

FM_Transmitter -- Overview



OBJECTIVES

After performing this lab exercise, learner will be able to:

- Build circuits using components from a schematic diagram.
- Explain the concept of Frequency Modulation (FM).
- Construct a FM Transmitter circuit and calculate the transmitting Frequency theoretically.
- Observe the output in the DSO and measure the transmitting frequency.

EQUIPMENT

To carry out this experiment, you will need:

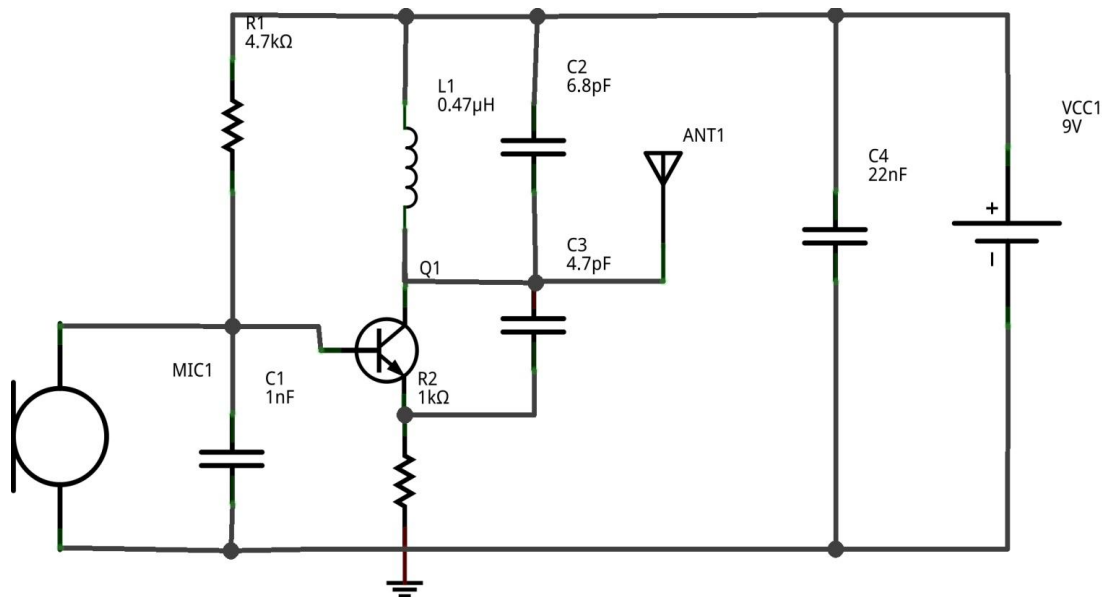
- TBS1KB-Edu Digital Oscilloscope of BW > 100 MHz from Tektronix
- Transistor (2n3904)
- Microphone / Condenser MIC
- Resistors (4.7K, 1K)
- Capacitors (4.7pF, 1nF, 22nF, 6.8pF)
- Inductor (0.47uH)
- DC Power Supply - 9V
- Voltage probe (provided with oscilloscope) / BNC cables
- Connecting wires

THEORY

- A personal FM transmitter is a low-power FM radio transmitter which broadcasts audio (often from an MP3 player or a microphone) to a standard FM radio, such as those found in cars.
- Most transmitters plug into the music player's headphone jack and then broadcast the signal over an FM broadcast band frequency so that it can be picked up by any nearby radio. This allows portable audio devices to make use of the better sound quality of a home audio system or car stereo without requiring a wired connection between them.
- Often called simply an FM transmitter, it is a low power device

which only works over distances of a few centimeters, compared to high powered commercial FM broadcasting transmitters which can be received many miles away.

CIRCUIT DIAGRAM



WORKING PRINCIPLE

- The microphone converts the sound into electric signal
- The audio signals are then amplified by a low power amplifier made using Transistor 2n3904.
- The transistor amplifier circuit amplifies as well as modulates the weak signal from the microphone and feeds to a LC tank circuit.
- The LC tank circuit generates the carrier signal and it defines the transmitting frequency of FM.

CALCULATIONS

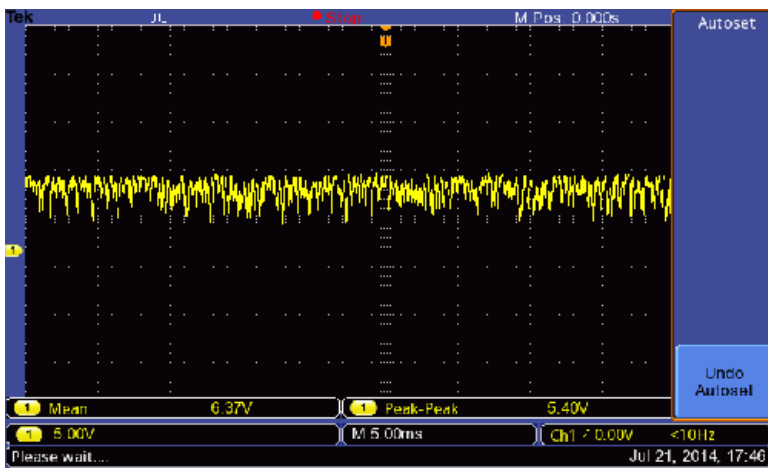
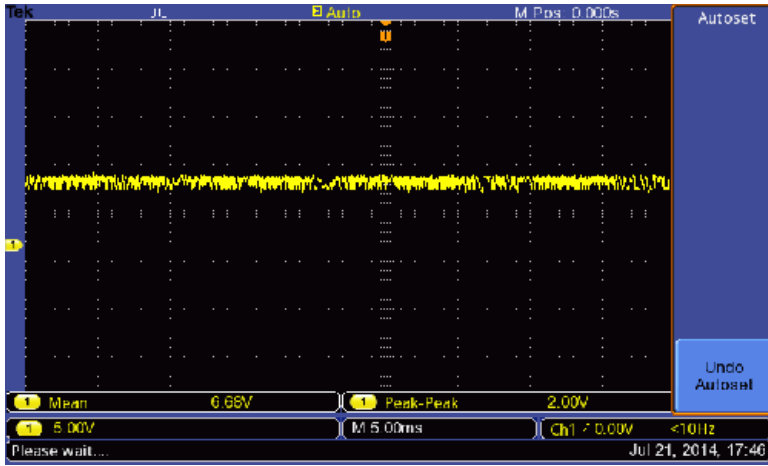
- The transmitting can be defined by the capacitor and inductor (L1 and C2), which is calculated using the formula

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

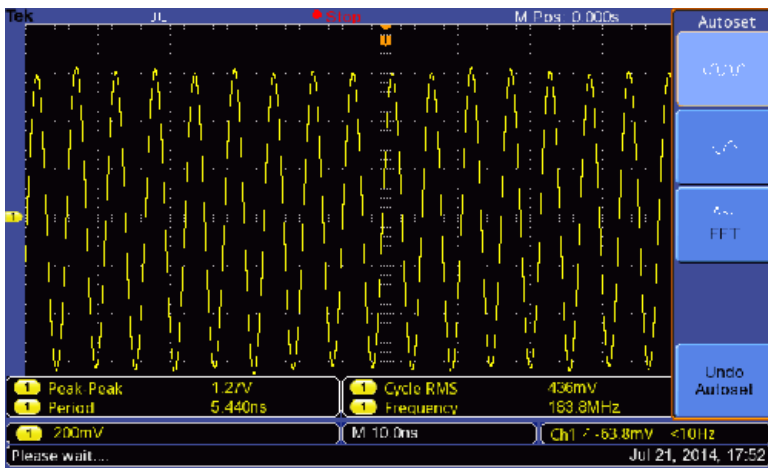
- With L=0.47, C=6.8pF, we get f = 89.02 MHz

Calculate the practical frequency.

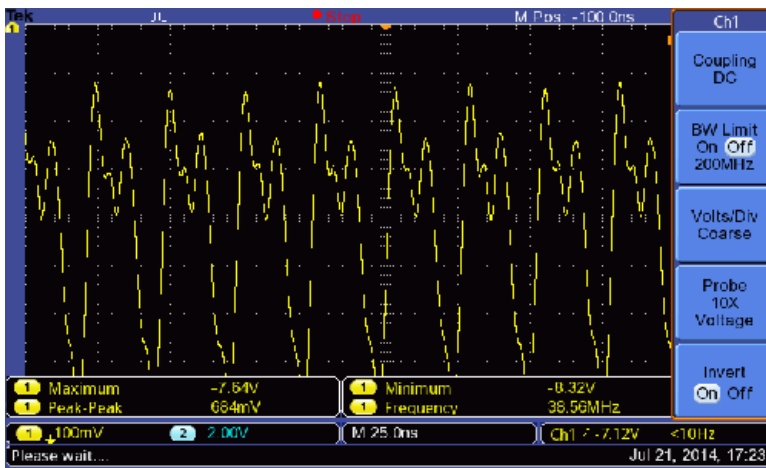
Waveforms:
Microphone Output



Carrier:



Output:

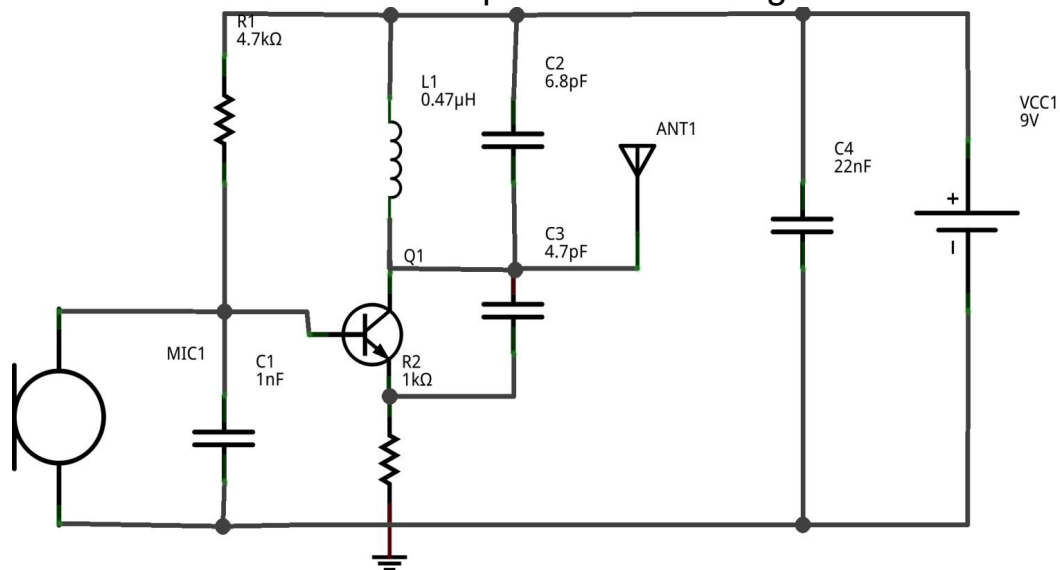


FM_Transmitter -- Procedures

Step 1

SOURCE SETUP

- Connect the connections as per the circuit diagram.



Step 2

SCOPE SETUP

- Power ON the oscilloscope
- Connect the Channel 1 probe of the oscilloscope across MIC output and Channel 2 across collector and ground of transistor
- Acquire the signal(s) from circuit on oscilloscope

Step 3

- Channel 1 will show the audio signal - voice that is converted to electrical signals by MIC
- Collector output of the transistor will show the carrier signal

Step 4

MEASUREMENT CONFIGURATION

- Using FFT, look at the frequency spectrum of the voice/audio signal coming from MIC. Verify that it would be bandlimited to 20kHz.

Step 5

MEASUREMENT CONFIGURATION

- Add **FREQUENCY** measurement on CH2 - note the measured carrier frequency and verify against the calculated one.

Step 6

- Check the output between antenna and ground by probing on CH2. Observe and verify FM modulated wave.