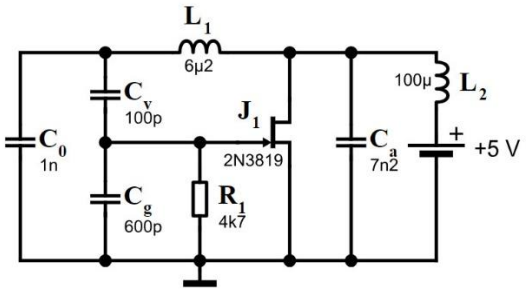
The Vackar oscillator – a 1949 electronics design

by Daniel Romila, VE7LCG

This article is intended for those readers wanting to have fun with CAD and breadboarding experimenting and learning/remembering some old analog oscillators. The article does not go neither into the theory, nor into building something that would take days/weeks to build and permanently use after; it is just for those wanting to exercise, have fun and see immediately something working. But I provide links for those that decide to go deeper into construction, and not just the links, but a short explanation what I learned myself from those external materials, and why I choose them.

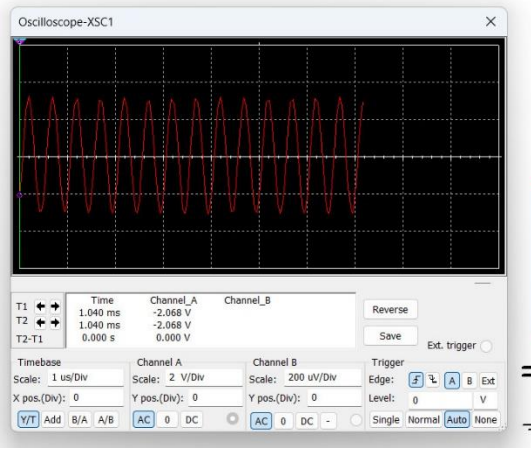
I was asked in an email by an older radio amateur colleague if I have experience with Vackzar oscillators. In that moment the answer would have been NO, so I decided to correct the situation and quickly build some, starting virtually with CAD (computer assisted design), and select after a schematic to implement on the breadboard.

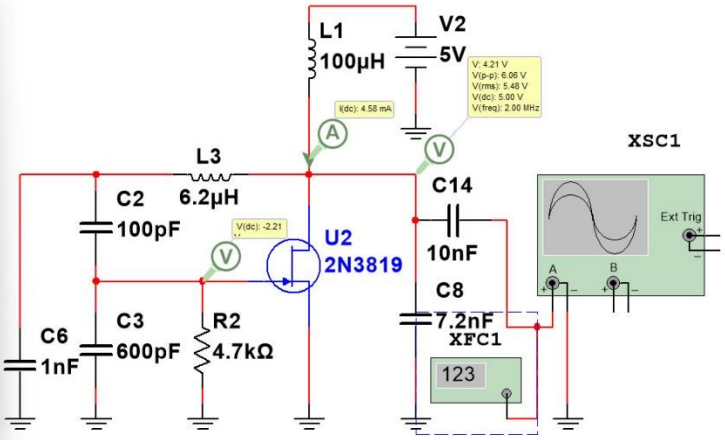
According to Wikipedia: “A Vackar oscillator is a wide range variable frequency oscillator (VFO) which has a near constant output amplitude over its frequency range. It is similar to a Colpitts oscillator or a Clapp oscillator, but those designs do not have a constant output amplitude when tuned.”



There is a schematic given on Wikipedia, as example of Vackar oscillator:

Initially, it did not work for me. I tried it in Multisim 14.3, and I simply could not make it oscillate. After verifying the schematic and repairing my mistakes I was able to simulate this 2 MHz oscillator:

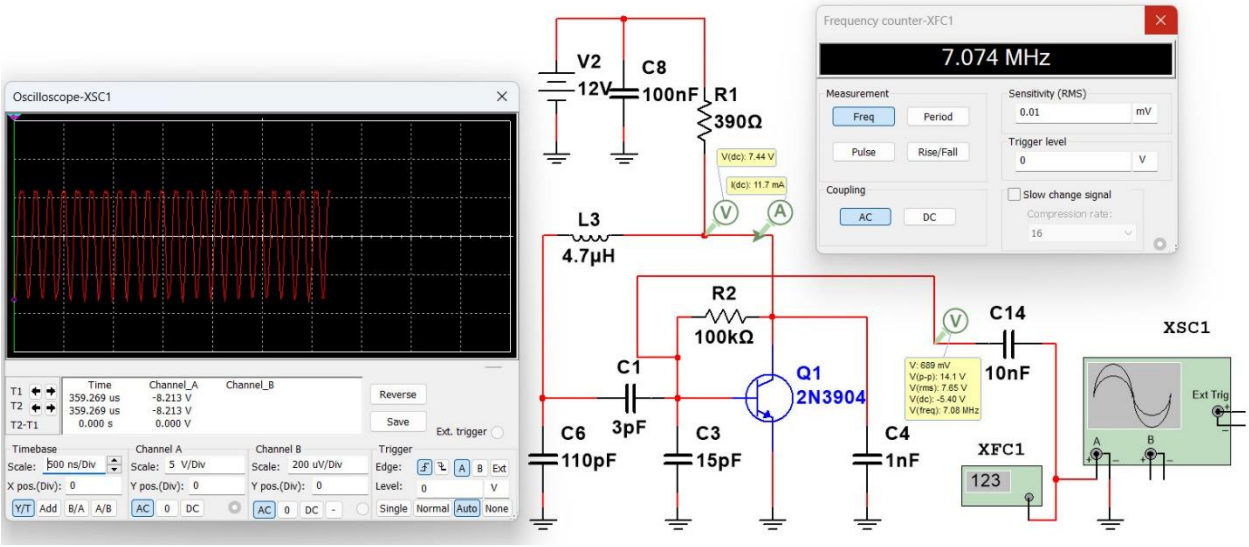




I also tried the above schematic with the transistor BF245, and it works the same.

Anyhow, in the while I remembered that Vackar oscillator is that oscillator where there is a PI kind of circuit, formed by an inductor and two capacitors, like a low pass filter. It is just a quick visual indication for me to recognize if an oscillator is the Vackar type.

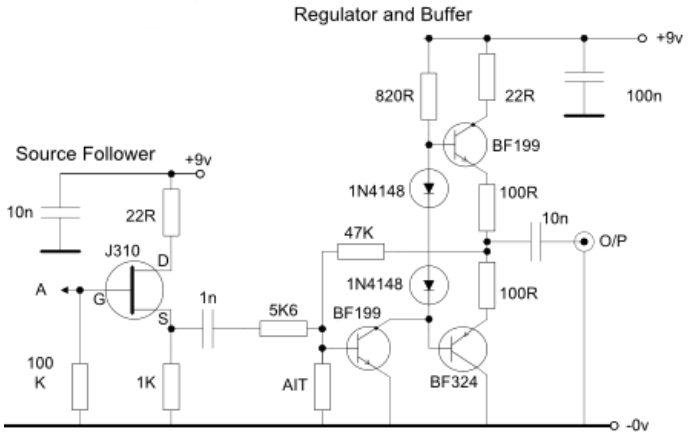
I drew another schematic, this time with a bipolar npn transistor, 2N3904:



I need to underline here that the material wrote by the Czeck engineer Jiri Vackar in 1949 was more than proposing a schematic. He gave practical means for making the inductors, combination of capacitors and calculations in order to obtain a variable frequency oscillator close to the stability of a crystal quartz oscillator.

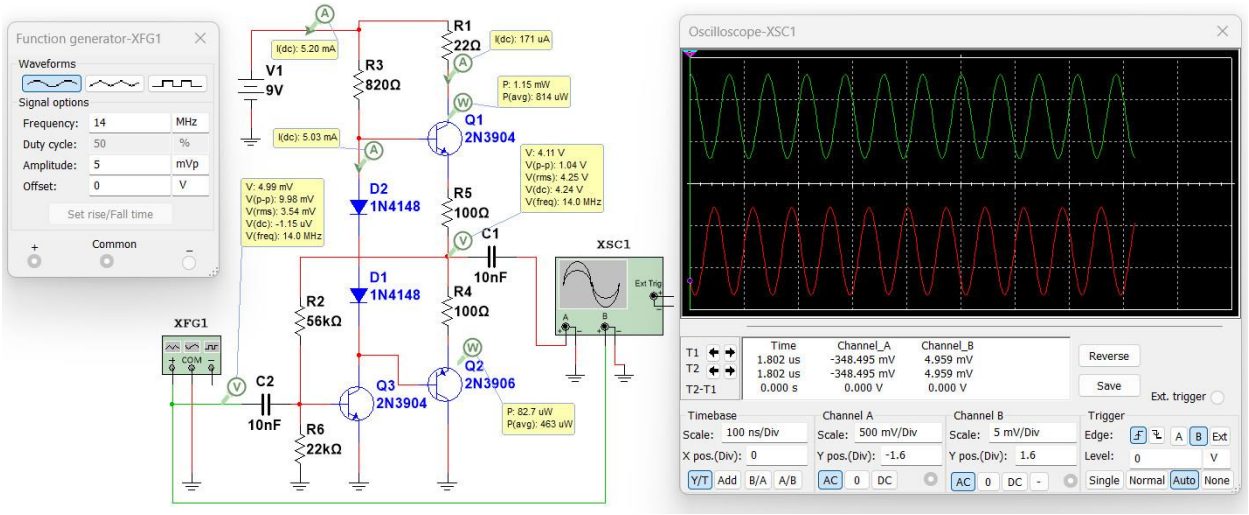
I looked on the Internet for something similar to Wikipedia's schematic, less theoretical and more practical. I found the website of Bob F. Burns, G3OOU, where he gives a practical schematic, he really made, with plenty of explanation and calculation for making a permanent built of a Vackar oscillator, with separator and amplifier, for various frequencies. G3OOU also gives details how to obtain a good thermic compensation and stability of his version of Vackar oscillator. https://www.qsl.net/g3oou/vackarvfo.html

I reproduce here just what follows after the oscillator, since the oscillator itself is the same schematic with Wikipedia's example, and it contains some Tx/Rx switching components irrelevant for this article.



The class AB amplifier, a classic vintage final audio schematic might be an overkill: in order not to distort the signal, the input of the BF199 transistor must be attenuated to some mVolts values. Here is my own drawing and simulation of the last stage. In the 14 MHz band I obtained

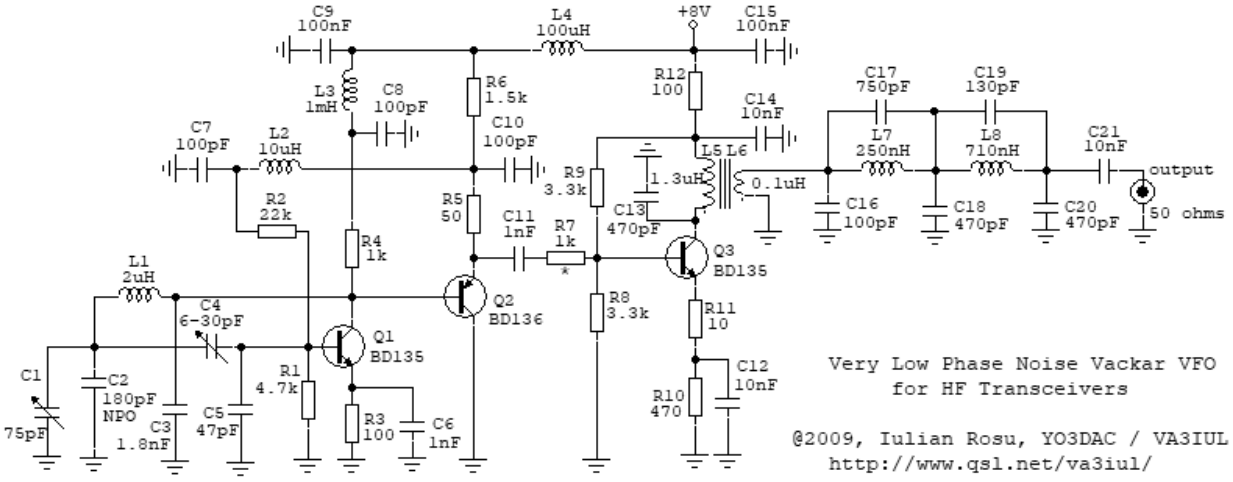
an amplification of 100 times. I limited the input to 10 mV peak to peak:



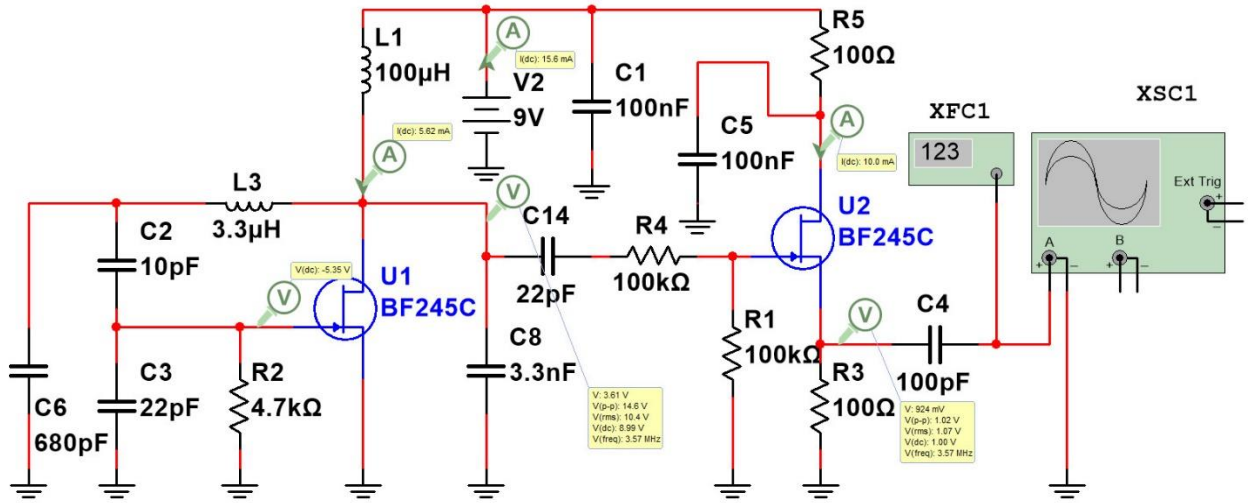
The complicated schematic designed by Bob F. Burns, G3OOU assures a very good separation of the oscillator from whatever it is connected at the output of the schematic, which has a low impedance.

A very different approach was adopted by Iulian Rosu, YO3DAC / VA3IUL. He designed a Vackar oscillator with medium power transistors, which have a low noise when used at very low power. There is also a loop for regulating the output of the oscillator, between the emitter of Q2 and the base of the Q1. The full article, with details about constructing such a very low phase noise Vackar oscillator can be found at:

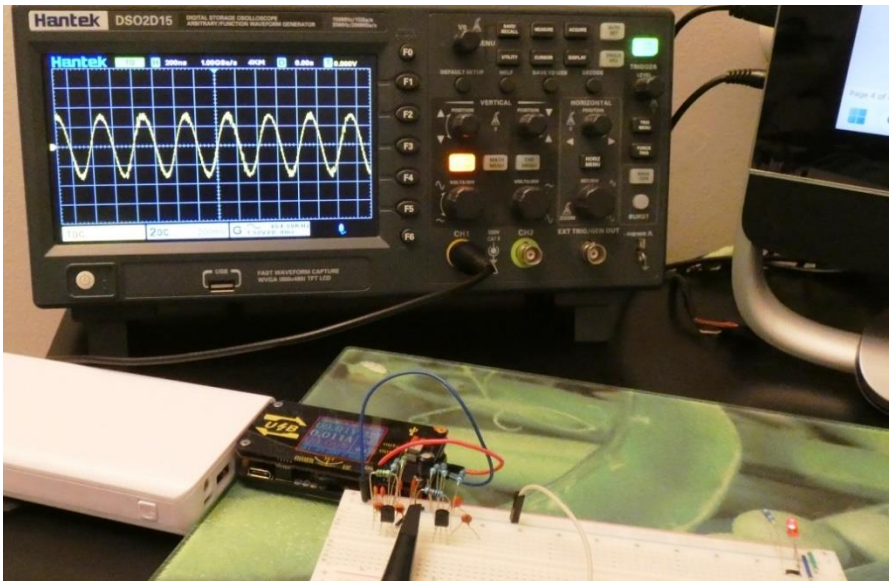
https://www.qsl.net/va3iul/Very_Low_Phase_Noise_VFO/Very_Low_Phase_Noise_VFO.htm



I decided that an experimental practical build, which I will do on the breadboard, verify and measure with an oscilloscope and tear apart after, would not follow a complicated schematic. I settled for an oscillator with FET and a source follower also with FET:



The output voltage is around 1 Volt peak to peak and the frequency is around 3.57 MHz.



The consumption, together with the LED on the breadboard, is around 11 mA. I took the signal immediately after the oscillator (as in the attached picture) and the voltage is indeed bigger than after the source follower, as I designed it to be.

VA3DIW has an interesting page about this vintage oscillator design with explanations and schematics: https://www.qsl.net/va3diw/vackar.html