Simple Superheterodyne Receiver for 40m

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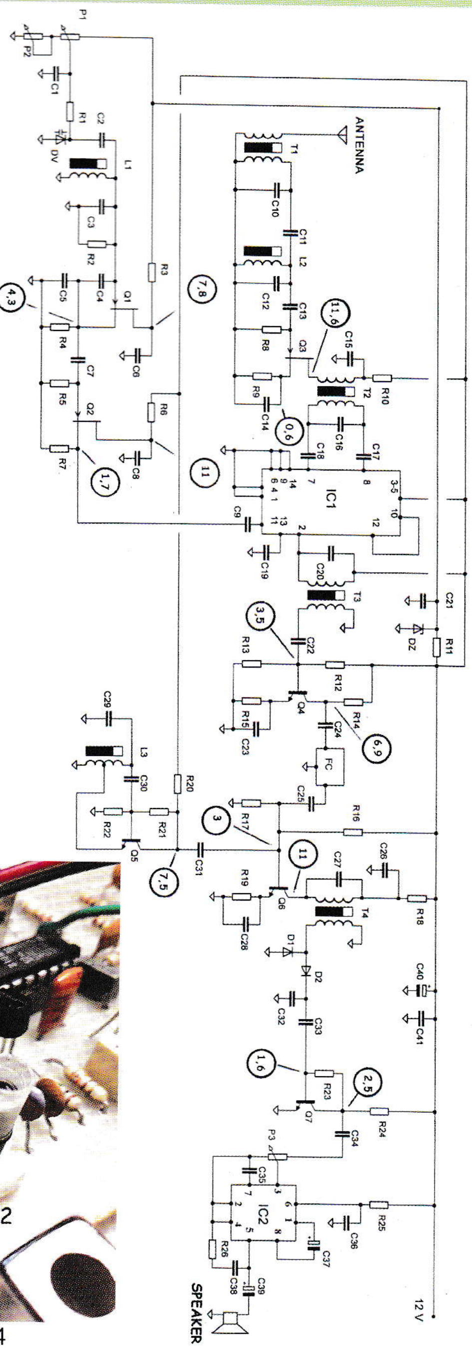


This project was born in a time of pandemic, with the consequent difficulty in finding the components necessary to carry out a project, I proceeded in two directions: developing ideas by relying on the things present in the junk drawer and designing circuits that are easy to make.

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).

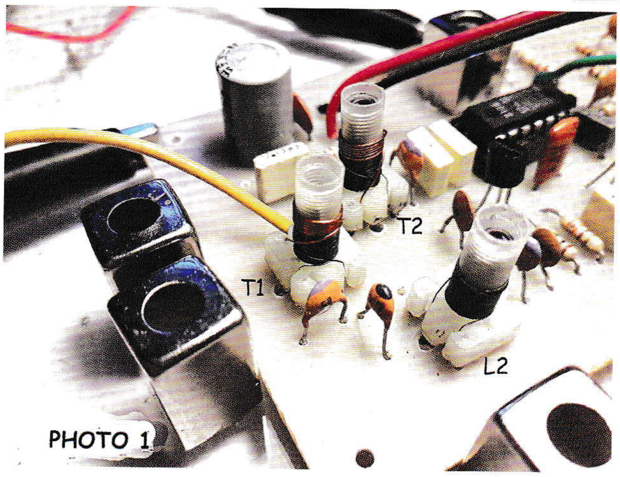
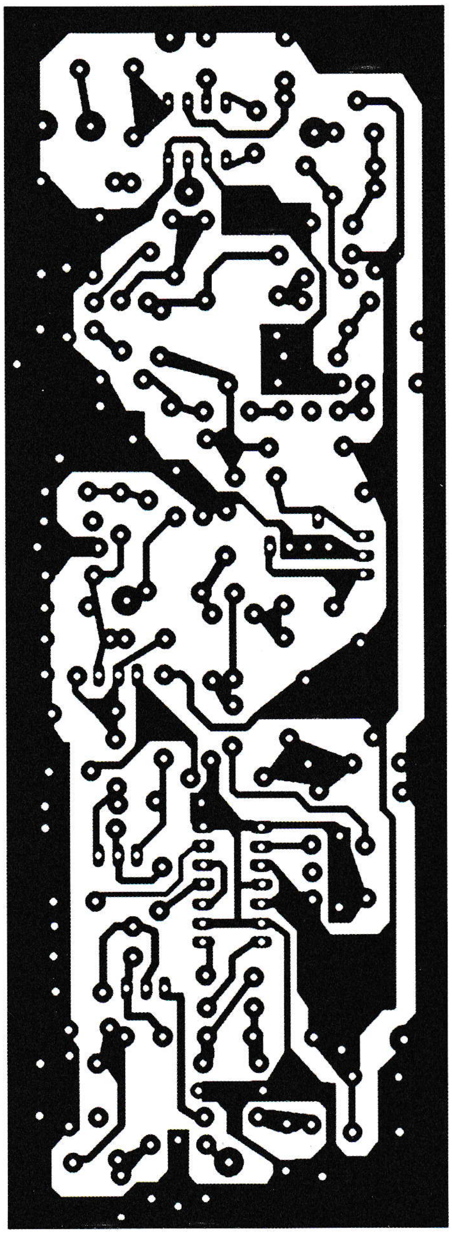


PHOTO 1



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.

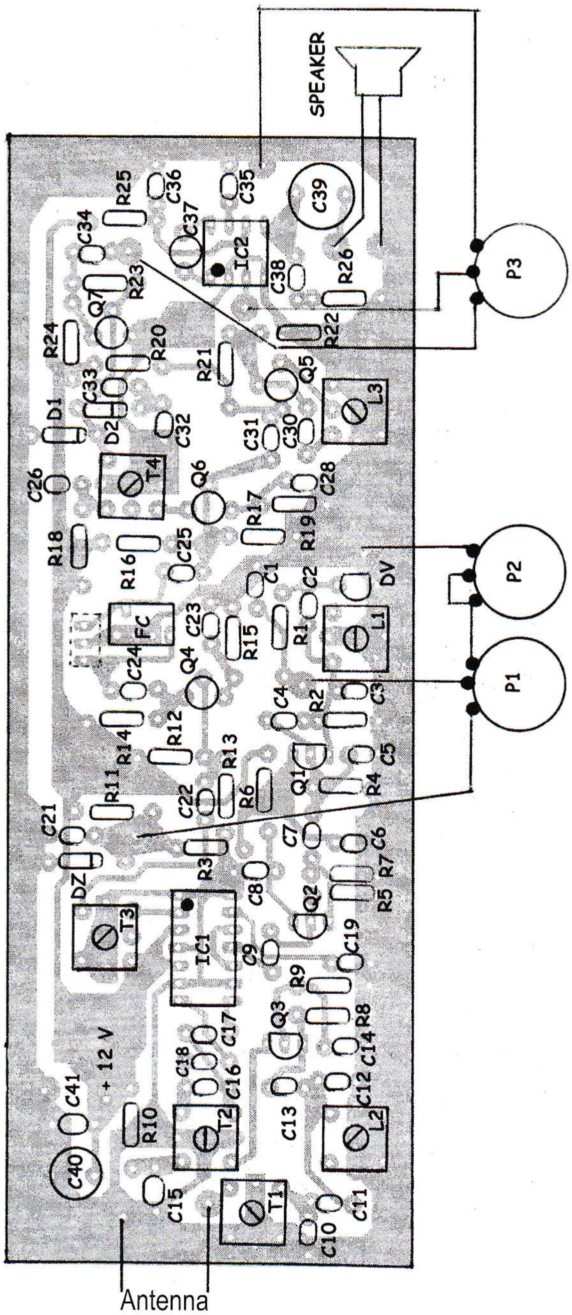
The detection of the audio signal is entrusted to a pair of Germanium diodes followed by a low value capacitor which serves to remove any residual high frequency signals.

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 µF Electrolytic
C39= 470 µF Electrolytic
C40= 100 µF 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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30THz Project – DX Record Increased

Remi M0LRH, Hieronim M7HBL

Further to the 30THz project that appeared on pages 4–6 of *SPRAT* issue 193, I recently increased the distance between Tx-Rx to 109m. I also updated the receiver - it is "fully digital" with direct 24-bit sampling – see the recent video below:

https://www.youtube.com/watch?v=Coo5u3XPHcs

My plans for this year include the following:

- *Basic experiments at 70THz - QRP, opposite to 30THz, both transmitter and receiver will be narrowband - I just found the inexpensive source of narrowband filters for 70THz. Additionally, the 70THz band may allow using of AM voice modulation.*
- *I plan to explore frequencies between 118-320GHz. Very low power, less than 1mW; unfortunately, Si Ge technology is unpleasantly expensive. I already started a VCO for 120GHz*
- *I am exploring the possibility of building a spectrum analyser 10-100THz - sounds exotic, but with optical techniques, it looks realistic. (it is a difficult 3D printed project but likely very affordable - estimated cost in the range of £30+)*
- *I also plan some exotic experiments in Exahertz (EHz)*

I will keep you informed about my progress.

73, Remi M0LRH