (2021)** studied the **evolution of signal jamming** in military applications, tracing its use back to **World War II**, where **radar jamming** was employed to disrupt enemy communication. Their research delves into the development of modern **jamming techniques** aimed at **cellular communication, GPS**, and **satellite signals**.

• **Xu et al. (2022)** proposed a **smart jamming system** that uses **machine learning** algorithms to detect and block communication channels in real-time. The system could selectively jam **Wi-Fi and Bluetooth signals**, adapting to environmental changes and communication patterns to maximize jamming efficiency while minimizing interference with non-targeted systems.

• **Low-Cost Mobile Jammers**: Egea-Lopez et al. (2013) presented a design for a cost-effective jammer focusing on simplicity and practicality for small-scale applications.

• **Wideband Jamming**: Naik et al. (2014) discussed high-power wideband jammer architectures for disrupting multiple frequency bands simultaneously, providing insights into countering modern cellular and wireless networks.

• **Ethical and Regulatory Aspects**: Akyildiz and Wang (2005) highlighted ethical concerns and the legal implications of using jammers, particularly their potential interference with public safety and emergency communications.

• **Low-Cost Designs**: Kwanshah (2018) developed a portable GSM jammer to block communication within small areas(IRJET-V11I4116).

• **Wideband Jamming**: Aina (2022) focused on jamming across multiple communication standards using affordable designs(IRJET-V11I4116).

• **Ethical and Practical Applications**: Madara (2016) highlighted practical designs for environments like libraries and hospitals while addressing ethical concerns about jamming technology(IRJETV11I4116).

Gaps in Existing Research:

Despite extensive research, key gaps remain in the literature:

1. Multi-Frequency Adaptability: Limited work addresses the simultaneous jamming of multiple communication protocols (e.g., GSM, Wi-Fi, Bluetooth).

2. Energy Efficiency: Current designs often lack optimizations for power consumption, especially for portable jammers.

Methodologies and Challenges:

Building mobile jammers involves designing circuits for specific frequency bands. However, challenges include:

• Regulatory Restrictions: The use of mobile jammers is illegal in many countries due to their potential to disrupt emergency services and violate privacy.

• Safety Concerns: Improper design or misuse of these circuits can lead to unintended interference with essential communication networks.

Ethical Considerations:

Given their disruptive nature, it is crucial to ensure ethical use of mobile jammers. Kumar et al. (2023) emphasize the importance of adhering to local laws and regulations, advocating responsible use in controlled environments.

Connection to the Current Project:

1. Extending jamming capabilities across multiple frequency bands, including mobile signals, Wi-Fi, and Bluetooth.

2. Using iterative simulations in LTspice to design efficient noise generators and oscillators for robust signal disruption.

3. Prioritizing ethical deployment in academic environments to preserve the integrity of examinations.

2.2 Theoretical Considerations

The design of a signal jammer involves theoretical calculations that ensure effective frequency interference while keeping power consumption and signal range in check. Key theoretical aspects include:

1. Oscillator Design: Oscillators generate the radio frequency signals that interfere with the targeted communication frequencies. The oscillation frequency (f_{osc}) must match or be close to the frequency of the target signal for effective jamming.

2. Signal Power Calculation: The power level of the jamming signal should be sufficient to override the communication signal.

The Friis transmission equation can be used to estimate the required power:

$$Pr = \frac{Pt \cdot Gt \cdot Gr \cdot \lambda^2}{(4\pi)^2 \cdot d^2}$$

Where: - P_r: Received power - P_t: Transmitted power - G_t, G_r: Gains of the transmitting and receiving antennas - : Wavelength of the signal - d: Distance between jammer and target

3. Noise Generation: For jamming to be effective, the system generates white noise at the desired frequencies. The noise source's voltage spectral density should match the signal level to produce interference.

2.3 Microstrip Antennas for Jammer

Recent research has focused on using **microstrip antennas** for signal jammers. Microstrip antennas are compact and efficient, making them ideal for integrating into jamming devices that need to operate across multiple frequency bands.

• **Liu et al. (2021)** demonstrated the use of **microstrip antennas** to create a **multiband jammer** that could simultaneously target mobile and Wi-Fi signals. Their design involved using **patch antennas** with tunable **resonant frequencies** to allow for jamming across the **800 MHz, 2.4 GHz**, and **5.2 GHz** bands.

• **Almeida et al. (2019)** explored the benefits of using **microstrip line structures** for integrating jamming systems into **portable devices**. Their work highlights the **ease of impedance control** and the **compact design** of microstrip antennas, making them suitable for **low-power jamming** in constrained environments.

2.4 Other Antennas for Jammer

1. **Discone Antenna**: Typically covers 10 MHz to several GHz.

Omni-directional. Ideal for wideband jamming.

2. **Log-Periodic Dipole Antenna (LPDA)**:

Can also cover from low frequencies to high frequencies.

Typically directional but can be used omnidirectionally if multiple are placed in a radial setup.

3. Some wideband antennas, like **rubber duck antennas**, may not operate effectively below 100 MHz, so it won't be ideal.

4. **Signal Hound SA124-WB** Wideband Antenna:

Transmission: 20 MHz to 2.7 GHz.

Omnidirectional and suitable for wideband operation.

High-performance design.

5. RF Solutions **ANT-WDB**:

Transmission: 50 MHz to 3 GHz (check for power-handling capacity).

2.5 Applications of Signal Jamming:

Signal jamming has diverse applications, including:

Academic Integrity: Ensuring the integrity of exams by jamming cellular and Wi-Fi signals in examination centers.

Security: Blocking communication in sensitive government and military areas to prevent data leakage or unauthorized access.

Crime Prevention: Jamming signals to prevent the remote detonation of explosive devices, especially in high-security zones.

Chapter 3

Work Done Till Midterm

Studied the essential components used in a signal jammer like the Single Frequency Oscillator, Single Stage Noise Generator and Double Stage Noise Generator.

3.1 Single Frequency Oscillator (LTspice)

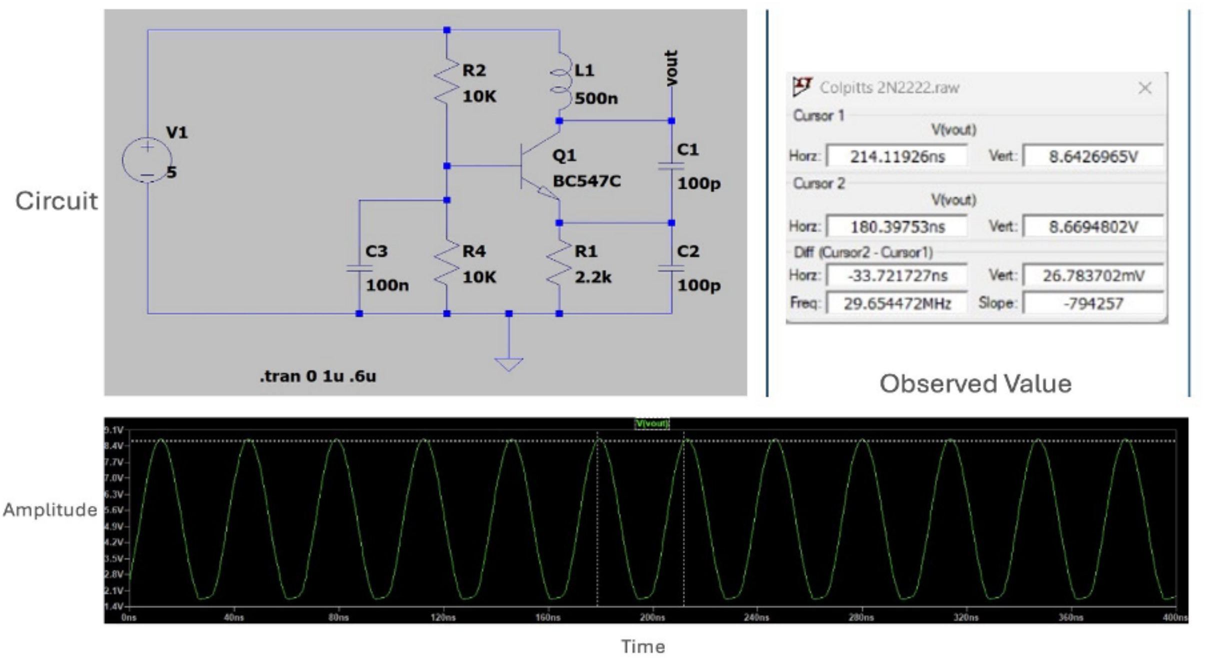

Figure 3.1: Single Frequency Oscillator Circuit and Simulation Result

The formula for the resonant frequency of an LC circuit, which is a combination of an inductor (L) and a capacitor (C). The resonant frequency f is given by:

$$f = \frac{1}{2\pi\sqrt{LC}}$$

This equation describes the natural frequency at which the LC circuit oscillates when there is no external resistance or driving force applied. It's commonly used in oscillators.

Theoretical Calculation:
L = 500 nH, C1 = 100 pF, C2 = 100 pF, C = C1 x C2 / (C1 + C2) ˜series
C = 50 pF
On performing calculation, we get,
F = 31.84 MHz or 0.032 GHz

3.2 Single Stage Noise Generator (LTspice)

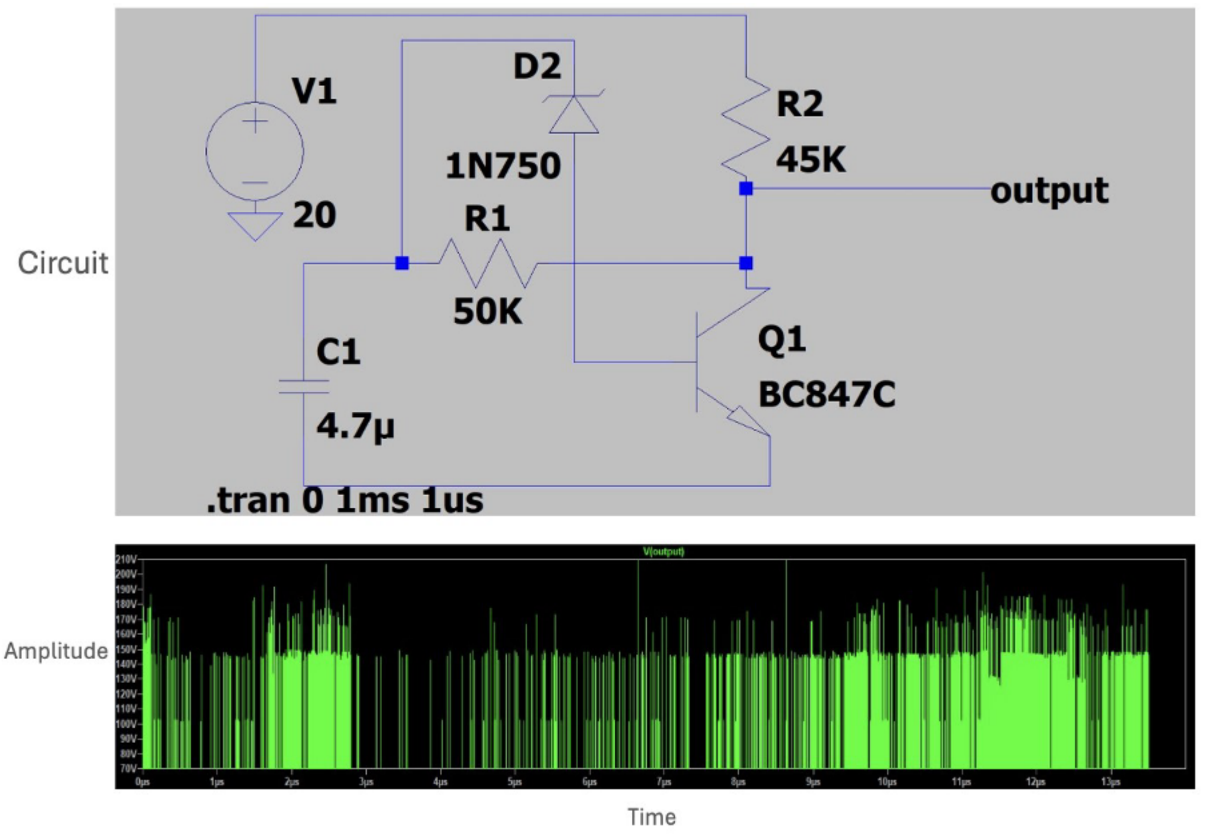

Figure 3.2: Single Stage Noise Generator Circuit and Simulation Result

Components Used:
1. BC847C Transistor (45 V)
2. 1N750 Zener Diode (4.3 V)
3. Capacitor (4.7 uF)
4. Resistor 45k
5. Resistor 50k

Only 1 Transistor associated with the circuit is used for amplification of weak signal.

3.3 Double Stage Noise Generator (LTspice)

We are using double stage noise generator to increase the amplitude of the noise signal generated.

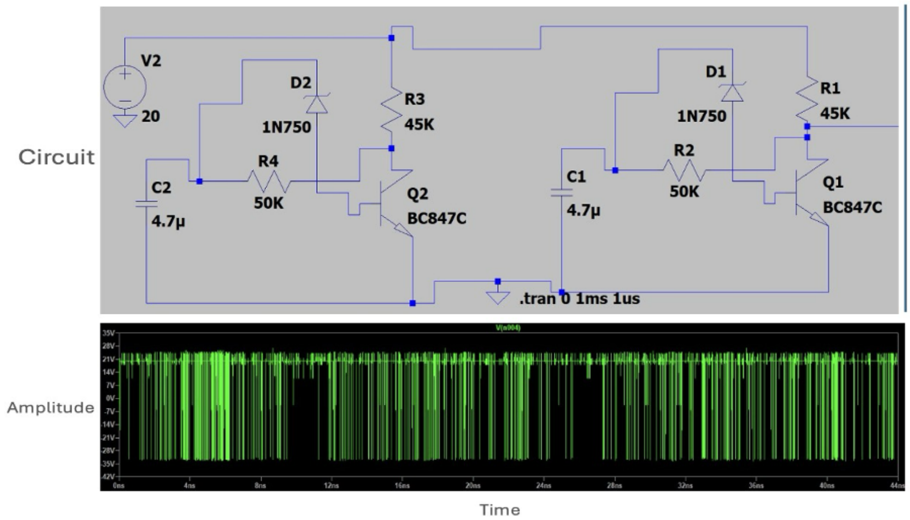

Figure 3.3: Double Stage Noise Generator Circuit and Simulation Result
21 V Amplitude

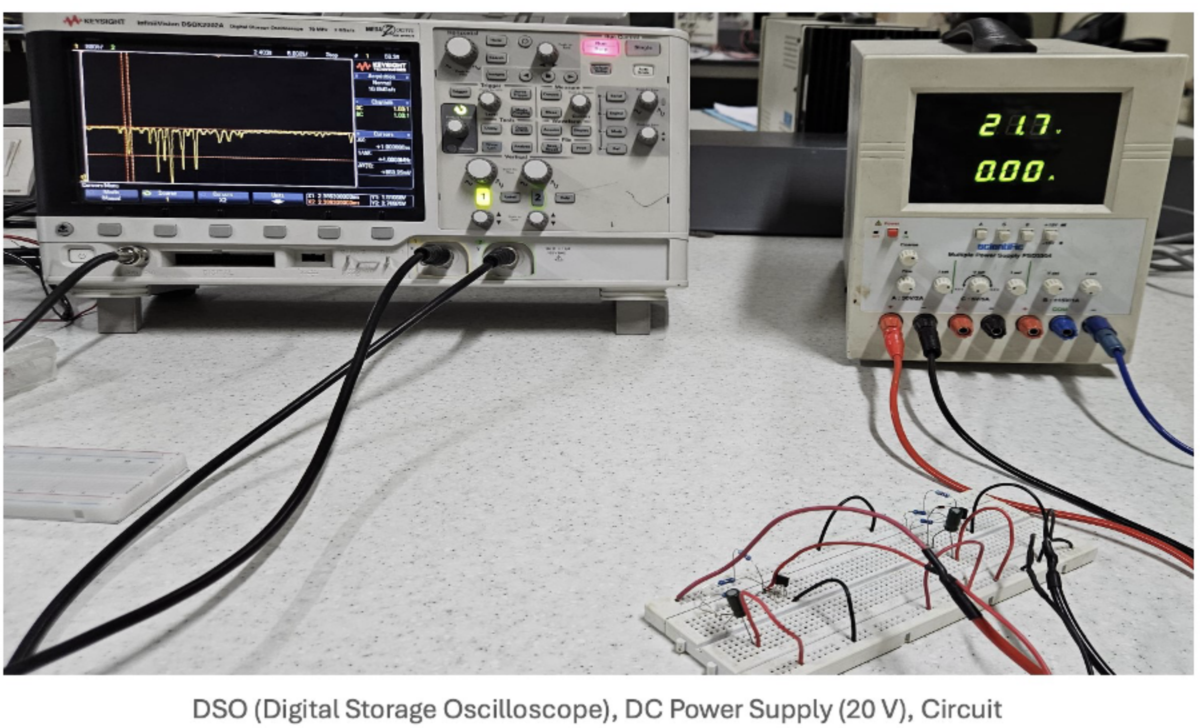

Figure 3.4: Hardware Implementation

3.4 Hardware

Breadboard Circuit

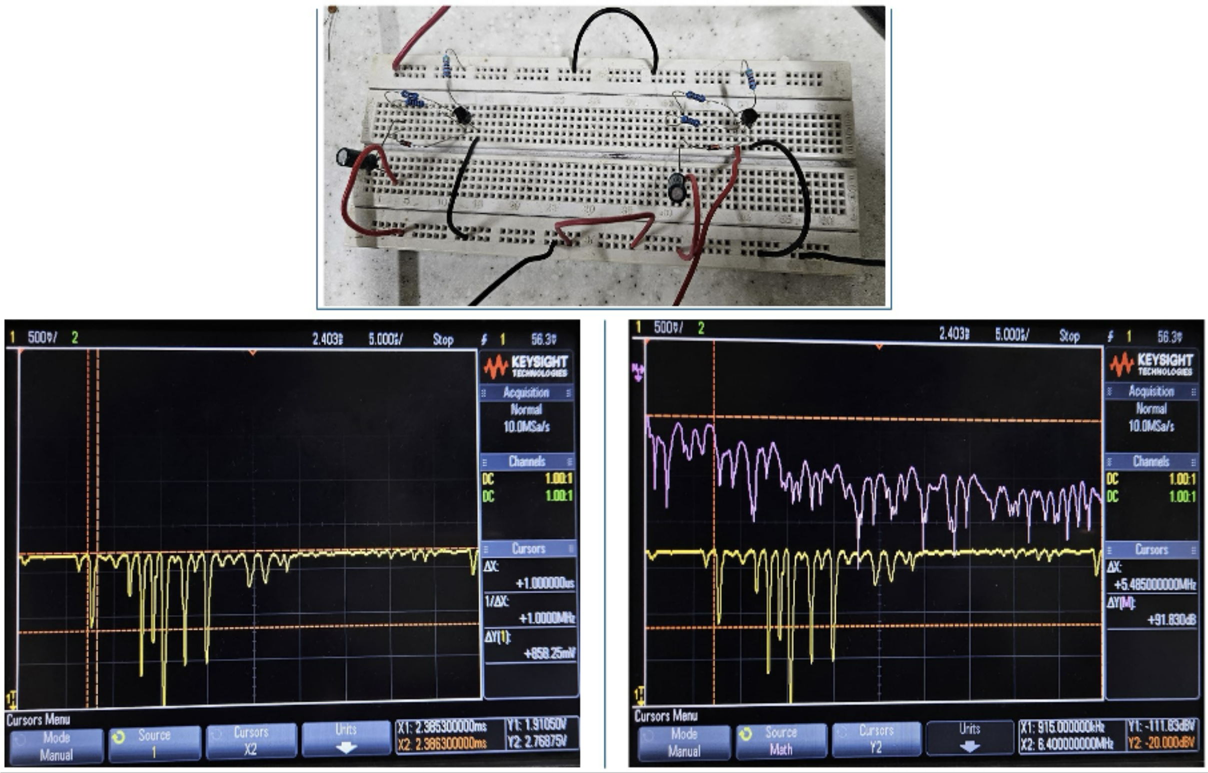

Figure 3.5: Circuit for Broadband Generation and Measurement
X Axis: Time (us), Y Axis: Gain (dB)

Chapter 4

Work Done Post Midterm

Studied and implemented NE555 Timer, various transistors and other components used in the jammer circuit.

4.1 NE555 Timer

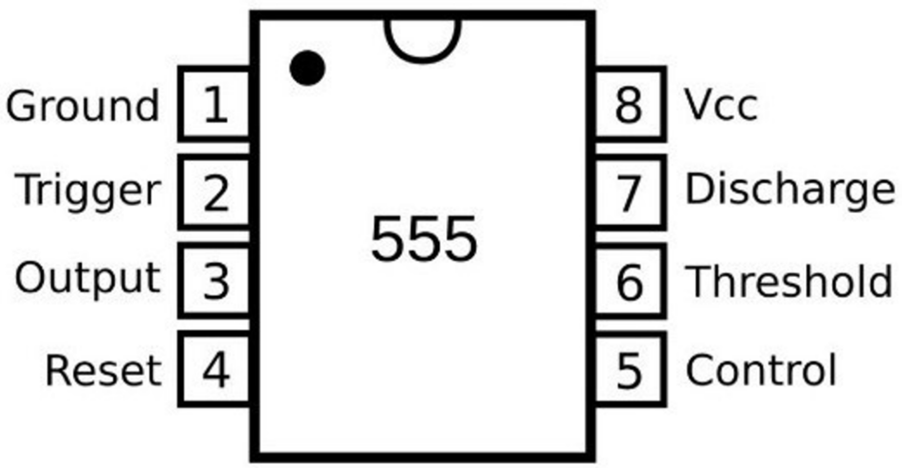

Figure 4.1: NE555 Timer having 8 pins

Pin 1 (Ground): Connect to 0 V (ground rail).
Pin 2 (Trigger): Detects when the voltage drops below 1/3 of the supply voltage, triggering the output to turn on.
Pin 3 (Output): Outputs a HIGH signal (˜supply voltage) / LOW signal (˜0.5 V).
Pin 4 (Reset): Typically connected to a HIGH state to prevent unintended resets.
Pin 5 (Control Voltage): Modifies timing thresholds.
Pin 6 (Threshold): Turns the output LOW when the voltage exceeds 2/3 of the supply voltage.
Pin 7 (Discharge): Discharges the timing capacitor when the output is LOW.
Pin 8 (VCC): Connects to the positive supply voltage.

4.2 How to use NE555 Timer?

There are a lot of ways to use the 555 IC. We can use them in hundreds of different circuits to create many clever things. But they can all be put into three groups. In different types of oscillators:

• **Astable Multivibrator** – constantly oscillates

– Any circuit which has cycled more than a few times per second like frequen-cies above 1 cycle per second, is called an oscillator (multivibrator or square wave oscillator).

– Below this frequency, we call it "cycling". The frequency of oscillation is measuredin cycles per second(cps) now called Hertz(Hz).

• **Monostable** – changes state only once per trigger pulse – also called a **ONESHOT** or It is called a *TIMER or DELAY* .

The 555 timers can provide time delays ranging from several minutes for one cycle of operation to many thousands of cycles per second.

1. The NE555 timer is used in your mobile jammer circuit because of its versatility and ability to generate precise signals.

2. The NE555 timer is configured in astable mode in this circuit to generate a continuous square wave or pulse signal. This output acts as the modulation signal that drives the oscillator circuit, enabling it to generate high-frequency signals required for jamming.

Astable mode is a configuration of the NE555 timer where it works as an oscillator, producing a continuous square wave signal (on and off cycles) without any external trigger. The circuit never stays stable in one state (high or low), which is why it is called "astable" (unstable). It automatically switches between high and low output repeatedly, creating a continuous pulse. The frequency and duty cycle of the output signal are controlled by resistors and a capacitor in the circuit.

3. The frequency of the signal generated by the NE555 timer can be adjusted using external resistors and capacitors (in this case, R8, R9, and C7). This flexibility allows you to Tune the circuit to different frequency bands.

4.3 Working of the Mobile Jammer Circuit

1. Signal Generation:

- The NE555 timer is set up in astable mode to generate a continuous square wave signal.
- This signal serves as the modulation source, which will control the amplitude or frequency of the jamming signal.

2. Coupling and Modulation:

- The square wave output from the NE555 is passed to the transistor base through a coupling capacitor (C12).
- This modulating signal dynamically drives the transistor to generate a variable RF signal.

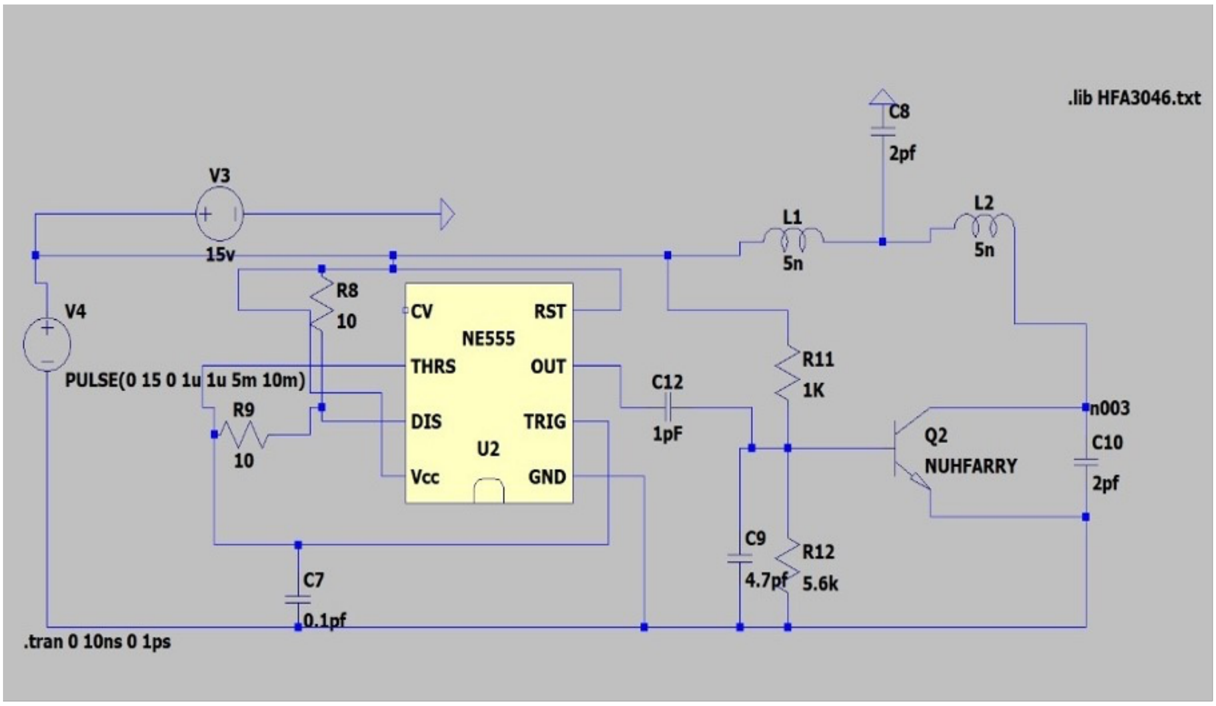

Figure 4.2: Jammer Circuit with NE555 Timer and HFA3046 Transistor

3. High-Frequency Signal Creation:

- We chose the transistor HFA3046 as it has a frequency range of 100 MHz to 8 GHz.
- The LC tank circuit (L1, L2, and C8) resonates at a specific frequency corresponding to mobile communication bands (e.g., GSM,).
- The transistor Q2 amplifies the oscillations in the LC circuit, ensuring a strong RF signal is produced.

4. Feedback for Sustained Oscillations:

- A feedback loop, including C9, stabilizes and sustains the oscillations in the LC circuit, ensuring the jamming signal remains consistent and powerful.

5. Jamming Mobile Signals:

- The generated RF signal is transmitted into the surrounding environment via an antenna or directly radiated.
- This signal overlaps with the frequency used by mobile devices, creating interference and effectively jamming their communication with the base station.

4.4 Working of each component in the circuit:

R8, R9, C7 :

• The combination of R8, R9, and C7 determines the frequency (fff) and duty cycle of the NE555 timer's output signal in astable mode.

• Frequency Formula:

• By adjusting R8, R9, or C7, you can fine-tune the output signal to modulate the RF oscillator for jamming the desired frequency band.

R8 (Resistor):

- Connected between pin 7 (Discharge) and pin 8 (Vcc).
- Its role is to control the charging time of capacitor C7, along with R9.

R9 (Resistor):

- Connected between pin 7 (Discharge) and pin 6 (Threshold) (which is internally connected to pin 2, Trigger).
- Controls the discharging time of capacitor C7.

C7 (Capacitor):

- Connected between pin 6 (Threshold) and GND.
- Charges and discharges through R8 and R9, creating the timing cycles for the NE555.

1. Coupling Capacitor:

- C12 allows the AC (modulating signal) from the NE555 timer to pass to the base of the transistor Q2, while blocking any DC offset from affecting the transistor.
- A DC offset is an unwanted constant voltage in a signal. C12 ensures that only the desired AC signal (without the DC offset) reaches Q2, enabling proper modulation and functioning of your jammer circuit. o This ensures that only the desired square wave signal is transmitted to the next stage (oscillator or amplifier).

2. Preventing DC Bias Issues:

- Without C12, the DC component from the NE555 output could interfere with the transistor's biasing, potentially saturating or cutting off the transistor.

3. Signal Transfer:

- It transfers the modulating signal generated by the NE555 timer to the RF oscillator stage for creating the jamming signal.

Function and Significance of the Tank (LC) Circuit with L1, L2, and C8 :

The combination of L1, L2, and C8 forms a tank circuit or LC resonant circuit, which is a critical part of the mobile jammer circuit. Here's what it does:

• The tank circuit is designed to resonate at a specific frequency determined by the values of L1, L2, and C8.

Where:

• L = L1 + L2 (combined inductance),

• C=C8 (capacitance),

• fr is the frequency

Functions of R11, R12, and C9 in the Circuit:

These components are part of the biasing and stabilization network in your circuit, which works to ensure proper functioning of the oscillator or amplifier stage. Let's break down their specific roles:

1. R11 (Resistor)

Biasing Resistor: R11 provides a stable base bias current to the transistor (Q2), ensuring it operates in the

desired region (active or oscillation mode). · Without R11, the

transistor (Q2) may not receive the proper base current. · This can cause the transistor to operate in an incorrect region

2. C9 (Capacitor)

Function:

- Coupling Capacitor: C9 act as a coupling capacitor, passing AC signals (oscillations) between stages while blocking any DC component.
- Stabilization Capacitor: If used in parallel with R12 or R11, it stabilizes the voltage by filtering noise or high-frequency components.
- Without C9, noise or high-frequency glitches can destabilize the circuit, leading to erratic behavior.

3.Q1 Transistor Role

• Q1 amplifies the oscillating signals generated by the LC circuit (inductors and capacitors) to ensure stable oscillation at the desired frequency.

• It works as an amplifier to maintain the oscillations by providing the necessary feedback to the LC tank circuit.

• The transistor provides the required feedback to sustain oscillations. The feedback is critical in maintaining a stable high-frequency carrier wave, which is essential for jamming the target signals.

4.5 Jammer Circuit 1 (Unrealistic Capacitance)

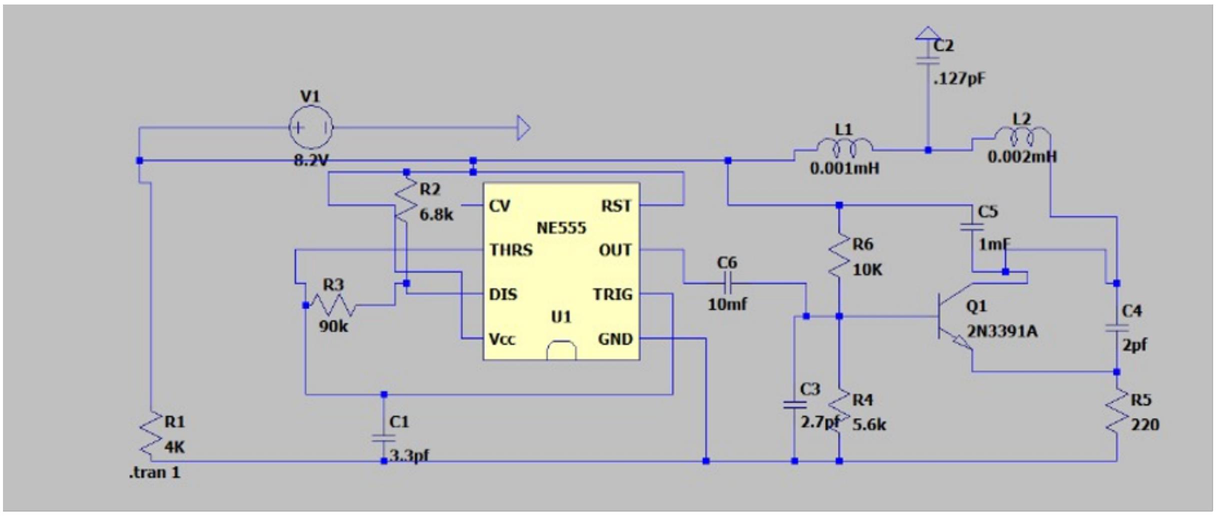

Figure 4.3: Jammer Circuit with NE555 Timer and 2N3391A Transistor

Studied the frequency generation, achieving high frequency ranges and bandwidth even with a transistor which is tuned to generate frequencies in MHz.

The signal was generated with unrealistic values of Capacitance.

X Axis: Frequency (GHz), Y Axis: Gain (dB)

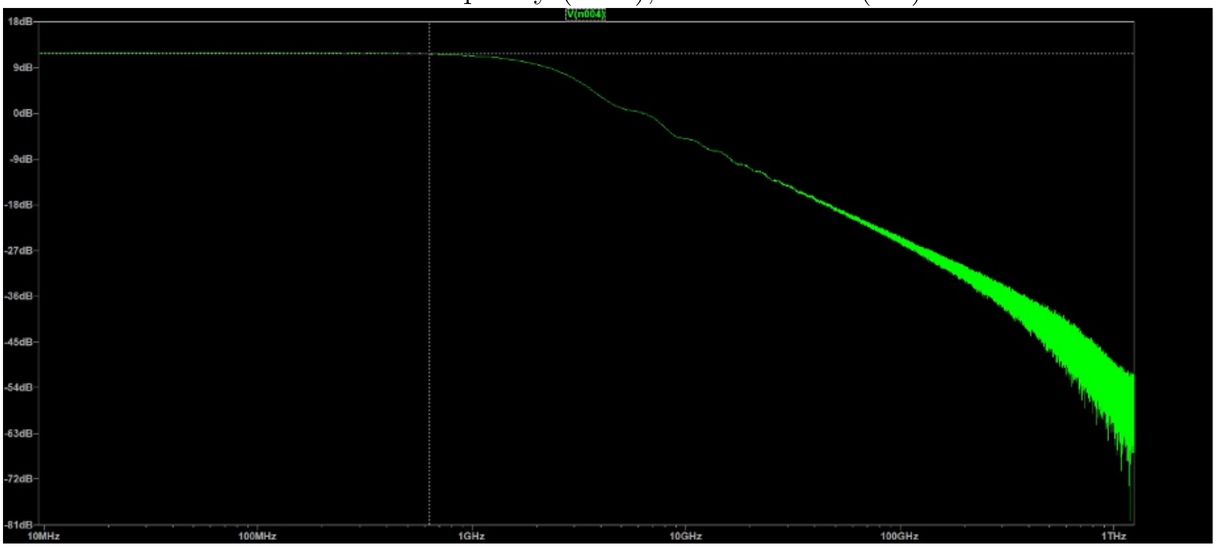

Figure 4.4: Frequency Response of the Output Signal

4.6 Jammer Circuit 2 (Realistic Parameters)

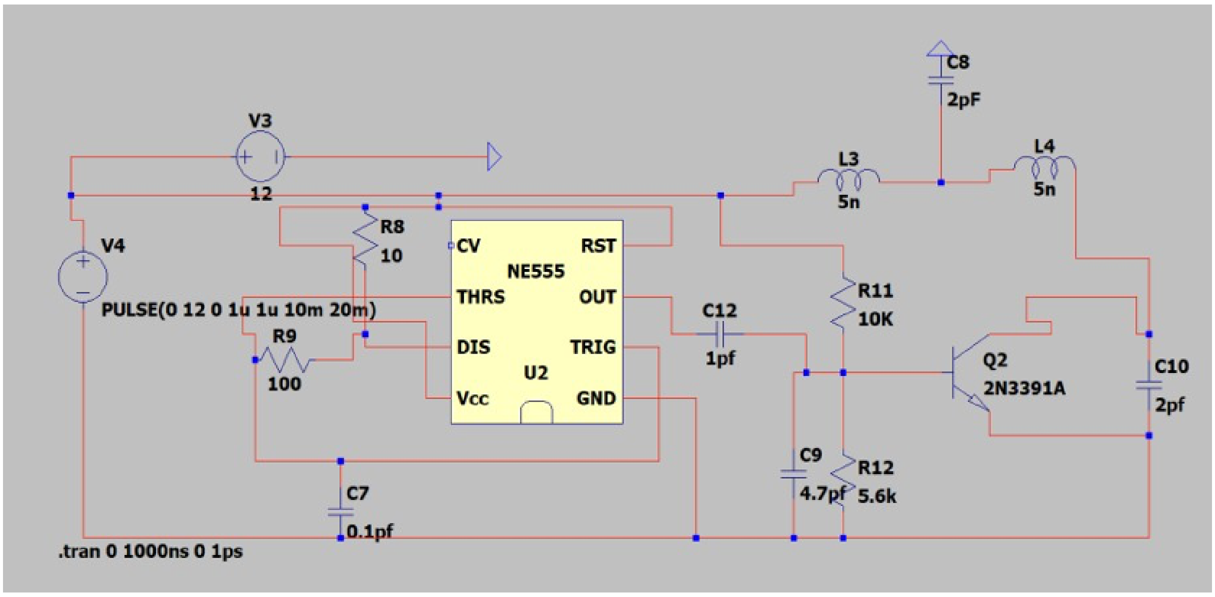

Figure 4.5: Jammer Circuit with NE555 Timer and 2N3391A Transistor

Parametric Tables for Circuit 2:
1. Parameter values for L1, L2

L1	L2	C8	fL	fH	f(obs)
50nH	50nH	2pF	201.3 MHz	284.98 MHz	217 MHz
30nH	30nH	2pF	300 MHz	347.7 MHz	323.85 MHz
20nh	20nH	2pF	411.6Mhz	448.75 MHz	430.17 MHz
10nH	10nH	2pF	05.4Mhz	659.8 MHz	632.66 MHz
5nH	5nH	2pF	815.3Hz	1.02GHz	1.01GHz

X Axis: Frequency (GHz), Y Axis: Gain (dB)

Figure 4.6: Frequency Response of the Output Signal with 100 nH Inductance

X Axis: Frequency (GHz), Y Axis: Gain (dB)

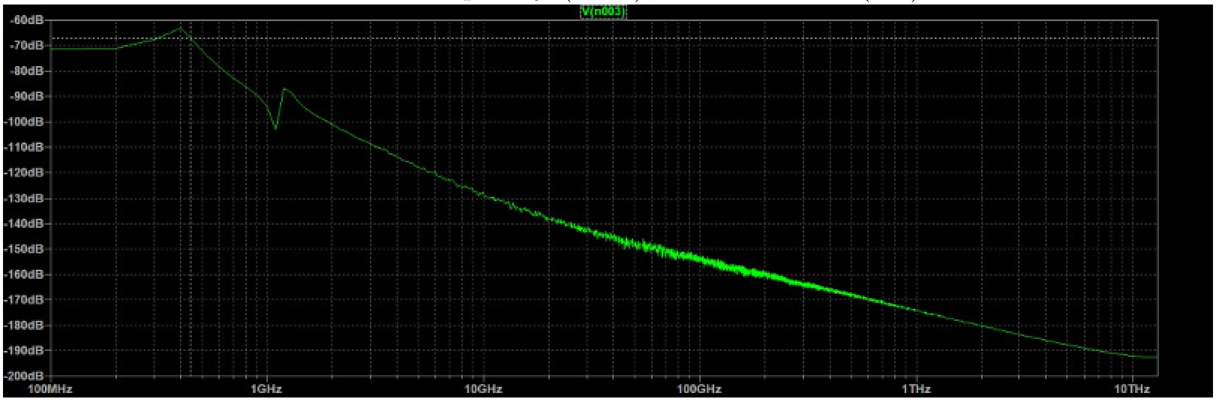

Figure 4.7: Frequency Response of the Output Signal with 40 nH Inductance

X Axis: Frequency (GHz), Y Axis: Gain (dB)

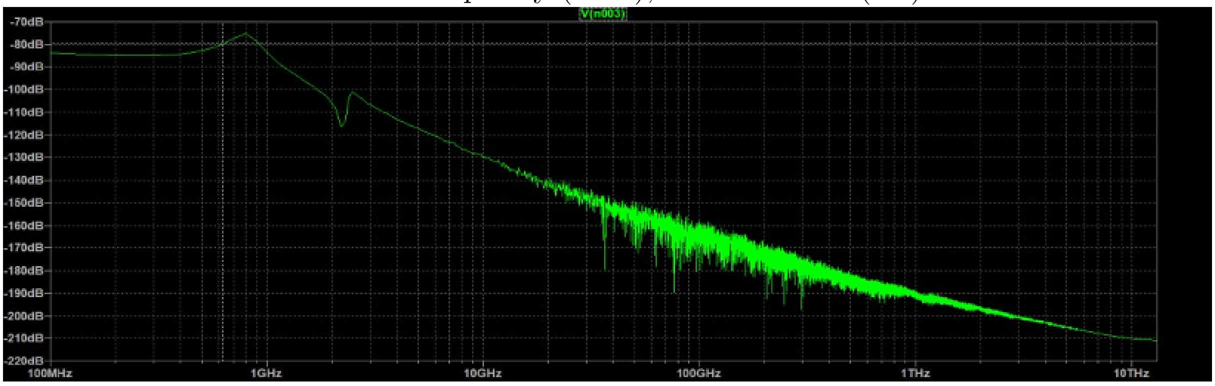

Figure 4.8: Frequency Response of the Output Signal with 20 nH Inductance

X Axis: Frequency (GHz), Y Axis: Gain (dB)

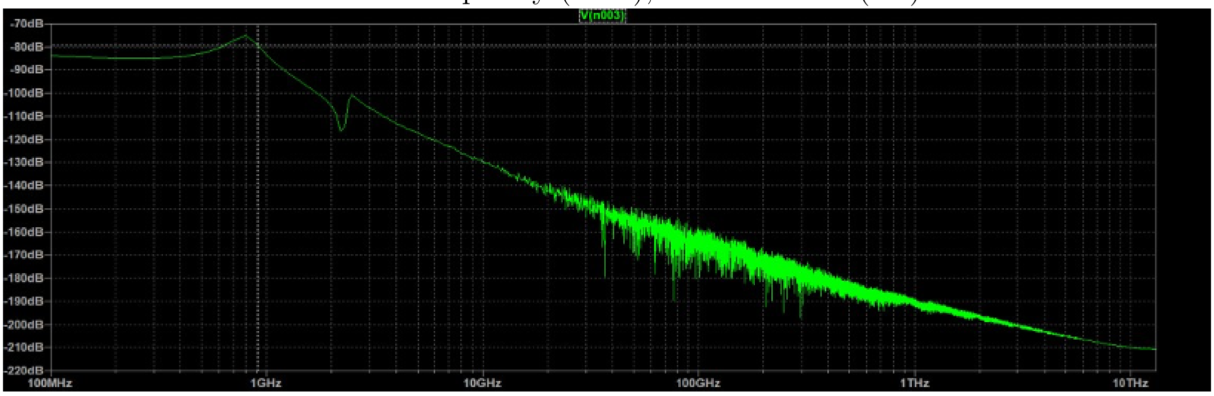

Figure 4.9: Frequency Response of the Output Signal with 10 nH Inductance

2. Parameter values for C12

L1	L2	C12	fL	fH	f(obs)	Gain (dB)
5nH	5nH	10 µF	952.7 MHz	922.09 MHz	951.8 MHz	-60 dB Negative Gain
5nH	5nH	5 µF	992 MHz	1 GHz	901.5 MHz	-64 dB Negative Gain
5nH	5nH	10 pF	1.009 GHz	1.245 GHz	1 GHz	-44 dB Negative Gain
5nH	5nH	1 pF	1 GHz	1.02 GHz	1.01 GHz	-8 dB Gain

X Axis: Frequency (GHz), Y Axis: Gain (dB)

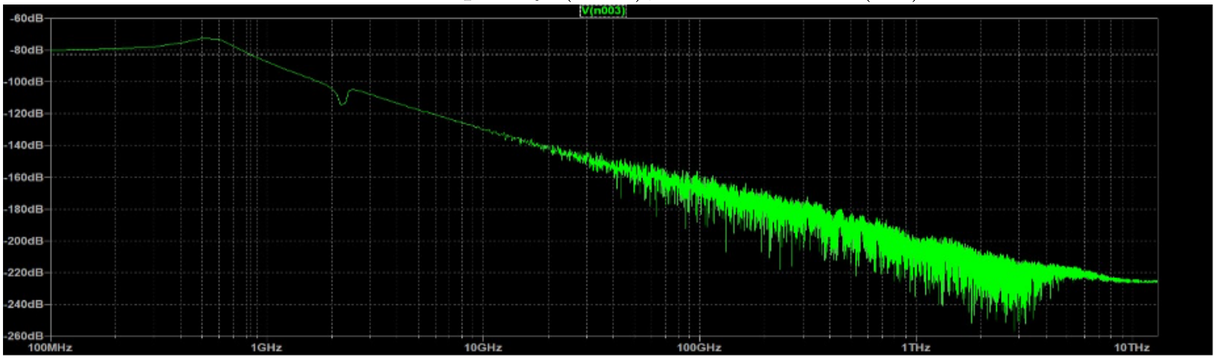

Figure 4.10: Frequency Response of the Output Signal with 10 uF Capacitance

X Axis: Frequency (GHz), Y Axis: Gain (dB)

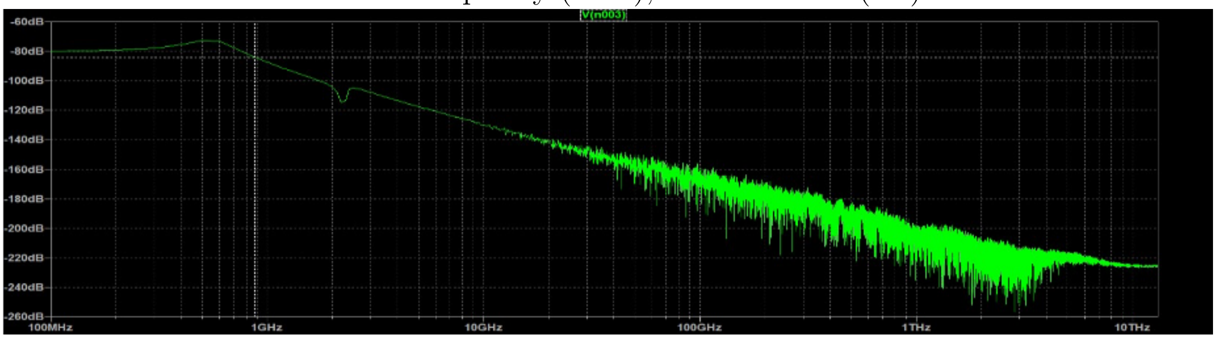

Figure 4.11: Frequency Response of the Output Signal with 5 uF Capacitance

We were able to achieve a desirable central frequency but the gain was not positive it was around -75 dB.

During the initial stages of circuit testing, it was observed that the frequency generated by the existing configuration was significantly lower than the desired target range. This issue was attributed to the limitations of the transistor used in the circuit, which was unable to operate efficiently at higher frequencies required for effective signal jamming.

X Axis: Frequency (GHz), Y Axis: Gain (dB)

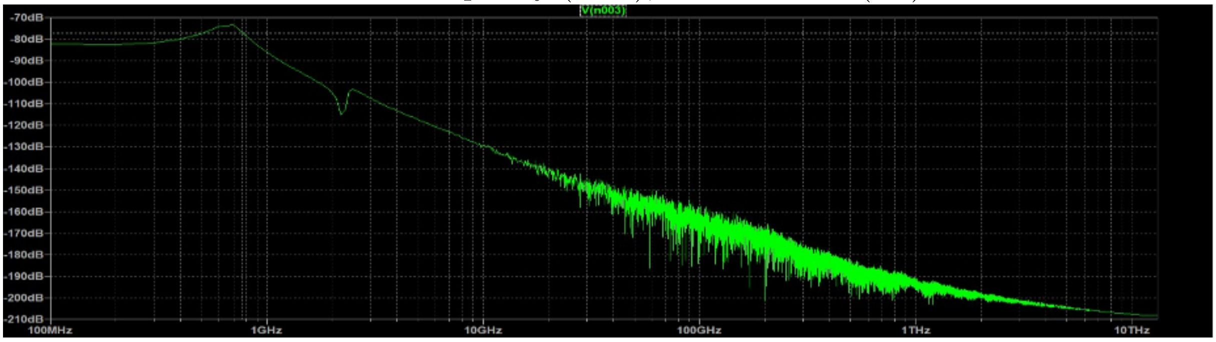

Figure 4.12: Frequency Response of the Output Signal with 10 pF Capacitance

X Axis: Frequency (GHz), Y Axis: Gain (dB)

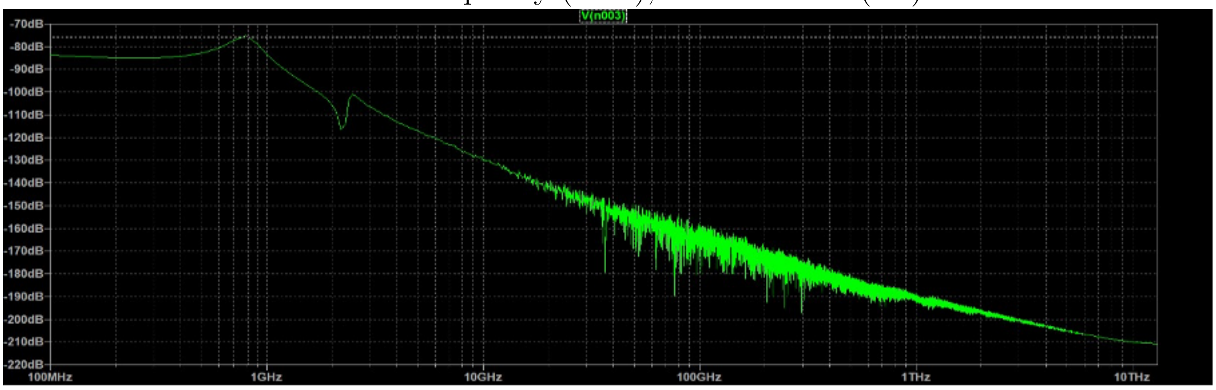

Figure 4.13: Frequency Response of the Output Signal with 1 pF Capacitance

4.7 Hardware Implementation

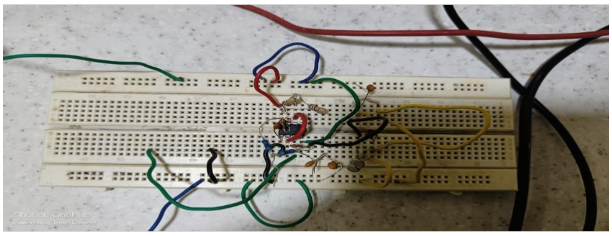

Figure 4.14: Breadboard Circuit

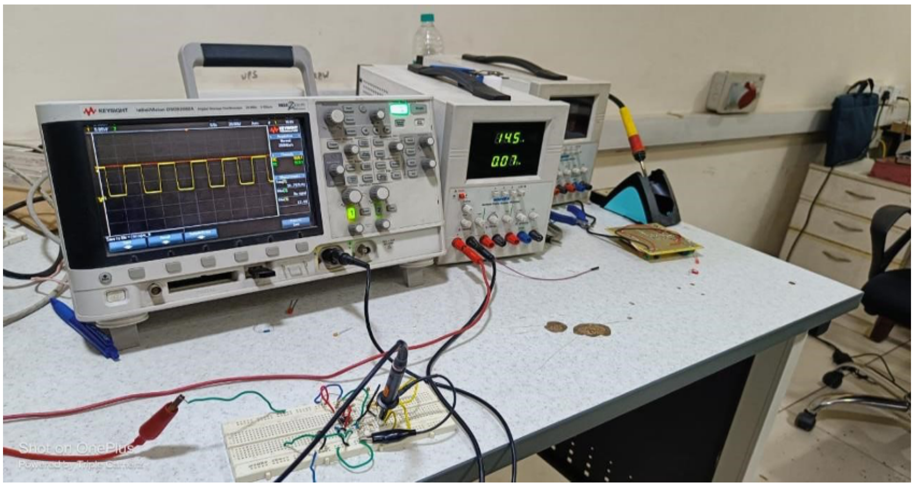

Figure 4.15: Experimental Setup

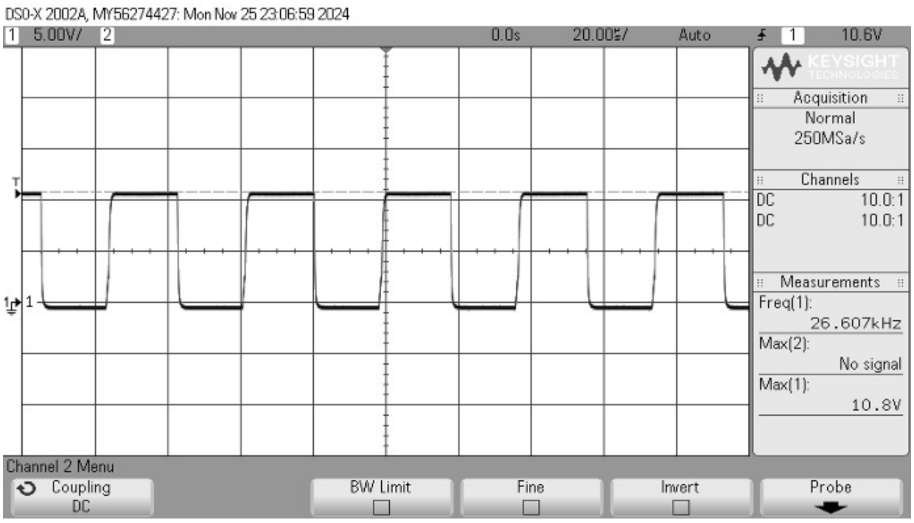

Figure 4.16: X Axis: Time, Y Axis: Voltage
DSO Result

4.8 Jammer Circuit 3

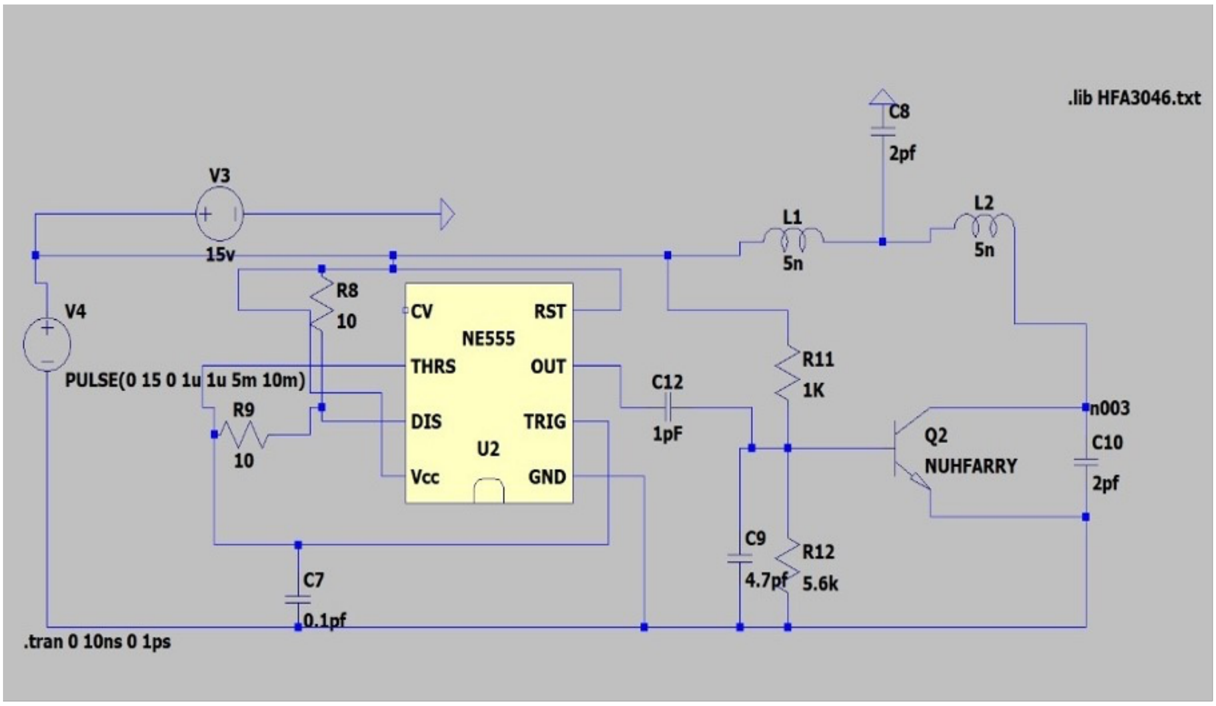

Figure 4.17: Jammer Circuit with NE555 Timer and HFA3046 Transistor

Parametric Tables for Circuit 3:

1. Parameter values for L1, L2

L1	L2	C8	fL	fH	f(obs)	f(cal)
50nH	50nH	2pF	101 MHz	134 MHz	117 MHz	350 MHz
30nH	30nH	2pF	100 MHz	153 MHz	126 MHz	459 MHz
20nH	20nH	2pF	100 MHz	118.75 MHz	109 MHz	562 MHz
10nH	10nH	2pF	101 MHz	218.8 MHz	310 MHz	700 MHz
5nH	5nH	2pF	1.00GHz	1.02GHz	1.01GHz	1.01 GHz

X Axis: Frequency (GHz), Y Axis: Gain (dB)

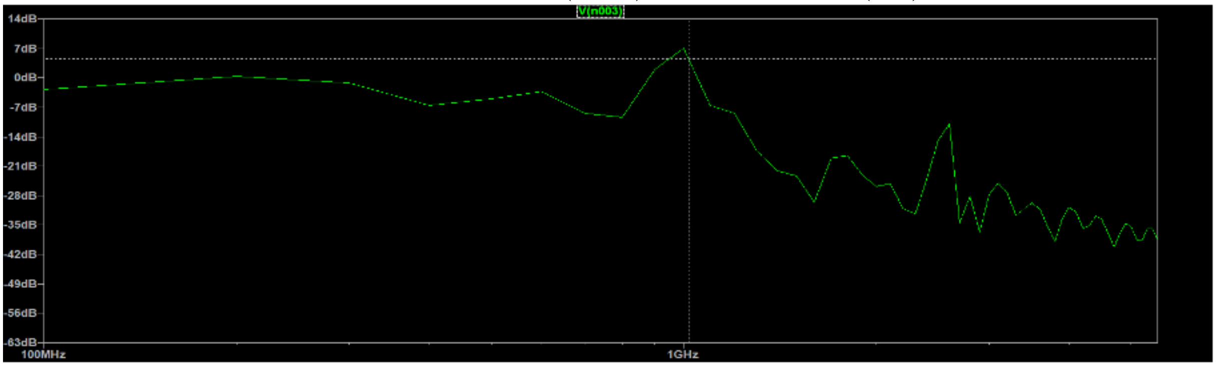

Figure 4.18: Frequency Response of the Output Signal with 10 nH Inductance

X Axis: Frequency (GHz), Y Axis: Gain (dB)

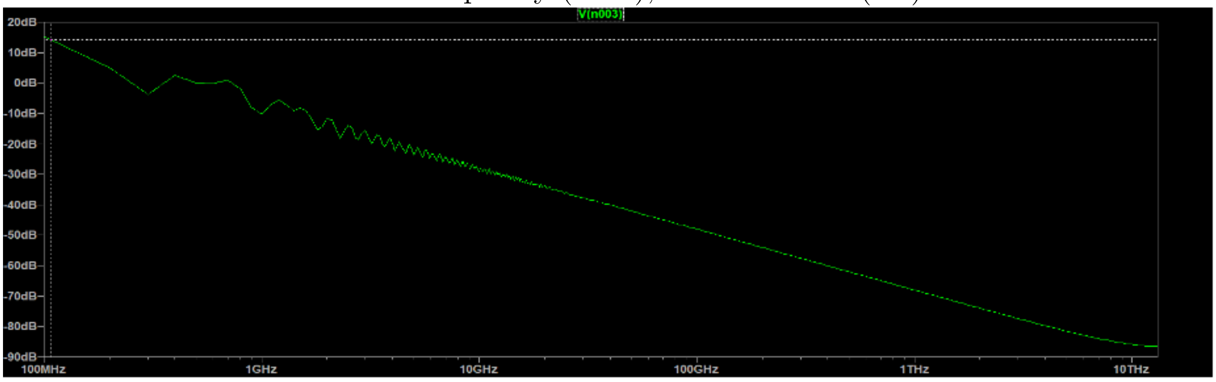

Figure 4.19: Frequency Response of the Output Signal with 40 nH Inductance

X Axis: Frequency (GHz), Y Axis: Gain (dB)

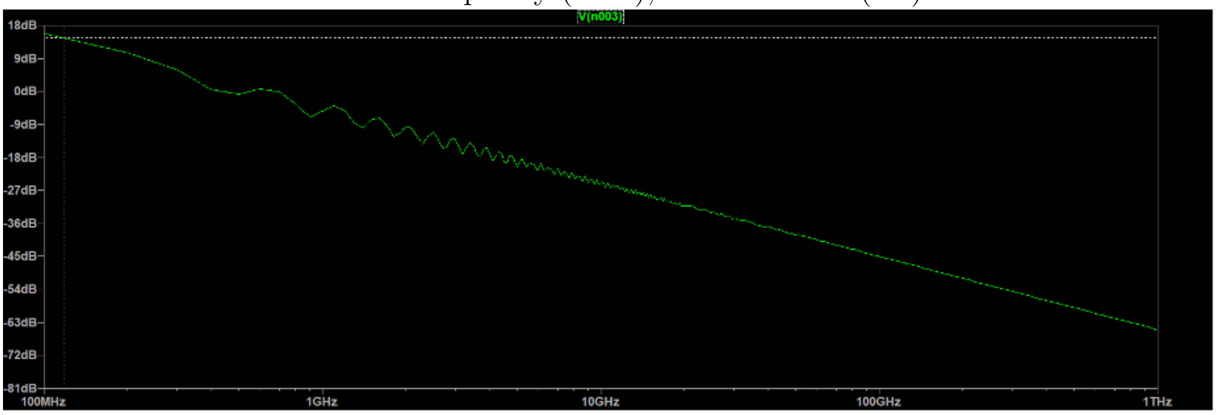

Figure 4.20: Frequency Response of the Output Signal with 100 nH Inductance

2. For Capacitor C12

L1	L2	C12	fL	fH	f(obs)	Gain (dB)
5nH	5nH	10 µF	992.7 MHz	962.09 MHz	950.8 MHz	-14 dB Negative Gain
5nH	5nH	5 µF	992 MHz	1 GHz	901.5 MHz	-14 dB Negative Gain
5nH	5nH	10 pF	1.009 GHz	1.245 GHz	1 GHz	Gain started increasing
5nH	5nH	1 pF	1 GHz	1.02 GHz	1.01 GHz	8 dB Gain

X Axis: Frequency (GHz), Y Axis: Gain (dB)

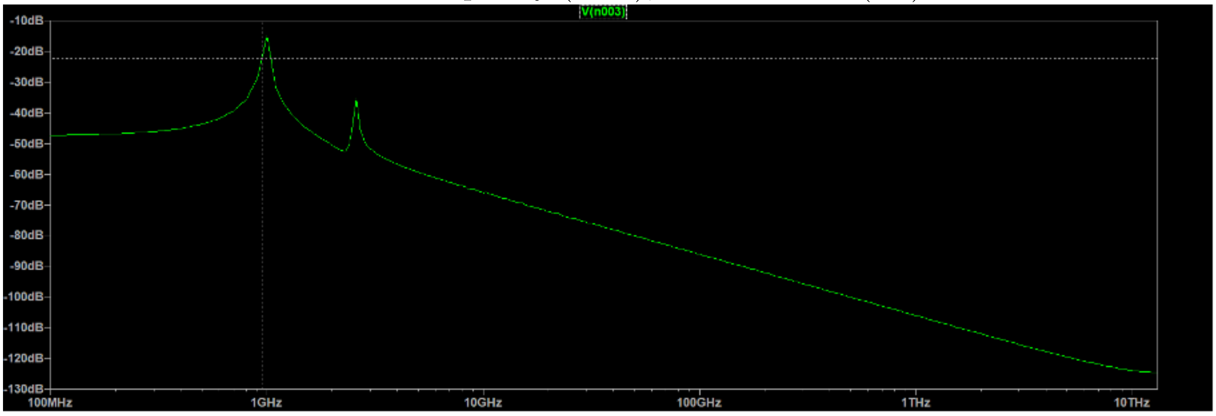

Figure 4.21: Frequency Response of the Output Signal with 20 pF Capacitance

X Axis: Frequency (GHz), Y Axis: Gain (dB)

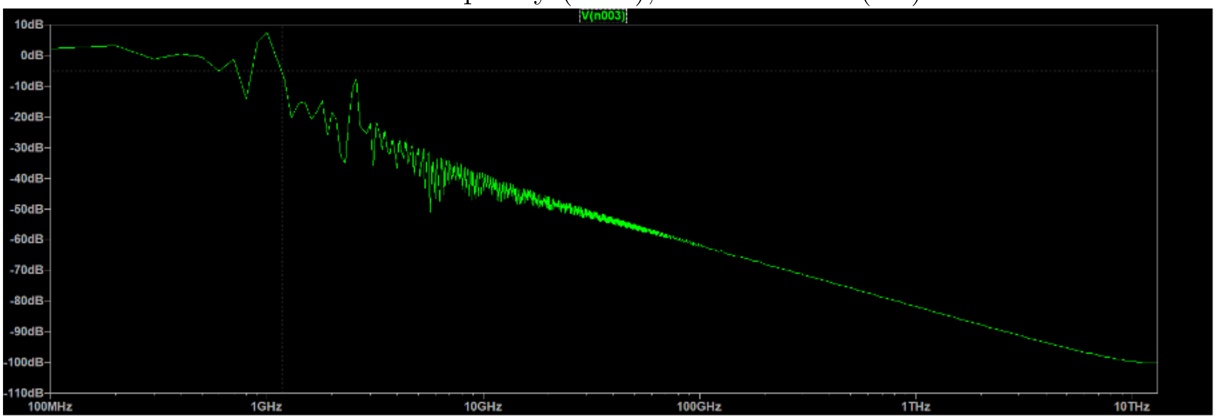

Figure 4.22: Frequency Response of the Output Signal with 20 pF Capacitance

3. 2. For Capacitor C8

L1	L2	C8	fL	fH	f(obs)
5nH	5nH	20 pF	485.5 MHz	327.723 MHz	406 MHz
5nH	5nH	15 pF	512.23 MHz	432.22 MHz	472.22 MHz
5nH	5nH	10 pF	802.3 MHz	848.94 MHz	825.62 MHz
5nH	5nH	2 pF	1 GHz	1.02 GHz	1.01 GHz

X Axis: Frequency (GHz), Y Axis: Gain (dB)

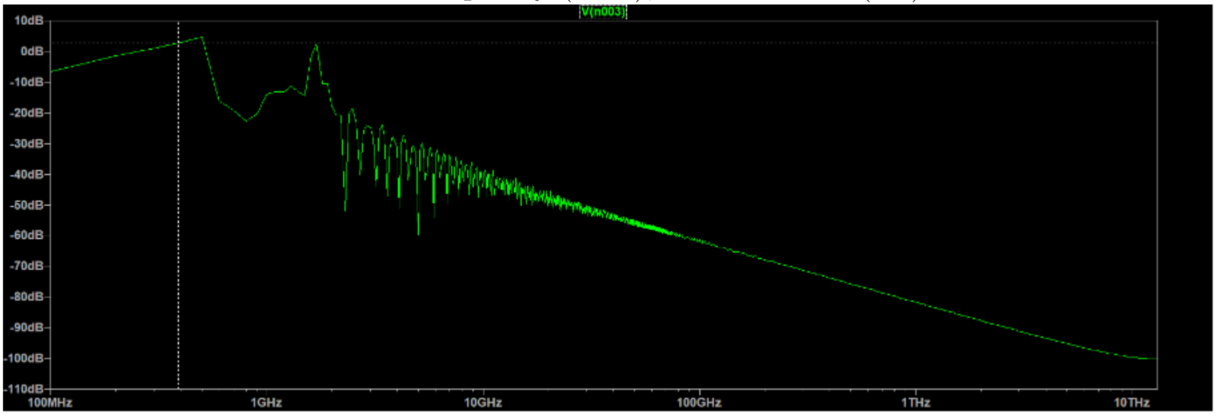

Figure 4.23: Frequency Response of the Output Signal with 20 pF Capacitance

X Axis: Frequency (GHz), Y Axis: Gain (dB)

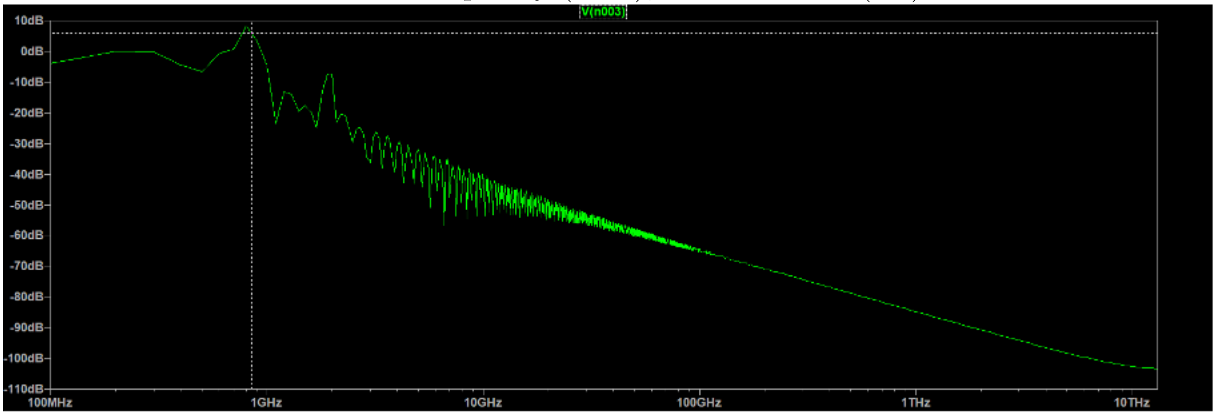

Figure 4.24: Frequency Response of the Output Signal with 10 pF Capacitance

4.9 Jammer Circuit 4

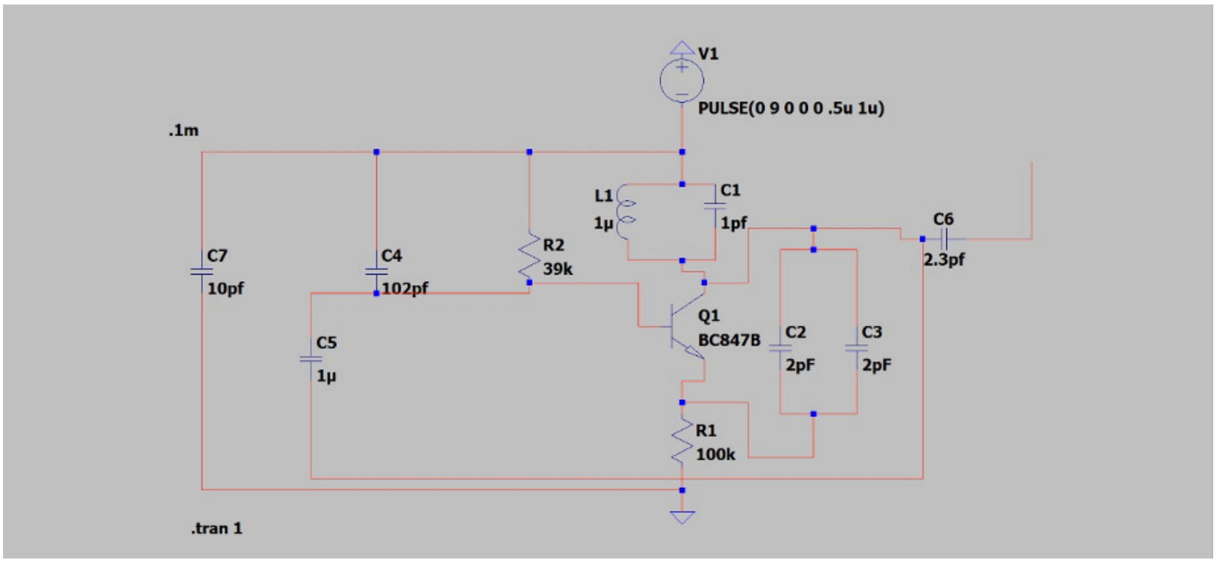

Figure 4.25: Jammer Circuit using Transistor BC847B without NE555 Timer

X Axis: Frequency (GHz), Y Axis: Gain (dB)

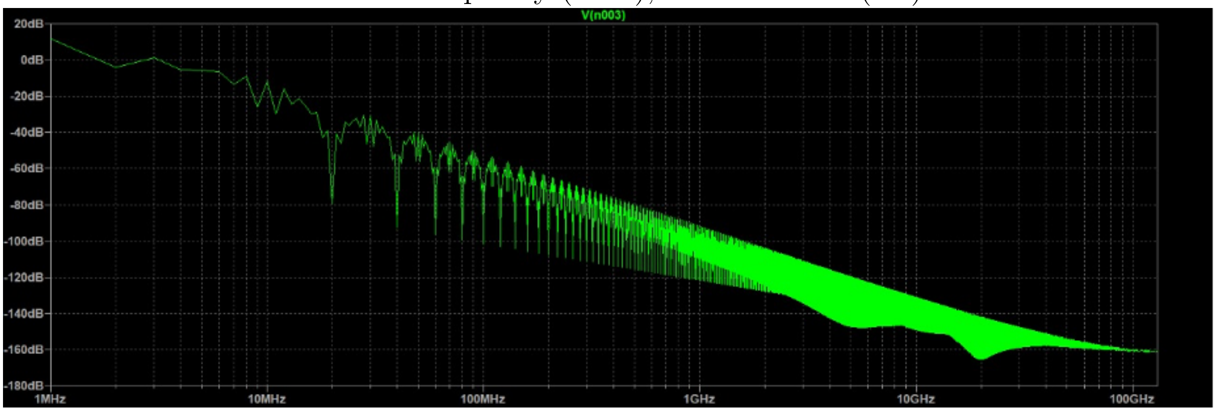

Figure 4.26: Frequency Response of the Output Signal
(1 MHz starting frequency at 10 dB)

Chapter 5

Results

1. **Outcomes:**

- Generation of frequencies in the targeted range (e.g., 900 MHz to 1 GHz in Circuit 2, 800 MHz to 2 GHz in Circuit 1, etc).
- Demonstration of jamming capability through simulated environments and hardware testing.
- Reduction in interference challenges with improved circuit stability and tuning.

2. **Key Measurements:**

- Different Gain values and frequencies achieved for different circuit iterations.

3. **Performance Highlights:**

- Stability of signal output across varying component tolerances.
- Improvements in noise generation and signal disruption with the NE555 timer integration.
- Scalability potential for multi-band jamming.

4. **Comparative Analysis:**

- Comparison of theoretical calculations versus observed results (e.g., frequency vs. gain).
- Analysis of challenges faced with earlier circuits and how they were resolved in subsequent iterations.

5. **Limitations:**

- Gain optimization not fully achieved for practical deployment.
- Power consumption and hardware complexity as areas for further improvement.

During the development of our mobile jamming system, we explored three distinct circuit designs, each presenting unique challenges and limitations:

1. **First Circuit**:

- Using a double-stage oscillator, we attempted to generate the required noise signal for jamming. While we achieved the desired central frequency, the capacitor value (C6) required for tuning was unrealistic, making practical implementation unfeasible. Furthermore, the circuit was highly sensitive to component tolerances, leading to inconsistencies in noise generation.

2. **Second Circuit**:

- Efforts to address the limitations of the first circuit included modifying the LC tank components (L1, L2, and C8). This approach achieved better frequency stability and bandwidth, but the circuit's gain remained negative, Analysis revealed that the transistor currents were insufficient to provide adequate amplification, further limiting the circuit's effectiveness. Also a transistor with high frequency should be used.

3. **Third Circuit**:

- To overcome the gain issue, a high-frequency transistor capable of operating at GHz frequencies was introduced. This modification improved frequency targeting, but gain values were still suboptimal, with a marginal increase. Additionally, the circuit required complex tuning and exhibited inefficiencies in power handling.

Chapter 6

Conclusion

Our project explored signal jamming techniques through iterative circuit designs, including single and double-stage oscillators and noise generators. While initial designs faced challenges such as unrealistic component values, limited frequency range, and negative gain, these were mitigated by incorporating high-frequency transistors and NE555 timers. The final design achieved targeted frequency ranges and improved stability, though gain optimization remains an area for further refinement. This work demonstrates the feasibility of multi-band signal jamming, providing a foundation for future advancements in controlled communication environments.

Chapter 7

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