

SMD FM Transmitter

ELECTRONICS123

Skill Level: Intermediate

OVERVIEW

FM Transmitter

The SMD transmitter presented in this article is as simple as it gets. With just a few components we are able to transmit audio over the RF range. The range of this transmitter is relatively low around 20—30 m in sight. The transmitter has some stability issues which will have a follow up article on a stable FM transmitter in future. The main point of this experiment was just to construct a functional FM transmitter.

The FM transmitter consists of a simple transistor biased using voltage divider network on the base in order to give us a relatively low amplification with a resistor on the emitter. The resistor on the emitter was not by passed in this experiment in order to keep the input impedance high.

As far as frequency adjustment this can be done with the variable capacitor and the coil, If you want to use the coil as well just spread it open or squeeze it closed.

PCB Image of SMD components

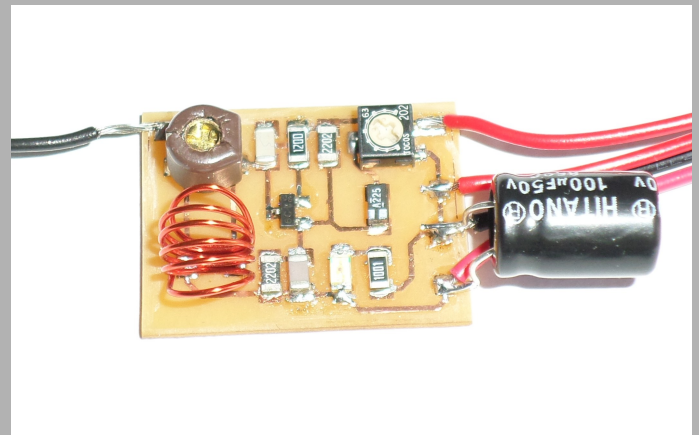
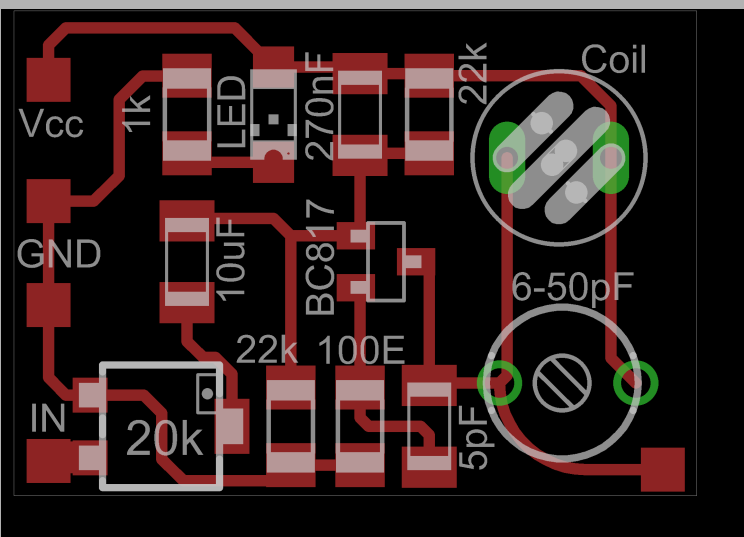
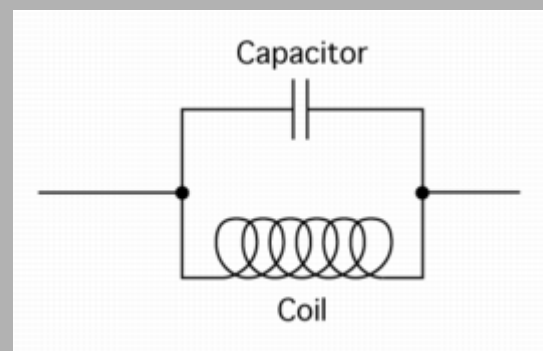


Figure 1: SMD FM transmitter constructed at the workshop

The FM transmitter works using an oscillator circuit using an inductor and capacitor connected in parallel. This circuit is commonly referred to the tank circuit as you will see on a schematic it looks like a tank, the capacitor being the barrel of the tank.



A brief description of how the tank circuit works will be given:

As a pulse enters the resonant circuit the capacitor charges, once the capacitor charges it discharges through the inductor which acts as a resistance to

To high current surges often called a “choke” but a low resistance to constant current. Ok now since the capacitor is discharging it reaches equilibrium at a stage where both sides of the capacitor are equal in voltage but, the magnetic flux in the inductor still exists. This concept was described in the joule thief. So the magnetic flux forces current flow in the inductor to exist even after equilibrium has been reached. This action causes the capacitor to charge now with the reversed voltage one could see it as an AC wave form.

This cycle continues till the internal resistances and power losses deprive the oscillation of all energy, Essentially the frequency is in the MHz range it could also be in kHz or Hz depending on inductor and capacitor values but we want the frequency to fall under the RF range which will help us create electro magnetic emissions that will carry our analog audio.

The charge time of the inductor and capacitors are used to work out a frequency, but luckily this has all been narrowed down to a formula we can use if the inductance value is known. The formula can be manipulated mathematically to calculate any one unknown whether you would like to find inductance, capacitance or frequency.

$$\text{Hz} = 1/(2\pi \text{ sqrt}(LC))$$

sqrt = Square Root

L = Inductance (H, Henries)

C = Capacitance (Farads)

You do not have to use the formula any where unless you interested at designing a transmitter for different frequencies. If so be aware of the local laws the last thing you would want to do is wander onto military air space. And yes they will find you!

MICRO PHONE

The transmitter can work with a microphone with a preamplifier circuit and the removal of a few components. The circuit will require an extra transistor which will be used for the amplifying stage. An article will be written on how to create a small signal amplifier. Once again an OP-AMP can be used instead but the transistor circuit works just as well.

TROUBLE SHOOTING:

Transmitters in general are tricky to build as you could sit for hours trying to tune it in not knowing whether you have a working circuit or a complete wrong frequency on the transmitter.

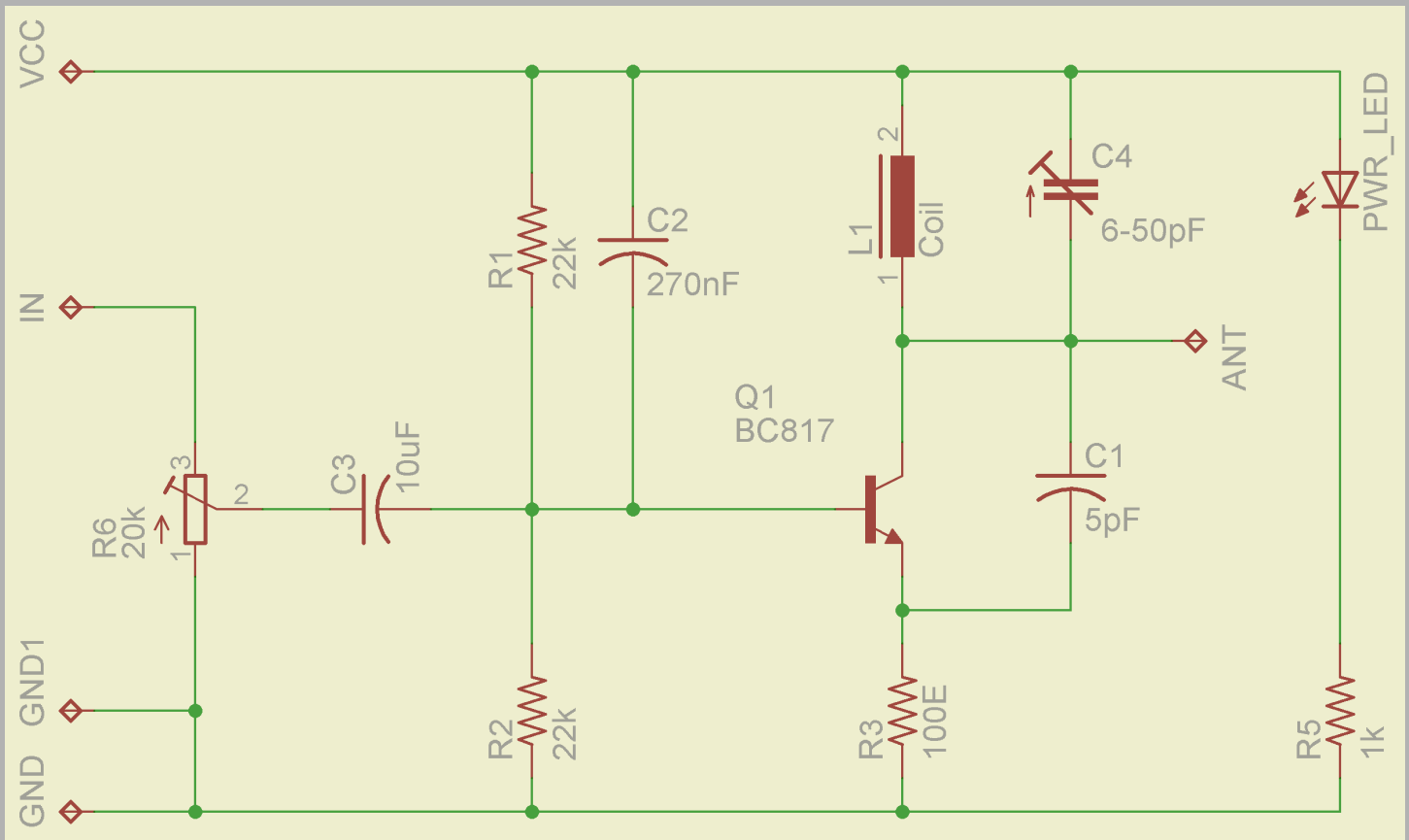
One way to test this is find a station on the radio where there's no radio station but you hear noise.

This will be a starting point, from here switch four transmitter on adjust the coil or capacitor in my case I had to split the windings a bit as I fell out of the radios searching range. Do not do an auto search chances are you wont find your signal.

Carry on adjusting till you hear your music playing or if you hear noise on the radio that only occurs when you touch or adjust something on the transmitter. This is a good sign and just fine tune the transmitter or radio. If your sound is distorted adjust the potentiometer on the transmitters input or lower your input signals volume by the source.

The other easy way is to use an RF lab to test the circuit unfortunately this costs quite a lot to set up so the above would be suggested.

SCHEMATIC



The circuit should not be constructed on bread board as there will be way too much stray capacitance for a high frequency circuit. Vero board or PCB will be the best, I have constructed one by just connecting all the components in a bird nest manner if you wish to call it that and it worked quite well! It's a good way to test it and play around with different components.

For the transistor you may use almost any transistor as long as its NPN, substitutes are: 2N3904, 2N2222A, BC547 and many others will work, keeping mind gain should be around 250—300 hfe so don't use a Darlington transistor they have gain exceeding 1000 hfe.