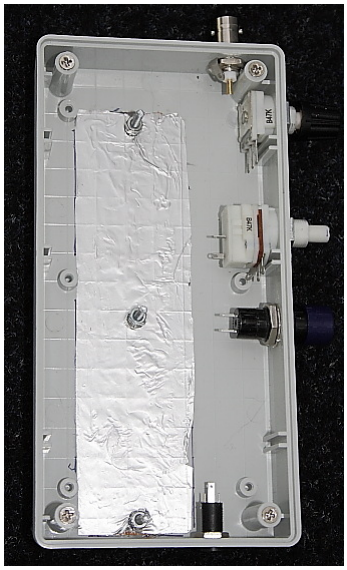
Make it yourself easy.
Order a factory made double sided PCB.

pa0nhc@veron.nl

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.

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 one link and two SMD trimmers. On the bottom copper are three SMD varicaps and two SMD FET's. That is all.

- **Nearly all components can be ordered at "conrad.com", all others at "box73.de"**. For your convenience ordering numbers are given in the component list.

- **Standard, ready wound coils from Neosid are used**. Only the antenna coil must be wound and adjusted by you, and two IF coils modified. *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 in contact with the middle supporting screw, as "grounded" screening against hand-effect.

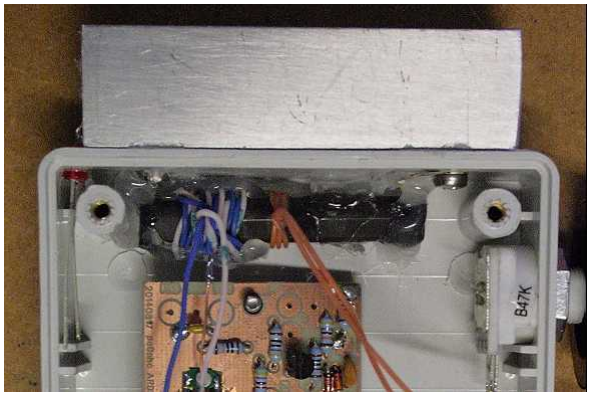
- **The small antenna rod is glued *inside* the plastic housing.** And the sense antenna can be low profile: a short piece of metal tubing, screwed on top of the box, or a 17cm whip antenna.

The sense signal strength is adjustable for an optimal directivity pattern.

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

- Tuning range is from 3.5 to abt. 3.63 MHz. The smooth working (and adaptable) gain adjustment has over 90dB control range, and is adjustable to your needs.

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 are powered by the unregulated battery supply. The oscillators, tuning- and gain adjustment, IF stages, product detector and BFO are powered by a very stable 5.0 V. 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 to the balanced low-Z input of IC1 (3k). 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 and adaptable to your needs. 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.

As the earlier used IF coils are not available anymore, Neosid 5170 10.7MHz IF coils are now used. Their Q is higher, so the maximal IF stage gain is higher.

20171129 : The "Max. gain setting" is set to max. by **R25 = 100 Ohms**.
As total IF gain is higher, the gain of the audio filter IC2 could be reduced by abt. 15 dB **(R15,18 = 22k, en C34,35 = 47 nF).**
The "Min. gain" setting by **R24 = 22k** now 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. The track between crystal filter parts F1 and F2 is relative wide, to create a very small coupling capacitor to mass, which sets the pass band curve of the crystal filter.

SMD Fet1 and 4 are modern high steepness dual gate MOS fets, designed for gain regulation. Ferrite beads in 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.

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, a foil capacitor C46 decouples for 10.7 / 14.3 MHz, and foil capacitor C3 for 3.5MHz. No ceramic capacitors are used here because these are to temperature unstable for this circuit.

Varying the voltage on gates2 of FET1 and 4 results in a very effective and supple gain regulation. 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 or 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.

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 two series resistors between the audio output connections on the PCB, and the connections on the headphone bus. Left and right on the 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 stage fully into saturation, as it will do with your the resonating hears in the snail house of your ears (if no protection is implemented).

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).