Circuit Bodging

FM bug transmitter

Many people have their interest in electronics start with radio. As much as radio is taken for granted by most people, the idea of sending information through the air at the speed of light remains enticing to anyone who thinks about it for longer than a few minutes. As such, we submit to you this simple yet effective FM transmitter.

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Everybody who has seen a James Bond movie, or anything involving spying of any sort, has heard of the concept of a bug. A small electronic device is placed in a person of interest’s room, and the agents in the other room can listen in on what’s going on. Evidence is gathered, and the story can move on.

Of course, in reality things are a little different. The microscopic devices used in Hollywood are slightly more advanced than what we can achieve on our breadboards. Unless you have a very steady hand or access to an smd soldering oven you’re not going to be able to replicate the miniature devices seen in the movies.

Legal concerns

There are a few less frivolous concerns when it comes to radio circuits. Radio frequency transmissions are strictly regulated and simply transmitting on AM/FM bands is illegal - something that has shut down many decent pirate radio station in the past. The reason for this is simple: you need a license to use a certain frequency - and these licenses are sold at auction. Because commercial radio stations are also interested in acquiring a license to transmit, these become incredibly expensive. As such, transmitting on AM band is illegal in the Netherlands. Luckily, there is a provision in the law for low-power FM devices, for instance to listen to your iPod in the car without having to fit a new stereo system.

Please note that the power allowed for these devices is severely limited. The circuit we have featured has a range of about 20-30 metres, but more powerful devices step over the low-power boundaries and as such are not permitted.

Listening in

Before we can even start to think about transmissions, we need something to transmit. In our case, we’re looking to transmit audio. In figure 1 we have a simple one-transistor amplifier that takes its input from a condenser microphone. A condenser microphone (figure 2) is a special type of microphone in which the diaphragm (the moving part of the microphone) acts as one of the plates of a capacitor. As the diaphragm moves, the capacitance changes.
Using a microphone
The circuitry in figure 1 is fairly self-explanatory. One thing to take into account is that the condenser mic needs a voltage to be applied across the device for it to operate. Unlike dynamic microphones, condensers don’t create an output by themselves. We are, in essence, measuring and amplifying the change in the device’s behaviour as opposed to measuring an output from the device itself.

Turning it into radio
The interesting stuff happens in figure 4. First of all, note that the input does not have a DC filtering capacitor. This is because the microphone amplifier circuit already features this capacitor, C2. If you intend to use the circuit to broadcast something other than the output from the microphone you should add the 100nF capacitor in series with the input.

C6 and L1 provide an oscillator, the frequency of which can be adjusted with C6. When tuning the circuit, tune your radio to 90MHz and attempt to receive a signal whilst adjusting C6.

Because the capacitance of T2 is in the same order of magnitude as C6, the idea is that as the transistor amplifies the input, this capacitance influences the oscillator, causing the frequency to change - Frequency Modulation.

This is presented, once again through a DC filtering cap, to the antenna, which broadcasts the signal.

Final Notes
Making an FM transmitter out of discrete parts is notoriously unreliable. A simpler, but less interesting way is to use ICs to provide modulation, as all they require is an input signal and an antenna, and in some cases a crystal for the oscillator. If your goal is reliability as opposed to experimentation, an IC such as the MC2833 or the MAX2606 might be more to your liking.

Part list:
R1: 22k
R2: 1M
R3: 10k
R4: 47k
R5: 470
C1: 223pF
C2: 100nF
C3: 102pF
C4: 5.6pF
C5: 27pF
C6: 6-45pF trimmer
L1: 1µH
ANT1: simple antenna
T1, T2: BC547

Figure 3. Power supply

Figure 4. The RF modulator.