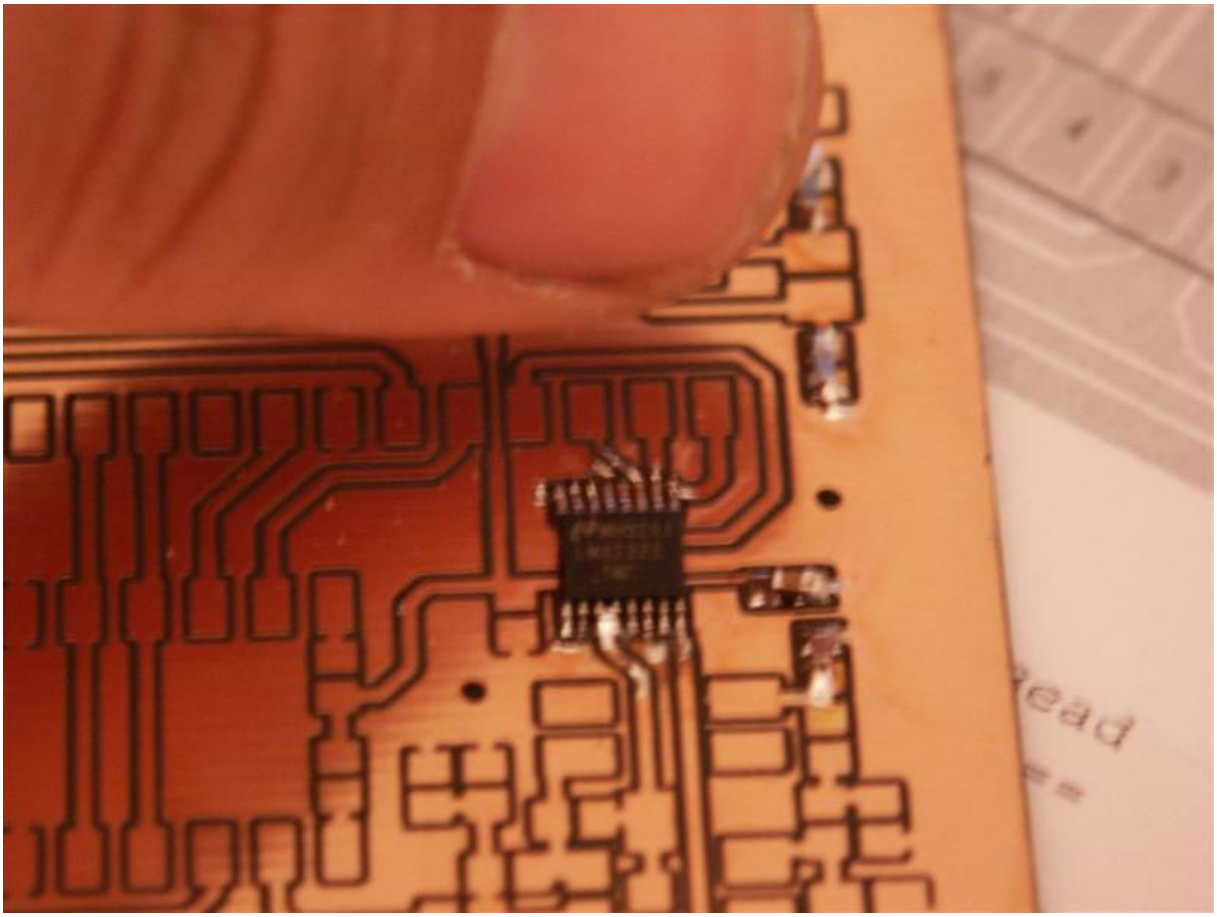
250 MHz RF generator

During September 2007 we (Piet Ooms, PE5OHM and Jesse Kluijfhout PE1RUI) decided to build a 250 MHz RF generator designed by Daniel Norman. We found the design on his great website http://hem.passagen.se/communication/meny.html. Be warned if you've visited his website you will get a lot of inspiration which costs a lot of time and money ;-)

We did order all parts, including PCB's from Daniel's own webshop www.rfcandy.com All small SMDs parts sorted, with value's and PCB location number. Piet's second and my first SMD project. Piet had already build Daniels frequency counter. Most PCB were easy to install and solder using tweezers. The three IC's where more difficult and must be really careful no to get bridges.

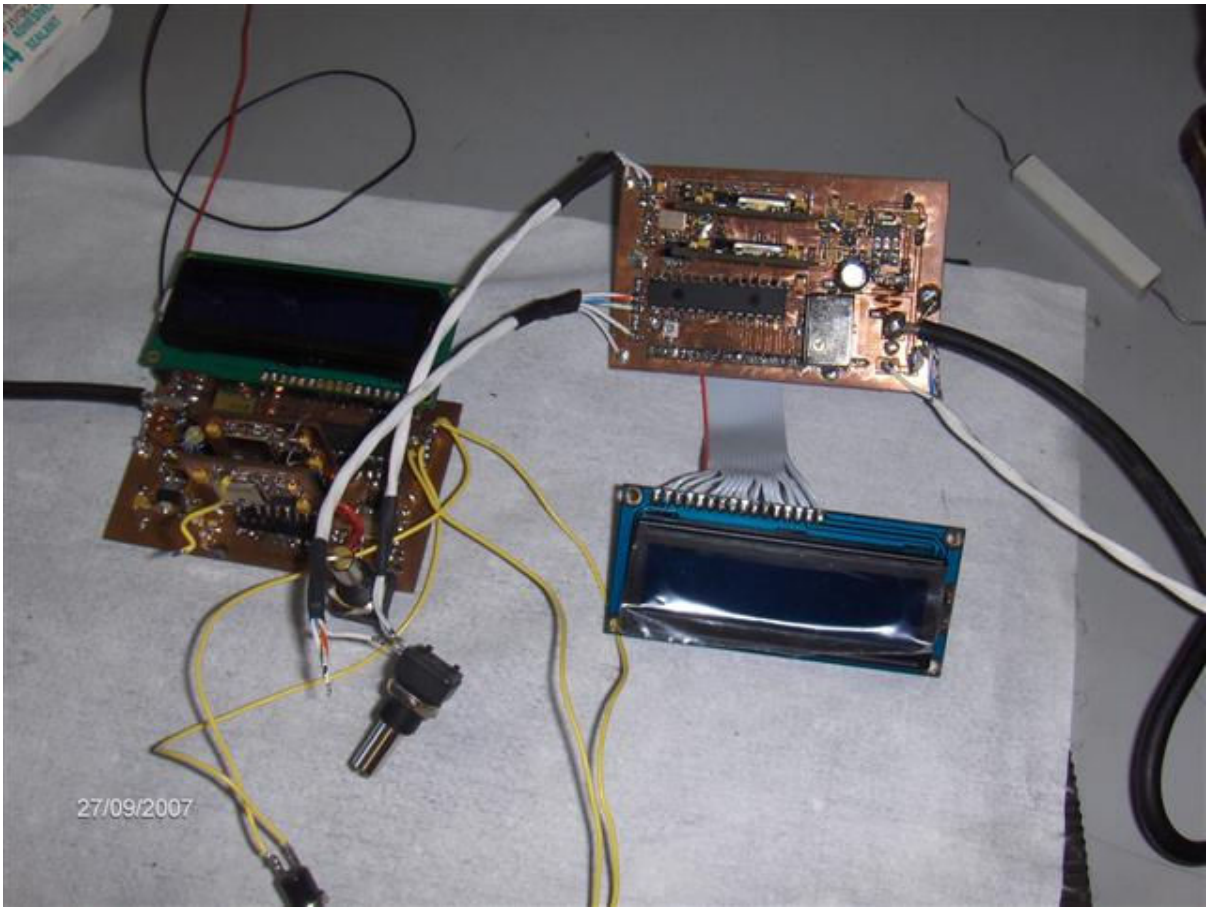


As you can see in relation with my thumb, the very small IC on the main board. Not that two of it's contacts are soldered together (intentionally)

What has gone wrong? Well at first power up Piet's RF generator was working, but the PLL wouldn't lock. This was due to a poor solder joint at a C on the VCO board. After this repair the generator would lock. Output signal was very strong on a lot of frequencies, and some ticking was heard on the correct frequency.

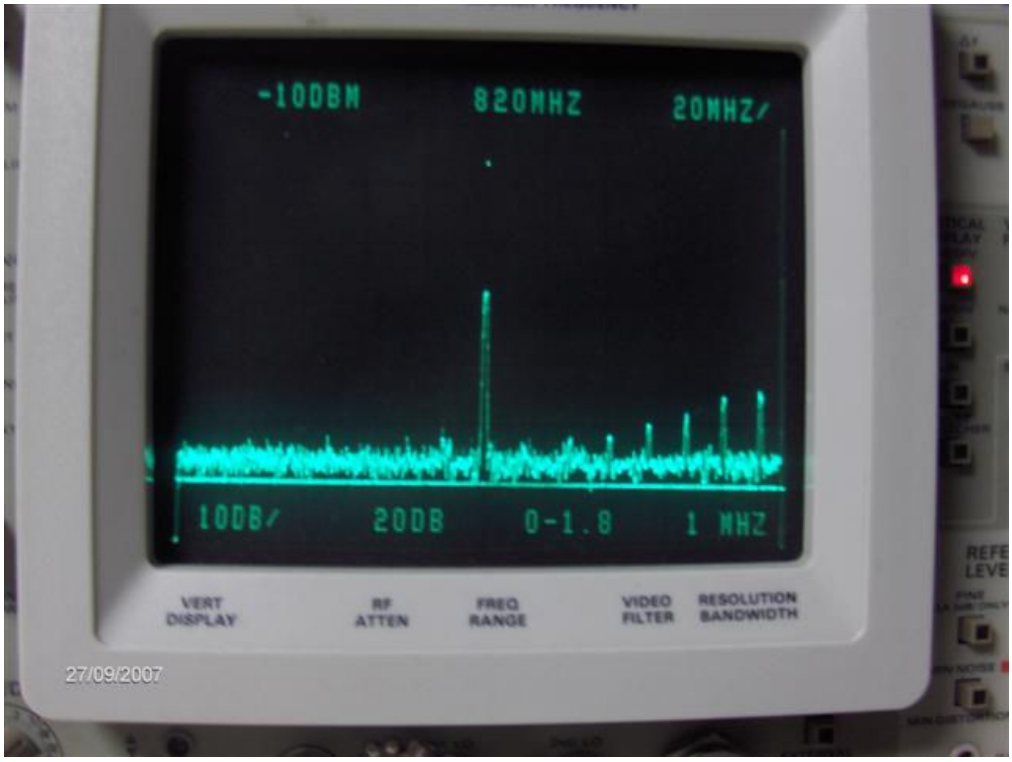
Before power up I decide to measure for shorts. There was a short present somewhere after the 78L05. Found a small drop of tin at C6 shorting. Removed C6, cleaned the pad and resoldered. Applied power and the RF generator did turn on. The VCO test was ok, but the generator wouldn't lock.

As Piet and I build the generator during the same period we were able to exchange parts. This is very handy, and very nice to get more knowledge with a friend. We did found out accidentally that my generator PLL wouldn't lock without a 50 Ohms load, while the generator build by Piet would lock anyway. My generator hadn't a problem as I first thought, it just wasn't matched.
After exchanging the VCO's we had found out one of VCO PCB's was the problem with Piet's RF generator. This VCO was radiating on a lot more frequencies with a high amplitude. Daniel supplied another VCO module, soldering the new VCO on the VCO PCB solved the problem.

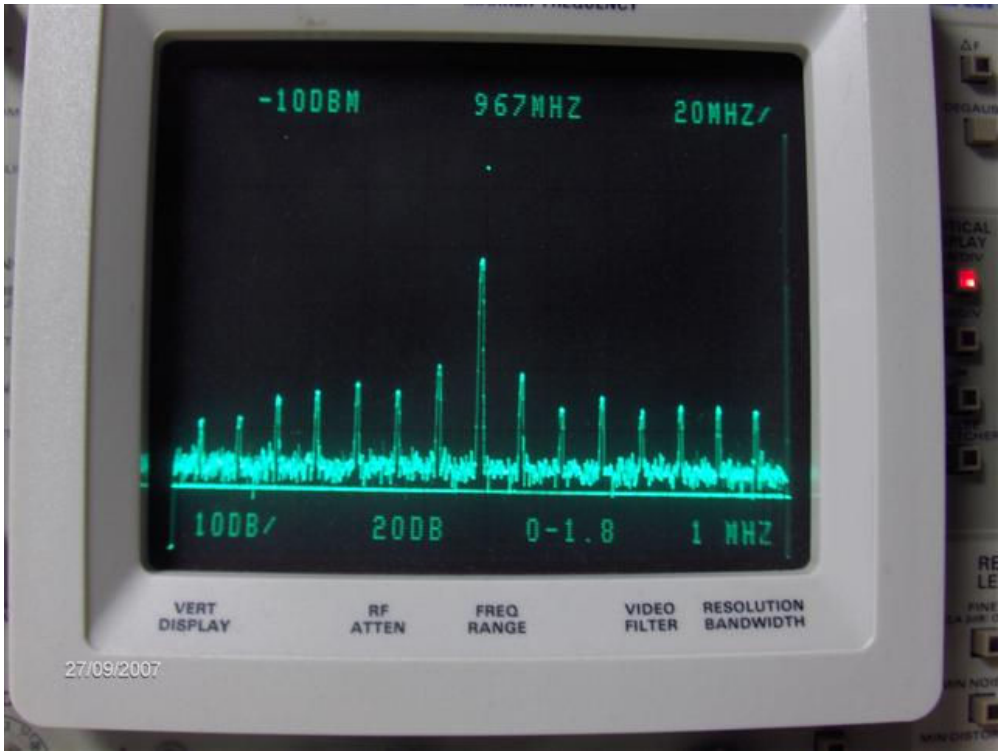


On the left you can see the RF generator build Piet, on the right you can see my RF generator.

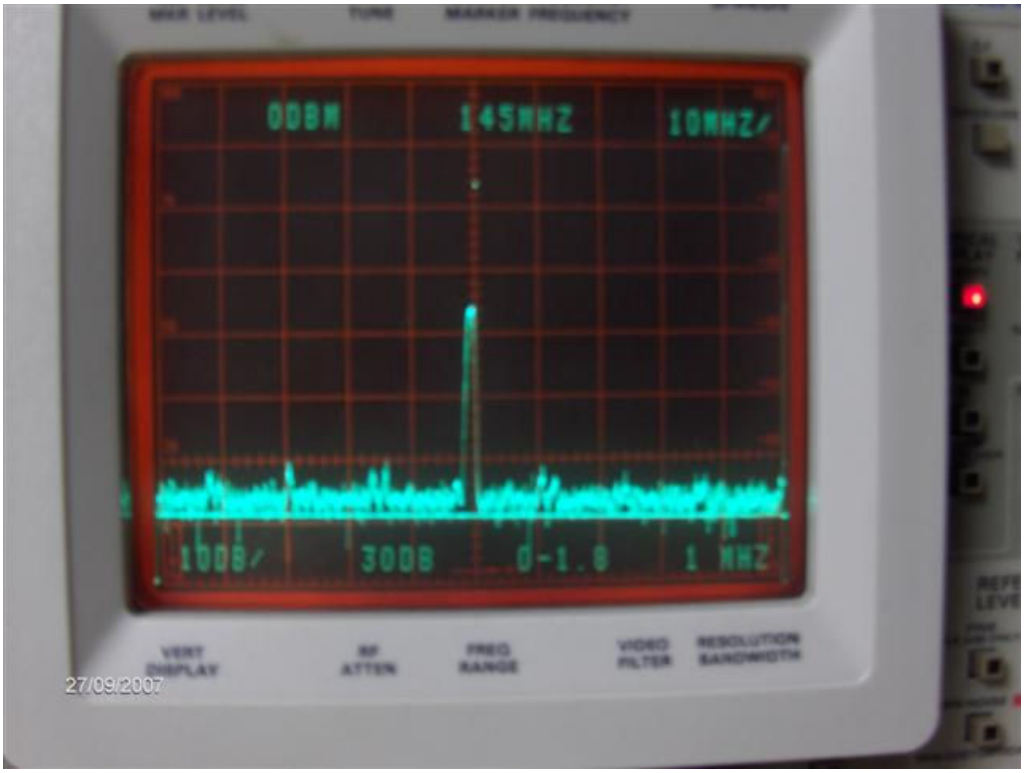
We were very lucky and got a change to test our RF generators on a spectrum analyzer.



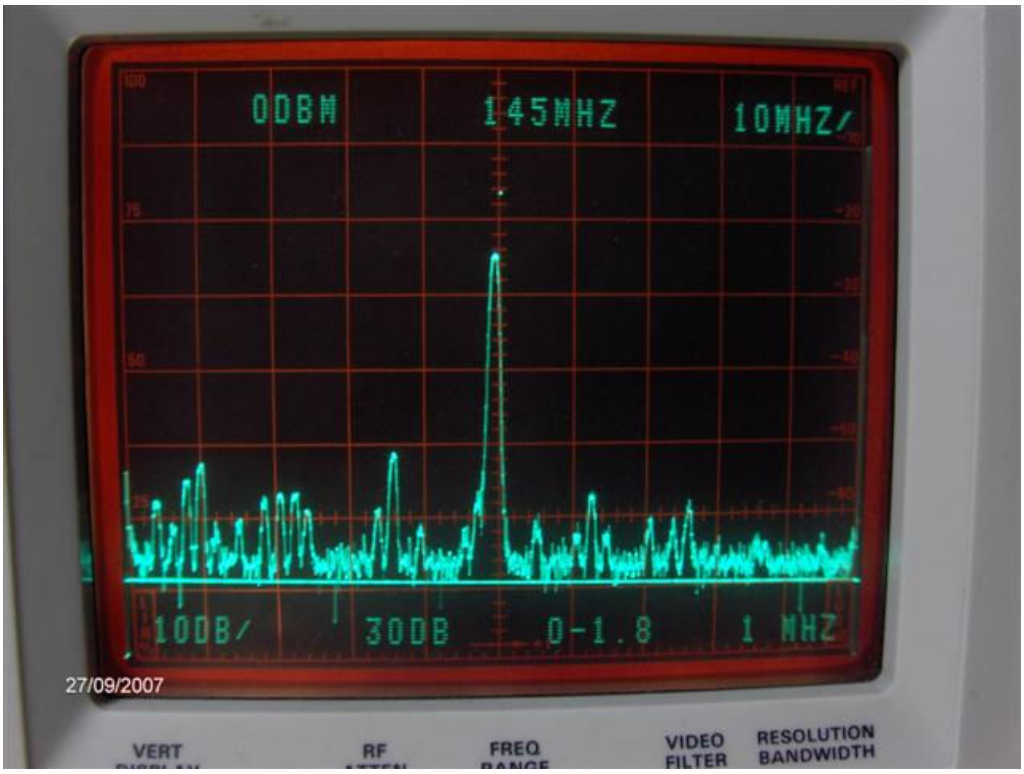
Spectrum analyzer set center frequency set on 820 MHz. This is the frequency of VCO1. VCO1 is fixed on 820 MHz, while VCO is variable. The span of this image is 20 MHz. RF output on 820 MHz is -28dBm.



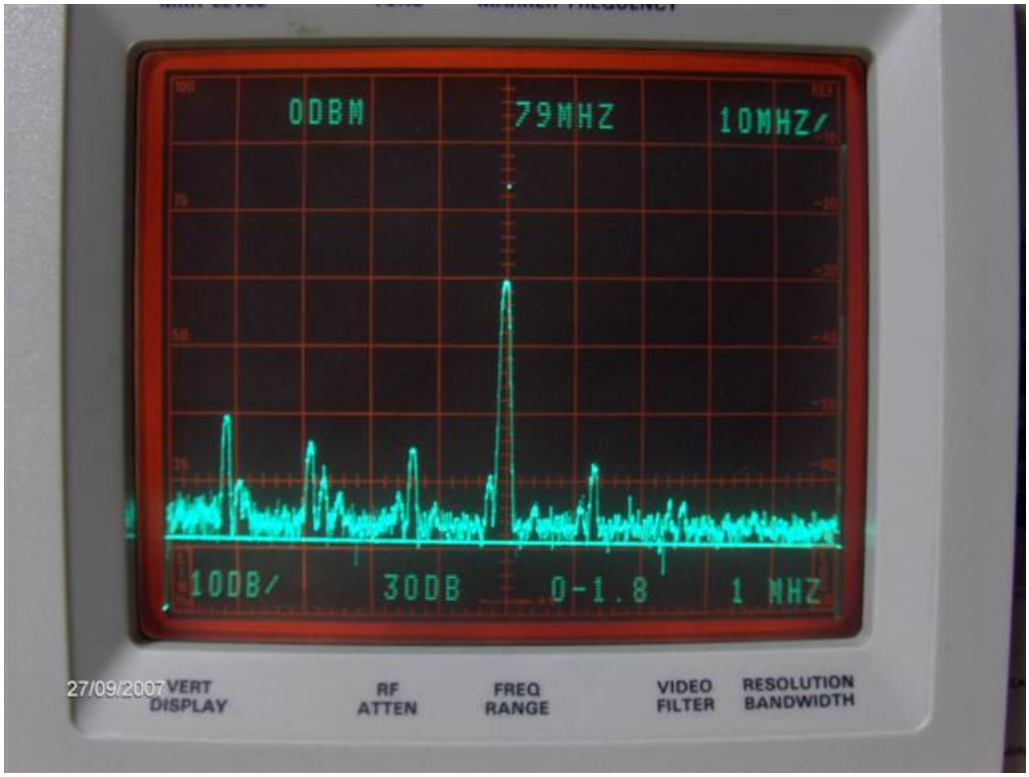
Spectrum analyzer set center frequency set on 967 MHz. This is the frequency of VCO2. Note the RF generator was operating at 967-820=147 MHz. The span of this image is 20 MHz. RF output on 967 MHz is -22 dBm. There are a lot more of side signals on this VCO compared to VCO1.



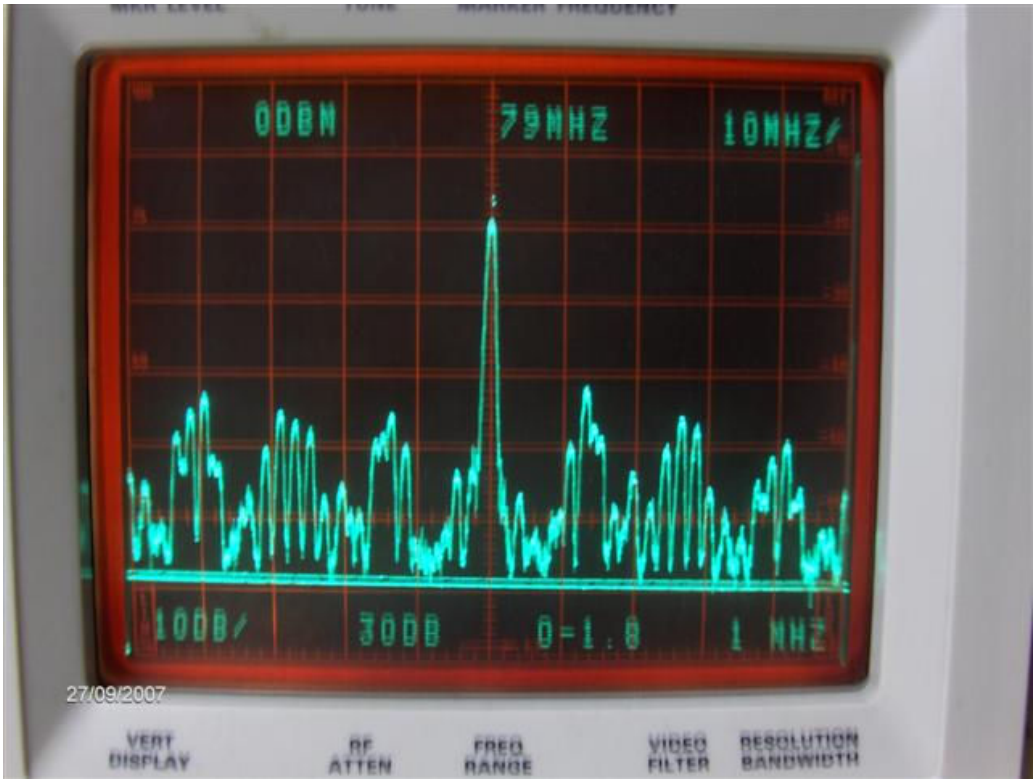
RF generator build by Piet set at 145 MHz. Spectrum analyzer set center frequency set on 145 MHz. The span of this image is 10 MHz. RF output on 145 MHz is -6 dBm. Output frequency is nice and clean. Very good for homebrew equipment.



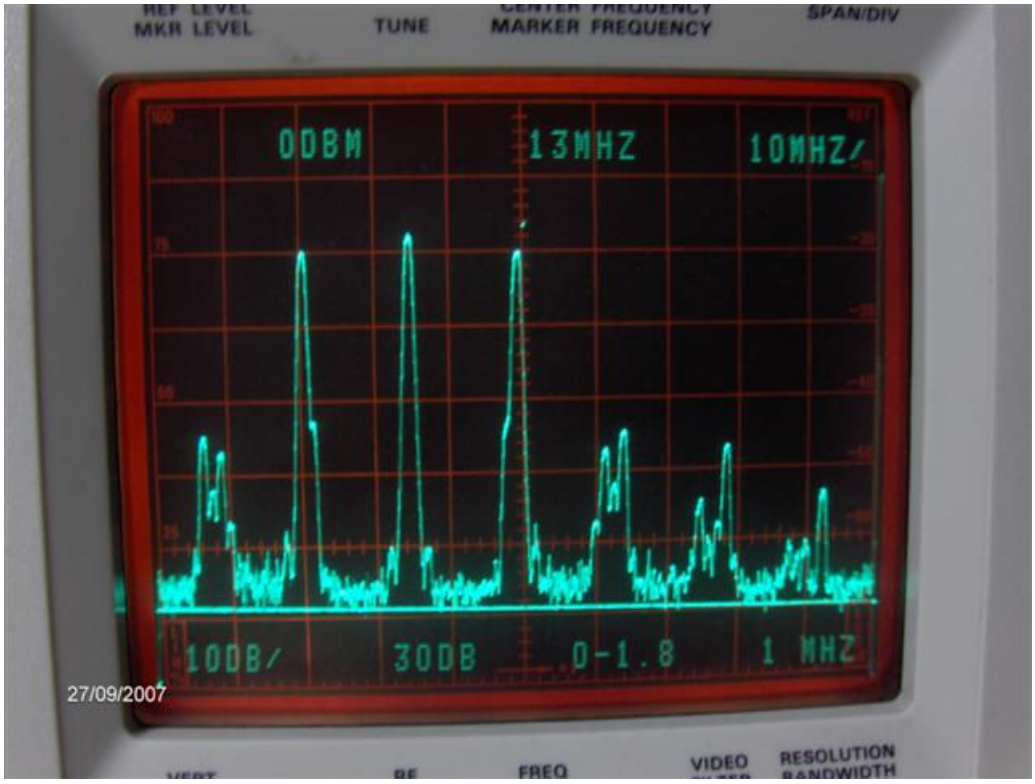
RF generator build by Jesse set at 145 MHz. Spectrum analyzer set center frequency set on 145 MHz. The span of this image is 10 MHz. RF output on 145 MHz is +6 dBm. Note that the RF output on this generator is 12 dB more than on the one by Piet. Not only the center. The sides are also stronger than at Piet's.



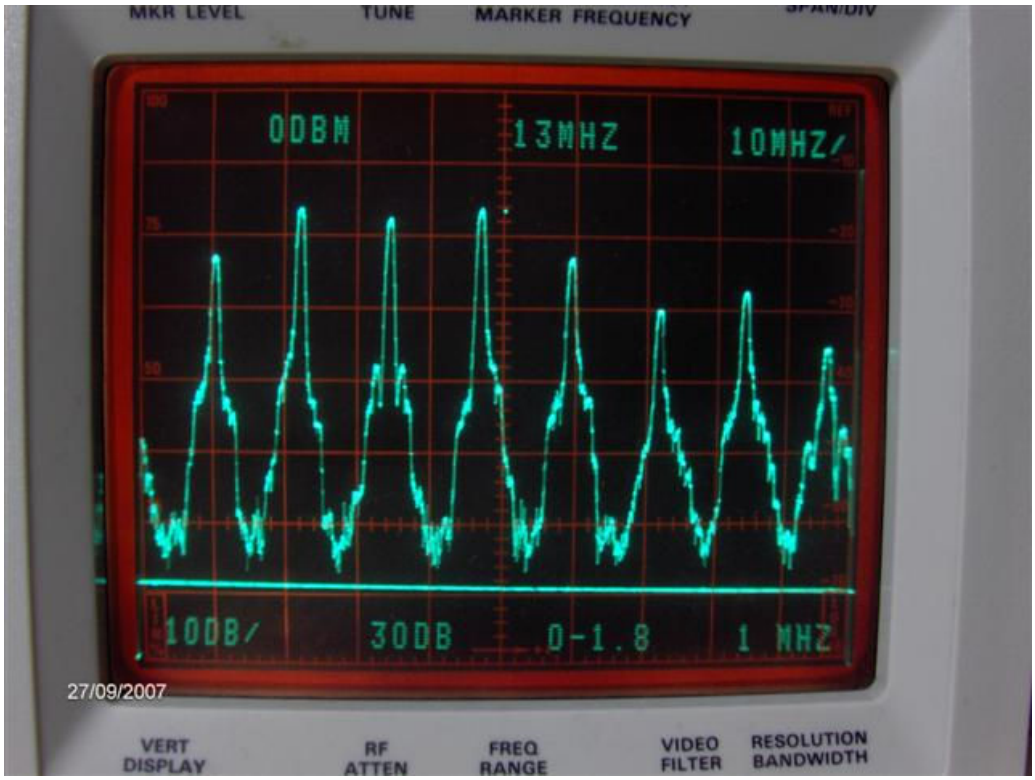
RF generator build by Piet set at 79 MHz. Spectrum analyzer set center frequency set on 79 MHz. The span of this image is 10 MHz. RF output on 79 MHz is 0 dBm. Output frequency has more mirrors. Likely because the smaller difference between VCO1 and 2 frequency.



RF generator build by Jesse set at 79 MHz. Spectrum analyzer set center frequency set on 79 MHz. The span of this image is 10 MHz. RF output on 79 MHz is +12 dBm. Again all RF output on this generator 12 dB more than on the one build by Piet.

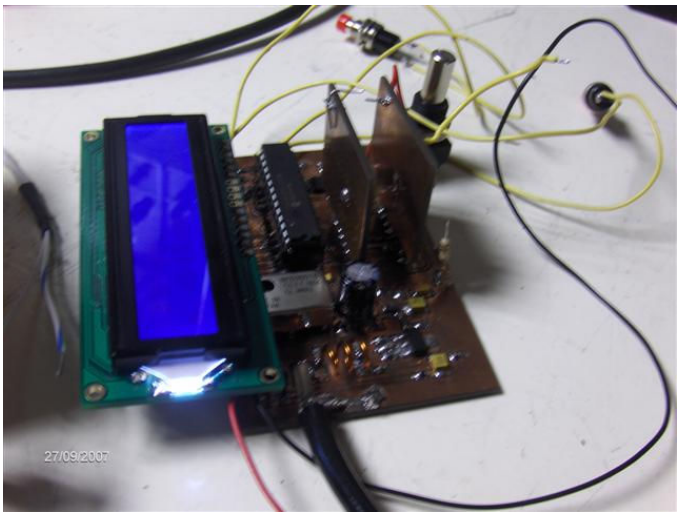


RF generator build by Piet set at approx13 MHz. Spectrum analyzer set center frequency set on 13 MHz. The span of this image is 10 MHz. RF output on 13 MHz is +10 dBm. Output frequency has more mirrors compared to the test on 79 MHz. Likely because the even smaller difference between VCO1 and 2 frequency.



RF generator build by Jesse set at approx13 MHz. Spectrum analyzer set center frequency set on 13 MHz. The span of this image is 10 MHz. RF output on 13 MHz is +14 dBm. Again more mirrors due to lower frequency and higher output compared to the RF generator build by Piet.

Overview RF generator build by Piet



What went wrong:

- Poor solder joint C on VCO board
- One poor VCO module

Results:

- RF generator 0-180 MHz. Won't reach 250 MHz. Display will get darker on load. Output -6 dBM to +10 dBM depending on frequency, clean signal, especially in VHF. On HF mirrors but this is likely to be in the design.

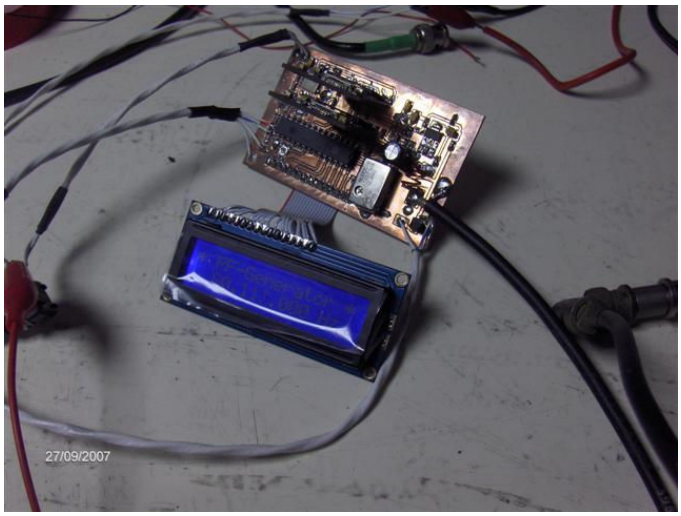
Overview RF generator build by Jesse

What went wrong:

- Short at C6 on main board

Results:

- RF generator 0-190 MHz. Won't reach 250 MHz. Output +6 dBm to +14 dBm depending on frequency, little less clean signal, especially in VHF. On HF mirrors but this is likely to be in the design.



Please take in account that all measurements have been made without a proper RF enclosure around the RF generator. Measurements have been taken with a direct coax cable connector to the spectrum analyzer.

This project is not suitable for as a first electronic project. It is suitable as first electronic kit for people with some soldering experience. Some RF knowledge is useful. Keep all leads as short as possible. Use the via's. Ground is very important in RF circuits. We did enjoy this project and learned a lot from it. It's good fun and easier to build these kind of projects as a club or with a friend.

Best regards,

Piet Ooms
Jesse Kluijfhout