902 MHz Transverter for the Multiband Rover
Simple and Cheap

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The original multiband transverter scheme did not include 902 MHz because it did not fit into the common local oscillator (LO) frequency scheme based on a 720 MHz common starting point. However, for a 2-meter IF, the normal LO frequency for 902 is not that much different, near 760 MHz, so eventually it occurred to me that the same LO board might be used with a different crystal. The transverter is similar to the 1296 MHz version except that the filter frequency is changed, of course.

Local Oscillator

The difficult part was finding a standard clock oscillator that would provide a useful IF frequency for 902 and 903 MHz. After considering a couple of possibilities that ended up with an odd, upside-down, IF in the 6-meter band, I settled on 756 MHz. This yields an IF frequency of 146 MHz for 902 MHz and 147 MHz for 903 MHz – a slight inconvenience, but most modern rigs have multiple VFOs and memories. 756 MHz is a simple multiple of 108 MHz, which is a fairly common frequency.

While I had hoped to find an oscillator for 108 MHz, there were none in the Digi-Key or Mouser catalogs. However, there were oscillators available for 36 MHz, one-fourth of 108 MHz. There are two obvious choices for getting from 36 MHz to 756 MHz: either multiply x3 to 108 MHz, then x7 to 756 MHz, or x7 to 252 MHz, then triple to 756 MHz. I chose the latter combination for two reasons: first, the oscillator square-wave output has plenty of odd-harmonic output even at x7, and second, the LO board was designed with a comb-line filter at 240 MHz – changing to 252 MHz is as simple as changing the tuning capacitors.

The hairpin filter at 720 MHz on the LO board is tuned lower than 756 MHz, but some simulation showed that trimming 1/8" off both ends of each hairpin would raise the frequency enough. I hacked up a board, assembled it with a 36 MHz oscillator, and it worked. Of course, there are now spurious responses only 36 MHz each side of the desired output.

What about a combination board? I went back and fine-tuned the hairpin filter dimensions so that it covers 720 to 760 MHz with the normal range of manufacturing tolerances. The revised LO board now works at either 720 MHz or 756 MHz, simply by populating the appropriate oscillator and tuning capacitors for the comb-line filter.
The schematic for 756 MHz is shown in Figure 1; the 720 MHz schematic is unchanged.

The revised LO board with the combination filter works very well, with a 756 MHz output of +7 dBm, perfect for driving a mixer. The spurious outputs at 36 MHz away on each side are at least 30 dB down, and all other frequencies are more than 40 dB down except for a strong second harmonic at 1512 MHz. Figure 2 is a photo of the revised LO board, populated for 756 MHz.

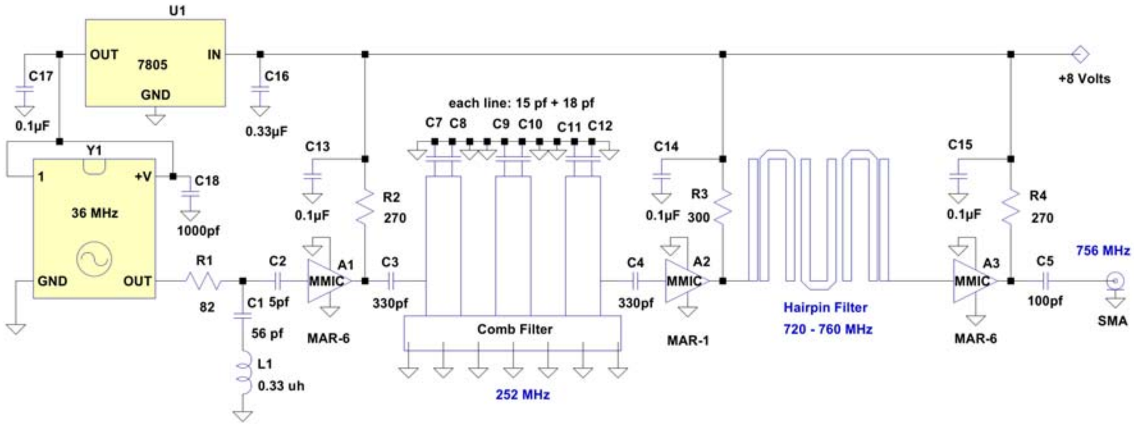

Figure 1 – Schematic of 756 MHz Local Oscillator

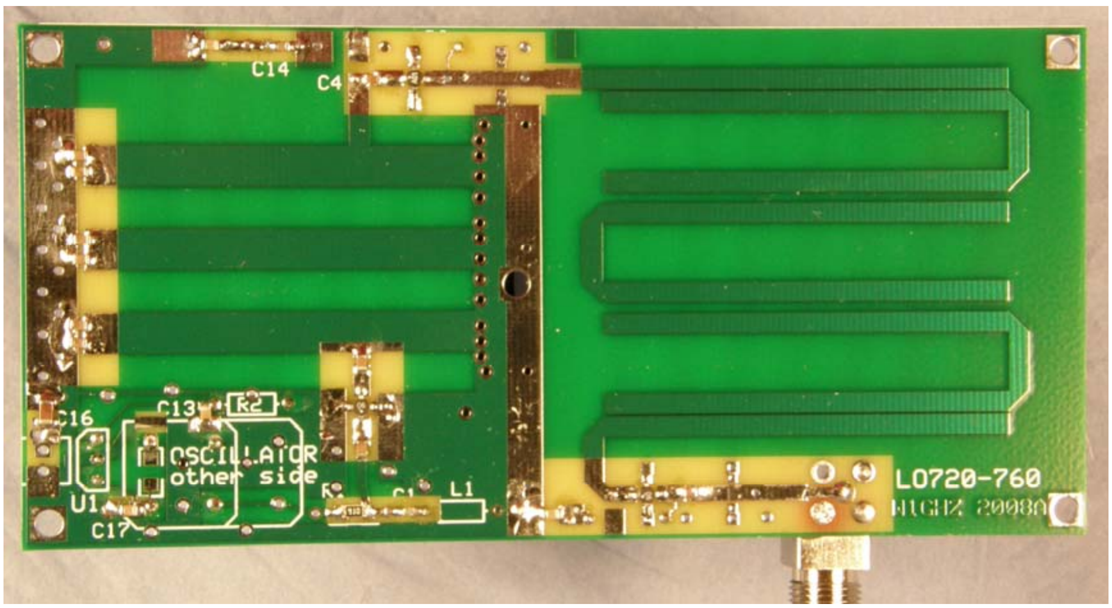

Figure 2 – Revised LO board for 756 MHz

Transverter Board

The transverter board for 902 MHz started with the 1296 design, using the same philosophy, that *gain is cheap*. Since the LO is now at the desired frequency, an LO multiplier and filter are not needed, saving some space on the board. Instead, there is a simple LO buffer MMIC in case the LO output is not sufficient to drive the mixer, which requires +5 to +7 dBm.   Since my LO board had enough output power, I used a jumper wire instead of U4. The extra space was needed for the larger 902 MHz filter – there is enough space available to fit a four-section filter rather than the three-section used at 1296 MHz. This should provide more out-of-band rejection, as shown in Figure 3. The LO rejection is about 40 dB.

Figure 4 is a photo of the transverter board for 902 MHz. Construction is straightforward – solder the parts in place. Figure 5 is the schematic diagram of the transverter board. No tuning is needed – mine came right up with 15 dBm output. The output is pretty clean, with the LO around 40 dB down. The biggest spurious output was 27 dB down at 1656 MHz.
I haven't measured the noise figure yet, but I did listen to our local beacon on 903 MHz.

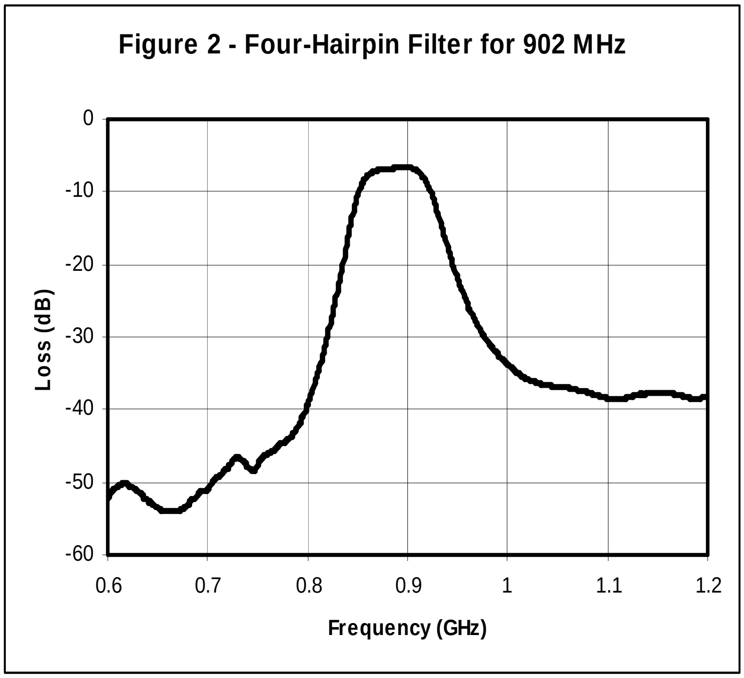

Figure 2 - Four-Hairpin Filter for 902 MHz

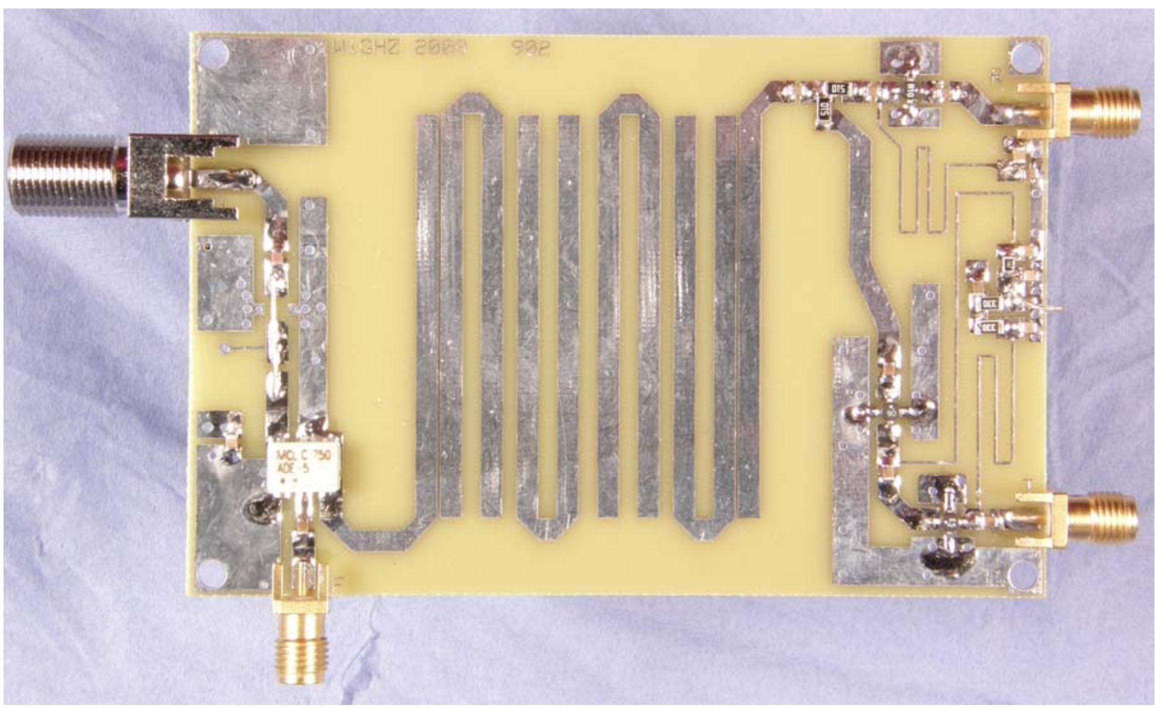

Figure 4 – Transverter Board for 902 MHz

Since the LO input is not tuned, this transverter may be used with other LO frequencies and sources, perhaps a synthesizer if you choose.

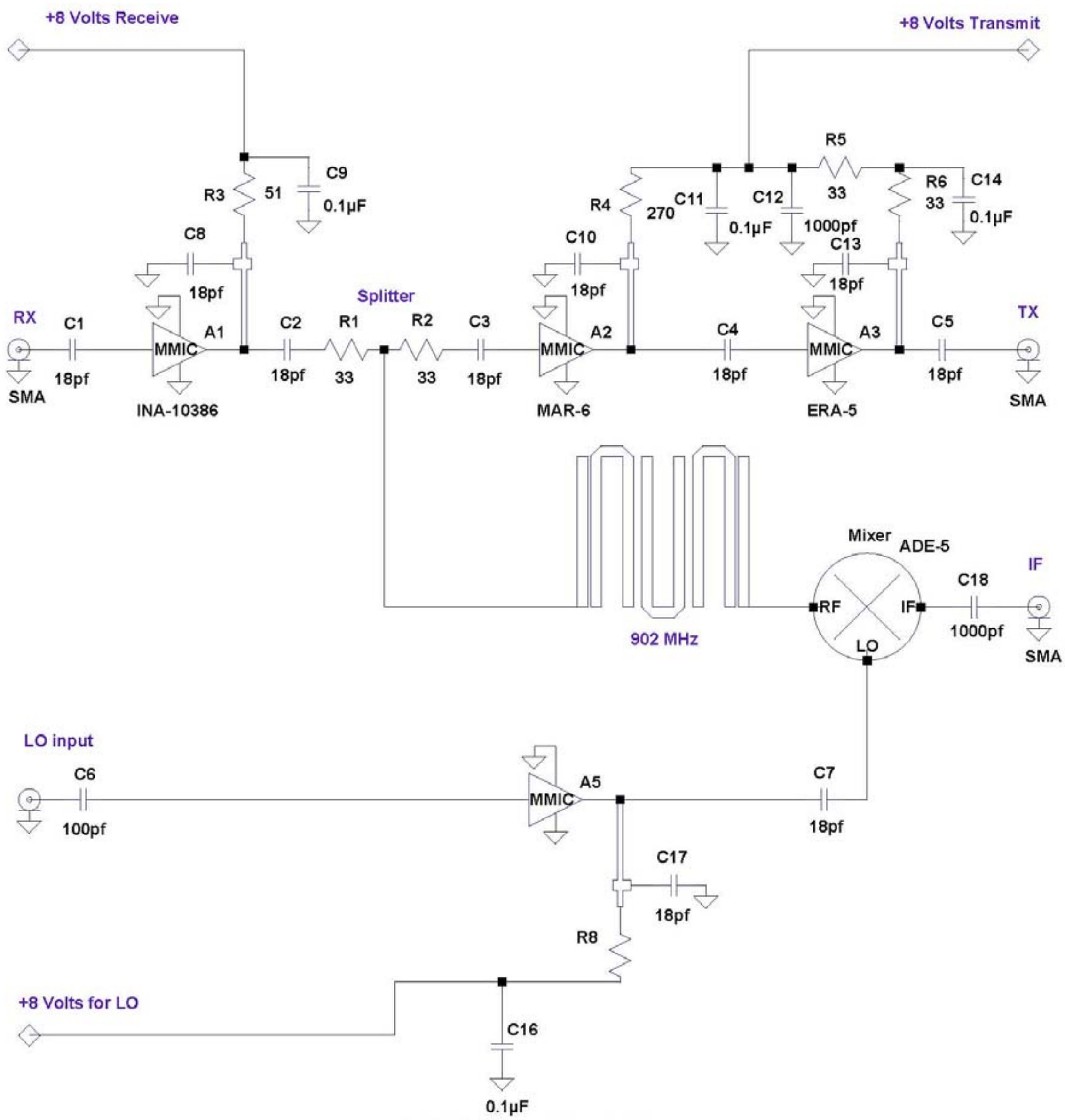

Figure 5 – Schematic Diagram of 902 MHz Transverter Board

Summary

This transverter is intended as a simple, cheap rover rig, and I think it will fill the bill. One advantage it offers is covering both 902 and 903 MHz within the 2-meter IF. For operation with power amplifiers, or near a cell site if you hope to hear anything, real metal filters are recommended. However, while testing this, I compared it to my current 903 transverter, based on an early Down East Microwave board, which I built when I had limited test equipment. I'd say that the simple one is not bad compared to what I and probably lots of others have been using.