Extended Range FM Radio Receiver

Overview

Common RF audio and telephone technical surveillance devices ("bugs") often operate in the commercial FM broadcast band between 88 and 108 MHz. The major reason for doing this is so that you can receive your surveillance device on a consumer FM radio, without the need for a specialized communications receiver. Another reason for using this band, which most people may not realize, is that if you set your surveillance device to operate at the *same* frequency of a remote FM broadcast station, you can then use that station's signal to "block" the reception of *your* surveillance device outside a limited local target area. At some range, say up to 200 feet or so, your little RF bug will have a *stronger* received signal power then that of a 100,000 watt FM broadcast station 20 miles away. This "snugging" technique is often used by the more experienced surveillance technicians.

One major drawback of using the FM broadcast band for surveillance devices – other than the fact anyone can listen in – is that consumer FM receivers are all made to receive and demodulate a *wideband* FM signal. When receiving a *narrowband* signal, like that from an audio bug, the receiver will have very low output audio power. The good news is that you can get around this by just turning up the volume, or if you are a perfectionist, you can modify the radio to receive narrowband FM by tapping the (typically) 10.7 MHz IF signal and running it into an external communications receiver like an AOR AR8000. It is also possible to make your own narrowband FM demodulator. These can be made from a Motorola MC3357 or MC3361 FM demodulator chip. These IF chips, and the IF filters they require, can often be found in old 49 MHz cordless phones or baby monitors. Refer to the MC3357 or MC3361 datasheets for for information on those.

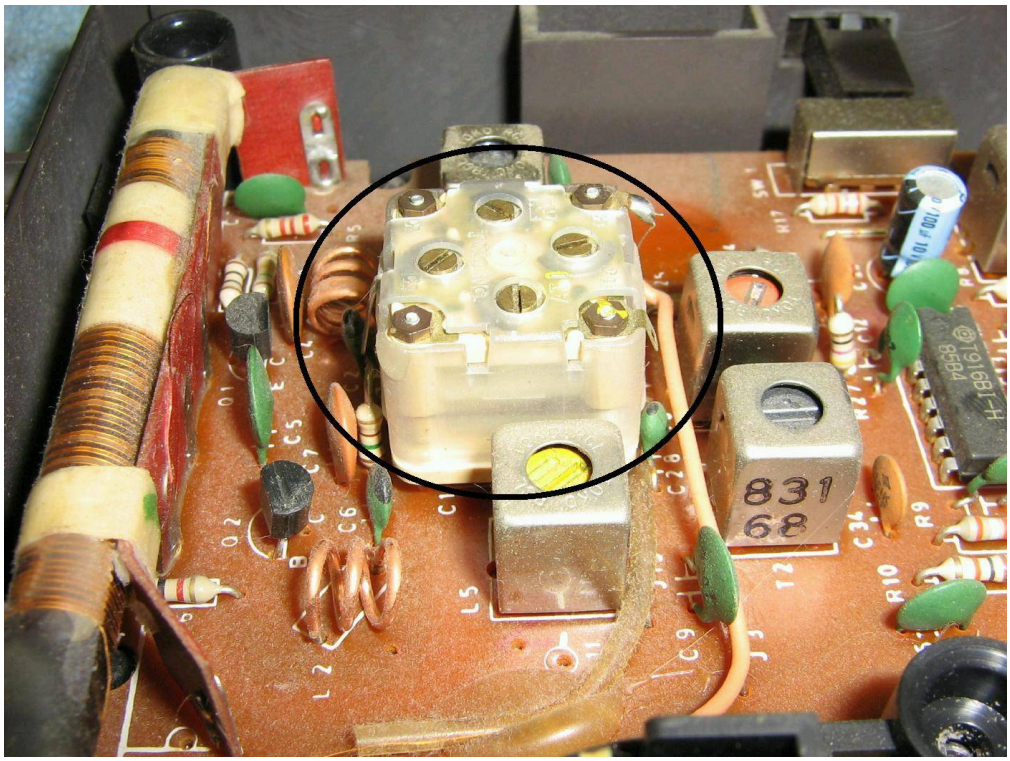
Frequency Range Modification

What this modification will do is to "shift" the radio's received frequency *up* a few megahertz so you can tune into FM signals slightly above 108 MHz. FM bugs operating around 110 MHz are easy to construct, and now you'll be able to properly receive them. This method can also be adjusted to make the radio tune *down* a few megahertz below 88 MHz. The modification only effects the radio's FM local oscillator, and there is no need for any major electrical work. A schematic for an optional narrowband FM demodulator will be shown at the end. This can be used with a tapped 10.7 MHz IF output from the radio.

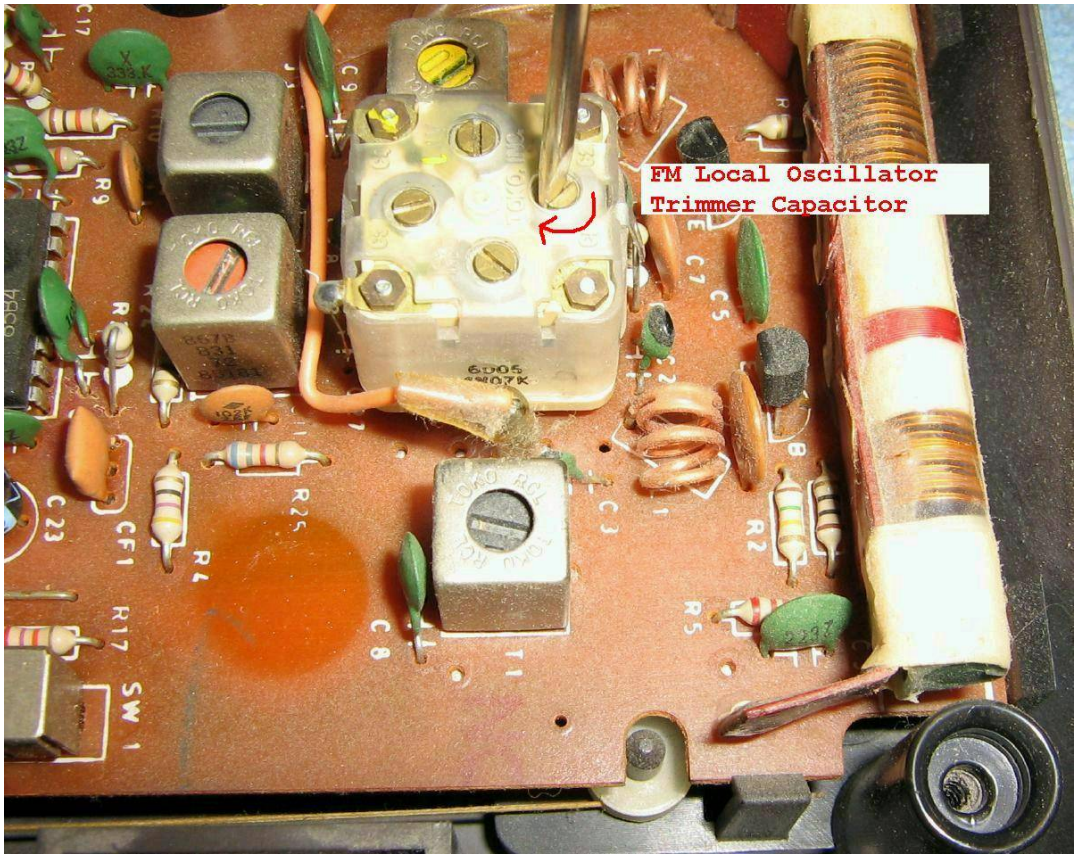
*For this modification to work, you **must** use an analog tuned receiver!*

Construction Notes & Pictures

This particular modification will be done to a General Electric Model No. 7−4215A "under−the−cabinet" FM radio. This radio was chosen for a number of particular reasons. It has good receiver sensitivity due to the filtering and the fact that it uses the AC power line as the antenna. It also has very good audio output power, and they can be found at most thrift stores.



Open up the radio, and locate the main FM/AM tuning capacitor. It will most likely be a clear plastic box that is somehow physically connected to the tuning dial. On top of this will be four little trimmer capacitors. The four trimmer capacitors are for trimming the FM & AM local oscillator frequency, and the FM & AM antenna input match. For this modification, we'll only need to slightly adjust the FM local oscillator.



This modification works by tweaking the local oscillator frequency so when the radio displays a *lower* frequency, say 106.7 MHz, it is actually receiving a *higher* frequency, say 110.7 MHz. The entire retuning process is quite simple. First, tune the radio to a strong station transmitting around the "high" end of the band between 107 – 108 MHz. Any station will do, just as long as the received signal is strong and you can remember what song is playing! Next, tune the radio down a few megahertz in frequency, being sure that there are no interfering stations. With the radio on this new frequency, begin to *slowly* rotate one of the four trimmer capacitors on the main tuning capacitor using a plastic or insulated "tweaking" tool. Rotate the trimmer about a quarter–turn in each direction, and listen for the "higher frequency" radio station to appear on this new lower frequency. If the received frequency doesn't appear to change, return the trimmer capacitor to its original location, and move onto the next trimmer.

On the Toko tuning capacitor shown in the above picture, the FM local oscillator trimmer capacitor was labeled **C2** and it needed to be rotated about a 1/8–turn clockwise (with the Toko label facing you) for a 2 MHz change. Other brand tuning capacitors should also be adjustable in this method.

If needed, you can also adjust the FM antenna input match trimmer capacitor for a better antenna impedance match and higher received signal strength.

Narrowband FM Demodulator

Example Application Schematic - No Squelch Control