

## Short Wave receiver

### Introduction

The receiver presented here is meant to make a variety of shortwave signals audible. In the first place designed for reception of strong broadcast signals; reception of weaker continuous wave (CW) and single side band (SSB) is certainly possible after adding a simple Beat Frequency Oscillator (BFO).

The receive frequency range stretches from approximately 4.5 till 11 MHz. For sure, this design is homebrew-friendly.

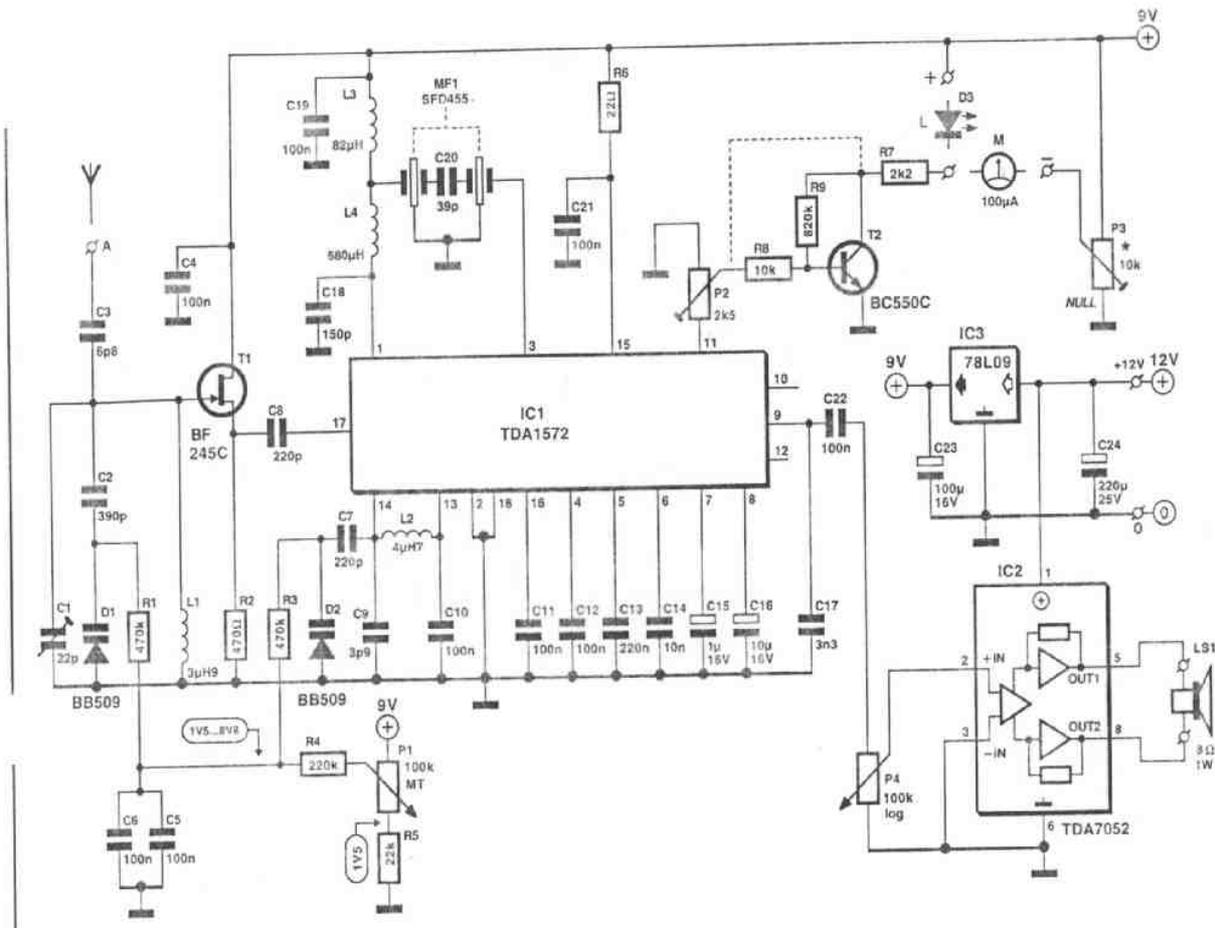
Please find below a picture of the receiver with on top a homebrew frequency counter.



Photo 1 Frontview SW receiver

### Description, circuit and details

This receiver has been designed around a splendid IC, the TDA1572 available for less than 5 euros (1.5 British Pounds). This IC has been designed for car radios. This component incorporates all the circuits required to manufacture a complete receiver: HF-preamplifier, mixer, oscillator, MF-amplifier, AM-detector and even a driver circuit for a signal strength meter.



Circuit diagram 1 SW receiver for 4.5 - 11 MHz

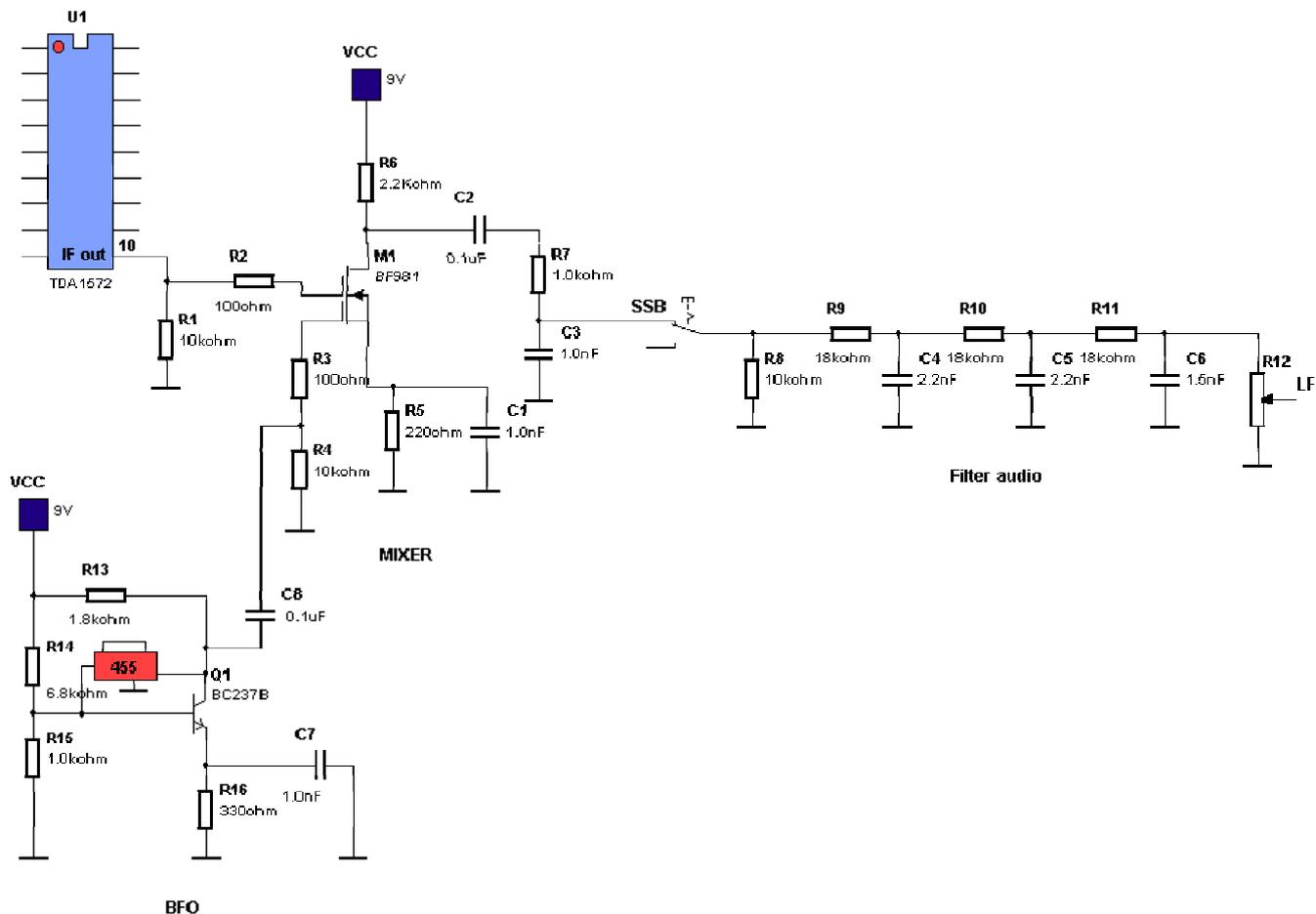
The design is derived from a circuit published in the October 1999 issue of the magazine *Elektuur*. After building the circuit it just worked! The circuit was built using the "dead bug" method (so not etched PCBs). As told, the frequency range stretches from appr. 4.5 till 11 MHz; the on-board oscillator appears to work with a simple (pre-wound) coil of 4.7 mH (between pin 13 and 14 of the TDA1572), a 10 pF capacitor and a varicap (BB509). A frequency band selector (various LC combinations) is not necessary to cover the whole frequency range. Good design! From pin 12 is, via a BC549, the oscillator signal available for frequency measurements. I have thought of a digital frequency presentation but decided not to do so because of the lack of space available inside the box and the additional heat radiation that comes with it. However, an analogue readout has been incorporated (old junkbox meter with calibrated scale connected to the tuning voltage. Unfortunately not visible on the picture, but I can assure that the meter is present behind the small dark window in the right hand upper corner).

To keep the device as simple as possible an intermediate frequency (IF) of 455 KHz was selected. A simple Murata filter (SFD455 with 6 KHz bandwidth) selects the 6 KHz wide band around the 455 KHz IF.

In fact, 455 KHz is too low to be a good IF (with respected to the relatively high frequencies received). Reason for this is the fact that mirrorfrequencies can spoil the receiving proces (definition of mirrorfrequency: 2 times the IF higher than the signal received. Example; oscillator works on 7.0 MHz; reception signals both 6.545 and 7.455 MHz, when using an IF of 455 KHz). To be honest I did not experience too much discomfort, but serious measurements and comparisons with profi equipment will certainly prove the presence of mirrors.

A multiple turn potentiometer of 50 KW is used to obtain easy tuning. The multiple version is an absolute must. Tuning with a regular potentiometer is not possible!

To facilitate the reception of CW and SSB signals, a product detector has been added (BF981 MOSFET). Inside this detector the IF signal of 455 KHz (pin 10 of the TDA1572) and the BFO signal are mixed. The BFO is made with a BC237B and an 455 KHz filter. The output signal of the product detector is presented via an LF filter to the LF amplifier. For this purpose a TDA7052 from Philips was selected, capable of delivering 1 W audio output power. (Not too much ? Ever heard 1 real Watt? No? You should try!). Please find below the set up of the product detector.



Circuit 2 BFO and product detector

I have been able to receive weak SSB and CW signals between 7000 and 7100 KHz. Patience and care are required to be able to decode the weak SSB signals from this ham radio band. Some skill will do no harm!

An adventitious circumstance is the presence of a fine Automatic Gain Control (AGC). Provided the antennesignal is not too weak, the receiver will always be controlled to its optimum (which is not always the maximum) HF gain enabling the reception of the weaker stations.

The receiver has been enclosed into a tight but neat housing of Canadian origin; originally used as a control unit for an airborne Omega receiver, the box now has begun a new life as SW receiver. An additional circuit was added into the box. This circuit makes a small part of the reception range visible on a normal oscilloscope (spectrum monitor mode).

On the backside of the receiver a D connector was fixed providing 2 signals to make the receive signals visible on an oscilloscope: A sawtooth voltage with a repetition frequency of about 11 Hz (External timebase, X-out) and a signal (Y-out) of which the voltage represents the strength of the received signal. The sawtooth voltage drives a tuning varicap, thus providing rapid tuning of the receiver. On the frontside I have inserted a switch which activates the spectrum monitor circuitry when set to SCAN. The monitor circuit settings were made in such a way that the ham band between 7.0 and 7.2 MHz can be visualized on the oscilloscope.

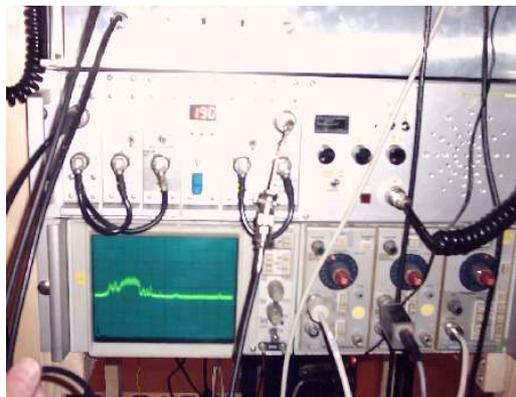


Photo 2 40m band spectrum

With great joy I have been watching the spectrum pictures. The strong broadcaststations (>7,1 MHz), are visible as thick "nails" and are very different from the tiny SSB signals, which can be recognized because of their smaller width, amplitude and of course the presence of the signal dependant on the amount of modulation (due to its nature). I knew that some sort of spectrum analysis was possible without expensive professional analysers but the simple means I used really surprised me. The TDA1572 appears to have a predecessor, the TDA1072. The pin setting is not identical. Also the improved signal/noise ration of the TDA1572 is an important difference. Most important data for both ICs are:

On-board oscillator till 50 MHz

Capable of handling HF signals until 500 mV without problems

Double balanced mixer on-board

Wide AGC range

Supply voltage somewhere between 7,5 and 18 VDC (internally regulated)

The integrated circuit can also be used as a tuneable SW generator, of course with limited HF output power.

The results:

With a free wire antenna in the garden of about 5 metres in length and an UNUN, the radio worked fine. As earlier mentioned, with some propagation conditions, CW, RTTY and SSB signals in the 40m band can be heard. CW signals in the WARC band (30 m, 10.1-10.15 MHz) can be heard as well. Radio Nederland Wereldomroep (no distortion) came loud and clear on various frequencies (time dependant!) out of the loudspeaker. The same story for the BBC and various other broadcaststations (like the more distant Voice Of America on 9622 KHz).

Note: An UNUN stands for unbalanced-unbalanced. An UNUN can easily be built by winding a ferrite ringcore bifilare (e.g. 10 and 15 turns for resp. antennecable and antennaside). On one end, both wires are connected and routed to the ground of the coaxial plug being in contact with the receiverside. Both wires are connected on the other end to resp. the receiver and the input of the wire antenna.