SOARA Workshop

9.0 MHz Crystal Oscillator

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In the last article, I presented the final version of the 5.0 to 5.5 MHz VFO. In this article I describe the design and construction of a 9.0MHz crystal oscillator. The circuits in these articles are not new and innovative circuits. They represent the fundamental circuits that are used and were used to develop ham radio transmitters, receivers and transceivers.

A classic design is to take the VFO described in the last article and a 9.0MHz crystal oscillator and mix them to get the difference frequency of 3.5MHz to 4.0MHz (80m and 75m) or the sum frequency of 14.0MHz to 14.5Mhz (20M).
If the designer is looking for just a CW transmitter then the 3.5MHz can be fed to a frequency doubler and yield 7.0MHz to 7.5MHz (40M). In a similar manner, the 14.0MHZ can be doubled into a 28.0MHz to 28.5MHz (10M) frequency.

The circuits come from a variety of ARRL handbooks. I also use an older QRP handbook from 1990. In most cases, the tubes outlined in the early handbooks can use a MOSFET as a substitute. Dual gate MOSFETs can be used as mixer devices.

OK, now let us look at the oscillator. There are two popular designs for RF oscillators. The Hartley oscillator uses a transformer for positive feedback. The Colpitts design uses capacitive feedback to achieve an oscillation. I prefer to use the Colpitts design.

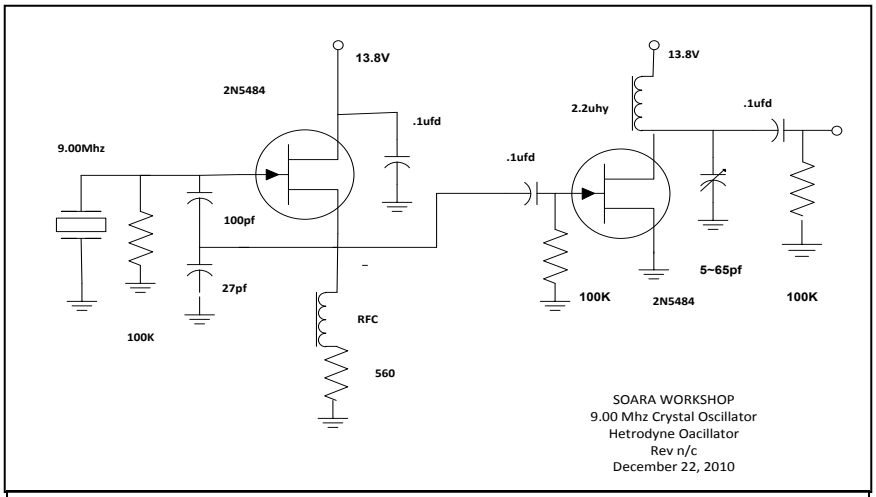

Figure 1 Schematic Diagram 9.0 Crystal Controlled Oscillator

The schematic in figure 1 is derived from the Heathkit HW32A 20M Single band transceiver. The circuit has been scaled from 18MHZ to 9.0MHz. The capacitor divider in the oscillator stage was changed to the values shown in the schematic. The inductor in the output stage was also changed to 2.2uHy. The circuit delivers about 2.0V p-p into a 100KΩ load. The 100KΩ load was chosen because the gate of the mixer will have a 100KΩ biasing resistor.

Figure 2, on the next page is a picture of the presentation on the scope.

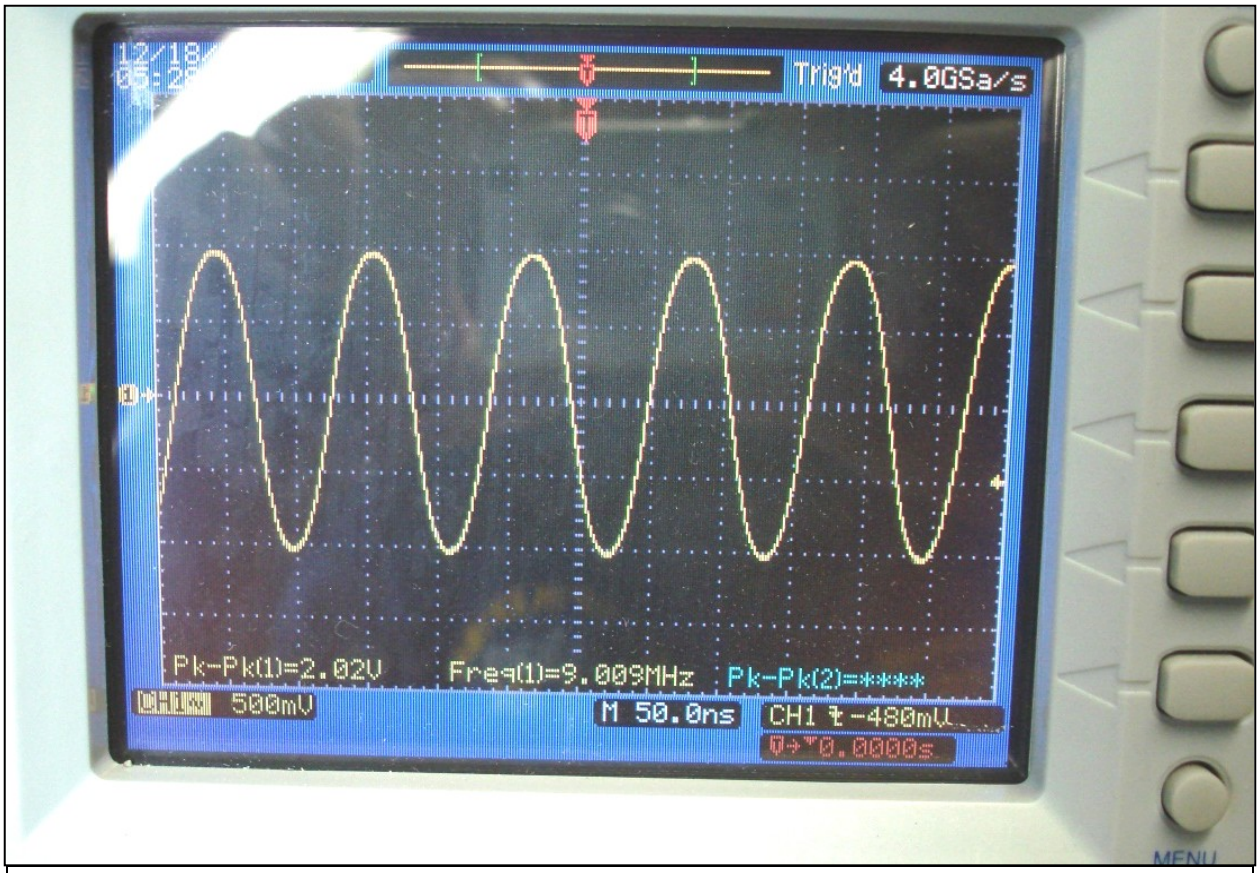

Figure 2 Waveform of the 9.0MHz oscillator

From figure 2, the designer can see the waveform. This waveform is acceptable as a decent sine wave. There is enough output voltage to drive a dual gate MOSFET mixer.

I also wanted to get an idea of how stable the output was. I used counter and made periodic observations. The output voltage stayed rock-solid over a several day period. This is a vast improvement over a tube type design as it takes time for the transmitter/receiver/transceiver to warm and the components to stabilize.

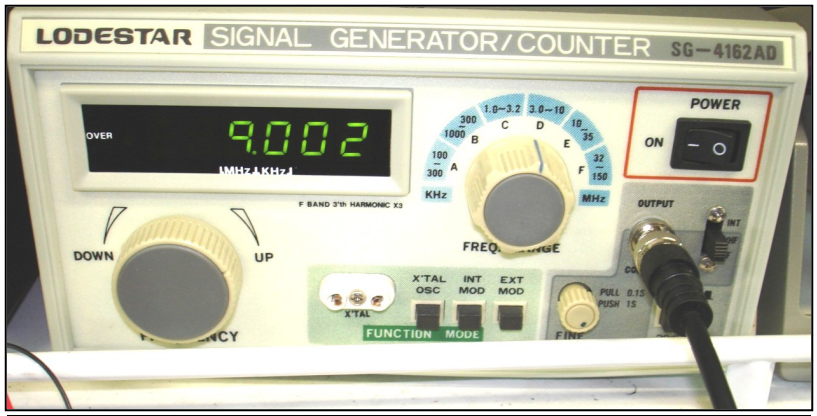

Figure 3 Counter used to check stability

Figures 4 and 5 are the layouts I used. I prefer to use a solderless breadboard and then a solderable board. The final design should have a PCB layout.

At these frequencies, lead length is not as important as it is at 5OMHz and above. As the frequency goes up, leads become small inductors and can affect performance.

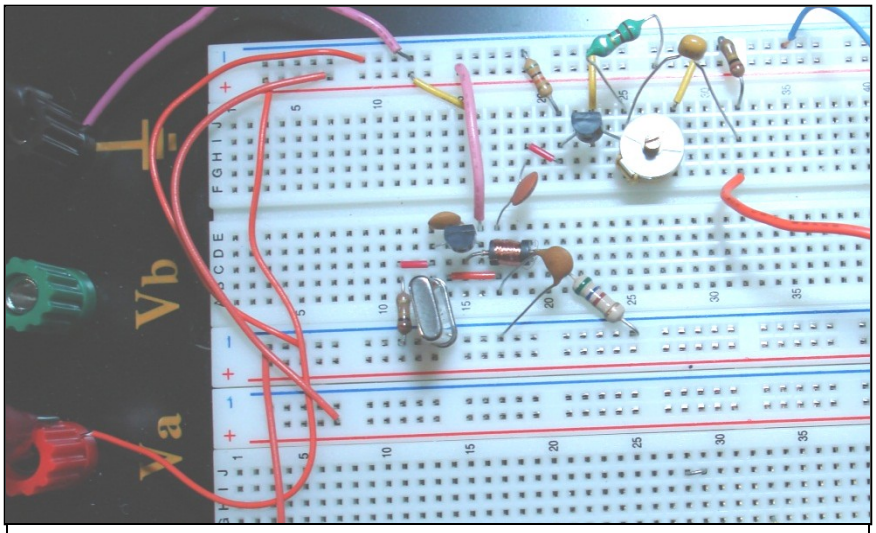

Figure 4 Solderless Breadboard Layout.

As you can see, with some judicious planning, the mixer circuit can be assembled on this breadboard. Both the solderless bread board and the soldered breadboard had approximately the same output.

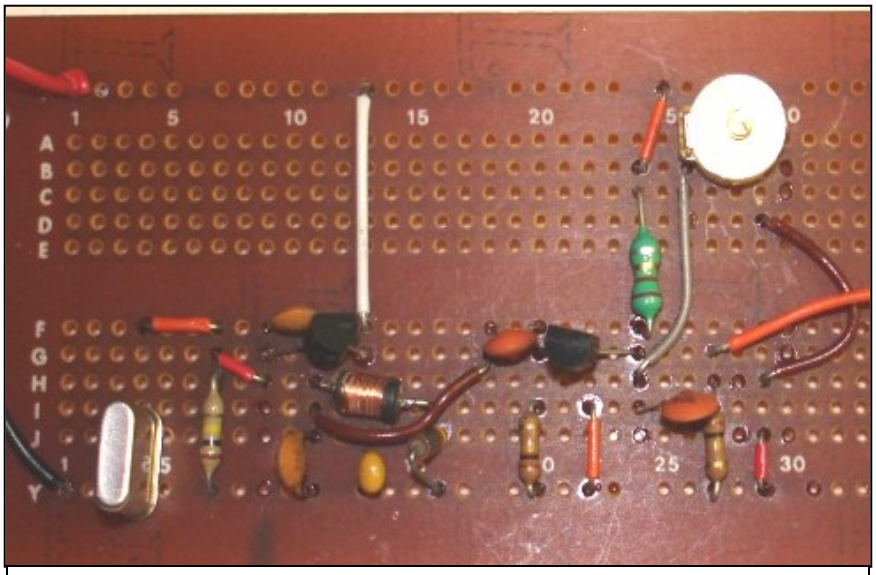

Figure 5 Breadboard Layout

The cost to assemble this circuit is about $20.00. The main expense is the crystal. I found a web site and ordered two. They were $12 each plus $5 shipping. The web site is http://AF4K.com/crystals.htm His name is Brian Carling AF4K. He can be reached at 321-262-5471. His E Mail address is af4k@af4k.com

If anyone wants to do this project, let me know and I will provide a parts list and a schematic.
My next project is to develop a mixer that is compatible with the VFO and the crystal oscillator. My plan is to report on that in the next Ham Radio 101

If there are any other questions or comments, drop me a note at WB6WXO@SOARA.com