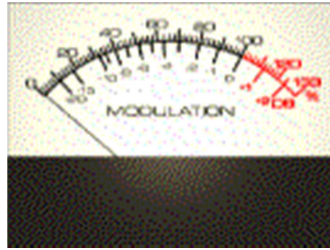


How to build a micro transmitter



Tetsuo Kogawa

Why was this site established?

Because transmission technology is esotericized and I believe that it provides exciting possibilities to art.

- **Diagrams**

- [The simplest FM radio transmitter](#) (for artistic or experimental use) with [FAQ](#) (How to build and tune up)
 - [Components](#) (resistors, capacitors, coil, trimcap, and so on).
 - [Basic tools](#) (soldering iron, tweezers, wire cutter, and epoxy[hard glue]).
 - [How to build?](#)
- [The simplest TV transmitter](#) (for artistic or experimental use) with [a theoretical introduction](#) (why simple and why transmitter?)
- [The simple but practical TV transmitters with sound](#) (you need some technical skills and proper tools)
- The 1-3 watt FM transmitter (You need [a power meter](#) and a frequency counter: otherwise don't try to build this model.)
 - Schematics: (1)[PDF](#) (2)[JPG](#) (3)[Symbolic](#) (4)[VRML](#) (needs [VRML-Player](#))
 - Components: [list pictures and tips](#)
 - [FAQ](#) (How to build and tune up)

- **Tools**

- [Basic](#)
- [Power meter](#)
- [Frequency Counter \(recommended\)](#)

- **How to build**

- [Step by step pictorial manual](#) [Movies\(WMV\)](#) [Movies\(Quicktime\)](#)

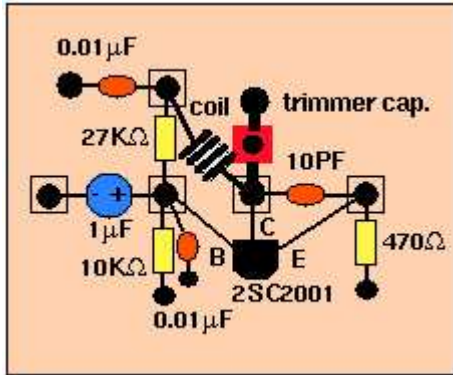
- **Antenna and How to operate**

- How to make a simple, inexpensive and effective Antenna?: (1) [HTML+JPG](#)
(2)[PDF](#)
- [How to stabilize the supplied power?](#)

- **Histories**

- The earlier "private" workshop to build a transmitter, June 3, 1990 [Video](#) [MP4, 41.3MB]
- The first "public" workshop to build a transmitter, April 28, 1991 [Video](#) [RealMedia]
- The first Workshop in the U.S. at Paper Tiger Television, November 4, 1991 [Video](#) [RealMedia]
- Other Transmitter Workshops: see the "Streaming Media Archives" [-->](#)

How to build the simplest FM transmitter?



This tiny transmitter has several "defects": smaller radius of the service area, lower quality of the sounds and the relatively unstable frequency. These can be considered as a compromise to easily have your own transmitter for the time being or as a more positive choice. These "defects" are only from the perspective of conventional transmission such as "clear stereo sound to receive anywhere". Artist could change these to another directions. Whether or not, you can experience a *convivial wireless imagination*

by this transmitter.

The schematics:

- the basic unit: [\(pdf\)](#) [\(jpg\)](#)

Given the most simplest model, it is a bit inconvenient to change the transmitting frequency: change the gap of the coil (closer gap --> lower frequency; looser-->higher).

- the standard model: [\(pdf\)](#) [\(jpg\)](#)

In this version, you can change the frequency by the trimercap (variable capacitor). If you can have a variable capacitor, I recommend you to choice this version.

- the standard model with a microphone: [\(pdf\)](#) [\(jpg\)](#)

This has a condenser microphone unit in it. Every version could use the same circuit. Usual microphone has not enough output to this unit, but condenser microphone unit can drive this system. See how simply it is installed--->[picture](#)

The list of components: [registers, capacitors, transistor and etc.](#)

The basic tools: [soldier \(less than 30 watts\), wire-cutter, tweezers, and etc.](#)

How to build and solder? [A visual manual.](#)

Pictures of the finished model: [Standard model](#)

FAQ

[didn't work well](#) ; [stabilize the voltage](#) ; [extend the area copper plate](#) [change the frequency](#) [trimmer cap](#) [alternative transistor](#) [make the coil](#) [microphone](#) [iPod](#)

[problem why need a power meter and a frequency counter](#)

Q: The transmitter works but the airwaves are too weak. I think there might be something wrong.

A: Every transmitter using the minimum parts like this has to have harmonic signals and "spurious". So you may sometimes not receive the authentic signal. Leave your radio receiver far at least three meters from the transmitter. Don't attach any cable to the antenna terminal. Then turn the trimcap slowly. The frequency will change and you will find the most strongest signal. (See "[the another Q&A](#)" below) In the 1.1 version with a variable capacitor to change the frequency, turn it very slowly until you get the most strongest signal at your radio. If you don't get, reduce the turn of the coil from 4 upto 2. When you use a variable capacitor over 10PF such as 20, 50 PF, 4 turns (I indicate in the schematic) would be too much. If you have a frequency counter, it would be easy to tune up the coil.

Q: I love the simplest transmitter. I wonder if this transmitter could be used for a practical Mini FM transmission.

A: The main problem is that the frequency is unstable. This is interesting from the perspective of radio performance, though. As the voltage of the battery is deteriorated, the transmitting frequency will be changed. In order to avoid it, you may use a [stabilized power supply](#). It would be a bit expensiver. You don't mix with a "[AC adapter](#)". When you use a ordinary "AC adapter", you should add a voltage regulator semiconductor for 9-12 volts such as "7809" or "7812". The simplest schematic is [here](#) (jpg).

Q: This transmitter can cover only a modest radius. Is it possible to extend it?

A: If you connect it to the proper antenna, you can do it. How to make an antenna is [here](#) (pdf). For this, you have to use a [thicker coaxial cable](#) between the transmitter and the antenna. The thinnest one can be used only for 1-2 meter extension. Think of the thickness of waterpipe and the length. Long extension increases the loss.

Q: I can't get "copper-coated plate". What else?

A: The schematic is supposed to use copper coated plate that is familiar with my design. When it is difficult to obtain, you can use even "[porous circuit board](#)" (jpg) that is popular in electronic hobby. [The schematic is here](#) (gif). I suggest you use the reverse side and directly solder the parts to it because this is convenient for your possible cut-and-paste and would be effective for your electro-magnetic performance.

Q: Can I change the frequency of the "basic" version? How?

A: In order to change the transmitting frequency without the trimcap, you a bit spread or compress the gap of the coil. When you do this operation, you have to have some distance (at least 3 meter) between the transmitter and the receiver

(FM radio): otherwise you may be disturbed by many "spurious" (harmonic signals) and may not find the main one you want. That's why the best thing is to use a frequency counter.

Q: What is "trimmercap" in ["the changable-frequency version"](#)?

A: Don't mix it with ["variable capacitance diode \(varicap\)"](#) for [the 1-3 W transmitter](#). What we need here is only for manually varying the capacitance from (theoretically) 0 to 20 PF max. There are the various types and appearances. The classical one consists of tiny brass plates and ceramics. Some of the pictures are [here](#).

Q: I can't obtain the transistor 2SC2001. What is compatible with it?

A: There should be many replacements: 2SC2003, 2SC458, 2SC1973, 2SC3358, 2SC3580, 2SC3605, 2SD734 and so on. The European or American models such as [BC337](#) or [NTE123AP](#) can be used, but be careful of the different position of the pins (E=Emitter, C=Collector and B=Base) depending the semiconductors. The circuit that I designed uses [2SC2001](#) because it is cheap and very obtainable in Tokyo.

Q: How to make a coil by myself?

A: Prepare a 5mm diameter cylindrical material and enameled wire of 0.8 mm diameter. The movie ([WMV 280KB](#) and [MPEG 1.2MB](#)) shows how to do.

Q: I prefer to use [a tunable mold coil](#). What kind of coil can I use?

A: I stopped showing the schematic with it because [the tunable mold coil \(3-4 turns\)](#) has become less obtainable now. If you can get it, just install it instead of a hand-made coil WITHOUT the trimmer capacitor.

Q: Can I build transmitter that a microphone is attached to in it?

A: You can get a "condenser microphone unit" in low price. Using this, you can build it very easily. Check [the partial diagram](#) (pdf) and [the complete diagram](#)(pdf) of the simplest transmitter with a microphone in it. When this is acrobatically soldered, [here](#)(jpg) is the example.

Q: When I connect my iPod to the audio input of this transmitter, it suddenly stops to work. What's happening?

A: The ealier model of iPod has an automatic shut-down system in it. When you pull out the plug of your headphone, it automatically stops working. When the left and right channels are short-circuited, the same thing happens. Presumably, you use a stereo cable and solderd the left (white) and right (red) lead together. Please use the left channel lead (white) only. Usually the left output is compatible with mono audio. If you, however, insist to mix the left and right output of your audio source into the transmitter, [make a simple "interface" like this by two sets of 1 kirohm registers](#).

Parts List of the Most Simplest Transmitter

Resistors:



1 10K Ohm 1/4 -1/8 Watt (brown-black-orange)

1 27K 1/4 -1/8 Watt (red-violet-orange)

1 470 - 500 1/4 Watt

Capacitors:



1(2) 10PF Ceramic

2 0.01MF (also indicated as 103) Ceramic

1 1 - 10 MF Electrolytic

Coil:



1 4 turns by 0.8 mm enamel wire

Trimmer capacitor:



1 10 - 20 PF

(there are [various shapes](#) but keep the value-10_20PF)

Copper-clad circuit board:



1 plate of 4 x 5 cm (minimum) and 0.5-1.0 mm(thick) and 4(5) small squares (5 x 5 mm)



Audio cable:

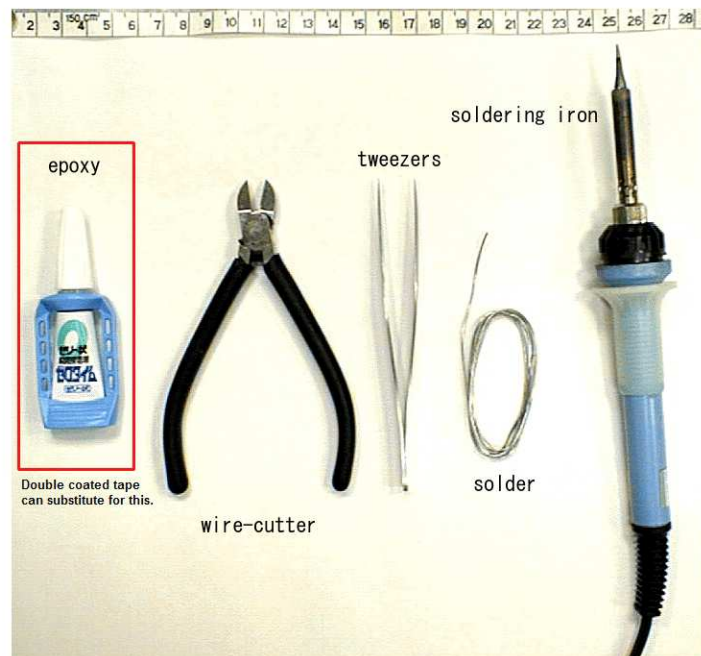
30 - 50 cm length of audio cable with mini-mono (or stereo) 3.5mm plug. When you use mini-stereo cable, you must use the left channel (white) only.

9 volts Battery and the snap connector

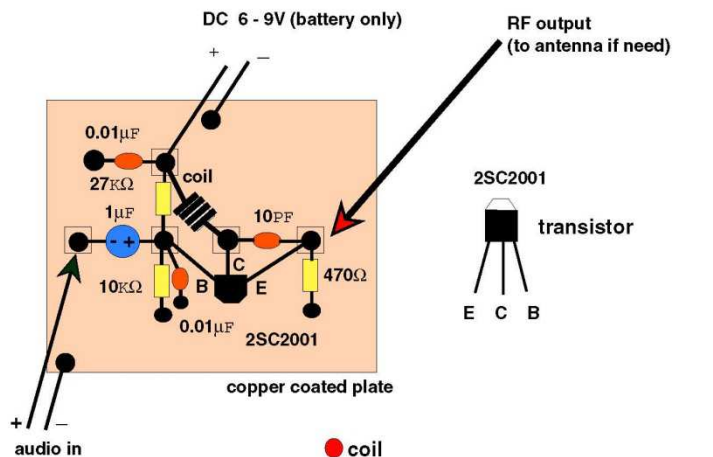


The basic tools for building the simplest transmitter:

- Soldering Iron (20-30W type; don't use a powerful one such as 60W. It will destroy the parts.)
- Solder (Usually this is sold as a roll but you need only 30 cm for one set to build).
- Tweezers: good example unsuitable one
- Small Wire Cutter
- Five-Minute Epoxy (the strongest type for metal and chinaware to glue)(Instead, you can use "Double sticky" or "Double coated tape" too.)



Making the simplest Transmitter



● soldered point:

● : direct to the ground



● : insulated from the ground



● coil

3 - 4 turns by coated 0.8 mm wire



● registers

470 Ω (yellow-violet-brown)

10K Ω (brown-black-orange)

27K Ω (red-violet-orange)

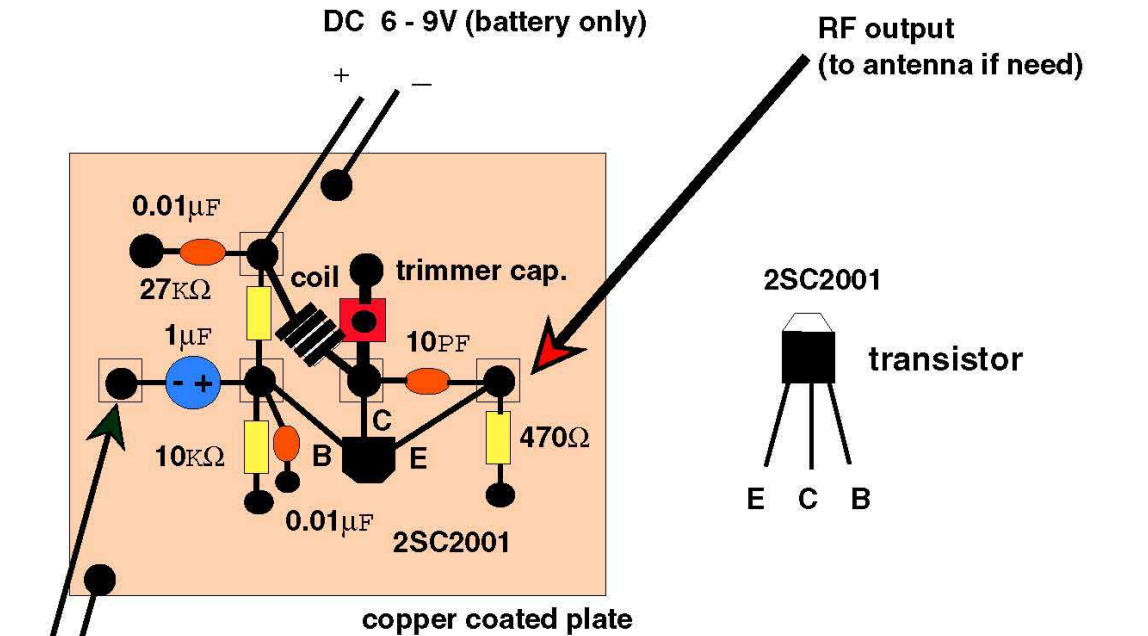
● capacitors

10 PF

0.01 μ F (103)

1 μ F

Making the simplest Transmitter



● soldered point:

● : direct to the ground

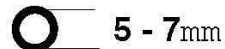


◻● : insulated from the ground



● coil

3 - 4 turns by coated 0.8 mm wire



● registers

470 Ω (*yellow-violet-brown*)

10K Ω (*brown-black-orange*)

27K Ω (*red-violet-orange*)

● capacitors

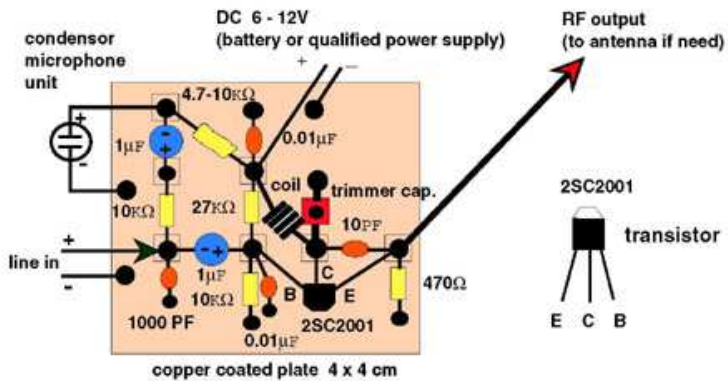
10 PF

0.01 μF (*103*)

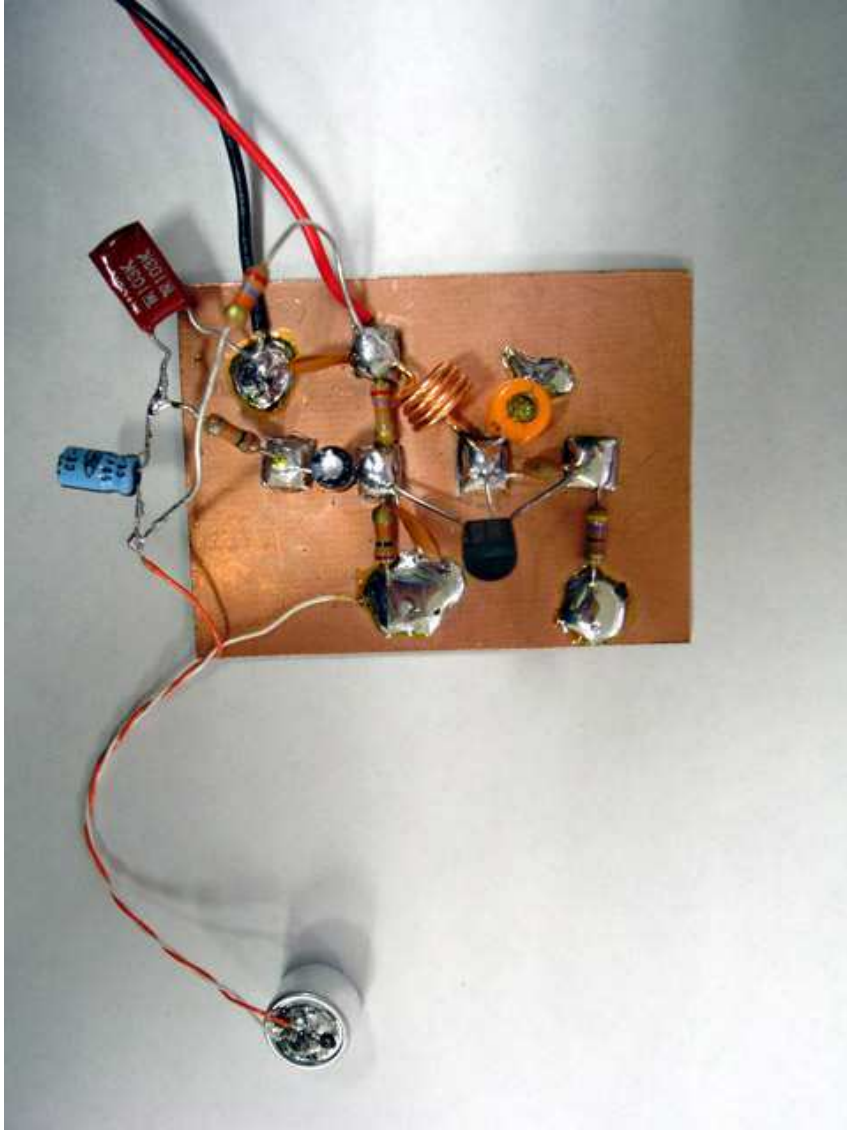
1 μF

● trimmer capacitor 20PF

Making the simplest Transmitter with a microphone



- soldered point:
 - : direct to the ground
 - : insulated from the ground
- Solder every part at the shortest distance.
- coil
 - 3 - 4 turns by coated 0.8 mm wire
 - 5 - 7mm
- registers
 - 470 Ω (yellow-violet-brown)
 - 10K Ω (brown-black-orange) 2 pieces
 - 27K Ω (red-violet-orange)
- capacitors
 - 10 PF
 - 0.01 μ F (103)
 - 1 μ F 2 pieces
- trimmer capacitor 20-50PF
- condensator microphone unit
- 4.7-10K Ω



How to build and solder?

The pictures are not of the most simplest transmitter but how-to is the same.



Make 5 x 5 mm squares.

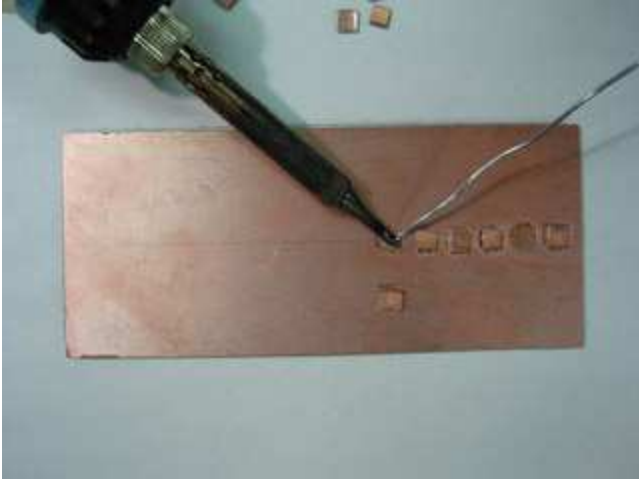
This size is not random nor appearance of good shape but is designed by the theory of "micro strip line" circuit.



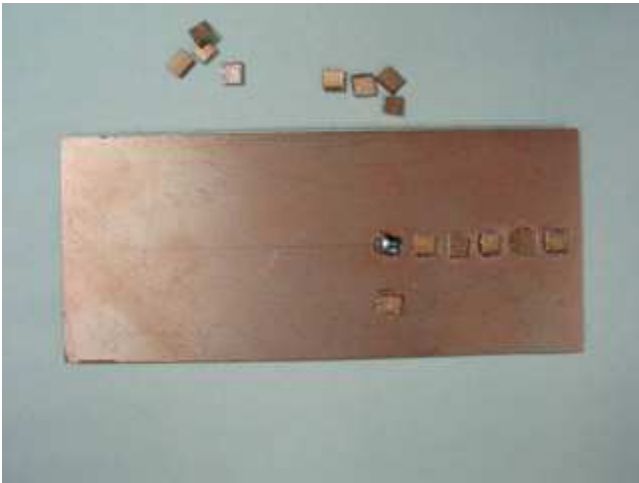
Drop a glue gel. The glue must be strong enough for fastening the squares on the board.



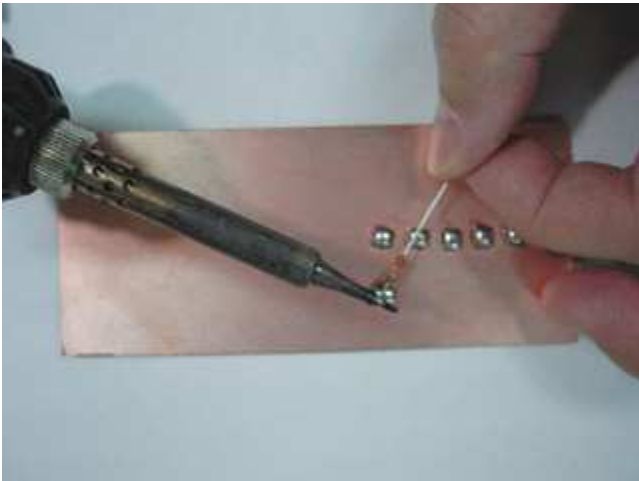
Paste a square on the copper-plated board one by one.



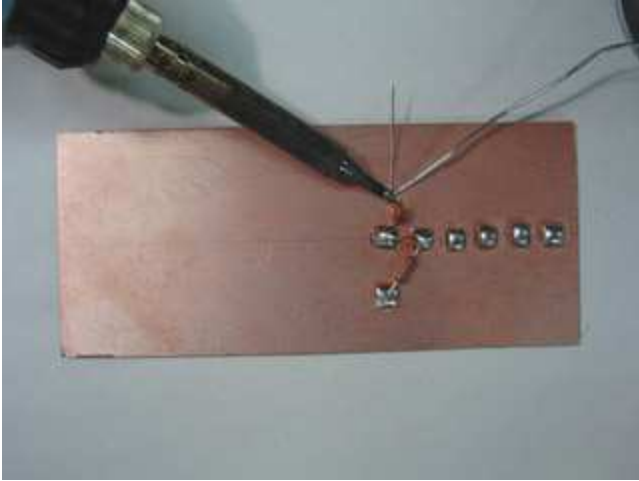
Solder on the surface of the square.



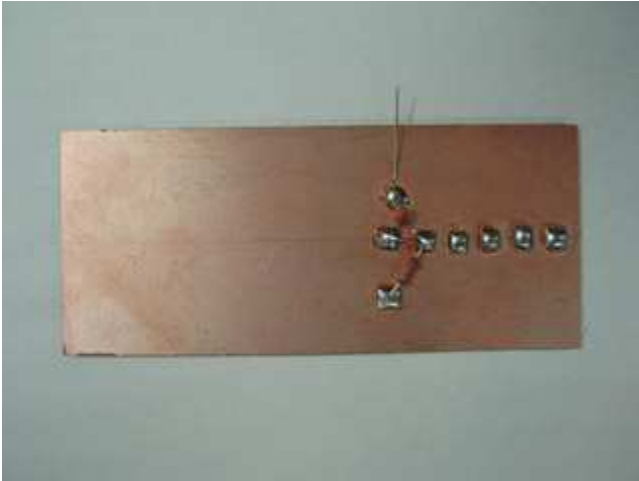
Fill the surface by solder.



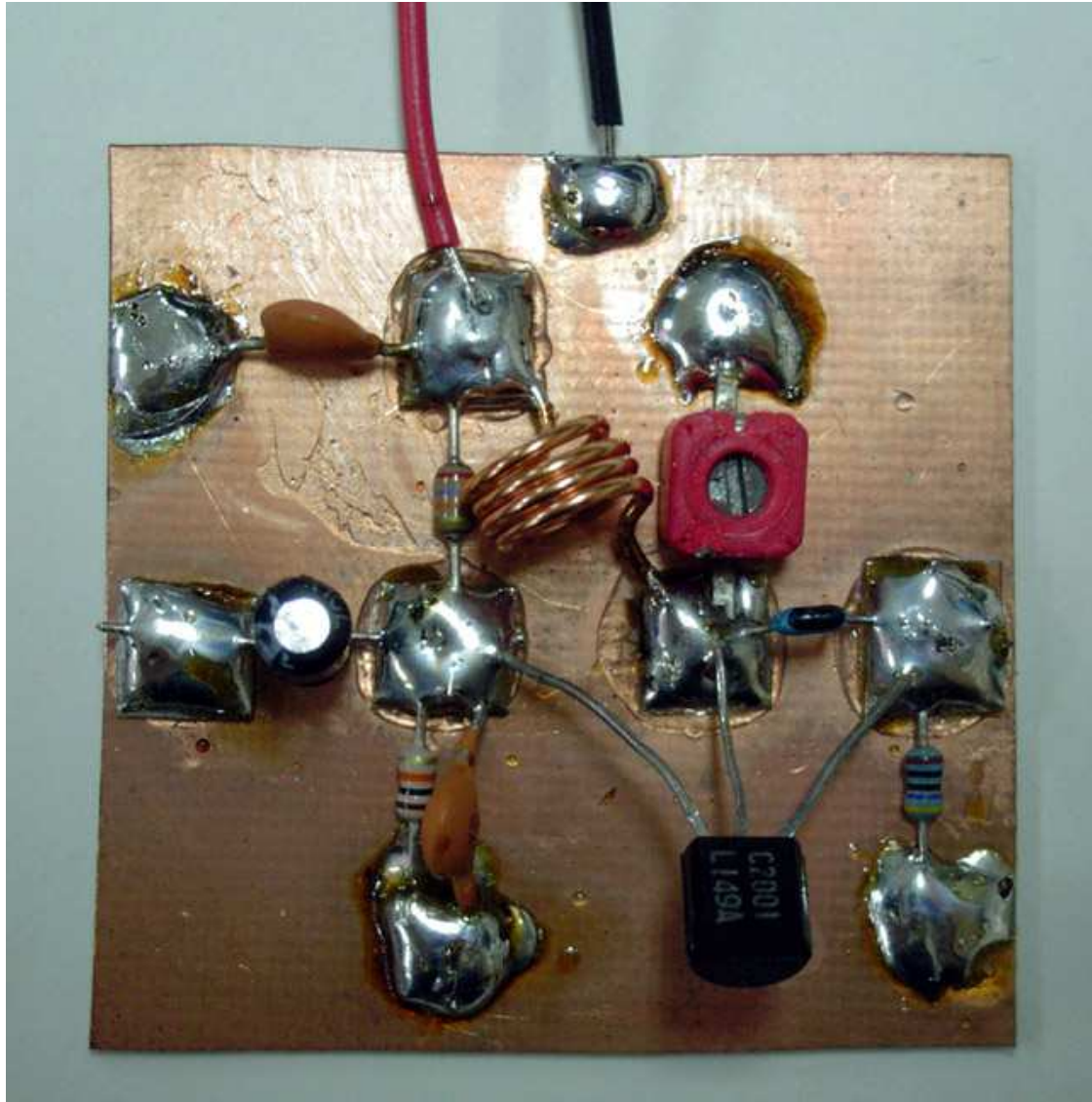
Start to solder each components one by one.

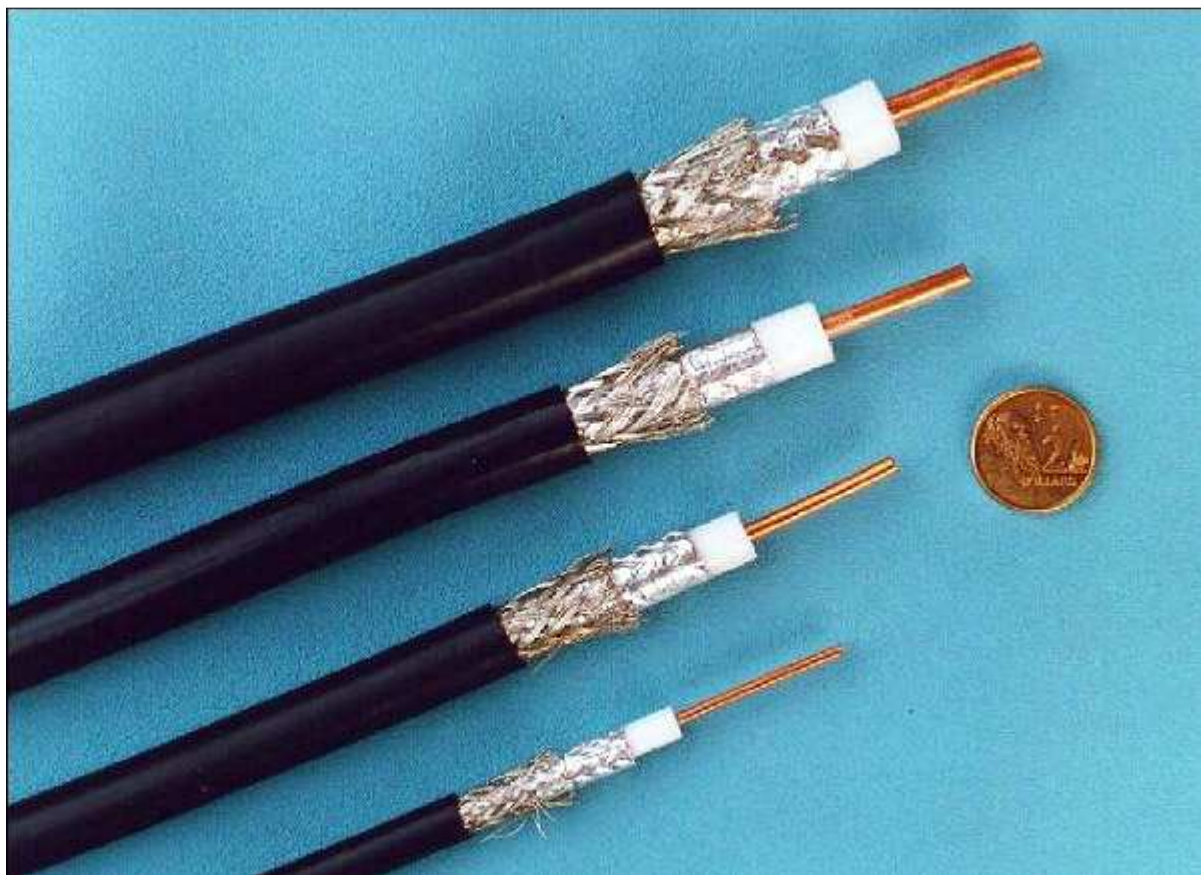
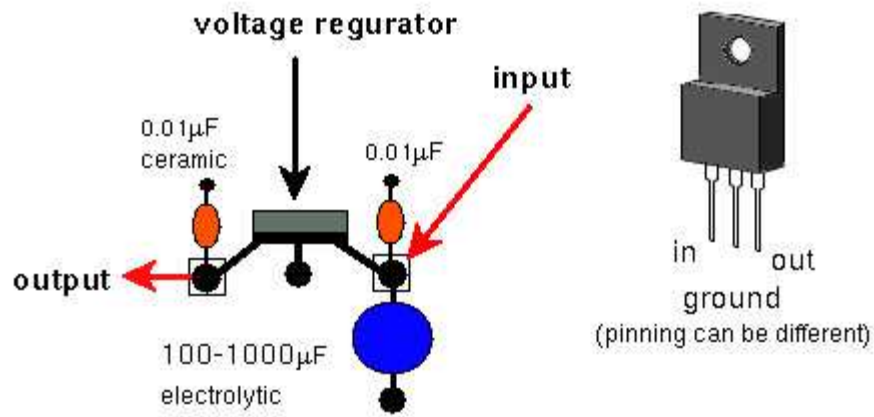


Solder on the ground.

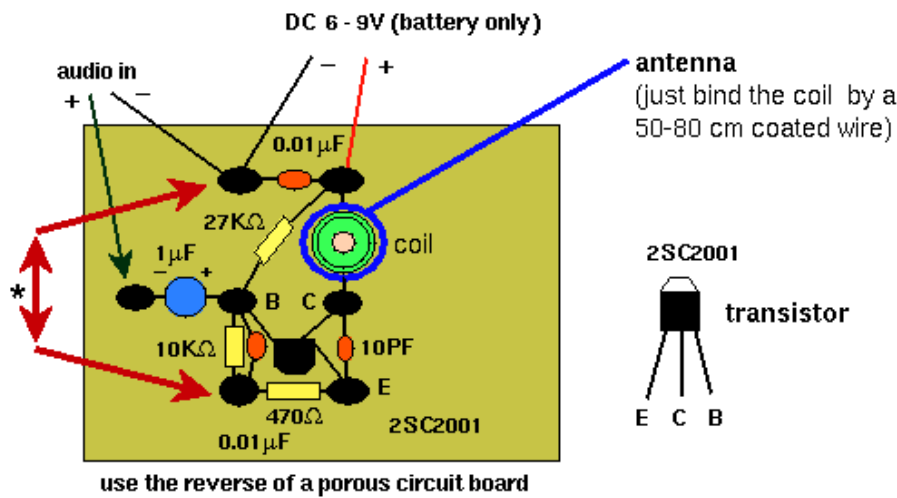


Every lead





Making the simplest Transmitter



solder directly
to the reverse



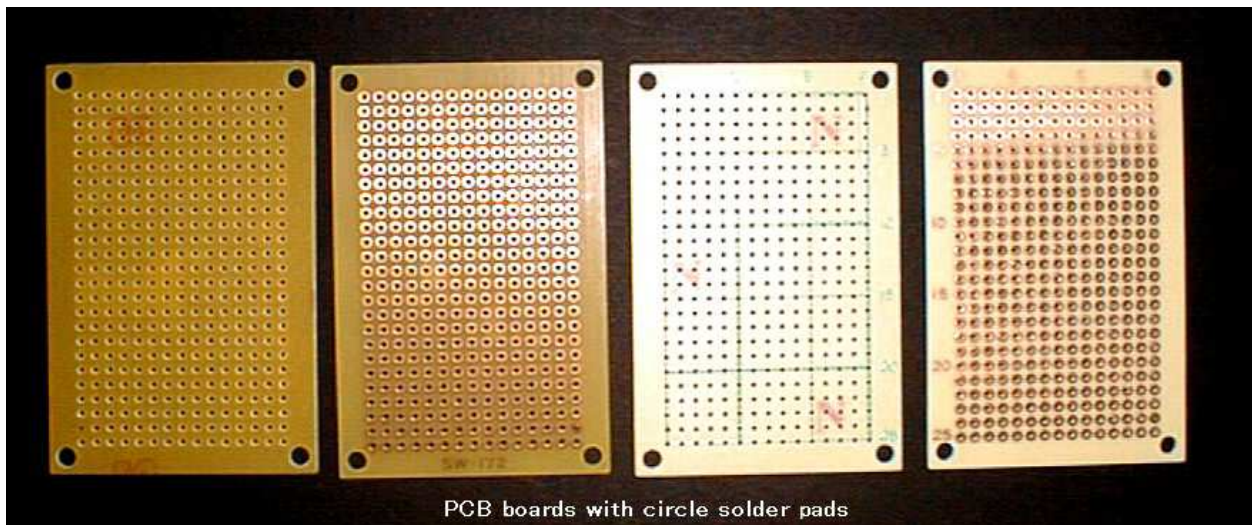
* Short-circuited at the back
using a cable

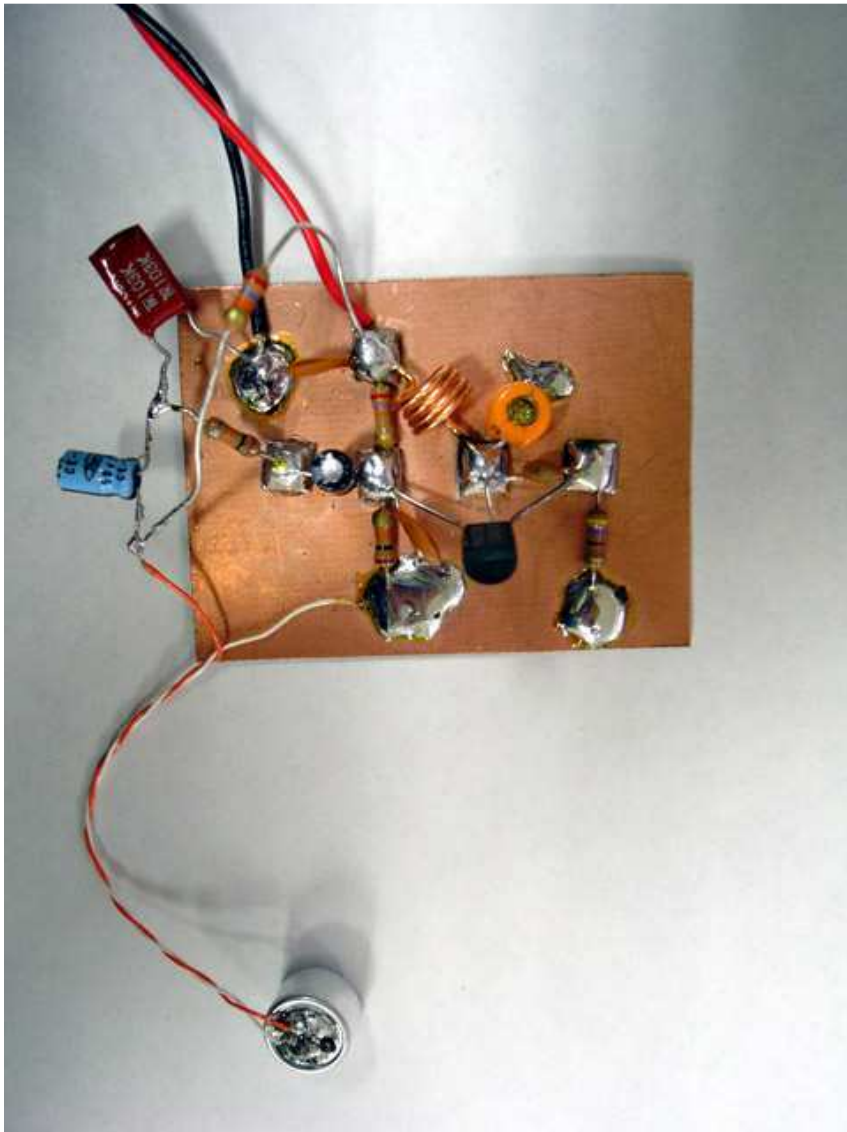
◆ coil
· 8.5 - 12 turns

◆ resistors
· 470 ohm (yellow-violet-brown)
· 10K ohm (brown-black-orange)
· 27K ohm (red-violet-orange)

◆ capacitors
· 10 PF
· 0.01 MF (103)
· 1 MF

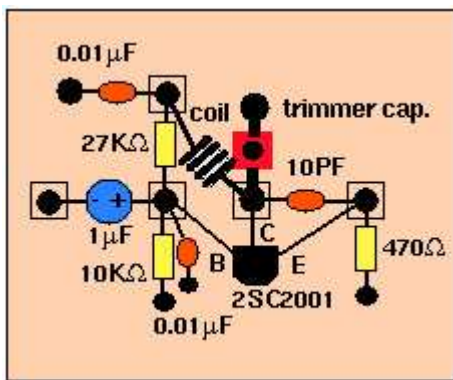
2002-03-26 by TK







How to build the simplest FM transmitter?



This tiny transmitter has several "defects": smaller radius of the service area, lower quality of the sounds and the relatively unstable frequency. These can be considered as a compromise to easily have your own transmitter for the time being or as a more positive choice. These "defects" are only from the perspective of conventional transmission such as "clear stereo sound to receive anywhere". Artist could change these to another directions. Whether or not, you can experience a *convivial wireless imagination*

by this transmitter.

The schematics:

- the basic unit:[\(pdf\)](#) [\(jpg\)](#)

Given the most simplest model, it is a bit inconvenient to change the transmitting frequency: change the gap of the coil (closer gap --> lower frequency; looser-->higher).

- the standard model:[\(pdf\)](#) [\(jpg\)](#)

In this version, you can change the frequency by the trimercap (variable capacitor). If you can have a variable capacitor, I recommend you to choice this version.

- the standard model with a microphone: [\(pdf\)](#) [\(jpg\)](#)

This has a condenser microphone unit in it. Every version could use the same circuit. Usual microphone has not enough output to this unit, but condenser microphone unit can drive this system. See how simply it is installed--->[picture](#)

The list of components: [registers, capacitors, transistor and etc.](#)

The basic tools: [soldier \(less than 30 watts\), wire-cutter, tweezers, and etc.](#)

How to build and solder? [A visual manual.](#)

Pictures of the finished model: [Standard model](#)

FAQ

[didn't work well](#) ; [stabilize the voltage](#) ; [extend the area copper plate](#) [change the frequency trimmer cap](#) [alternative transistor](#) [make the coil](#) [microphone iPod problem](#) [why need a power meter and a frequency counter](#)

Q: The transmitter works but the airwaves are too weak. I think there might be something wrong.

A: Every transmitter using the minimum parts like this has to have harmonic signals and "spurious". So you may sometimes not receive the authentic signal. Leave your radio receiver far at least three meters from the transmitter. Don't attach any cable to the antenna terminal. Then turn the trimcap slowly. The frequency will change and you will find the most strongest signal. (See "[the another Q&A](#)" below) In the 1.1 version with a variable capacitor to change the frequency, turn it very slowly until you get the most strongest signal at your radio. If you don't get, reduce the turn of the coil from 4 upto 2. When you use a variable capacitor over 10PF such as 20, 50 PF, 4 turns (I indicate in the schematic) would be too much. If you have a frequency counter, it would be easy to tune up the coil.

Q: I love the simplest transmitter. I wonder if this transmitter could be used for a practical Mini FM transmission.

A: The main problem is that the frequency is unstable. This is interesting from the perspective of radio performance, though. As the voltage of the battery is deteriorated, the transmitting frequency will be changed. In order to avoid it, you may use a [stabilized power supply](#). It would be a bit expensiver. You don't mix with a "[AC adapter](#)". When you use a ordinary "AC adapter", you should add a voltage regulator semiconductor for 9-12 volts such as "7809" or "7812". The simplest schematic is [here](#) (jpg).

Q: This transmitter can cover only a modest radius. Is it possible to extend it?

A: If you connect it to the proper antenna, you can do it. How to make an antenna is [here](#) (pdf). For this, you have to use a [thicker coaxial cable](#) between the transmitter and the antenna. The thinnest one can be used only for 1-2 meter extension. Think of the thickness of waterpipe and the length. Long extension increases the loss.

Q: I can't get "copper-coated plate". What else?

A: The schematic is supposed to use copper coated plate that is familiar with my design. When it is difficult to obtain, you can use even ["porous circuit board"](#) (jpg) that is popular in electronic hobby. [The schematic is here](#) (gif). I suggest you use the reverse side and directly solder the parts to it because this is convenient for your possible cut-and-paste and would be effective for your electro-magnetic performance.

Q: Can I change the frequency of the "basic" version? How?

A: In order to change the transmitting frequency without the trimcap, you a bit spread or compress the gap of the coil. When you do this operation, you have to have some distance (at least 3 meter) between the transmitter and the receiver (FM radio): otherwise you may be disturbed by many "spurious" (harmonic signals) and may not find the main one you want. That's why the best thing is to use a frequency counter.

Q: What is "trimmercap" in ["the changable-frequency version"](#)?

A: Don't mix it with ["variable capacitance diode \(varicap\)"](#) for [the 1-3 W transmitter](#). What we need here is only for manually varying the capacitance from (theoretically) 0 to 20 PF max. There are the various types and appearances. The classical one consists of tiny brass plates and ceramics. Some of the pictures are [here](#).

Q: I can't obtain the transistor 2SC2001. What is compatible with it?

A: There should be many replacements: 2SC2003, 2SC458, 2SC1973, 2SC3358, 2SC3580, 2SC3605, 2SD734 and so on. The European or American models such as [BC337](#) or [NTE123AP](#) can be used, but be careful of the different position of the pins (E=Emitter, C=Collector and B=Base) depending the semiconductors. The circuit that I designed uses [2SC2001](#) because it is cheap and very obtainable in Tokyo.

Q: How to make a coil by myself?

A: Prepare a 5mm diameter cylindrical material and enameled wire of 0.8 mm diameter. The movie ([WMV 280KB](#) and [MPEG 1.2MB](#)) shows how to do.

Q: I prefer to use [a tunable mold coil](#). What kind of coil can I use?

A: I stopped showing the schematic with it because [the tunable mold coil \(3-4 turns\)](#) has become less obtainable now. If you can get it, just install it instead of a hand-made coil WITHOUT the trimmer capacitor.

Q: Can I build transmitter that a microphone is attached to in it?

A: You can get a "condenser microphone unit" in low price. Using this, you can build it very easily. Check [the partial diagram](#) (pdf) and [the complete diagram](#)(pdf) of the simplest transmitter with a microphone in it. When this is acrobatically soldered, [here](#)(jpg) is the example.

Q: When I connect my iPod to the audio input of this transmitter, it suddenly stops to work. What's happening?

A: The earlier model of iPod has an automatic shut-down system in it. When you pull out the plug of your headphone, it automatically stops working. When the left and right channels are short-circuited, the same thing happens. Presumably, you use a stereo cable and solderd the left (white) and right (red) lead together. Please use the left channel lead (white) only. Usually the left output is compatible with mono audio. If you, however, insist to mix the left and right output of your audio source into the transmitter, [make a simple "interface" like this by two sets of 1 kirohm registers](#).