

Simple Superheterodyne Receiver for 40m

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This project was born in a time of pandemic, with the consequent difficulty in finding the components necessary to carry out a project, I proceeded in two directions: developing ideas by relying on the things present in the junk drawer and designing circuits that are easy to make.

The circuit diagram shown here is simple: on the far left the front end, whose signal, filtered, is amplified by Q3 and sent to IC1, which constitutes the mixer. This IC was recovered in the drawer and proved its worth by inspite of those who felt it was obsolete. Below, on the left, is the VFO which in superheterodyne devices is called the local oscillator (LO). The circuit is the usual and tested Colpitts followed by a buffer that guarantees excellent stability from the first seconds of starting. The signal emitted by the LO mixes with the one coming from the antenna and there is always only one at 455kHz. This is the value of the average frequency set for which the LO must oscillate between a maximum frequency of 7655kHz ($7200 + 455$) and a minimum of 7455kHz ($7000 + 455$).

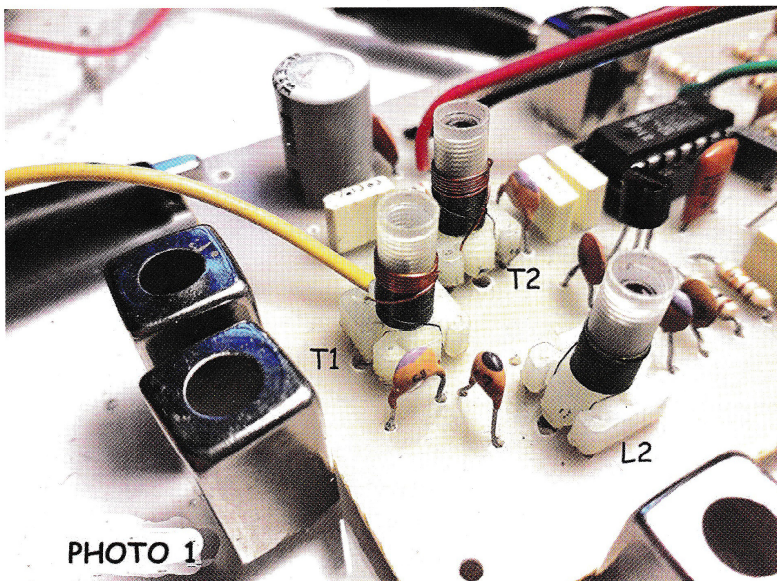
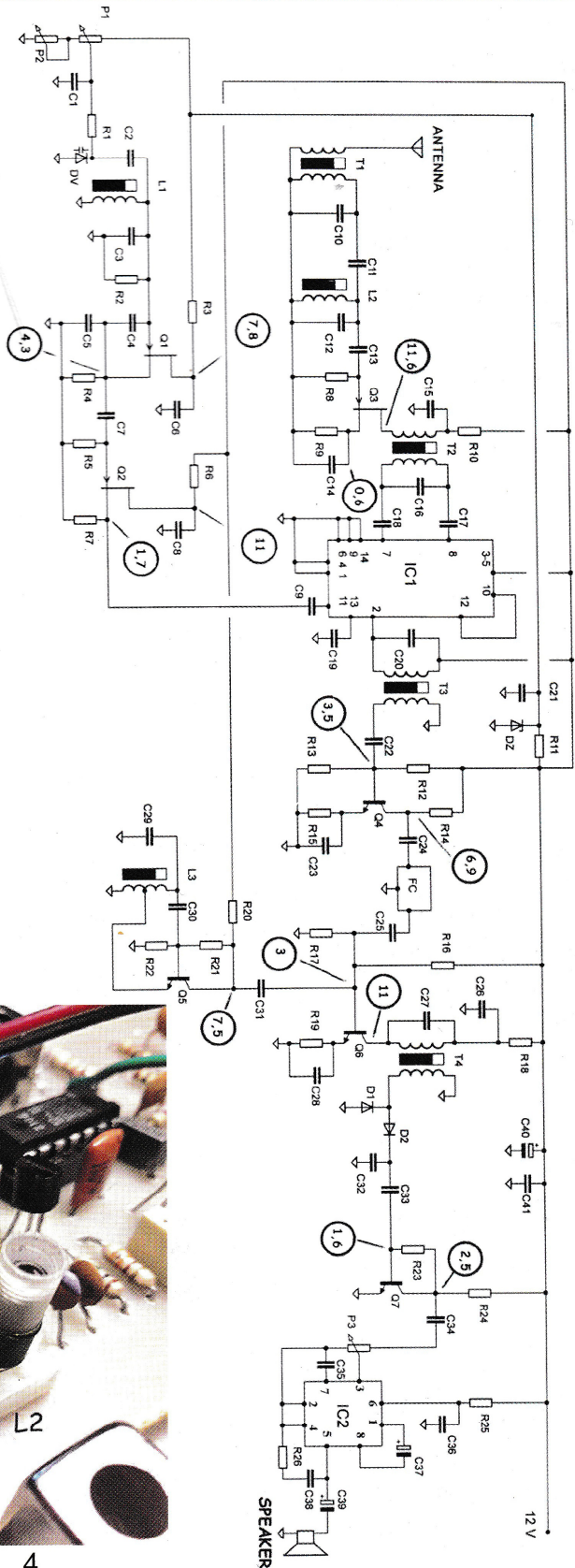
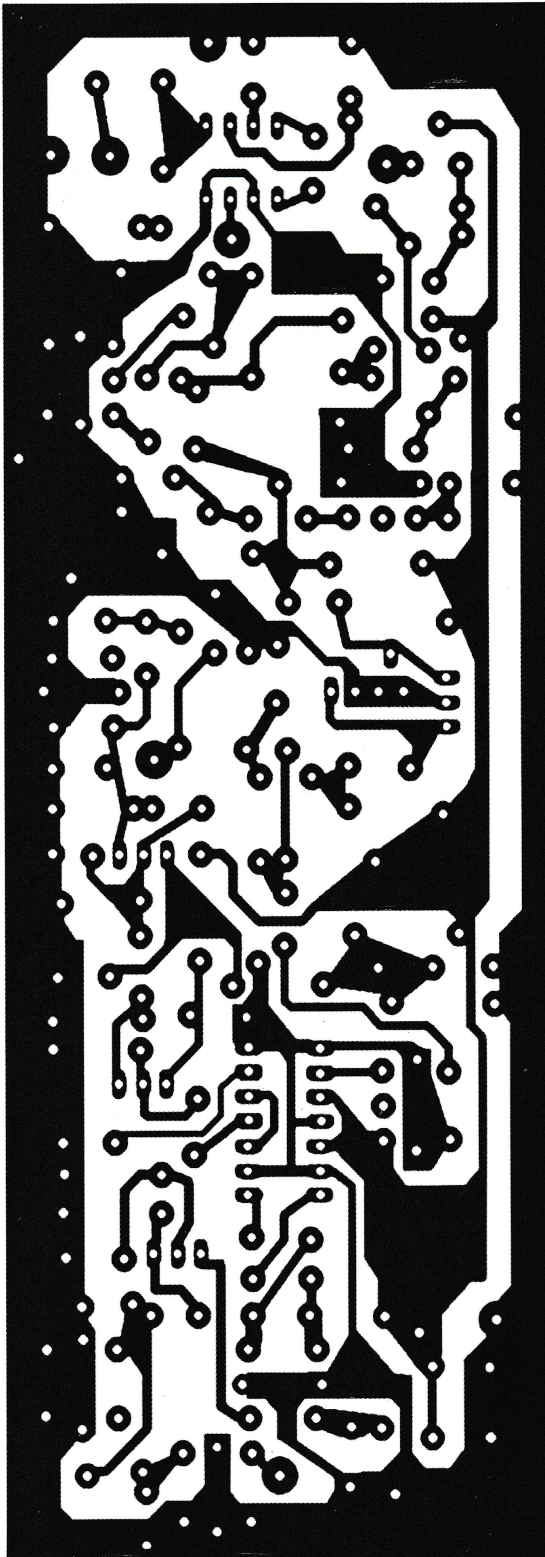


PHOTO 1





The T3 medium frequency coil, calibrated on 455kHz, contributes to this first filtering.

For the medium frequency filter, instead of the desirable quartz crystals that make up a reliable and highly selective ladder, I used a Murata filter of the type CFW 455 with 5 pins, extracted at the time from a cordless telephone. However, I have designed a printed circuit that can also include a very common ceramic filter from Murata with three pins. This possible component in the layout is indicated with hatching.

Finally, a second amplifier-mixer stage follows in which the 455kHz signal mixes, as a product detector, with that generated by the BFO, at the bottom right of the diagram, composed around L3 and configured as a Hartley oscillator.

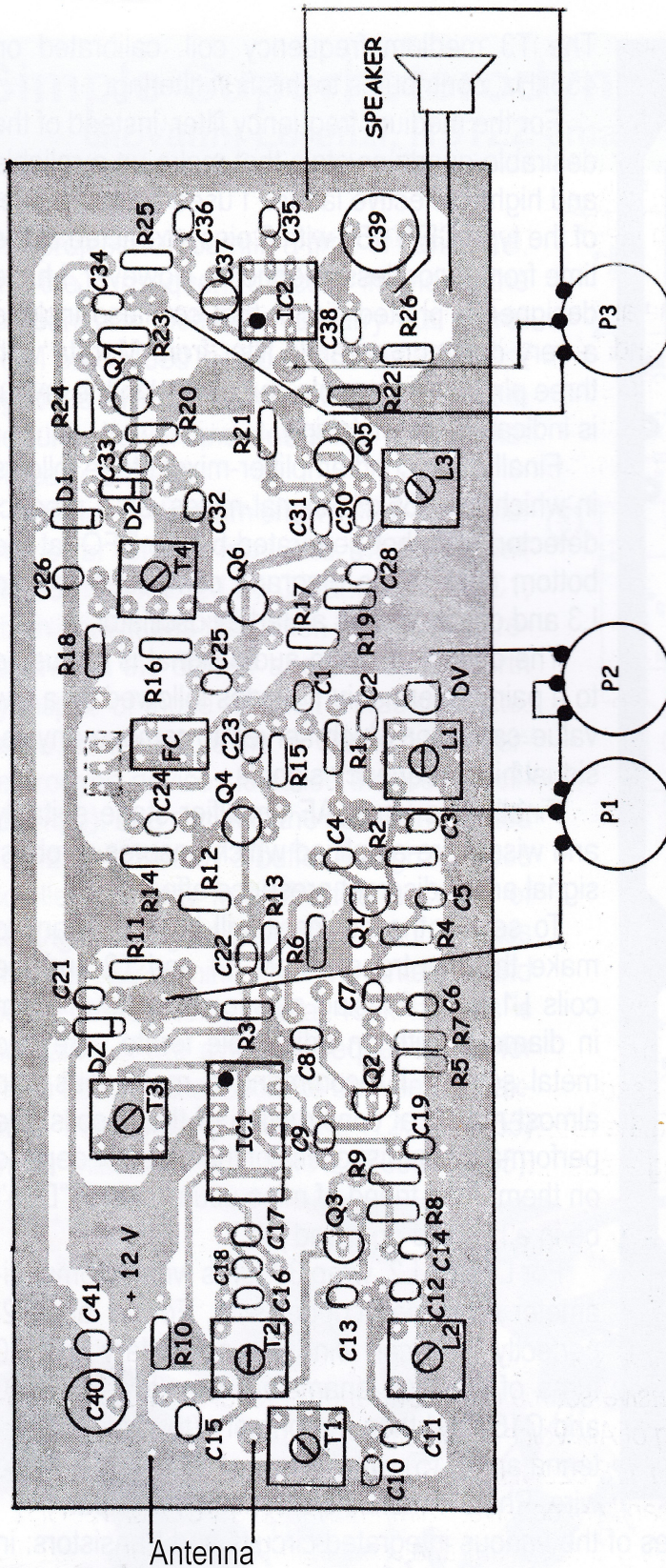
The detection of the audio signal is entrusted to a pair of Germanium diodes followed by a low value capacitor which serves to remove any residual high frequency signals.

Finally, the usual AF amplifier stage suitably and wisely pre-amplified which ensures a robust signal and a discreet presence effect.

To set up the device it will be necessary to make the two transformers T1 and T2 and the coils L1 and L2 using plastic supports of 5mm in diameter with an adjustable ferrite core and metal screen. I recommend a meticulous and almost maniacal construction of these coils: the performance and success of the receiver depend on them. As a friend of mine usually says: "Don't be in a hurry to do a bad job."

For L1 and L2, wrap 30 turns with 0.16mm diameter enameled copper wire. For T1 and T2, perfectly identical, wind the secondary with 30 turns of 0.16mm enameled wire (towards C10 and C16) and then the primary (towards the antenna and C15) with 6 turns of 0.2mm enameled wire. Photo 1 makes the construction clear.

To set up, check the supply voltages of the various integrated circuits and transistors: in figure 1 I have reported the measurements made and which represent a certain indication. In the second time, the LO will be raised to the frequency by turning the cursor of P1 to the maximum and adjusting the core of L1 to read the value of 7655kHz. I remind the reader that the varicap diode returns the value of the minimum capacitance at the maximum voltage and vice versa. With the values of the components indicated in the C2-DV group and the voltage



Components

Resistors

- R1= 22 k Ω
- R2=R5=R8= 1 M Ω
- R3=R6=R10=R18=R25= 100 Ω
- R4=R7=R14=R15= 1 k Ω
- R9= 220 Ω
- R11= 330 Ω
- R12=R16= 10 k Ω
- R13=R20=R24= 4,7 k Ω
- R17= 3,3 k Ω
- R19= 470 Ω
- R21=R22=100 k Ω
- R23= 220 k Ω
- R26= 10 Ω
- P1 = 100 k Ω tuning potentiometer
- P2= 1 k Ω fine tuning potentiometer
- P3= 10 k Ω volume potentiometer

Capacitors

- C1=C14=C23=C28=C34= 10 nF
- C6=C8=C19=C21=C22=C24=C25=C26=C33=C35=C36=C38=C41= 100 nF
- C2=C3=C5=C10=C12=C16=C31= 68 pF
- C4=C7=C11= 27 pF
- C9=C13=C31= 47 pF
- C15= 4,7 nF
- C17=C18= 2,2 nF
- C20-C27-C29= inside T3-L3-T4
- C30= 560 pF
- C32= 120 pF
- C37= 10 μ F Electrolytic
- C39= 470 μ F Electrolytic
- C40= 100 μ F Electrolytic

Semiconductors

- Q1=Q2=Q3= BF245 or similar FET
- Q4=Q5=Q6= 2N2222
- Q7= BC109 or similar
- IC1= SO42P
- IC3= LM386
- DV = BB112 Varicap diode
- DZ = Zener diode 8.2 V

Various

- L1-L2-T1-T2 = see text, T3 = 455kHz medium frequency coil black core
- T4 = L3 = Medium frequency coils 455kHz yellow core, FC = Murata CFW 455kHz ceramic filter (see text)

of 0-8.2 V there will be a range of capacitances from about 40 to 80 pF.

Subsequently, bring the cursor of P1 to zero to verify that the oscillator covers the frequency of 7455kHz, which guarantees the reception of the lower limit of the 40 m range. To test the BFO beat oscillator it will be sufficient to listen to the generated signal, rotating the core of L3, with the aid of a continuous coverage receiver tuned to 455kHz. With the same receiver you can monitor the signal emitted by the LO by inserting a piece of wire with antenna function in pin 11 of IC1.

At this point, connect a good antenna and adjust T1, T2 and L2 to receive maximum signal with minimum noise. Slowly adjust T3 and T4 to achieve the ultimate. Receiving the CW will not entail any difficulties whatsoever; instead, for the SSB, adjust the L3 core as specified above, once and for all, until the modulation is clear. In both reception modes, the P2 potentiometer will allow a fine tuning to better center the signal.

My prototype extends the reception capacity up to 7500kHz by at least partially including the adjacent broadcasting band of 41m. As usual, I didn't want to exclude my BCL soul, which is alive in my heart along with the radio one.

The project is complete with printed circuit board (fig. 2), real dimensions 16.3x6 cm, layout of the components (fig. 3) and a photograph that will guide you in the realization. Three Youtube videos will give an idea of the receiver's performance:

CW reception: <https://youtu.be/SszDpd08ijl>

SSB reception: <https://youtu.be/mf0QuTqS2JQ>

AM reception: <https://youtu.be/uolca3kCQnQ>

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