Ham Radio 101

Ham Radio Building Blocks

9.0MHz Crystal Oscillator

Hal Silverman WB6WXO

I often look at today's engineering marvels and the growth in technology of the modern ham radio "rigs". When I get on the air, I almost have to read the manual again to remember how to operate the rig.

Several years ago, I hooked up my old Kenwood TS520 and SB200 linear. It does generate heat and the linear arcs and sparks but it does work and is relatively stable.

I then started to look at some relatively simple Heathkit radios. The HW100, HW101, SB100 and the SB101 are classic examples of classic designs of AM/CW/SSB 5 band radios. (These were introduced before the WARC bands were added).

I thought that it would be easy to isolate these building blocks, breadboard them and test them. The circuits are not rocket science and are available from ARRL Handbooks and from Heathkit manuals.

I chose to start with the 9.0MHz crystal controlled oscillator. The circuit came from the HW32A 20M single band rig manufactured by Heathkit.

The crystal is available from Electronix Express for a nominal price. I also wanted to use as many parts from my collection in my workshop.

For specialty parts, I look on E Bay or I will by small quantities from JK Electronics located on Westminster Blvd, Westminster.

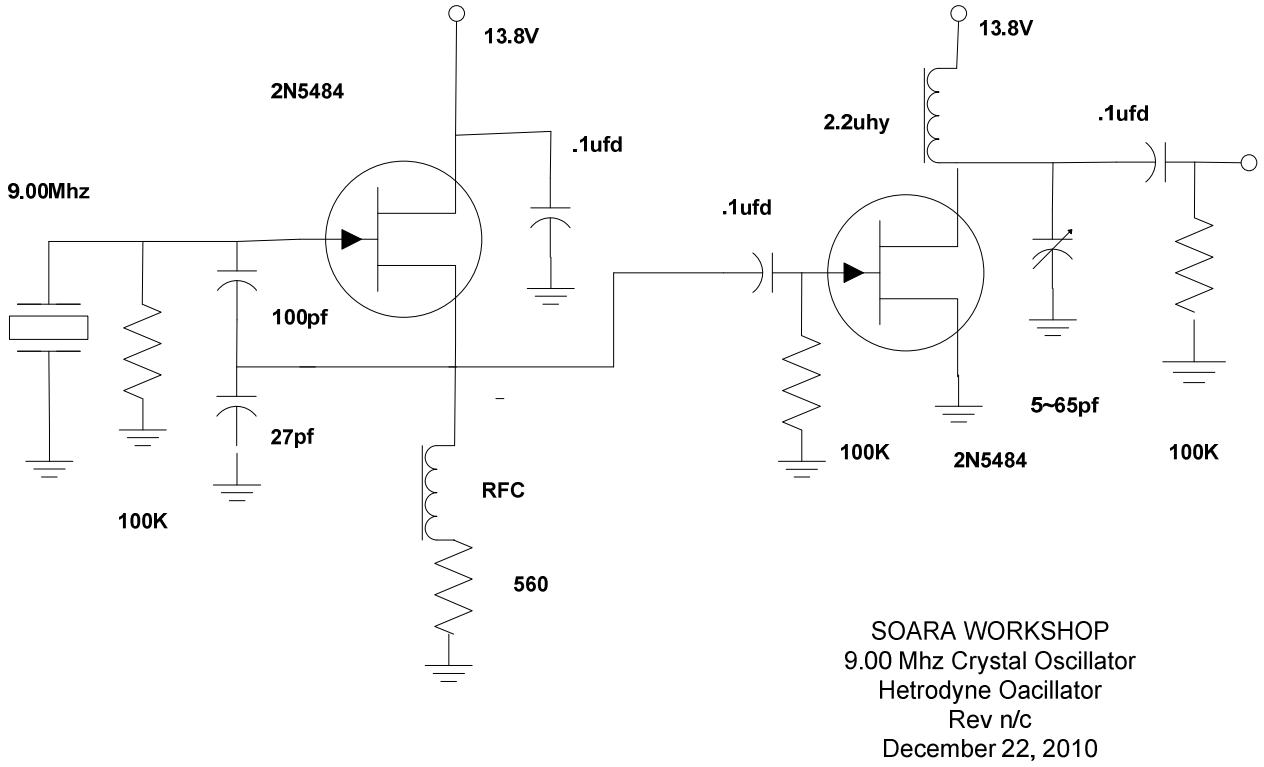


Figure 1

9.0MHz Crystal Oscillator

The output of the oscillator will feed one end of a mixer. The input of the mixer will have the 9.0MHz crystal controlled oscillator and the 5.0MHz to 5.5MHz VFO. The output of the mixer will provide four signals. It will contain the two originals, the sum of the two (14.0 to 14.5 MHz) and the difference (3.5 to 4.0MHz).

If it begins to look familiar, it is the 20M and the 75M/80M bands.

Back to my process for building the oscillator.

I first used a solderless breadboard to test out the design. This allowed me to make any minor changes to the circuit.

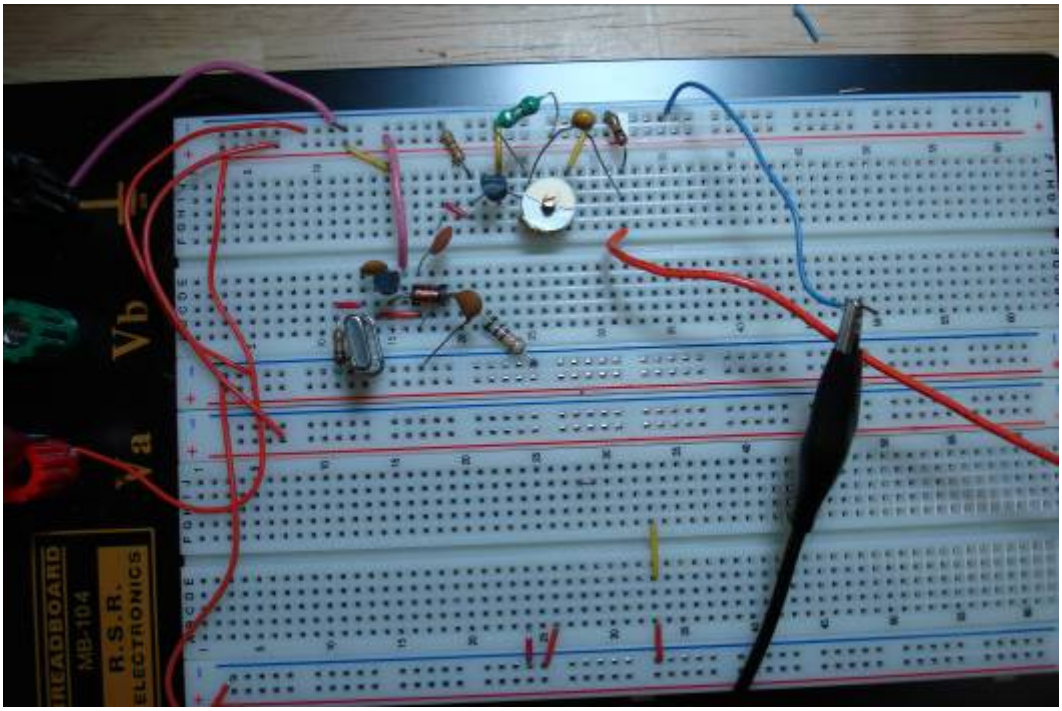


Figure 2

9.0MHz circuit assembled on a solderless breadboard

Once I was satisfied with the output voltage and waveform, I then assembled the circuit on to a solderable breadboard.

I wanted to look at the waveform and determine if I was going to have enough output voltage to drive the mixer.

The breadboards are available from JK Electronics, Westminster.

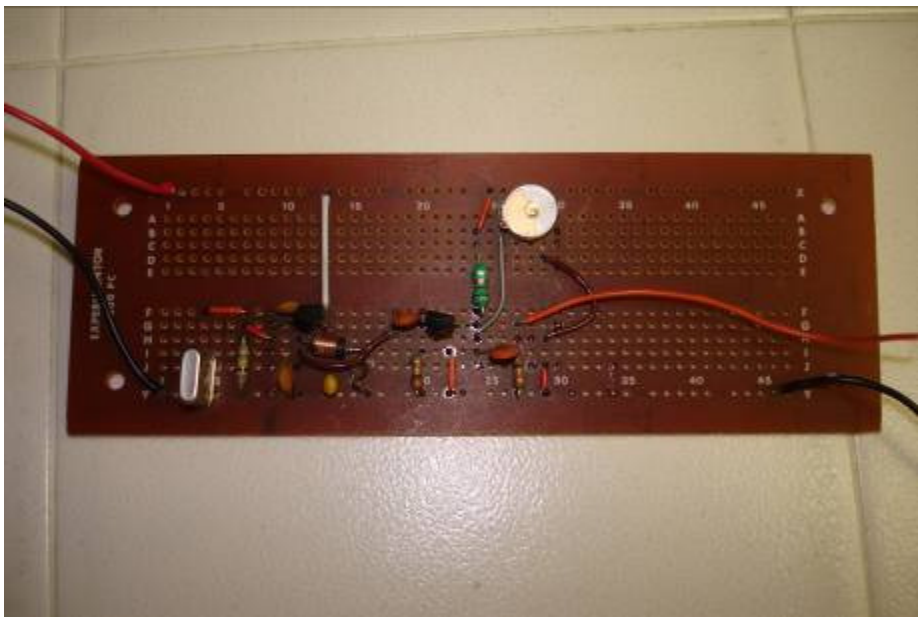
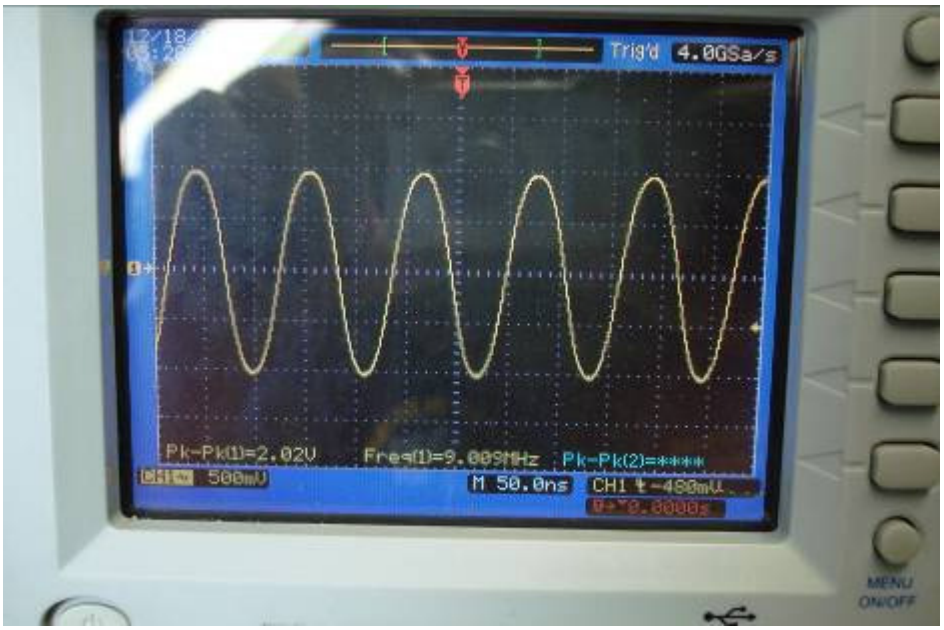


Figure 3

9.0Mhz assembled on a solderable breadboard.

As sanity check, I took some pictures from my scope. Figure 4 below is the result of the breadboard assembly.



The output pictured on the scope shows the waveform voltage at 2.02 V p/p

The frequency of the oscillator is 9.009 MHz. I felt that this was ok to package up in an aluminum chassis. This would simulate a radio packaged in a chassis.

The aluminum chassis is the next step in the process. A final design with printed circuit boards will be packaged in a chassis. Sometimes, there is a change in performance due to stray capacitance. The effect of stray capacitance is more prevalent at higher frequencies.

The variable capacitor that was assembled on the breadboard was relocated on the rear panel of the chassis. This would allow for tuning of the circuit for best waveform and maximum output.

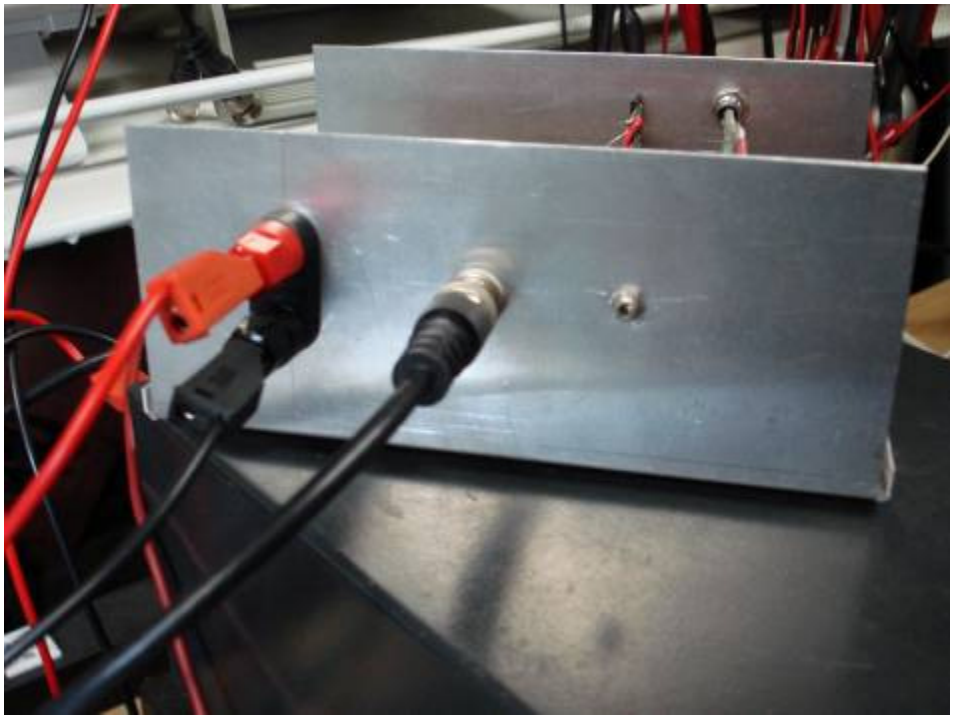


Figure 5 Rear Panel

Figure 5 is a picture of the rear panel with the variable tuning capacitor at the right hand side. The DC input and the RF output are also located on the rear panel

With the top cover assembled on the chassis the next two pictures show the waveform and frequency as measured by a scope and counter.

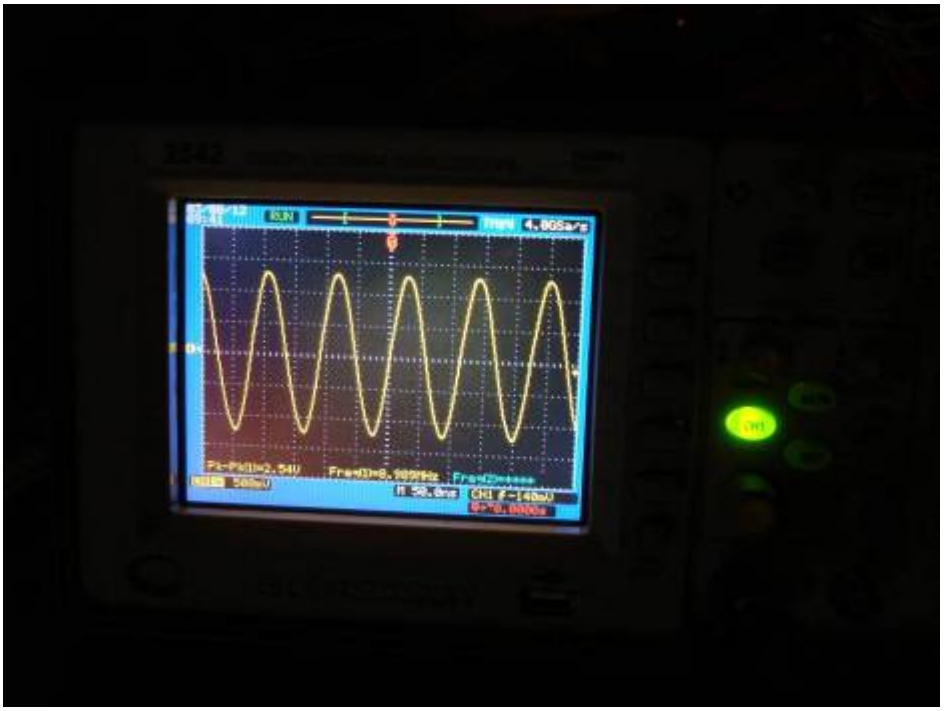


Figure 6 Output Voltage Waveform

Figure 7 Output Frequency

The end result is that the 9.0Mhz crystal controlled oscillator has an output of 2.54V p/p at a frequency of 8.9997 MHz. The output voltage is measured across a 100K ohm resistor. This will approximate the input gate of a dual gate MOS FET.

The next installment will detail the 5.0MHz to 5.5MHz variable frequency oscillator (VFO).

If there are any questions or comments, please contact me at WB6WXO@ SOARA.org