Pa0nhc ARDFrx80
PCB 20180128-16 v.20180130
Properties.

Receiver properties:

- This receiver has a small *build-in*, **balanced** hi-Q ferrite rod antenna, followed by a **balanced** buffer stage, and a **balanced** low noise mixer, then a selective **10.7MHz IF** amplifier with varyable gain.

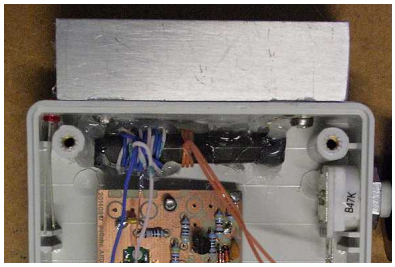
Even with this cheap little 50x8mm ferrite rod, it results in a *sensitive* and clean reception. Its own noise level is below the noise level of a silent 80m band during evening time.

- The design uses modern, **readily available and cheap components,** mostly *wired*. On the top copper are two SMD trimmers. On the bottom copper are two SMD varicaps and two SMD FET's. That is all.

- **Nearly all components can be ordered at "conrad.com", all others at "amidon.de"**. For your convenience Conrad ordering numbers are given in the component list.

- **Standard, ready wound coils from Neosid are used**. Availability is checked, and various coils are given. An extra possebility is, to wind both IF coils yourself on Neosid 7F1S bobins.
Further only the ferrite antenna coil must be wound and adjusted by you. *Simple*.

- A cheap (9 Euro) standard available PLASTIC (ABS) box is used for the housing. A drilling drawing for it is downloadable.
- In its bottom a 125mm x 30mm piece of ALU foil must be glued as "grounded" screening against hand-effect.



– **The small antenna rod is glued *inside* the plastic housing.** A larger ferrite rod can be used too.

– **The sense antenna** can be a short whip, or a short piece of metal tubing, screwed on top of the box. The sense signal strength is adjustable

for an optimal directivity pattern.

- Reception is clean, due to the fully balanced RF stages, the very *selective* high-Q antenna coil, the high IF frequency (10.7MHz) and a selective 10.7 Mhz IF Xtal filter (-80dB @ +- 50kHz).

- Tuning range is from 3.5 to abt. 3.63 MHz. The smooth working gain adjustment has over 90dB control range.

Schematic details.

The battery current is 16-26 mA. The expected alkaline battery life is abt. 10 hours. D4 protects the circuit for wrong battery polarization. The audio stages, balanced RF buffer, and sense amplifier are powered by the unregulated battery supply for maximal dynamic range. The oscillators, tuning- and gain adjustment, IF stages, product detector and BFO are powered by a very stable 5.0 V low drop regulator. The red 3mm "ON" LED darkens when the battery voltage becomes to low for the 5.0V stabilizer, to keep the tuning voltage stable. Due to extensive power filtering and a thoughtful, double sided "radio-communications" PCB design, all stages are parasitic oscillation-free and injection-free.

HF.

For best direction finding properties, the ferrite antenna circuit is balanced and followed by balanced buffers FET102/103, which match the hi-Z antenna (abt. 20 kOhms) to the balanced low-Z input of IC1 (2x 1k5). Resulting in a high Q antenna circuit, maximal signal output and selectivity, even when using this 8x50mm small ferrite rod. To preserve the good properties of mixer IC1, and to prevent "oscillator pulling", IC1 has no gain regulation. The gain regulation in the IF stages is more than enough. Careful design of the tuning components should ensure good tracking between the oscillator circuit and the antenna circuit, resulting in reasonable constant sensitivity over the tuned band segment. *For the local oscillator is a standard 7mm Neosid coil used* to simplify construction

Due to the high IF frequency (10.7MHz) and the high Q of the antenna, mirror reception (17.7 - 17.9 MHz) is very unlikely. I expect no broadcast or airfield communication interference.

IF.

Neosid 7mm coils are becoming scarce. They are still available, but winding yourself on a Neosid 7F1S or 7V1S bobins is an extra possibility.

If the total RF+IF gain is to high or to low, the gain of the audio filter IC2 could be changed, by changing the value of R15 and C34. For instance : 6 dB more gain if R15 = 4k7 and C34 = 220 nF

The "Min. gain" setting by **R24 = 27k** ensures optimal use of the adjustment range of R21.

Excellent IF selectivity (better than 80dB @ +- 50kHz) is obtained by crystal filter F1+F2 and the unloaded IF coils L3 and L6.

For maximal effectiveness, all decoupling capacitors and inductors are chosen for a SRF (series resonance frequency) of about equal to the circuits working frequency. At the output of mixer IC1, capacitor C46 decouples for 10.7 / 14.3 MHz, and capacitor C3 for 3.5MHz.

SMD Fet1 and 4 are modern high steepness dual gate MOS fets, designed for gain regulation. Resistors at their gates2 discourage UHF oscillations. *Standard 7mm Neosid IF coils are used also* to simplify construction. Thanks to the high audio gain in IC2, and the very sensitive (linear) product detector, the IF gain of the two stages is more than enough. Varying the voltage on gates2 of FET1 and 4 result in a very effective and supple gain regulation of over 90dB. D1 generates the *positive* part of the gain regulation voltage (+0.63V), which is current-stabilized by regulator VR1. The total battery current flows through D2, generating the *negative* part of the gain regulation voltage.

Detector and BFO.

The product detector is of the "Infinite Impedance" type. Its simplicity, very high input impedance and low current consumption are the wanted properties. High ohmic R22 sets its working point simply and stable into class B.

>> The injected BFO signal from T1 "biases" this product detector, resulting in high sensitivity and good linearity <<.

The BFO ***must*** be working for good overall sensitivity. To make CW and SSB signals audible, it generates a 10.700MHz carrier (or 10.7015 for LSB, 9.9985 MHz for USB), which is injected into

detector FET5.

TIP : If you only want to demodulate AM signals, then order a 10.670 MHz crystal for BFO crystal Xt. Its frequency then is just outside the total passband, and heterodyne whistling will not occur. But will still be within the resonance curve of L6 for ample injection of BFO signal. If needed, the value of C207 could be changed for optimal sensitivity of detector FET5.

Audio.

IC2 amplifies the audio by 60dB, hard-limits the output to 3Vpp, and narrows the audio pass band to 150Hz / 2.0kHz, improving the signal-to-noise ratio.

Protect your ears from overload.

After finishing the construction and setup, the maximal loudness in the headphone can easily be reduced to your needs, by inserting series resistors between BOTH audio output connections on the PCB, and both connections on the headphone bus. These two resistors also do help keeping out posible RF signals induced on the phone cord, enhancing the accuracy of bearings.

The left and right channels of the phone bus should be connected in parallel.

WARNING: Long-term listening to audio with a loudness of over 85dBspl can cause *definitive* damage to your hearing.

Example :

When listening to a weak signal, an unexpected STRONG signal *will* drive the audio output stage into full saturation, as it will do with your the resonating hairs in the snail house of your ears.

Without R20 the maximal power delivered to a headphone capsule could be up to 30mW (!), resulting possibly in a sound pressure of a deafening 110dBspl (like standing near a starting jet plane).