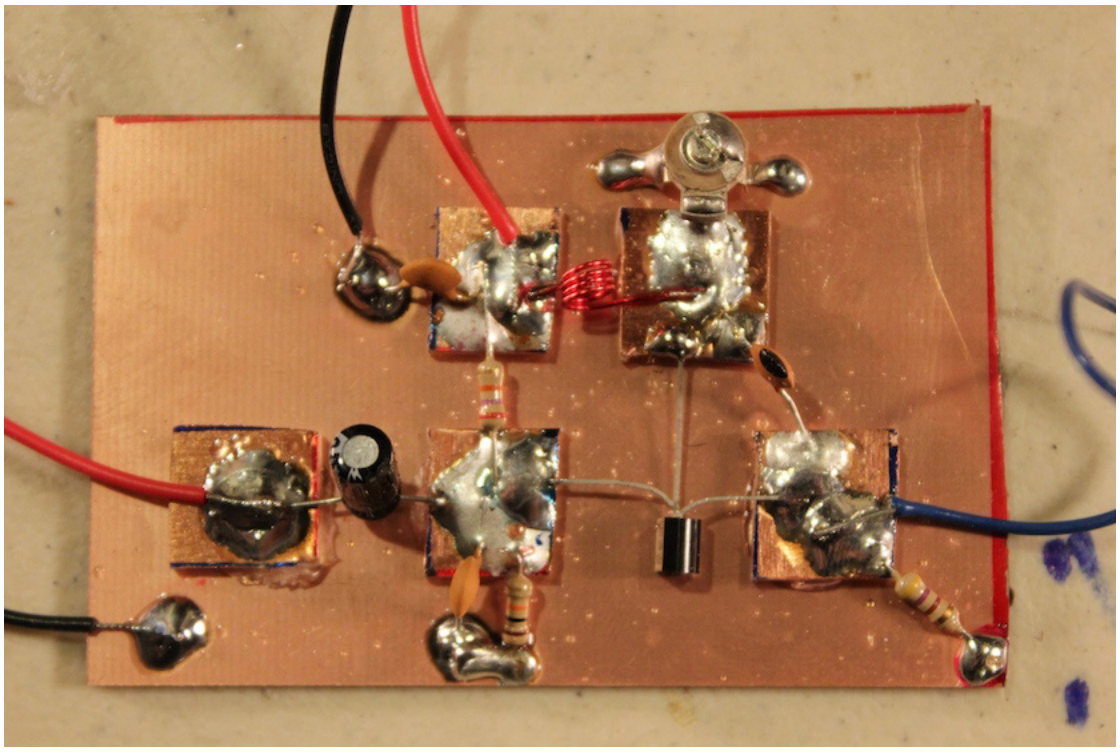
# BUILDING A DIY FM RADIO TRANSMITTER



**What you need:**

- Blank PCB Copper Plate (jameco.com part #169279)
- Capacitors:
  - 2x 0.01uF
  - 10pF
  - 1uF

~6-70pF Variable Cap (jameco.com part #32855)

- Resistors:
  - 27K Ω
  - 10K Ω
  - 470 Ω
- Transistor-MPSA18 or similar (jameco.com part #210681)
- Small amount (~4”) of magnet wire 24 AWG or close (jameco.com part #2098419)
- 9 Volt Battery Snap (jameco.com part #109154)
- Sand paper
- Hookup wire
- Hacksaw or Dremel tool
- Headphones with 1/8” plug (from iPod or MP3 player)
- Hot glue or super glue
- Soldering Iron
- Sound source (Phone, MP3 player, computer etc.)
- FM Radio

**Introduction:**
This micro FM radio transmitter was designed by DIY radio artist Tetsuo Kogawa. His website (http://anarchy.translocal.jp/) is full of great info on DIY radio, and all credit for this circuit goes to him. It is a small variation on the Micro TV transmitter (http://crackedraytube.com/pdfs/building_a_diy_transmitter.pdf), using the same fundamental principals of a basic RLC circuit. If you have any previous experience with electronics or circuit building, you will notice that this method of building is different. The circuit is constructed on top of a copper "ground plate" which is common in radio applications. This tutorial uses step-by-step sketches and photos created based on Tetsuo Kogawa's design. The radio transmitter will broadcast a sound source over the air that can be received by an FM radio. With a little bit of tuning, the transmitter can generate a relatively stable transmission and a range of ~50 feet. Tetsuo Kogawa gives examples on his website on how to enhance the transmitter with a larger and more stable power supply, as well as designing a better antenna, to give the transmitter a much larger range.

## Building the Transmitter:

**1. Preparing the copper plate:**

-Take the bare copper plate and cut off around 1 inch of material using a Dremel tool or hacksaw.

-Use this material to cut out 5 ½" x ½" squares

*Note: In this tutorial, the copper ground plate size I use is 2" x 3". (See figure 1) This size is not important, it just needs to be big enough able to fit all the components. In fact, making a 3" x 3" plate could be easer to solder to if you are new to the process. The exact size is up to you.

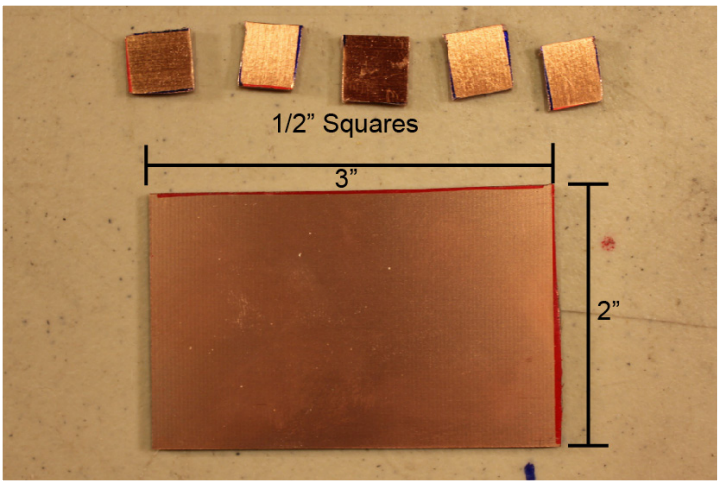


Figure 1

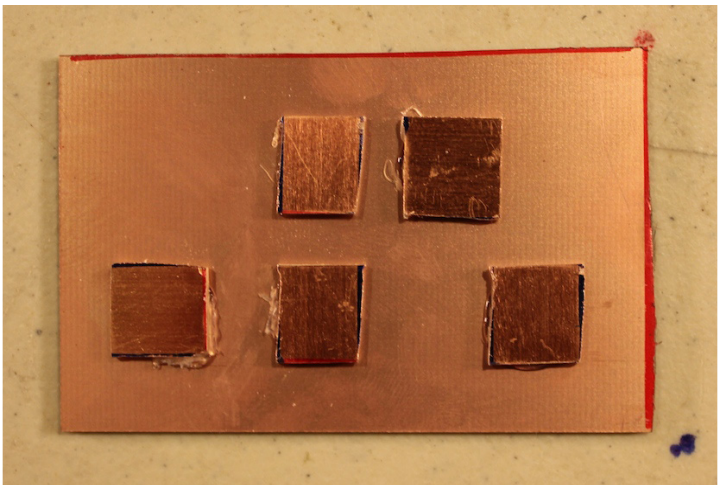


Figure 2

-Arrange the 5 smaller ½" squares on the larger copper plate as shown in figure 2 and glue them down using hot glue or super glue. (Make sure the copper side is facing up)

**2. Soldering the 1uF Capacitor**

- Melt a blob of solder onto the two bottom left squares. (See figure 3) To do this, apply your iron to each square to transfer heat for an extended period of time until the solder flows onto the surface.

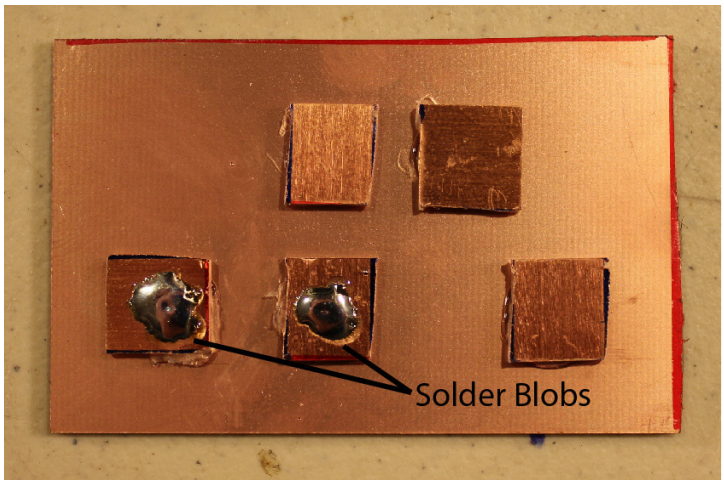



Figure 3

-Bend the legs out of the 1uf capacitor and straddle them between the two squares making sure that the leads are only touching the two small squares and not touching the ground plate. (See figure 4)

-Cut the excess off of the leads. (See figure 5)

-One at a time, re-heat the solder blobs and place the capacitor leads into them, allowing them to cool down until they stay in place. (See figure 6)

*Note: The 1uF capacitor is polarized, meaning it has a specific way it needs to be positioned. The cap acts as a coupling capacitor to keep any stray DC electricity from entering the circuit so it is important to make sure the negative lead (the shorter of the two) touching the left most square.

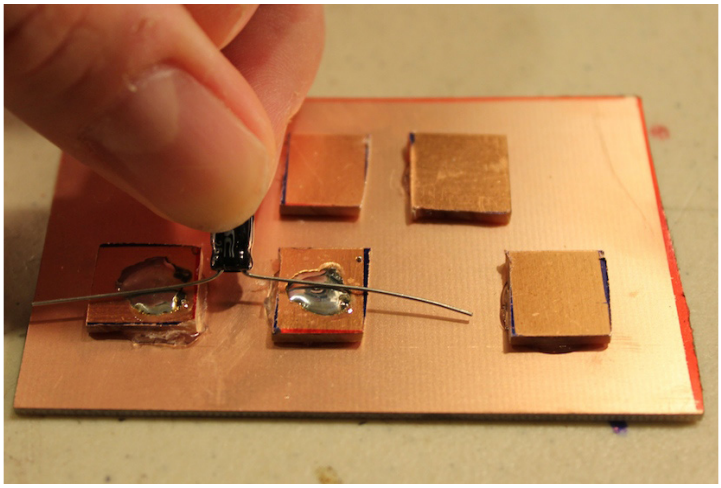


Figure 4

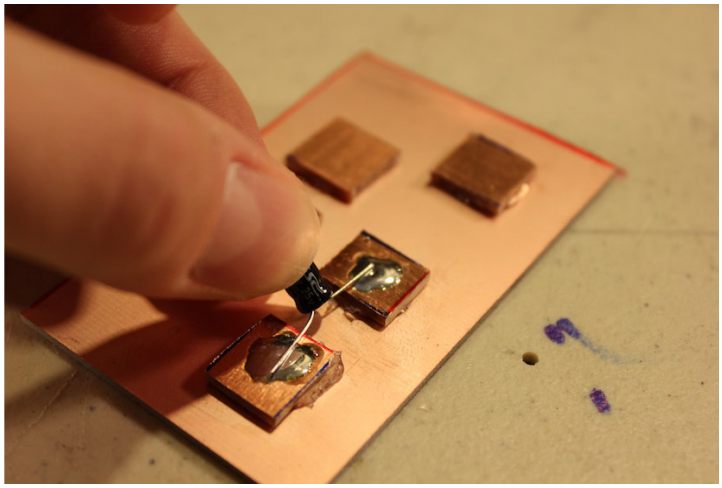


Figure 5

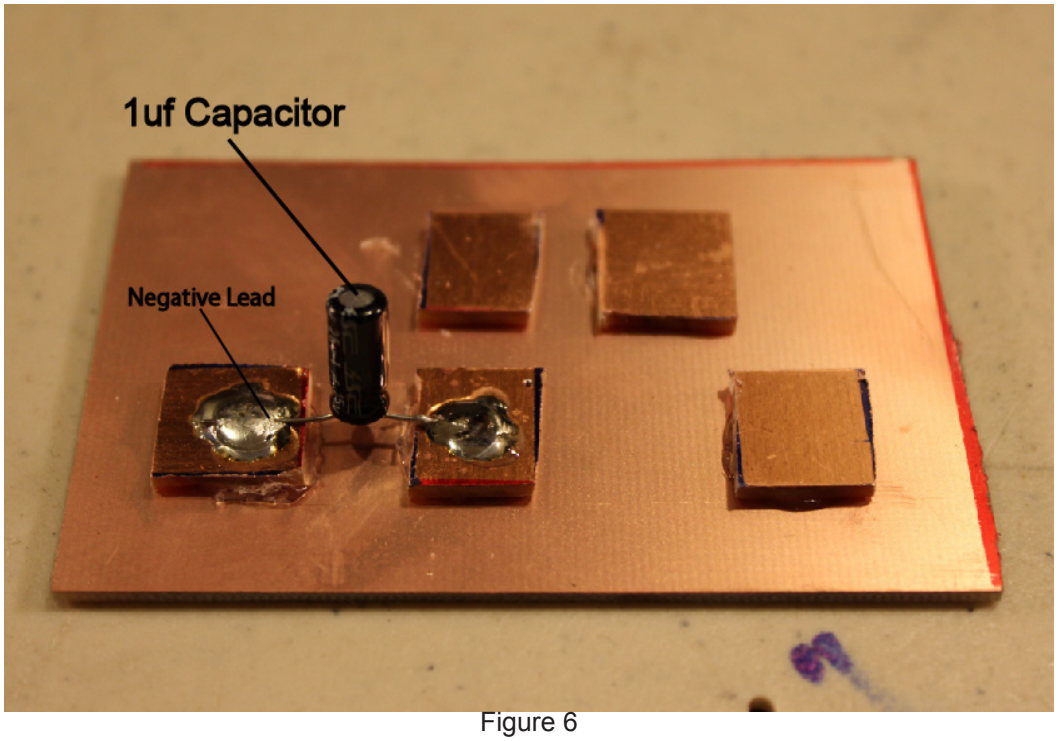


Figure 6

**3. Soldering the two .01uF Capacitors** (the two disks with 103 printed on them)

-These two caps will be soldered:

1) Between the upper left square and the ground plate

2) Between the middle lower square and the ground plate

-Melt a blob of solder on these two squares and two blobs on the ground plate beside each. (See figure 7 for exact positioning).

-Cut the leads to fit and then re-heat the blobs and position the capacitors accordingly as in step 2.

*Note: These capacitors are not polarized, meaning you can solder them in either direction

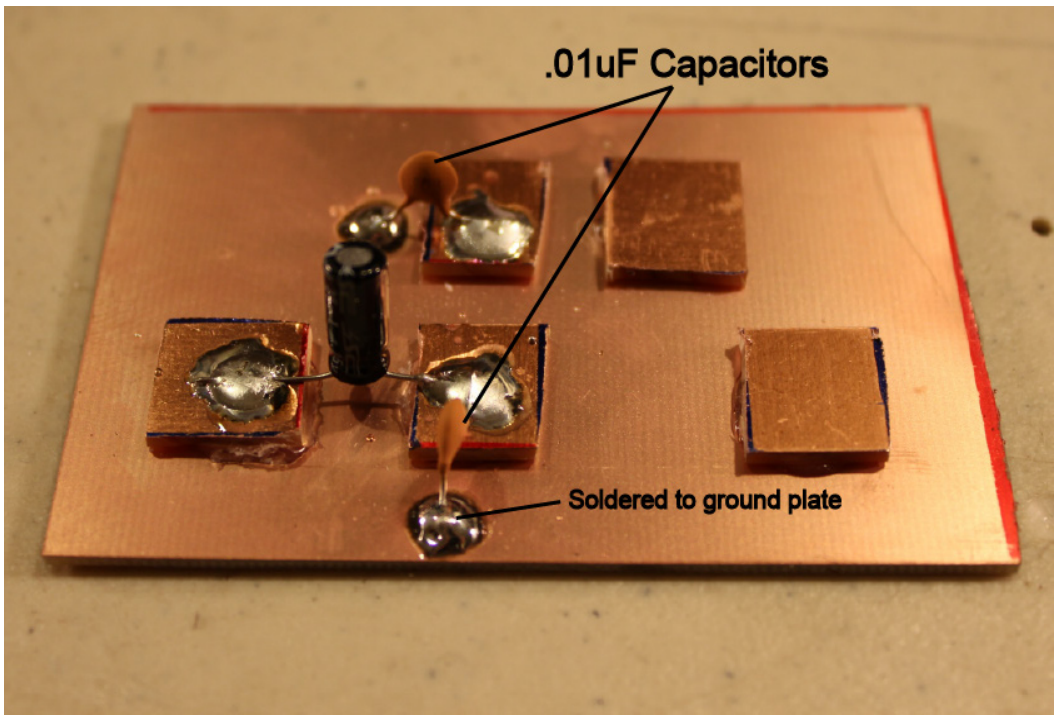


Figure 7

**4. Soldering the 10pF Capacitor (disk with 10 printed on it)**

-Solder the 10pF capacitor (non polarized) between the upper right and lower right squares (see figure 8)

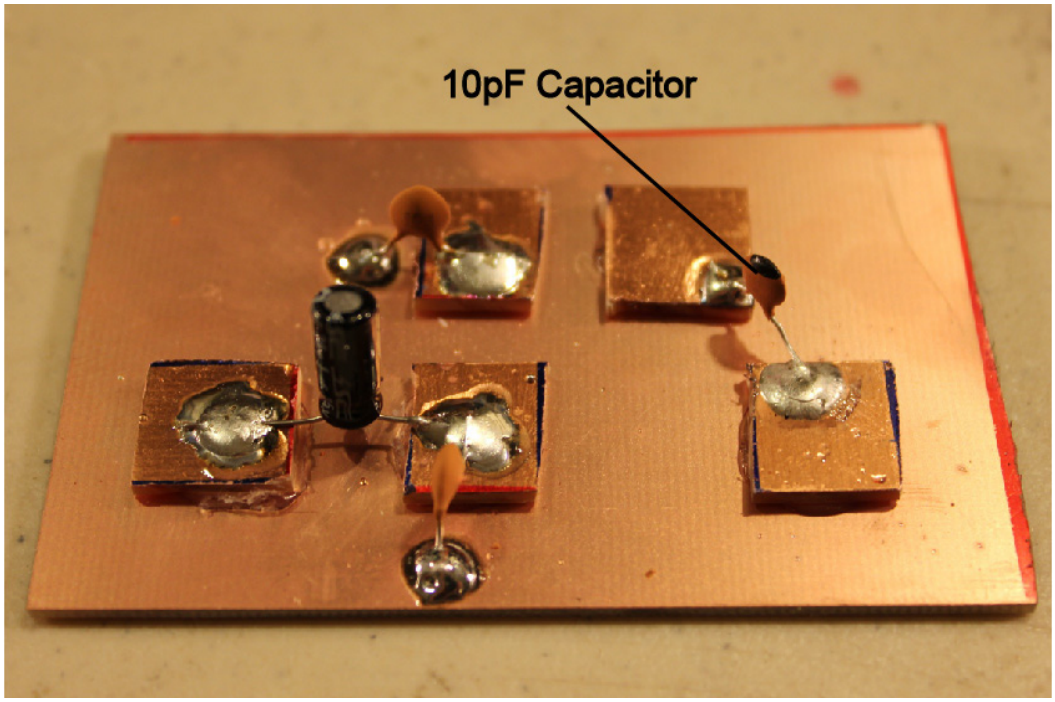



Figure 8

**5. Soldering the resistors (470Ω, 10KΩ and 27KΩ)**

-Solder the 470Ω resistor (Yellow/Violet/Brown) between the lower right square and the ground plate

-Solder the 10KΩ resistor (Brown/Black/Orange) between the lower middle square and the ground plate

-Solder the 27KΩ resistor (Red/Violet/Orange) between the lower middle square and the upper left square right above it.

-See figure 9 for positioning

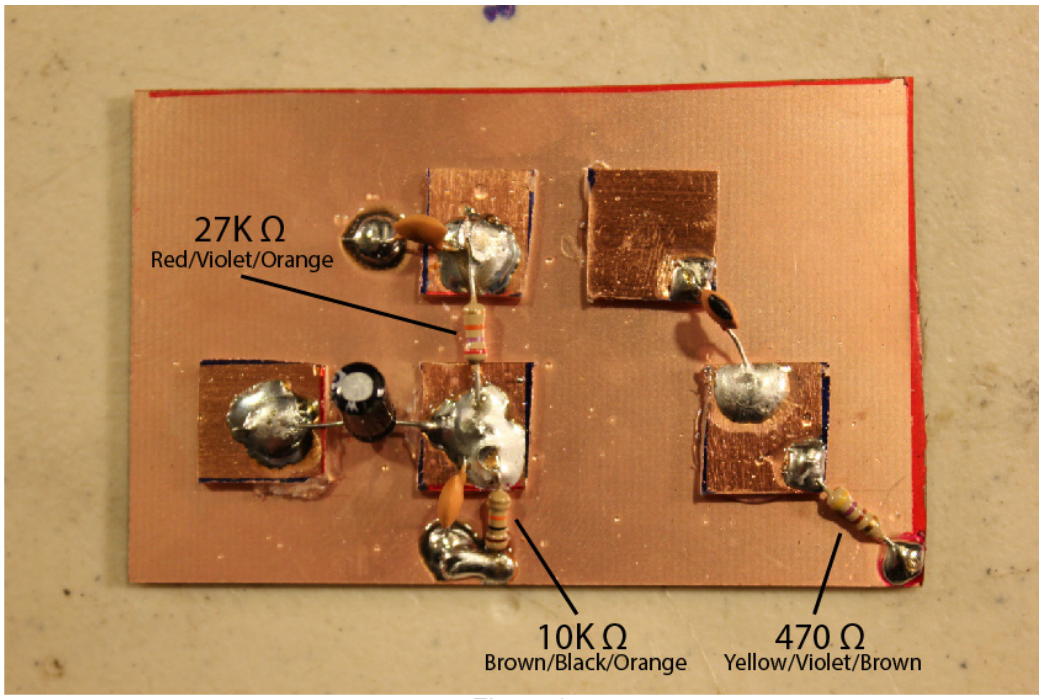



Figure 9

**6. Making and soldering the coil**

-Cut about 4” of the magnet wire (24 AWG or close)

-Use the plug from your headphones to wrap the wire around. Make 5 turns. (See figure 10)

-With the wire still wrapped around the headphone plug, take a small piece of sand paper and rub off the colored insulation of each end until the bare copper is exposed. If the copper is not exposed, you won’t be able to make a connection. (See figure 11)

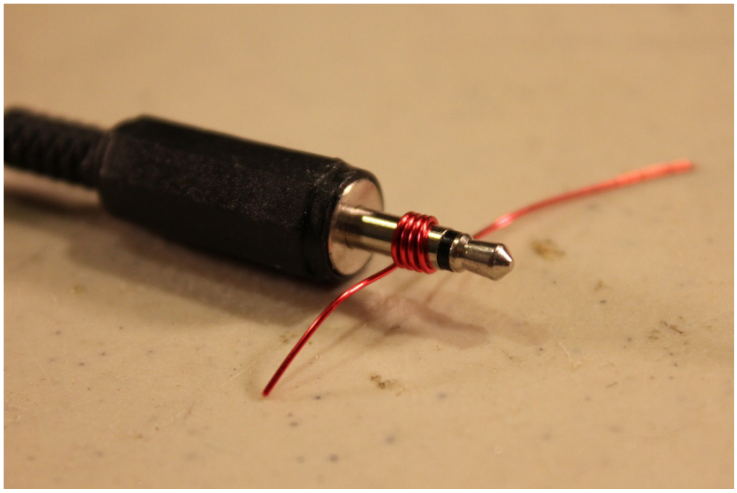


Figure 10

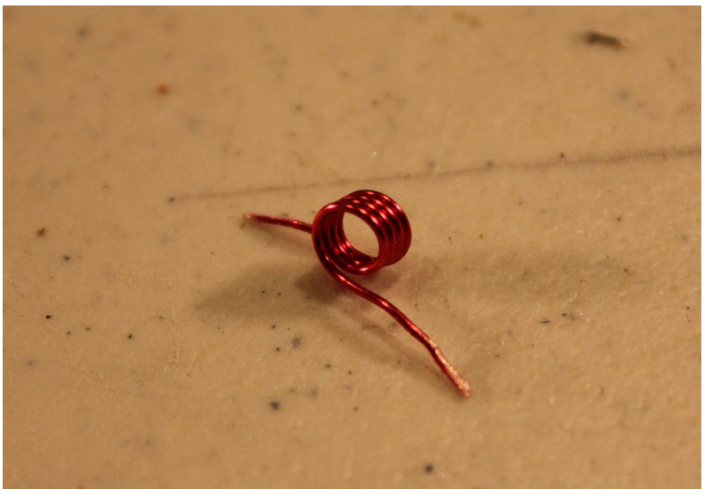


Figure 11

- Solder the coil between the upper two squares. (See figure 12)

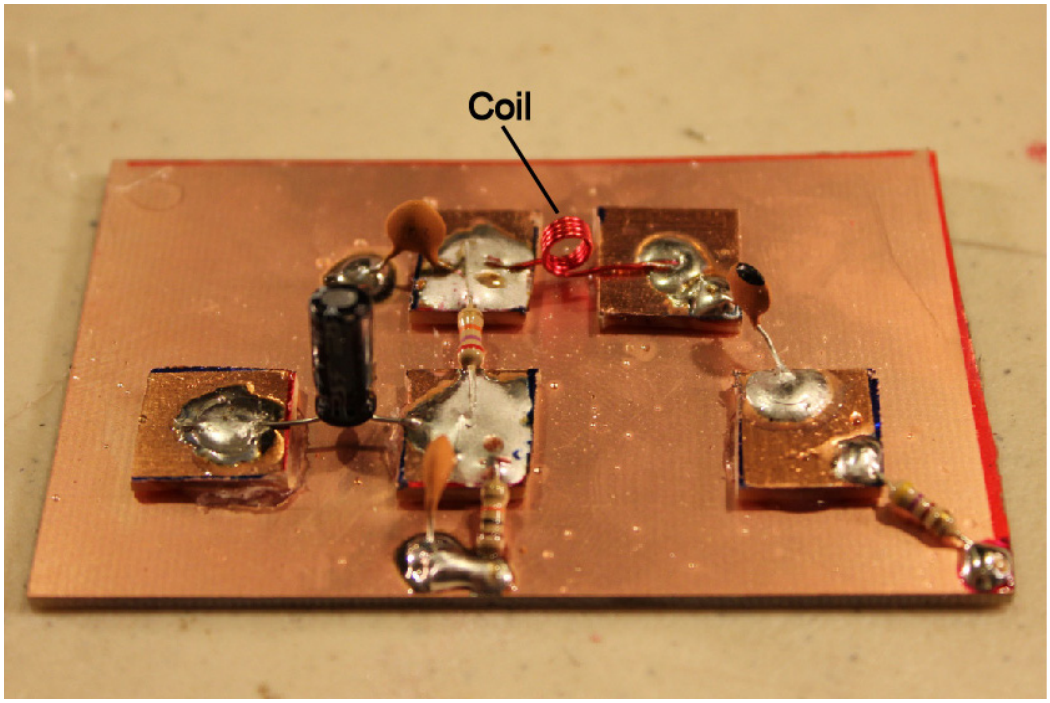



Figure 12

**7. Soldering the variable capacitor (trimmer cap)**

-The variable capacitor will be soldered between the top right square and the ground plate.

-Bend the leads out to get the component to fit properly. (See figure 13)

Figure 13

*Note: Some variable capacitors have 3 leads while others have two. It doesn't make a difference which kind you use but each is installed slightly differently. Below are instructions on how to solder each kind.

-If your variable capacitor has 3 leads:

- Solder the "nose" of the capacitor (the lead in the middle that is different from the other two) to the square, and the other two side leads to the ground plate. (See figure 14 and 15)

- If your variable capacitor has 2 leads:
  - Solder one lead to the square and the other to the ground plate

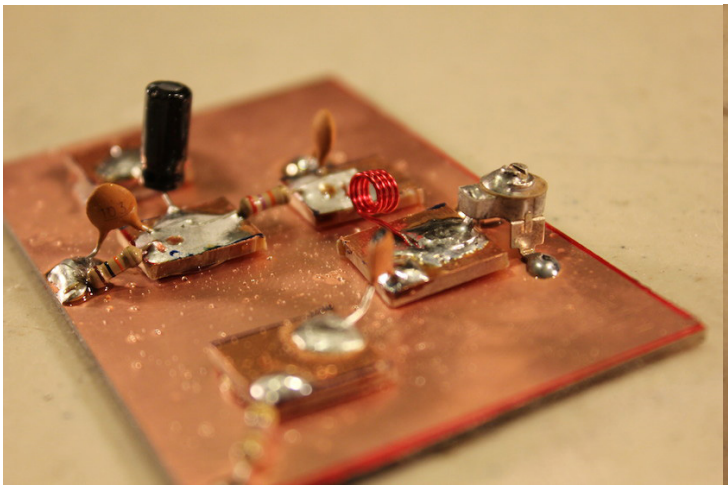


Figure 14

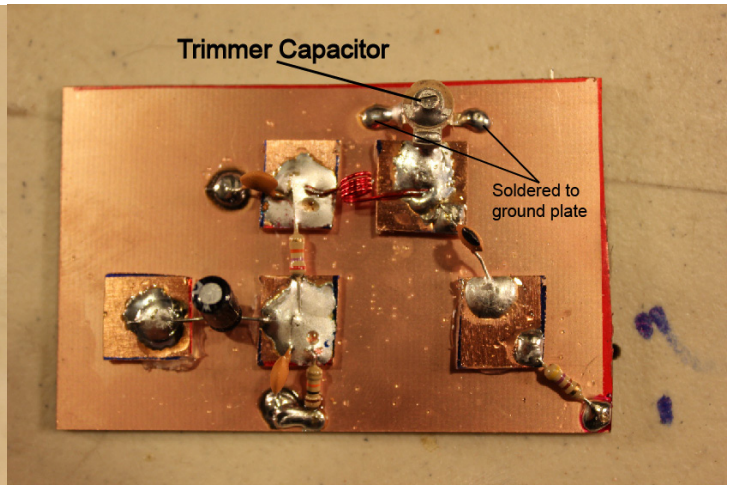



Figure 15

**8. Soldering the transistor (MPSA18)**

*Note: This transistor is sensitive to heat and can be destroyed by the heat from your iron. Be sure to follow the necessary precautions below. But don't worry if you do kill one, they are only ~$.10 a piece.

-The three leads of the transistor all do specific things and must go to the appropriate places. Here is an image of the orientation of this transistor:


- Each lead from the transistor will be soldered to the three different square so you will have to bend the leads accordingly. (See figure 16)

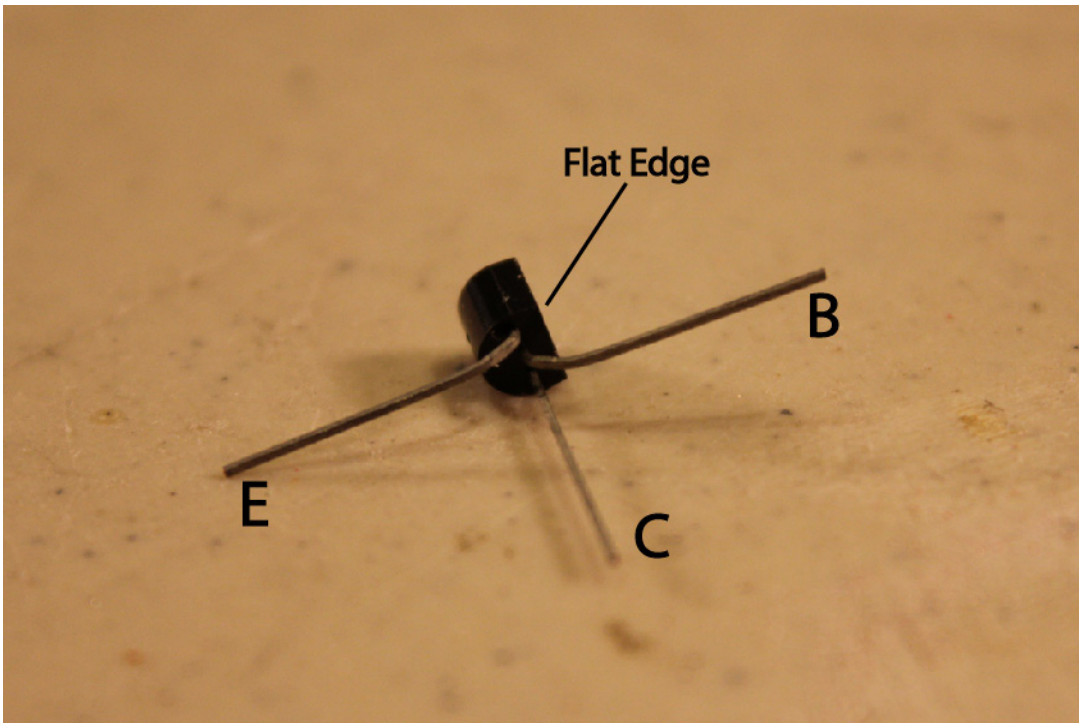


Figure 16

- Before you solder the transistor in place, you need to have a “heat sink” attached to protect it. This will draw some of the heat from the transistor to something else. To do this, simply take an alligator clip and attach it to the lead you are soldering. (See figure 17)

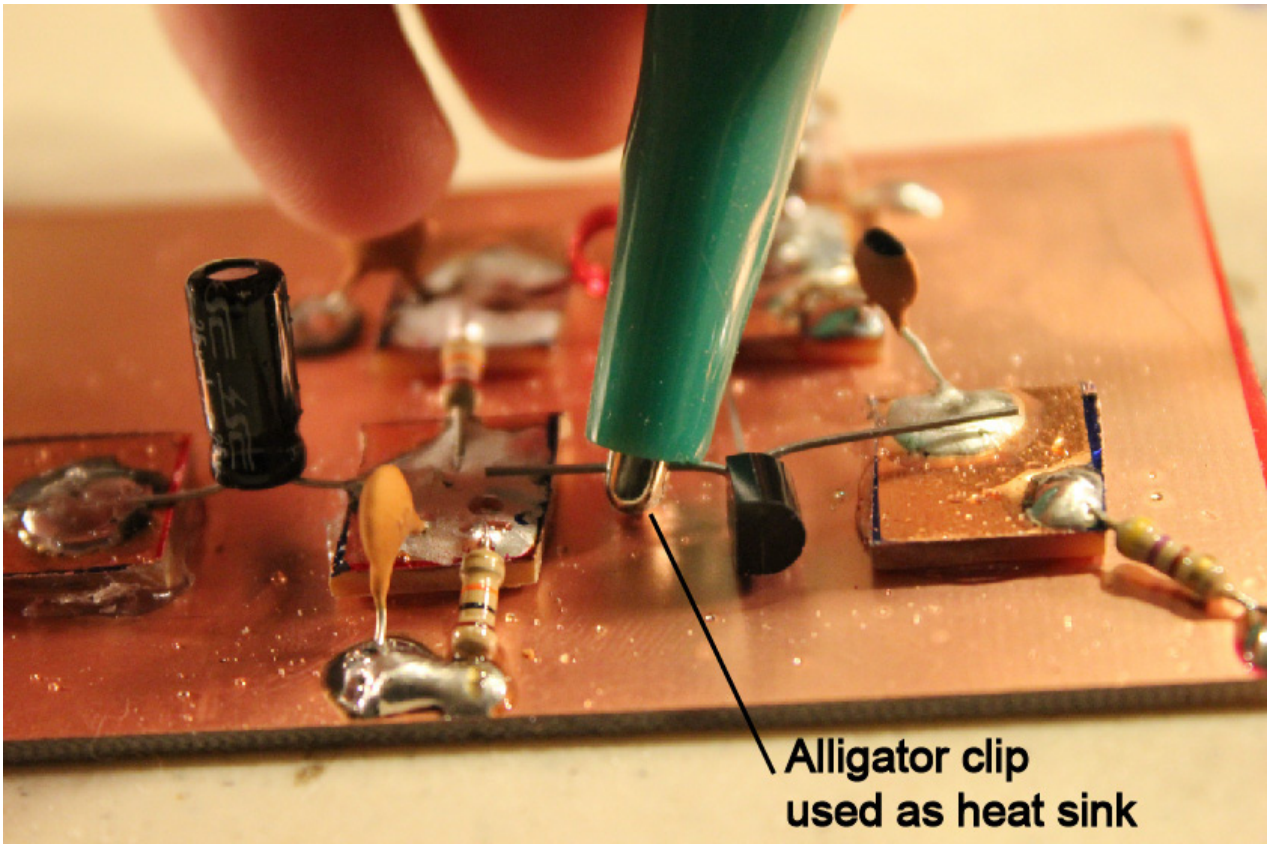


Figure 17

- The B lead (base) goes to the bottom center square, the C lead (collector) goes to the top right square, and the E lead (emitter) goes to the bottom right square. (See figure 18 + 19)

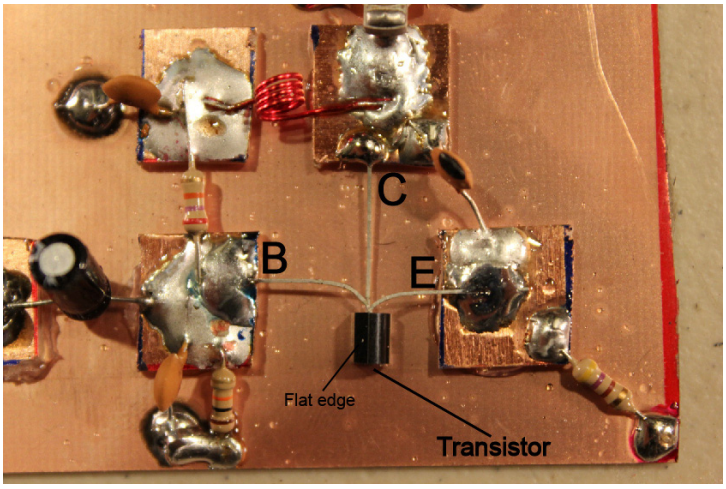


Figure 18

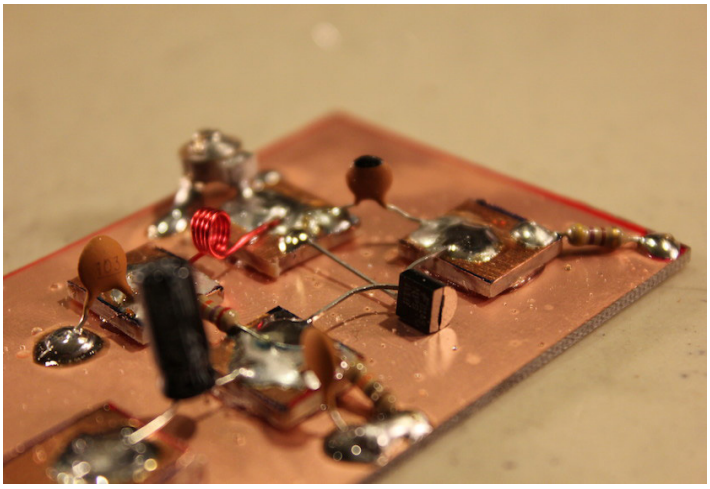


Figure 19

**9. Soldering the 9 volt battery snap and input wires** (See figure 20)

- Solder the positive lead (red) of the battery snap to the upper left square.
- Solder the negative lead (black) to anywhere on the ground plate.

*Note: A 9 volt battery nap is not required to make the transmitter work, two pieces of hookup wire with clip leads attached to a 9 volt battery will also work.

- For the audio input:
  - o Cut off two short pieces of wire and strip both ends
  - o Solder one wire to the ground plate. This will act as the ground connection (sleeve) of the audio input.
  - o Solder another wire to the lower left square. This will act as your signal connection (tip) for the audio input.

*Note: You can also connect a 1/8” plug to the end of these wires to make it easier to plug into the headphone output of a computer or mp3 player.

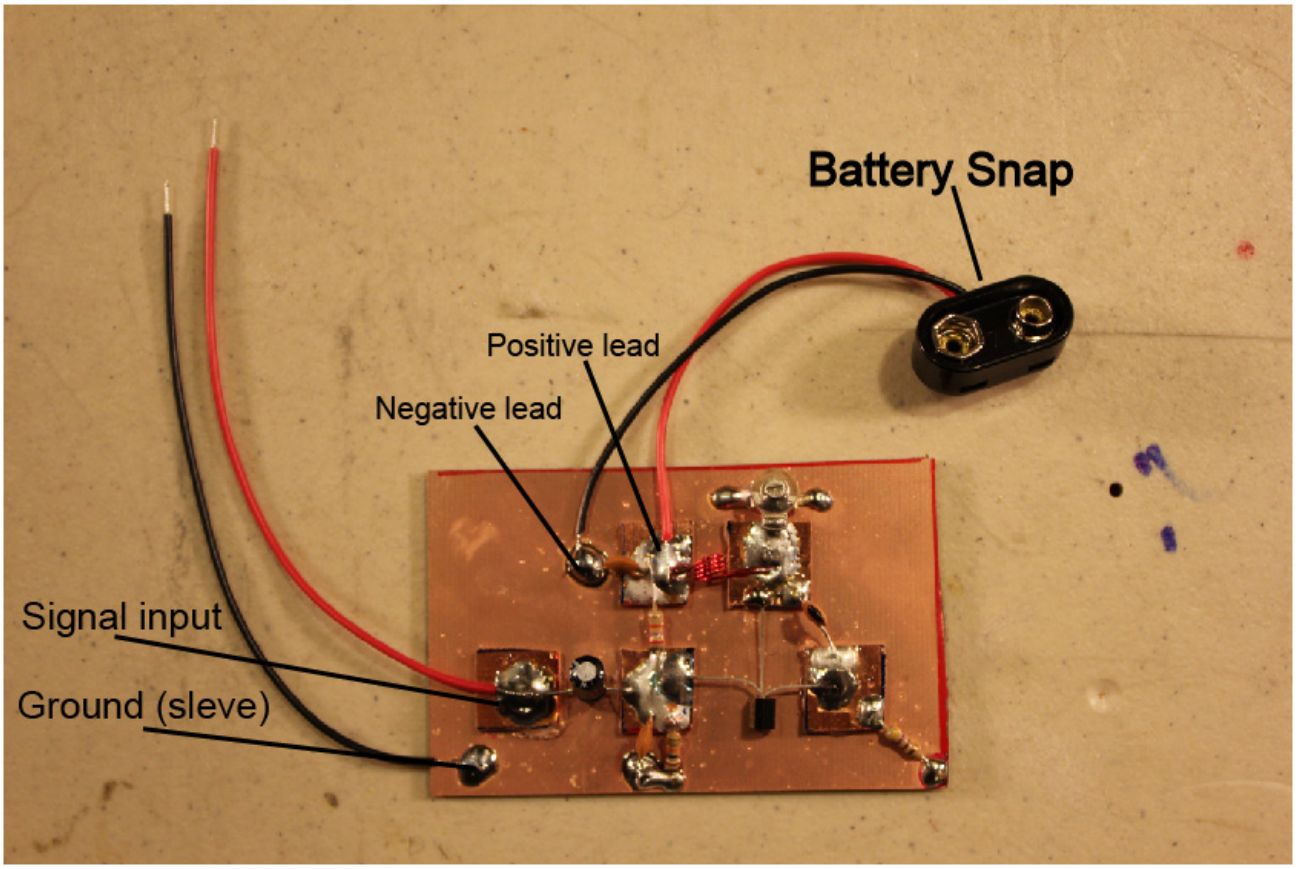


Figure 20

**10. Soldering the antenna wire**

-Cut about 2 feet of wire and strip one end.

-Solder the wire to the bottom right square. (See figure 21)

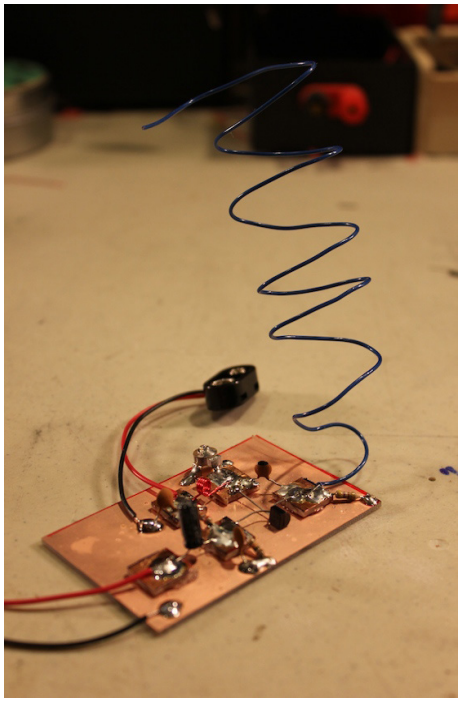


Figure 21

**Operating:**

(Figure 22 + 23)

- Find an audio source (iPod, computer etc.) and attach an 1/8” aux cable to the headphone output to get access to the audio signal.
- Use an alligator clip lead to connect the ground (sleeve) from your audio source to the ground input of the transmitter. Using another alligator clip lead, attach the signal output from your source (tip or ring) to the signal input of the transmitter.
- Use two more alligator clips to connect the positive and negative of a 9v battery to the positive and negative battery inputs of the transmitter.
- Turn on a radio, set it to FM and tune it to a empty frequency somewhere on the lower end of the spectrum
- Using a small screwdriver, tune variable cap slowly until you hear a change on the radio
- Keep tuning the variable capacitor until you start to hear some strong signal coming through, or change the radio dial to a different frequency and repeat.

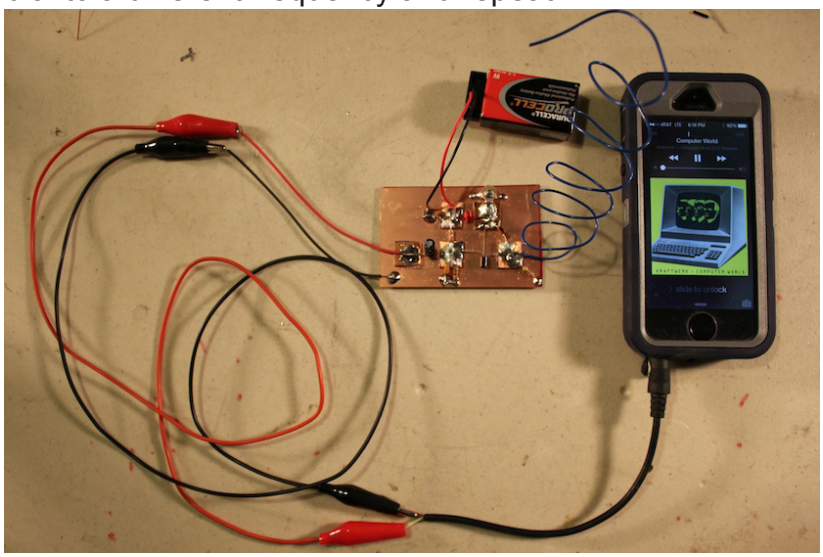
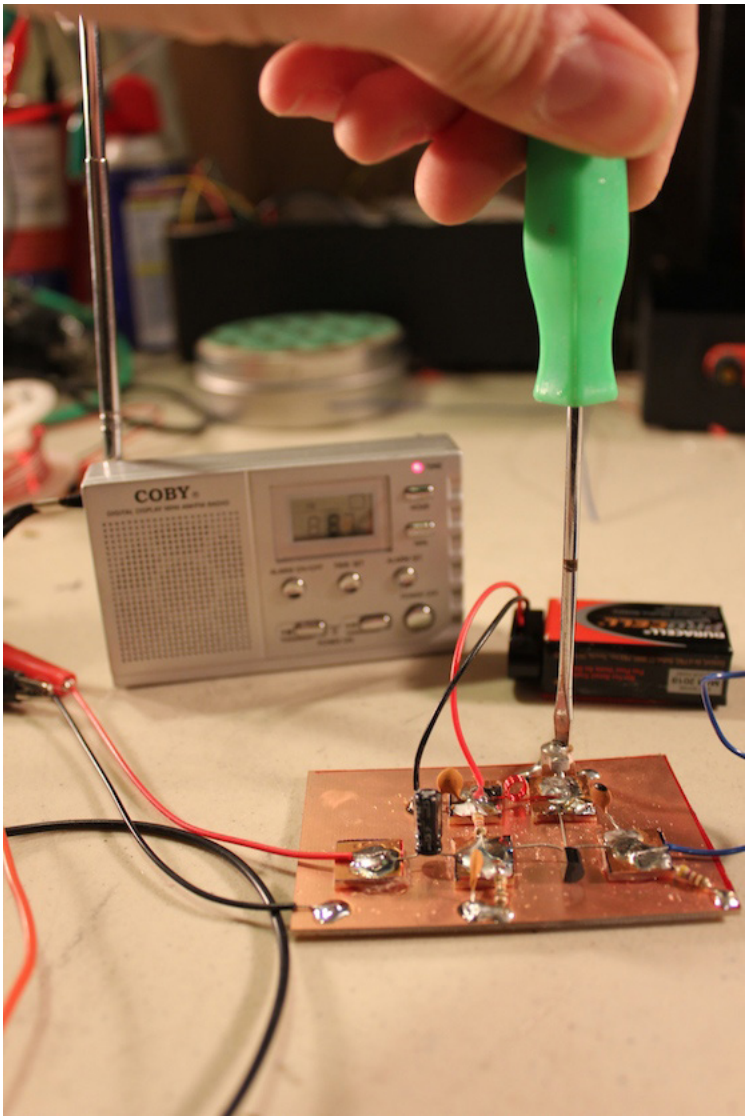


Figure 22




**Upgrades and add-ons:**
There are several methods outlined by Tetsuo Kogawa on his website, that can enhancing the transmitter by stabilizing the signal and increasing the transmission range.

- Add a dipole antenna: http://anarchy.translocal.jp/radio/micro/20050327antenna_e.pdf
- Use a AC to DC wall wart with more power capabilities, but you will need to use a voltage regulator to stabilize it: http://anarchy.translocal.jp/radio/micro/voltageregulator.jpg
- Other general FAQ and trouble shooting info can be found here: http://anarchy.translocal.jp/radio/micro/howtosimplestTX.html#fandq_simplesttx

crackedraytube.com
kyleellisevans.com
jameshconnolly.com

Send any comments, questions or suggestions to yaktronix.online@gmail.com