DIY Kit 51. MINIATURE FM TRANSMITTER

This FM transmitter is a minuature version of Kit 18 using normal passive components. Components have been squashed together as much as possible while still allowing good access to the tuning capacitor. The PCB-etched inductor of Kit 18 has been replaced by a small inductor. To reduce the size any more you would have to use surface mount components and a double sided PCB.

ASSEMBLY INSTRUCTIONS

Components may be added to the PCB in any order. First identify the single EC24 inductor. It looks like a 1/2W resistor. It goes in the location marked L. The electret microphone should be inserted with the pin connected to the metal case connected to the negative rail (that is, to the ground or zero voltage side of the circuit.) This is marked with a '-' sign at the MIC on the circuit board. Follow the overlay to add the other components.

The battery snap must be connected with the Red lead going to the 9V+ pad and the Black lead going to the '-' or ground rail. Adding and removing the batteries acts as a switch for the kit. Or you may add your own switch.

Connect a half or quarter wavelength length of hookup wire (supplied by you) to the aerial point. At an FM frequency of 100 MHz these lengths are 150 cm and 75 cm respectively.

CIRCUIT DESCRIPTION

The circuit is basically a radio frequency (RF) oscillator that operates around 100 MHz (100 million cycles per second). Audio picked up and amplified by the electret microphone is fed into the audio amplifier stage built around the first transistor. Output from the collector is fed into the base of the second transistor where it modulates the resonant frequency of the tank circuit (the inductor & the tuning capacitor) by varying the junction capacitance of the transistor. Junction capacitance is a function of the potential difference applied to the base of the transistor. The tank circuit is connected in a Hartley oscillator circuit.

The electret microphone: an electret is a permanently charged dielectric. It is made by heating a ceramic material, placing it in a magnetic field then allowing it to cool while still in the magnetic field. It is the electrostatic equivalent of a permanent magnet. In the electret microphone a slice of this material is used as part of the dielectric of a capacitor in which the diaphram of the microphone forms one plate. Sound pressure moves one of its plates. The movement of the plate changes the capacitance. The electret capacitor is connected to an FET amplifier. These microphones are small, have excellent sensitivity, a wide frequency response and a very low cost.

First amplification stage: this is a standard self-biasing common emitter amplifier. The 4n7 capacitor isolates the microphone from the base voltage of the transistor and only allows alternating current (AC) signals to pass.

The tank (LC) circuit: every transmitter needs an oscillator to generate the radio frequency carrier waves. The tank (LC) circuit, the BC338 and the feedback 10pF capacitor are the oscillator in this kit An input signal is not needed to sustain the oscillation. The feedback signal makes the base-emitter current of the transistor vary at the resonant frequency. This causes the emitter-collector current to vary at the same frequency. This signal fed to the aerial and radiated as radio waves. The 10pF coupling capacitor on the aerial is to minimise the effect of the aerial capacitance on the LC circuit.

The name 'tank' circuit comes from the ability of the LC circuit to store energy for oscillations. In a pure LC circuit (one with no resistance) energy cannot be lost. (In an AC network only the resistive elements will dissipate electrical energy. The purely reactive elements, the C and the L simply 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. (Look up Hartley and Colpitts oscillators in a reference book for more details.)

CALIBRATION

This should be done with the kit at least 10 feet from an FM radio, preferably in another room. The kit should be near (note ‘near’, not right next to) some source of sound, like a TV, ticking clock or just people talking. Plug in the battery. Use a small screw driver or your fingernail to move the movable plates so they are about half overlapping. Go back to the FM radio and move the tuning dial at around 90 - 94 MHz. Somewhere there the transmission should be picked up.

Note that you must not hold the kit when doing this calibration. Your own body capicitance is more than enough to change the tank frequency of oscillation.

WHAT TO DO IF IT DOES NOT WORK

Poor soldering is the most likely reason that the circuit does not work. Check all solder joints carefully under a good light. Next check that all components are in their correct position on the PCB. Thirdly, follow the track with a voltmeter to check the potential differences at various parts of the circuit particularly across the base, collector and emitter of the two transistors.

Check that the following collector-emitter voltages are present; about 2V across the 548, 5V across the 338.

If you hear an oscillation or 'putt-putt' at all frequencies then it is possible the unit is in oscillation due to the load resistor on the microphone being too low. Increase it to say 22K or 47K. This should overcome the problem.

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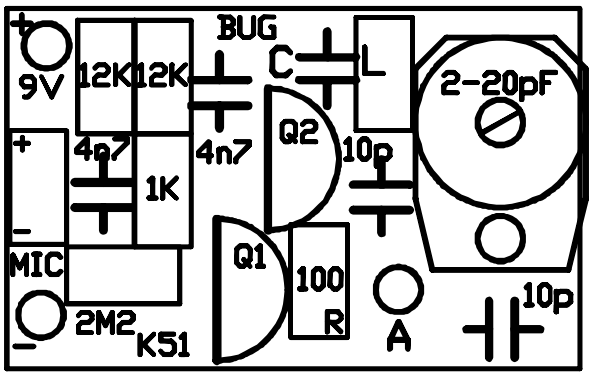
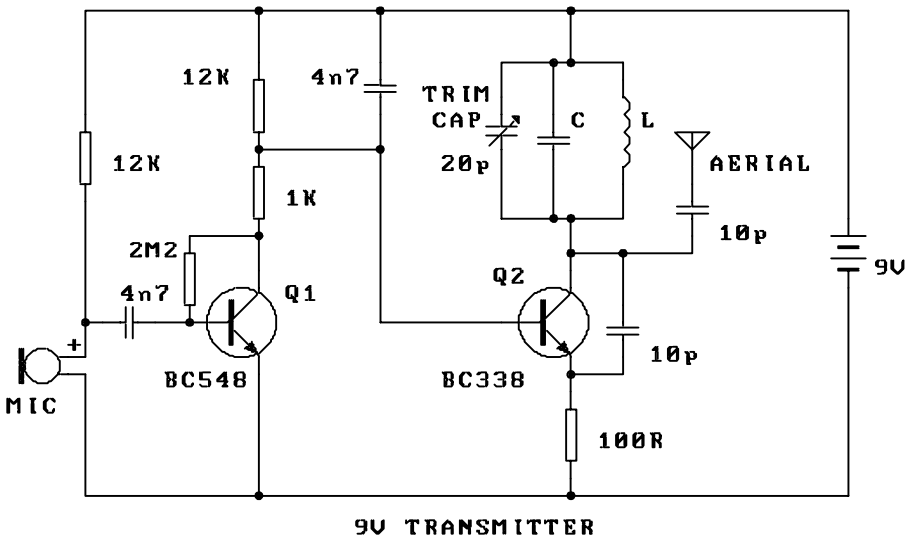
COMPONENTS		
Resistors 5%, 1/4W:		
100R brown black brown	R1	1
1K brown black red	R4	1
12K brown red orange	R2 R3	2
2M2 red red green	R5	1
Tuning capacitor 2-20pF		1
ceramic capacitor, 4n7		2
ceramic capacitor, 10pF		2
ceramic capacitor, 47pF	C	1
Inductor 39nH	L	1
BC548	Q1	1
BC338	Q2	1
Electret microphone		1
9V battery snap		1
Kit 51 pcb		1





9V TRANSMITTER