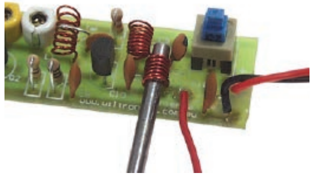


A connection (or tap) is required from the middle of the L1 tinned copper wire coil to the pad marked TAP next to the coil. Solder a piece of wire, about 1cm long, into the "tap" hole. It should be long enough to reach over the top of L1 to the middle turn.
Bend the wire so it touches the top of the turn then solder it in place.

Operating Voltage

The FM Transmitter was designed to operate from 9V DC, however you can increase the output power by using a 12 or 15V DC supply. If you try this then the values of some resistances will have to change. You can experiment by changing the component values shown.

Supply Voltage	R3 Value	R5 Value	R6 Value	R7 Value
9Vdc	4K7	470R	39K	100R
12 to 15V dc	10K	560R	68K	150R

Tuning The FM Transmitter

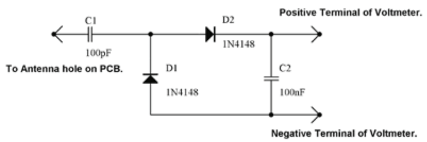
Once you have assembled your transmitter you will have to tune it to a frequency on the FM broadcast band, a part of the band that is clear of local stations.

- Tune your FM receiver to a part of the dial where you cannot hear any radio stations.
- Turn "on" your FM transmitter, do not fit the antenna just yet, and preferably with an earphone connected to the receiver, adjust the Yellow trim capacitor until you hear your signal in the earpiece.
- By tapping the microphone you will hear your signal, if you don't then continue tuning until you can. Because the transmitter has a RF amplifier it can overload the receiver and it may sound like you have tuned to the right spot but tapping the microphone will make sure.
- Use the White trim capacitor to fine-tune the transmitter to the receiver.

Next you need to tune the RF amplifier as explained below.

Peaking Circuit

To get maximum power out of the RF amplifier stage the circuit - coil L3 and C10 the 47pF capacitor - needs to be tuned to the oscillator frequency.
By making up the simple circuit below and using a multimeter the output of the RF amplifier can be measured.



The circuit is simply a RF detector that uses diodes to charge a capacitor. A multimeter set to 2V or 20V DC will indicate the voltage level on the capacitor.

HOW IT WORKS

The components of the RF detector can be directly soldered to each other without any PCB.
The output across C2 is to be connected to the multimeter's positive and negative terminals as shown.
Solder the input of the circuit directly to the antenna wire hole on the PCB, using a 5cm length of wire.
Moving the turns of L3 apart or together will cause the meter reading to change. L3 is tuned when the windings are spaced to provide the greatest meter reading possible.
Note that while you are touching the coil the reading will be lower, only take your measurements after you have adjusted the coil.
You will find that if your transmitting frequency is down around 90 MHz then the coil turns will be close together, at around 107 MHz the windings may need to be spaced so far apart
that the end coils are almost flat on the PCB surface.

When you have peaked L3 for maximum output remove the circuit and solder the antenna lead in its place.
If you change transmitting frequency then you will need to repeat the peaking procedure in order to get maximum power output.
WANT MORE RANGE?
You can get more range as a trade off against stability and battery life.

- reduce R5 to 100R
- reduce R7 to 47R
- increase C7 to 470p

Dipole Antenna

The half-wave antenna (the length of wire about 160cm long) you are supplied with will give you good range.
However a dipole antenna will work better and this is basically two wires attached to two points in the circuit, each point oscillating 180degrees out of phase with each other.
The antenna point and the positive of the battery are two points that you can connect to. A dipole antenna can be made from your existing antenna by cutting it in half,
ie, two 80cm lengths, leave the half soldered into the antenna point and soldering the other free half to the +9V pad. Point the two wires in opposite directions.

What to do if it Doesn't Work

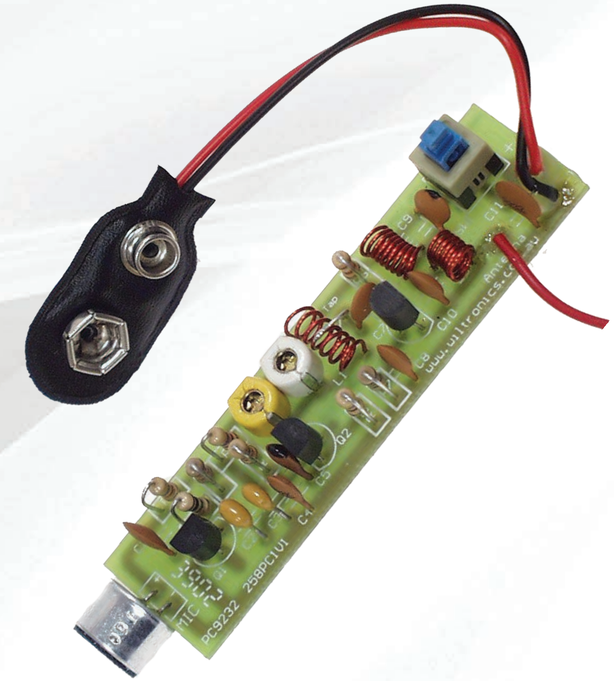
Have you turned the switch ON?
Check your soldering, particularly around the leads of the coils, any enamel left on them can cause problems. Use a strong light if necessary.
Check that you have placed the components in their correct positions on the PCB.
Is the connection to the middle turn on?
L1 made cleanly and securely?
Check for solder connections (shorts) across solder pads that are next to each other and shouldn't be there.
Are the transistors the correct way round and in their proper places?
Have you really spread out the coils of L3? At the high frequency end of the FM broadcast band each end of L3 should just about be bent over and touching the PCB.

ElectroTech Brands Pty Ltd
www.electrotechbrands.com.au

(KI0232)

3 Stage FM Transmitter

Tekky Kit



Component List

Designator	Part Description	Part No.
C1,C11	22nF Ceramic Capacitor	CC0153
c7,C8,C10	47pF Ceramic Capacitor	CC0121
C6	6.8-45pF Trimmer Capacitor Yellow	CC9028
C2, C3	100nF Mono Capacitor	CC0049
C4	1nF Ceramic Capacitor)	CC0137
C5	4p7 (5pf) Ceramic Capacitor	CC0109
C12	3-11pF Trimmer Capacitor White	CC9023
C9	10pF Ceramic Capacitor	CC0113
MIC	Electret Mike, 2 Pin	MI2000
Q1, Q2	T0-92 NPN 300mW Transistor	BC547
Q3	T0-92 NPN 500mW Transistor	BF199
R1	47K 0.25W Resistor (Yellow, Purple, Orange) OR 100K 0.25W Resistor (Brown, Black, Yellow)	RS1685 RS1725
R4	47K 0.25W Resistor (Yellow, Purple, Orange)	RS1685
R2	22K 0.25W Resistor (Red, Red, Orange)	RS1645
R3	4K7 0.25W Resistor (Yellow, Purple, Red)	RS1565
R5	470R 0.25W Resistor (Yellow, Purple, Brown)	RS1445
R6	39K 0.25W Resistor (Yellow, Purple, Brown)	RS1675
R7	100R 0.25W Resistor (Brown, Black, Brown)	RS1365
R8	1M 0.25W Resistor (Brown, Black, Green)	RS1845
SW1	DPDT Push ON-Push OFF Switch	SW1845
B1	9V Battery Snap	BA9000
HUW	2 Metre Grey Wire for Antenna	CB2201GRY
L1, L2, L3	35cm Enamelled Wire for Coils	CB2665

RF Detector Circuit - Components

C1	100pF Ceramic Capacitor	CC0125
C2	100nF Mono Capacitor	CC0049
D1,D2	DO.35 Silicon Switch Diode	1N4148
PCB	FR4 PCB	PC9232

Note: 9V Battery (BA1822) not included in the kit

Circuit Description

The transmitter picks up the audio from its surroundings with an electret microphone, the signal from the microphone is then fed to the first transistor Q1 which performs as an audio amplifier stage. Output from this first stage is fed into the next which is an oscillator comprising of transistor Q2 and a resonant circuit (L1 coil and the yellow and white trimcaps, C6 and C12).
The coil and capacitors are able to be tuned to your desired transmitting frequency.
Junction capacitance of the transistor Q1, varies with the applied voltage to its base, so the audio from the first stage causes the junction capacitance to vary (modulate) which in turn causes the frequency of the oscillator to vary (modulate). The oscillator circuit is connected in what's called a Hartley configuration.
The modulated signal from the oscillator is then applied to the last stage using transistor Q3, as an amplifier of the signal to feed more power to the antenna.

Transmitter Operation

This Three-Stage FM Transmitter has an RF stage in its output to amplify the modulated signal. By using a antenna it has a range of up to 1 kilometre. The transmitting range is dependent upon a number of variables.

- Location of the transmitter, (inside, outside, metal buildings).
- Single wire or dipole antenna.
- Power supply voltage.

The transmitter is constructed on a single-sided printed circuit board (PCB) with a silk screen overlay on top to aid in component placement. A solder mask on the copper side helps in soldering of the components.

Electret Microphone

This is a capacitive type of microphone comprising of two dielectric plates. One is a permanently charged dielectric plate made of a ceramic material that has been heated and allowed to cool in a magnetic field. The other plate is formed by the diaphragm on the front of the microphone case. Sound pressure moves the front plate and this vibration of the plate changes the capacitance resulting in a changing voltage that is fed to a Field Effect Transistor amplifier built inside the microphone case. Electret microphones have excellent sensitivity, a wide frequency response, are low in cost and small in size.

Audio Amplification Stage

Capacitor C1 isolates the microphone from the DC base voltage of the transistor Q1 but allows the alternating audio signal from the microphone pass to be amplified by Q1 which is operating in a self-biasing common emitter mode.The output signal then comes from the collector of Q1 and feeds the oscillator stage.

Oscillator Stage

The oscillator stage is where the RF carrier is produced and modulated by the audio signal from Q1. The resonant circuit (L1, C12, and C6), the transistor Q2 and the feedback capacitor C5 are the oscillator circuit here. An oscillating current flows around the resonant circuit. The circuit oscillates because of feedback occurring though C5. The feedback signal makes the voltage across R5 vary and hence the base-emitter current of the transistor Q2 vary at a resonant frequency thus causing the emitter-collector current to vary at the same frequency. This current helps maintain oscillation in the resonant circuit.

Resonant circuits are sometimes called LC or 'tank' circuits. This comes from the ability of the LC circuit to store energy for oscillations. In a pure resonant LC circuit (one with no resistance) energy is not lost. However in a real AC network the resistive elements will dissipate electrical energy, such as wire and joint resistance and dielectric losses.
The purely reactive elements, the C and the L, just store energy to be returned to the system later.
Note that the tank circuit does not oscillate just by having a DC potential put across it.
Positive feedback must be provided in this case by C5.

Trim Caps

To enable the oscillator to tune the full range of the FM broadcast band two trim caps are fitted into the circuit. The Yellow trim cap is used to tune the transmitter to a clear part of the band and the White can be used to fine tune the transmitter to the desired frequency.
You can also change the frequency by altering the space between the coils of L1.
Spread the L1 coil wide apart.

Final Amplification Stage

The RF stage adds power to the RF signal. We use a BF199 RF transistor for this.
L2 (an RFC - radio frequency choke) and capacitor C9 in parallel are placed so as to prevent any RF signal from reaching the positive voltage rail, if it did then RF would be fed back to the input and unwanted uncontrolled oscillation would occur. L3 and C10 are resonant at the transmitter frequency and adjusting L3 to set the resonant frequency correctly will allow the circuit to amplify the RF signal to its maximum. The adjusting of L3 can be done with the peaking circuit provided and described at the end of this set of instructions.

Assembling The Kit

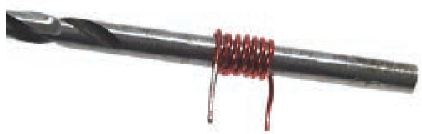
The kit can be assembled in any order but it is recommended that the coils and electret microphone be added last.
To keep the PCB small all resistors are inserted vertically. Use care and make sure the transistors are placed in their correct positions and the right way round.
The electret microphone is polarized and to be fitted with the pin that is connected to the microphone case, connected to the '-' hole at the MIC position on the PCB.

Making The Coil

The transmitter uses 3 coils (L1, L2 and L3) and the wire to make them is supplied in the kit.
The coils are made out of the red enamel covered wire provided. The red enamel paint insulates the wire so that when it is wound into a coil the turns can touch each other and not create a short circuit.
All three coils are wound on a 3mm-diameter former, a 3mm-drill bit for example using the smooth end that usually goes into the drill chuck.
It is best to make these coils as you are about to fit them to your circuit board because the drill bit can help you fit the coil to the board without causing any damage to it
(fit coil to pcb before removing drill bit).

Coil	Wire Type	No of Turns
L1	Enamel Copper	6
L2	Enamel Copper	6
L3	Enamel Copper	6

The following picture shows the wire wound on a 3mm drill bit, note the direction of winding the wire. If wound in the wrong direction it won't fit properly onto the circuit board.



Leave about 5mm of wire leading away from the coil so that it can be soldered onto the circuit board, next the red enamel needs to be removed where it is going to be soldered. This can be done with a soldering iron and some solder.
Firstly place the coil so that the wire ends point way from the bench top then place the soldering iron tip against the side of the enamelled wire, after about 3 seconds apply a little solder. Moving the tip around the wire should burn off the enamel and tin the copper wire underneath. Depending on how hot the iron is this may take a little longer. Remember to clean the tip of the iron after you have removed the enamel from the wire. Coil L1 also has to have some enamel removed from the top of the centre turn to allow a wire to be soldered to it. You can either scrape away the enamel with a knife while it is on the drill or wait until the coil is soldered into position on the PCB and the windings opened up and use the soldering iron method described earlier.
The circuit board is layed out so that you can leave the coil on the drill bit and solder it into place using the bit as a guide to steady and not damage the coil. When fitting L1 spread the windings a little to get it to fit, about 1mm space between each turn is enough and this can be done while the coil is still on the drill.