EVOLUTION OF A SIMPLE SSB TRANSCEIVER

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I believe two of the best words in the English language are; “cheap” and “easy”. In my quest for a cheap and easy build of a 17M QRP SSB Transceiver, I noted that by employing standard, low cost computer crystals certain combinations resulted in signals in the 17m ham bands.

One of the currently available standard computer crystal frequencies is 4.9152 MHz, (which also happens to be the IF frequency of the K2 transceiver). I noted that if an 11.520 MHz crystal (another standard frequency) was used in a Super VXO (Variable Crystal Oscillator) and then frequency doubled, it produces an output of 23.04 MHz. By using this as a LO (local oscillator) with a 4.9152 MHz IF, the difference frequency falls within the 17m band producing a USB signal with a 4.9152 MHz carrier crystal. I used this combination of LO and IF frequencies to prototype a simple 17m QRP SSB transceiver design which, in its final form will be a very compact transceiver for portable and vacation use. The transceiver uses two bilateral amplifiers that were described by Ron Taylor, G4GXO in SPRAT #128. Other G4GXO designed circuits were used in the project. The Super VXO provides about 30kHz of tuning range from 18.120 to 18.150 MHz. The results on the air have exceeded my expectations; with around 5 watts output I have worked 7 states, mostly in the mid-west, a distance of 1800 miles from my QTH near Seattle on the west coast. As a bonus this same IF when used with a 2.2 MHz VFO works on 40 Meters. The transceiver can be seen at the following website www.jessystems.com.

Operation on other bands is possible by careful selection of LO and IF crystals but care should be exercised in the selection of frequencies to avoid unwanted mixing products. Below is a table that demonstrates some of the possible combinations that will provide operation on most of the HF bands;

IF Filter Frequency	**VXO Frequency**	**Resulting Frequencies**
4.9152 MHz	11.520 MHz X 2	18.120 to 18.150 MHz
4.9152 MHz	2.2 MHz VFO	7.165 to 7.185 MHz
7.3728 MHz	11. 0 MHz, 11.046 MHz, 11.059 MHz, 11.228 MHz	3.66 MHz +/- 3.86 MHz +/-
7.3728 MHz	10.7 MHz X 2	28.8 MHz
9.0 MHz	5.185 MHz	14.185 MHz

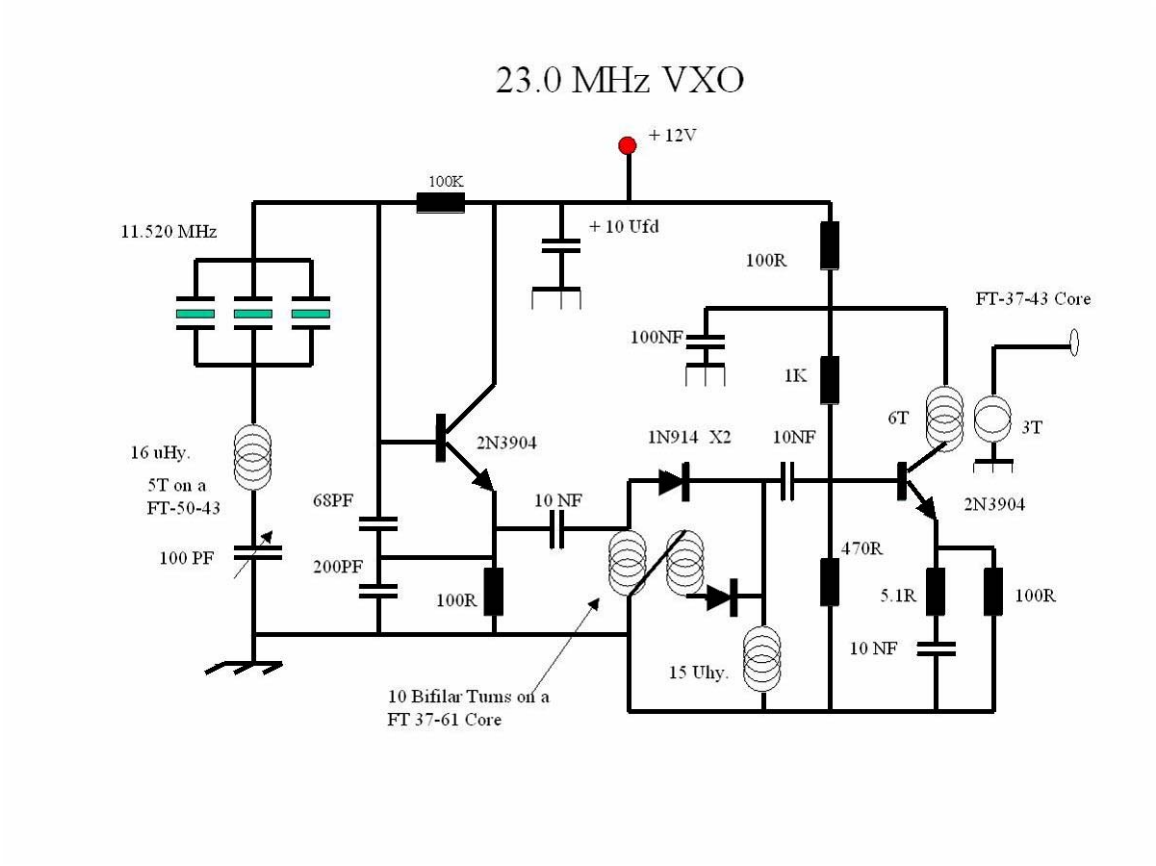
9.0 MHz	12.288 MHz	21.288 MHz +/-
3.2768 MHz	11.0 MHz, 11.046 MHz	14.276 MHz, 14.322 MHz
6.0 MHz	8.192 MHz	14.192 MHz +/-

Following the success of my 17m tests I have purchased all of the crystals listed in the table with a view to testing the transceiver on each of the bands.

The SSB filter is a standard four-pole Cohn ladder filter for which an impedance of 150 ohms was assumed. While more precise impedance values could have been calculated, either by using software or long hand, at 4.9152MHz the 150 ohms assumption works fine.

When building a filter the first step is to find four crystals that are within 50Hz of each other. Frequency matching is easily done using a simple oscillator and a frequency counter. Any crystal that doesn't meet the 50Hz limit can be used in the carrier oscillator. When used in a VXO type oscillator, there is adequate tuning range to place the carrier crystal frequency at the correct point on the filter slope. I purchased 10 crystals each for the VXO frequencies and 20 crystals for the filter frequencies. Out of a batch of 20 crystals I managed to realize three filters, two 4 pole and one 8 pole.

In its final configuration, the Super VXO employs three crystals all at the same frequency. By adding the third crystal the upper frequency limit was extended. Experimentation also revealed that a point is reached were too much inductance will cause the circuit to cease oscillation. Experimentation is the key operative word! The schematic is shown below.



Many thanks to G4GXO who reviewed this article and for designing some great circuits that can be employed to create cost effective ("cheap") and "easy" to build SSB QRP radios.