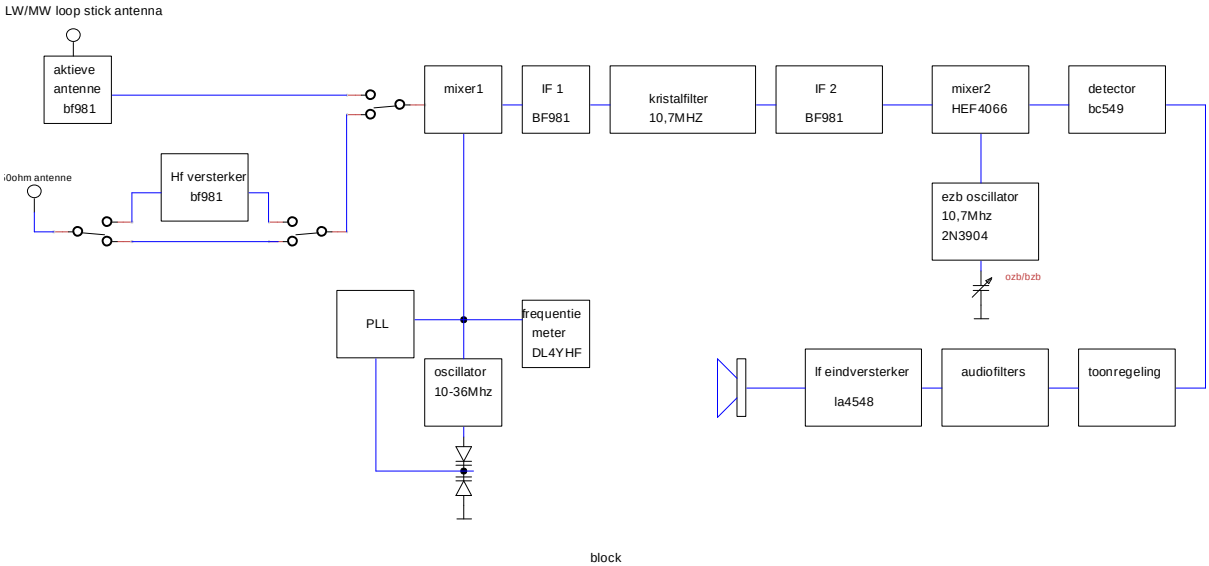
General coverage shortwave receiver. On1mws.

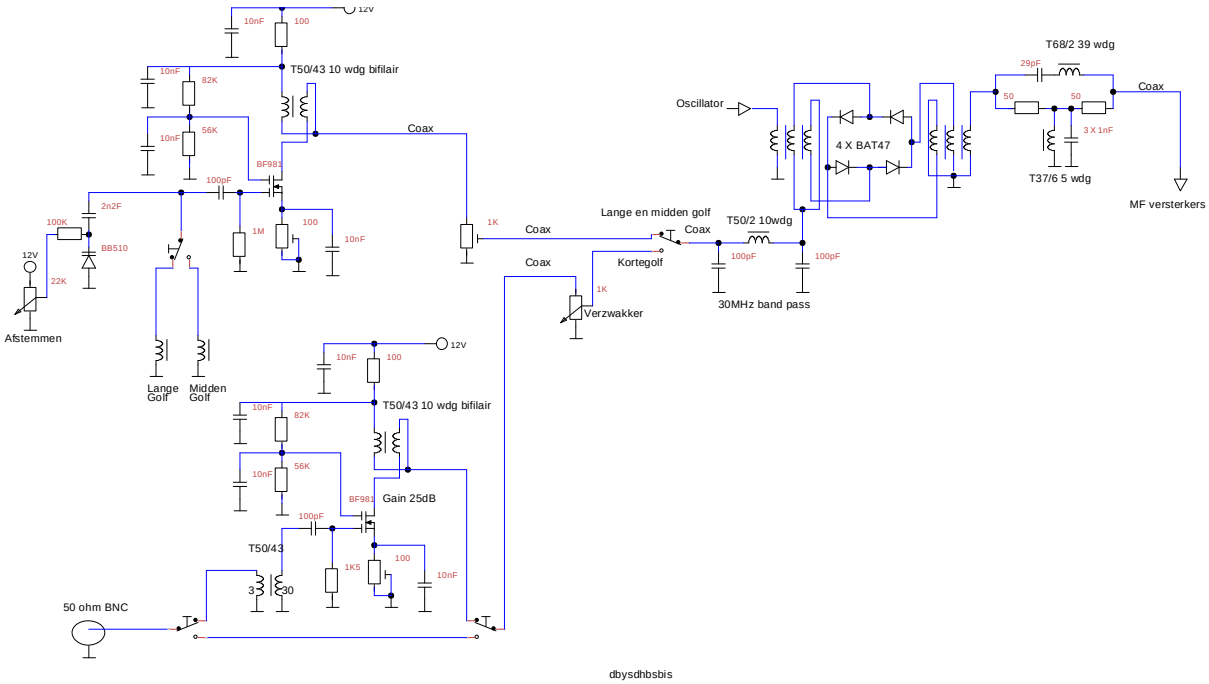
This receiver is a rebuild of my 2015 receiver. That receiver was overly complicated and the S/N ratio was not so good compared to the BITX based stuff I build later on. So the intention was to build a simpler receiver, with a better S/N ratio and maybe even better than the receivers I build based on the BITX schematic. I wanted to keep the BF981s and did some research. I found that the BF981 should reach it incredible Nf of 0,7dB when the gate 2 voltage is 4V and the current is 10mA. I did that, but am not convinced it is better this way.

Well, I partitional succeeded… It is simpler (and easier to use) and has a much better S/N ratio then my 2015 radio. However, It's in the same ballpark as an BITX receiver, but certainty not better.

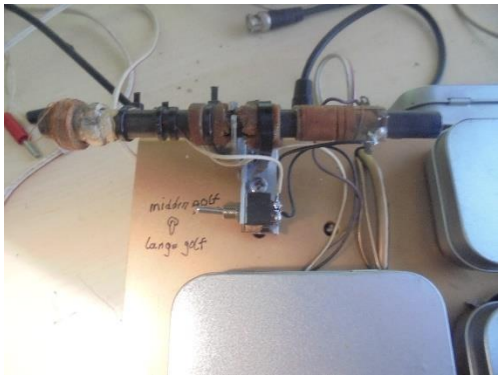


block

Besides short wave, CW and SSB, LW and MW can also be received.



The LW/AM loop stick amplifier is a circuit I build back in 2008. Most of what I do with this receiver is listening to the few remaining LW and MW stations. The HF pre amplifier has a gain of approximal 25dB and adds almost no noise. Strong signals can be received without the amplifier engaged. The mixer is a copy of the mixer circuit in the BiTX receiver.

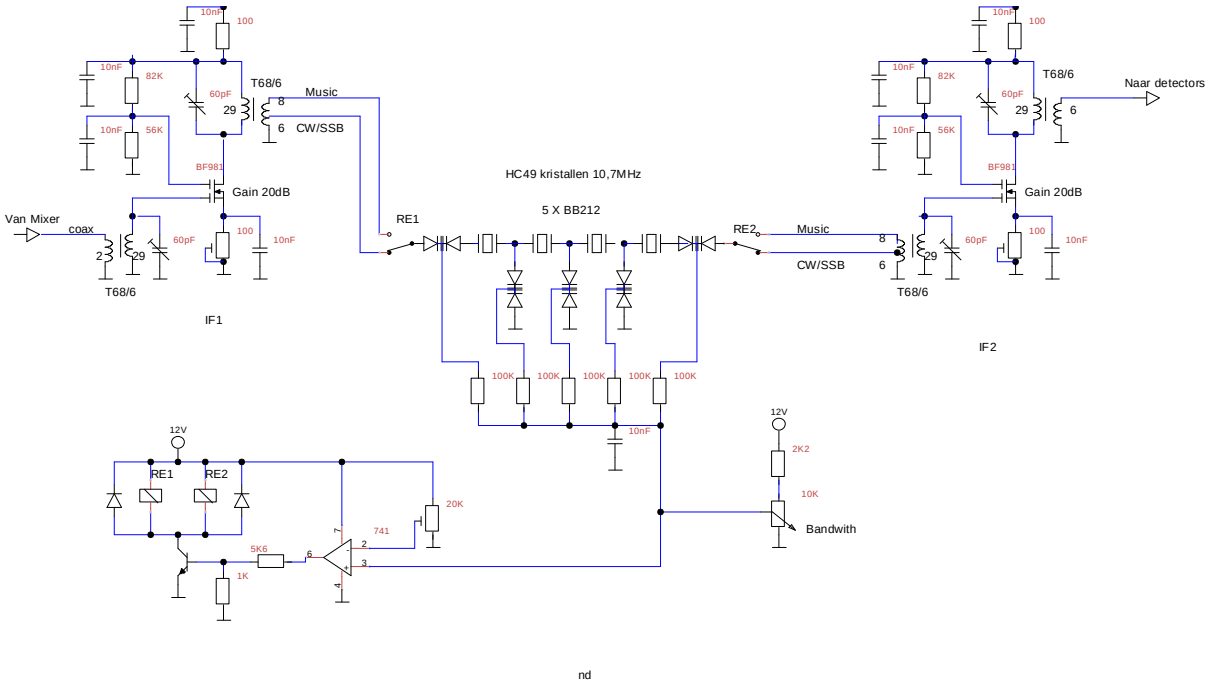


Loop stick.

LW/MW antenna amplifier.

RF preamplifier.

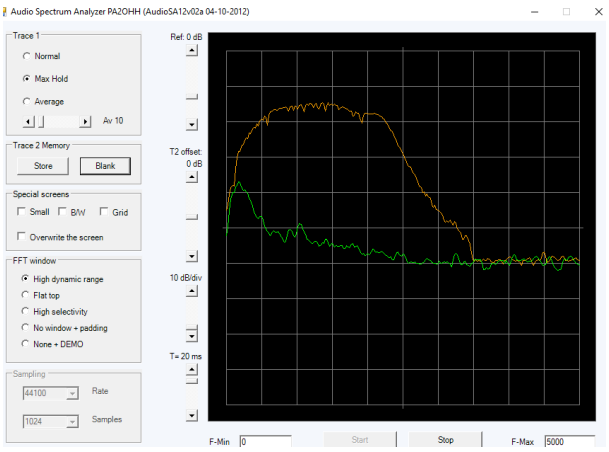
Mixer and IF amplifier 1.



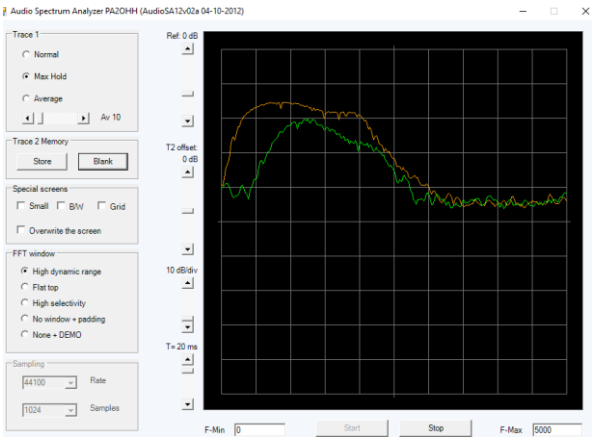
nd

The two IF amplifiers and the tunable crystal filter. The bandwidth is adjusted with five BB212 MW varactors. More capacitance is a narrower bandwidth. To calculate the impedances I used a online calculator, CW should be about 30 Ohm, SSB (2,5kHZ) about 90 Ohm and music in the 450 Ohm ball park. These significant differences poses a serious problem as you tune the crystal filter. The previous receiver possessed a very complicated control circuit and a 3 way switching system with PIN diodes. As the voltage changed, the appropriate impedance was connected.

For this receiver I made a simpler circuit, 2 impedances instead of 3 and relays to switch instead of Pin diodes. One impedance fits SSB/CW and the second one is for music. As the voltage changes over the bandwidth potentiometer a opamp comparator set on about 5V will active or deactivate the relays. Under 5V the crystal filter is connected to 6 turn windings, above 5V, to the 8 turn windings.

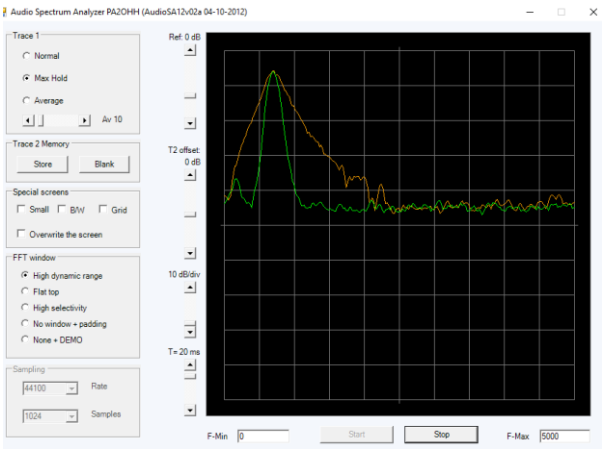


The filter set on 2,5 kHz for listening to SSB. Green is the unwanted sideband.



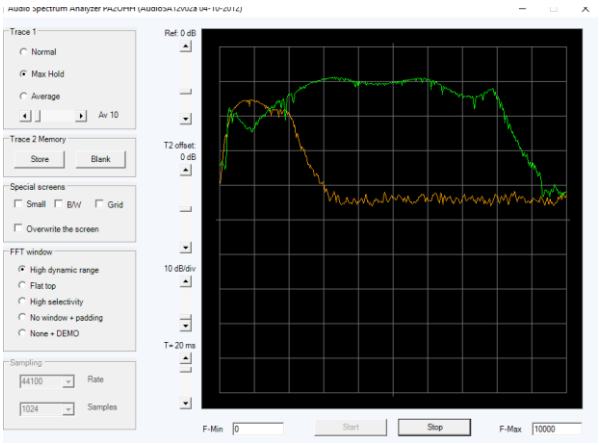
Orange is SSB, green is the filter set on the narrowest bandwidth. Four crystals is clearly to wide for CW. You need probably 6 of them. If the filter is set in the narrowest setting and connected to 4 windings, the bandwidth becomes much better but still to wide for CW.

However CW is no problem… The crystal filter removes the unwanted sideband and the audio filters do the rest.

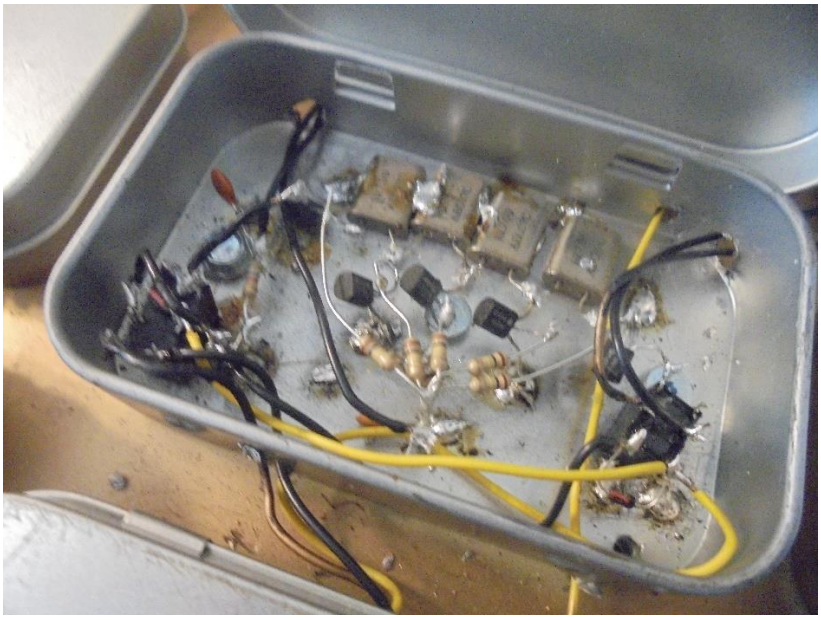


. Bandwidth CW, wide and narrow audio settings.

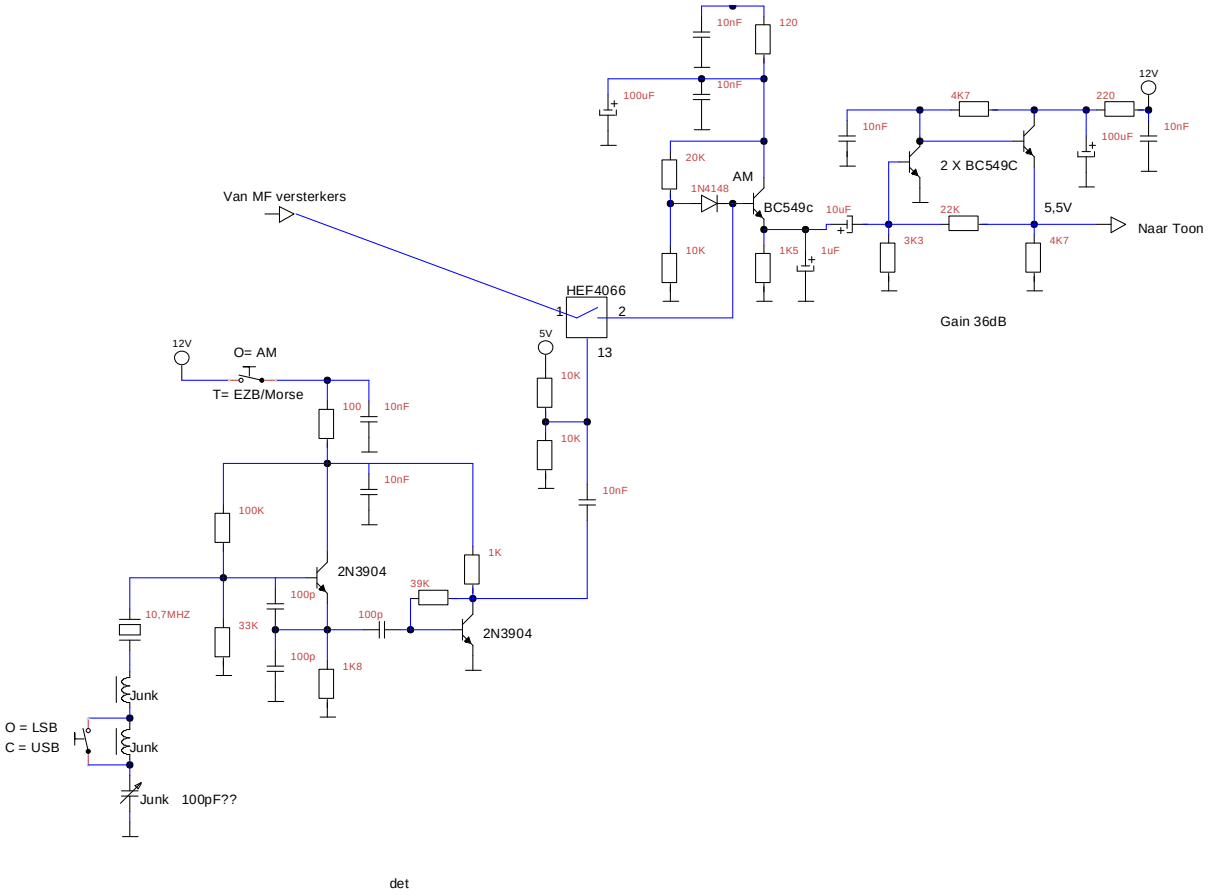
And then there is music….



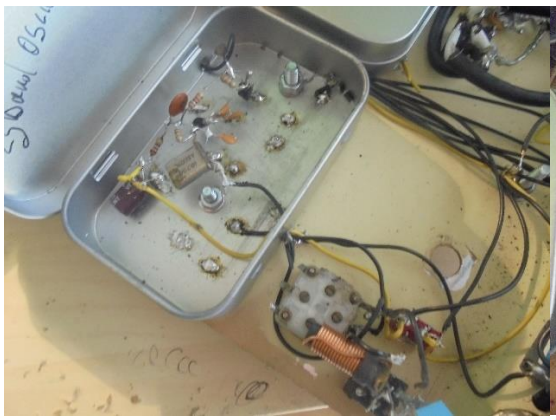
Orange is SSB, green is the crystal filter set on 8kHz for music. It can be set wider but 8kHz is ideal to listen to the last MW stations here in Europe.



Tunable crystal filter.



My 10,7MHZ crystals were very hard to pull from their frequency and I can't give values for the coils. They come from my junk. The capacitor is a plastic one from an old 1980s radio. Over the years I tried many mixer circuits for decoding SSB and CW. I found a simple 4066 digital switch simply the best. It does not care if the input signal is small or large, or the ratio between the input signal and oscillator signal. It always decodes. The circuit does not work with a HCT4066 and should work with a HC4066. The AM detector is a circuit from National semiconductors. Turning off the sideband oscillator makes the set receive AM. The low noise LF pre amplifier is the circuit from the BITX. However, I used low noise BC549s instead of 2n3904s.



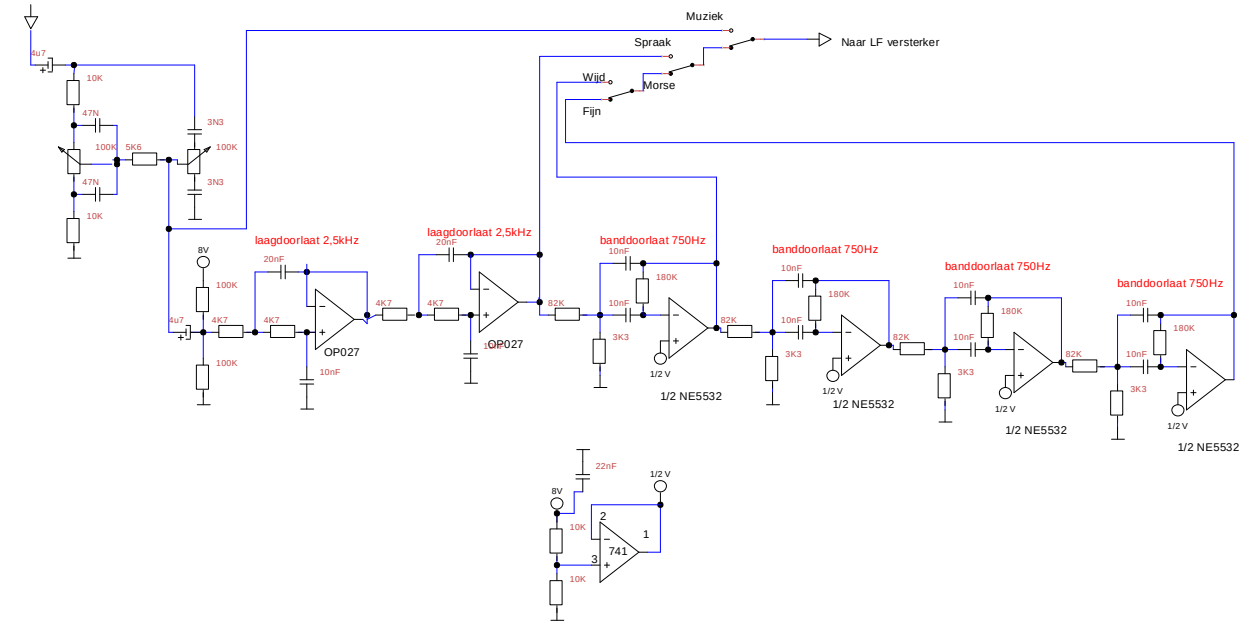
Sideband oscillator.

CW/SSB detector and Am detector.

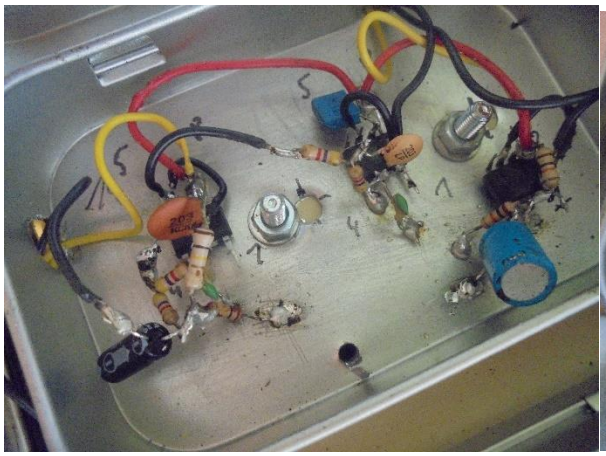
LF pre amplifier.

AUDIOFILTERS 2022

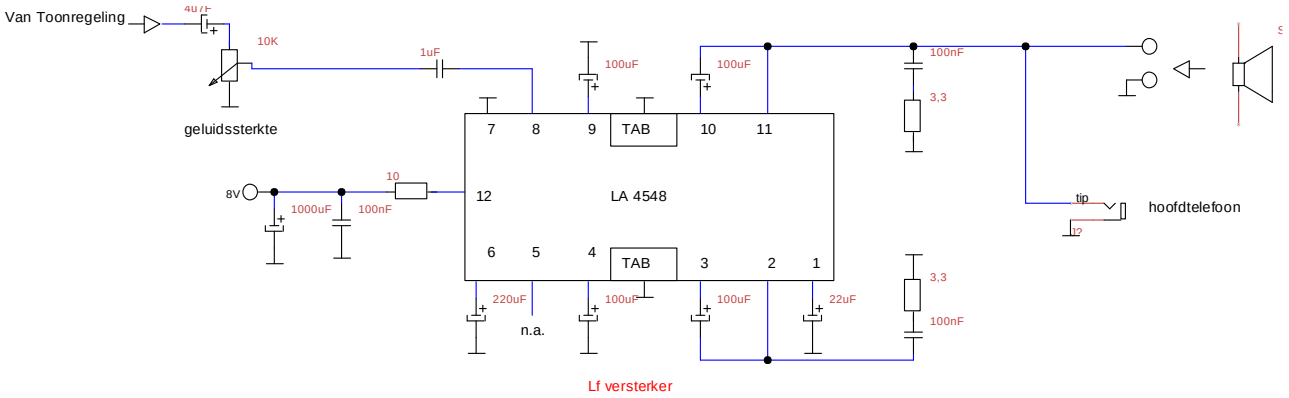
van LF voorversterker



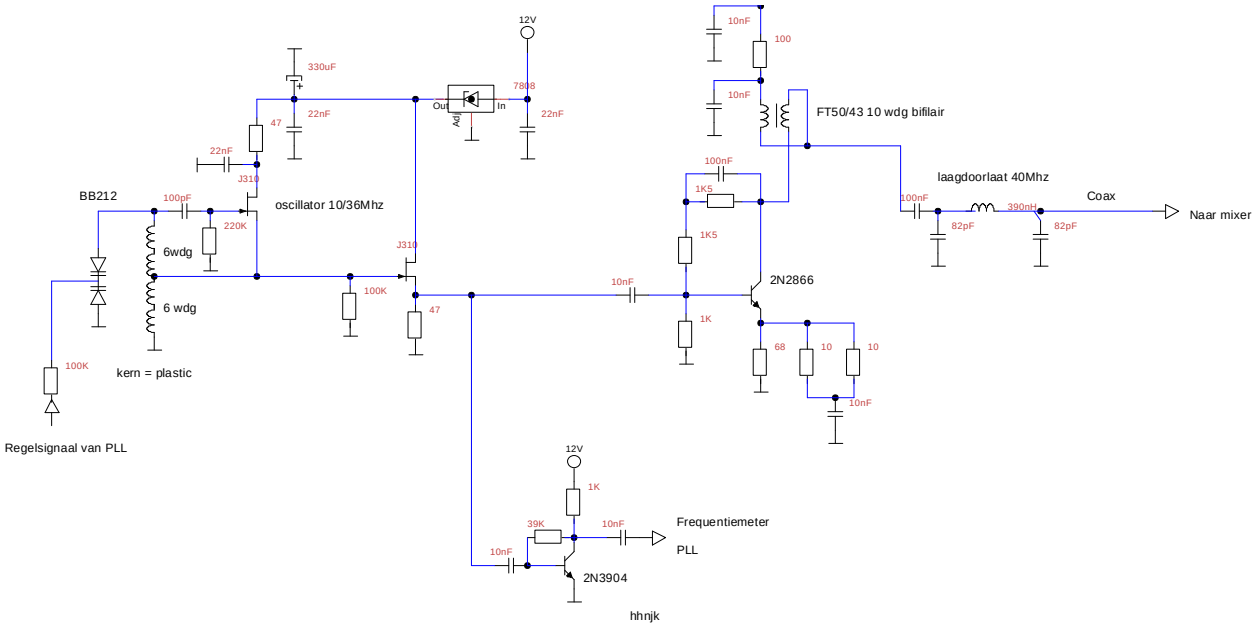
Standard audio filters. The tone control for music is passive to limit extra noise.



CW filters. SSB filters.



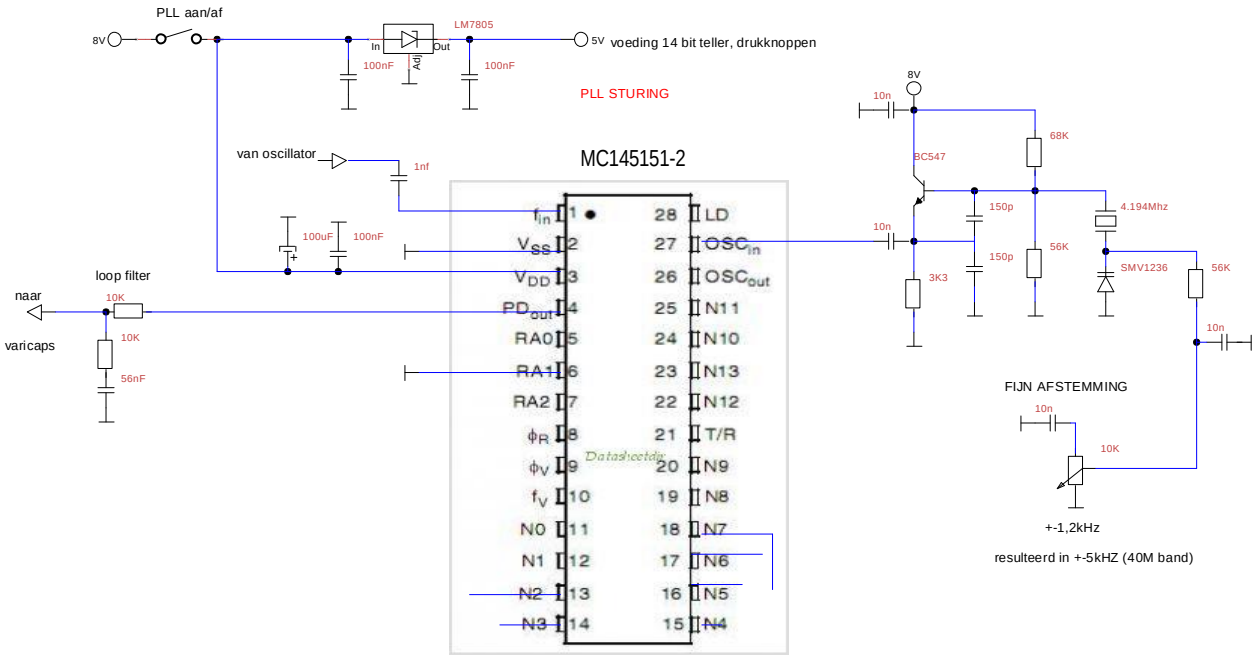
Audio amplifier can easily drive 5 watt in a loudspeaker and is salvaged from an old stereo radio from our local scrapyard.



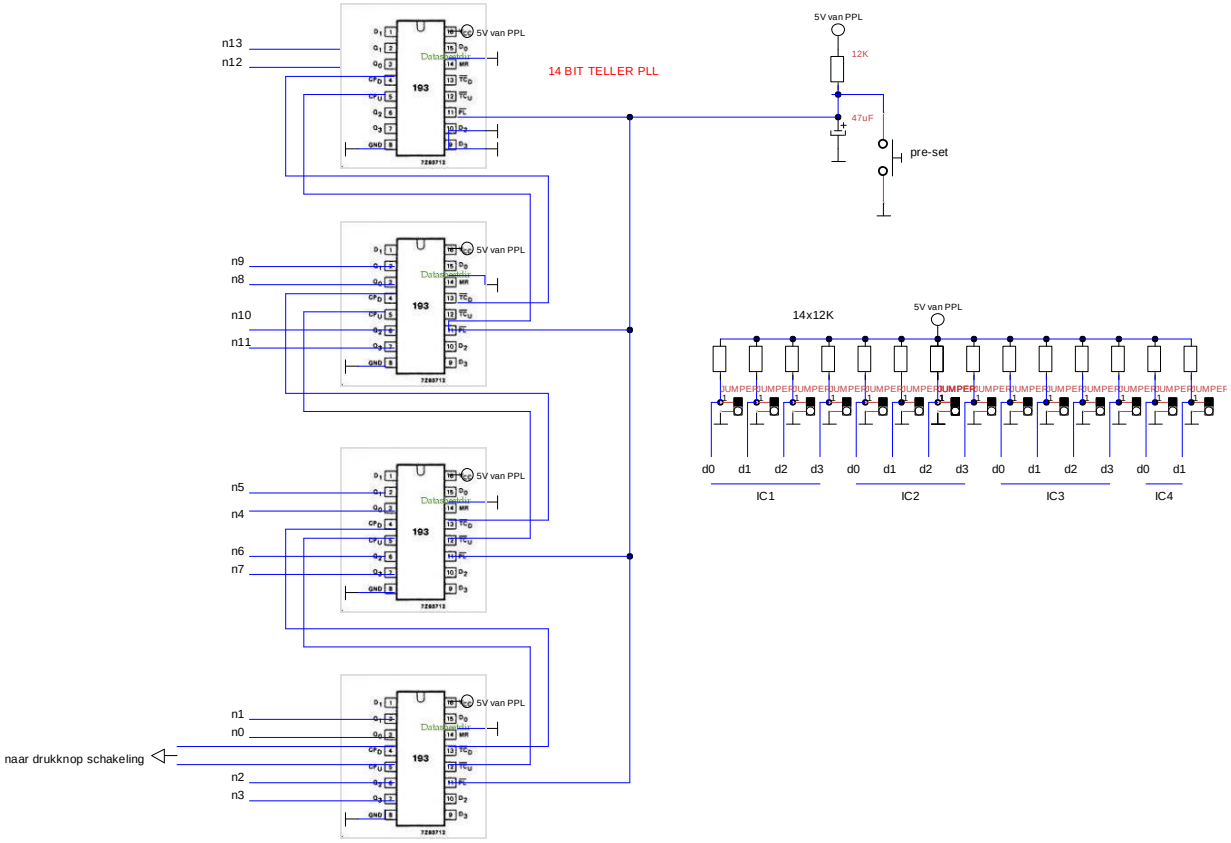
Oscillator.

Oscillator.

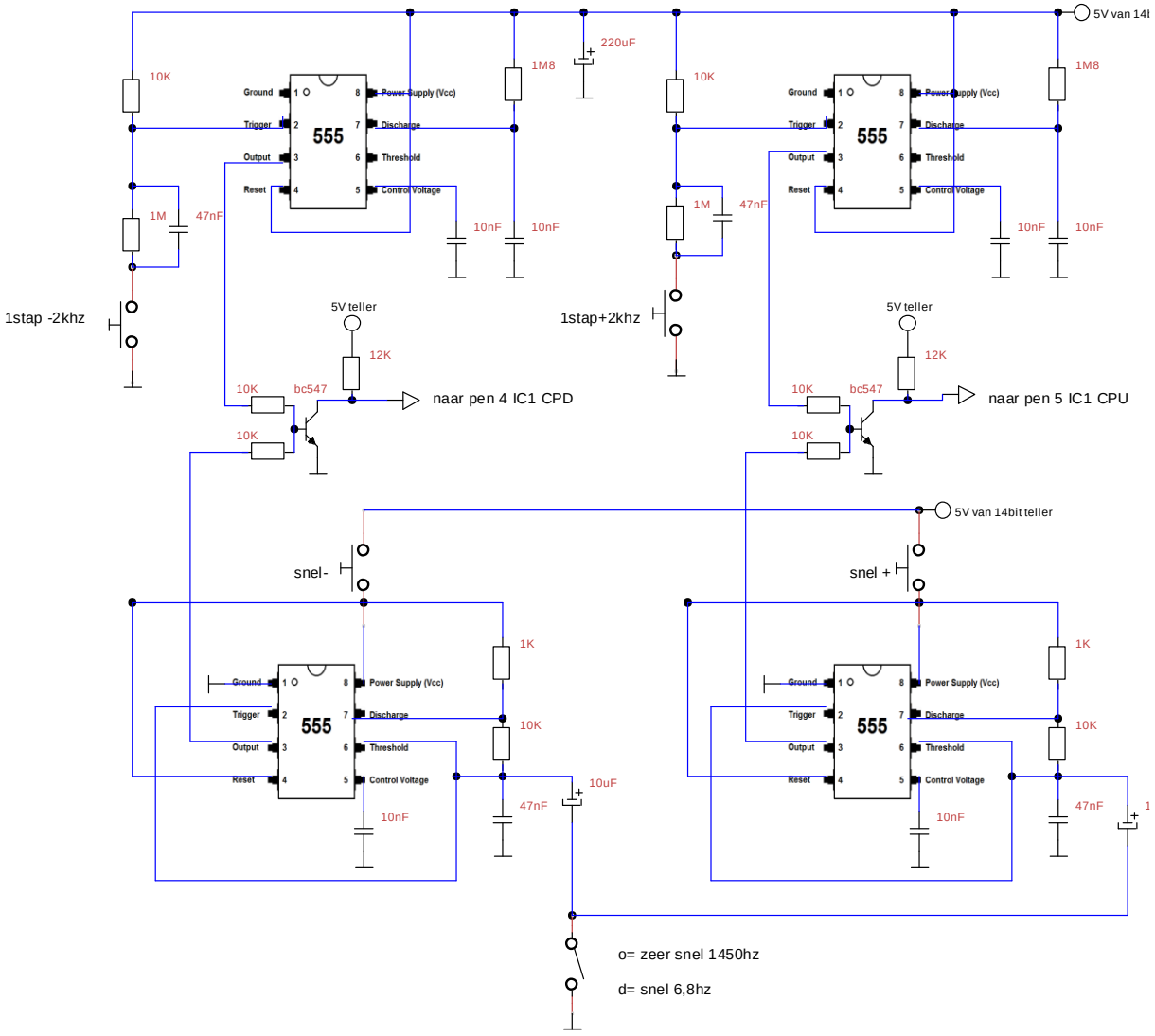
Oscillator buffer amplifier.



Fine tuning with the PLL is done by adjusting the reference frequency of the PLL. First I use the 14 bit counter to tune in as close as possible. The counter takes steps of about 2,1kHZ, the I fine tune by changing the reference frequency. I have no idea what so ever how commercial PLLs fine tune 😊. Also the MC145151 begs for a microprocessor control, but I can't do that either. So my counter and is done with 1970s analog ICs..



drukknop bediening PLL



Oscillator left down, Buffer middle down. The PLL is located in the cigar box, and the 14 bit counter and 555 debouncing circuits on the right. The box was a Belgian chocolate box.