

1296 MHz Transverter – Right Side Up

Simple and Cheap

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The Multiband Microwave Transverter scheme included 1296 MHz with high-side LO injection, to take advantage of the common local oscillator at 720 MHz. This results in tuning that is backwards, tuning down from 144 MHz, and reversed sidebands. While the common LO source has advantages in cost, power, and transfer of frequency offset between bands, a transverter with traditional tuning and frequency readout has some attractions as well, particularly in operating convenience.

The 902 transverter board is pretty simple, with only one frequency-dependent part, the printed hairpin filter at the output frequency – the LO input is untuned. Obviously, changing the filter to 1296 MHz, or other frequency, would make it a transverter for that frequency. All that is required is an LO for that frequency and desired IF.

Local Oscillator

One choice for the local oscillator might be a synthesized source – the new apollo from N5AC and Down East Microwave (www.downeastmicrowave.com) looks attractive. However, even though the cost is quite reasonable, it is still more than any of the multiband transverters, complete with LO. And there is the question of phase noise – the crystal source on the LO board provides lower phase noise, but the real significance is still open to debate.

The other choice is a new local oscillator board for 1152 MHz. Starting with 64 MHz, the highest readily available oscillator frequency, a multiplication of x18 is required. If we are to stick with two stages of multiplication then one is x3 and the other is x6, a bit harder. The first multiplication on the other LO boards is simply a matter of selecting the desired odd harmonic from the oscillator square wave output – x6 will not do here. Also, the comb-line filter on the other LO board works well at 240, 252, and 144 MHz, so it should also do fine at 192 MHz with appropriate capacitors.

The remaining question is how much output will be available at 1152 MHz from a x6 multiplier. I hacked a 720 MHz LO board to look at the 2nd multiplier output with no filter – roughly -25 dBm was available at 1152 MHz. Allowing for filter loss, 6 or 7 dB for a four-section hairpin, two stages would be required to drive a mixer. Placing one on the LO board, A3, and the other on the transverter board limits the amount of gain in one place, reducing the chances of making an oscillator.

Making an 1152 MHz LO board was then a matter of replacing the 720 MHz filter with an 1152 MHz version. I chose to use a 4-section filter at 1152 MHz in place of the 3-section at 720 MHz, hoping to reduce unwanted outputs. The final board still ended up being slightly smaller, as shown in Figure 1. The schematic diagram in Figure 2 is very similar to the other LO boards – only the component values change.

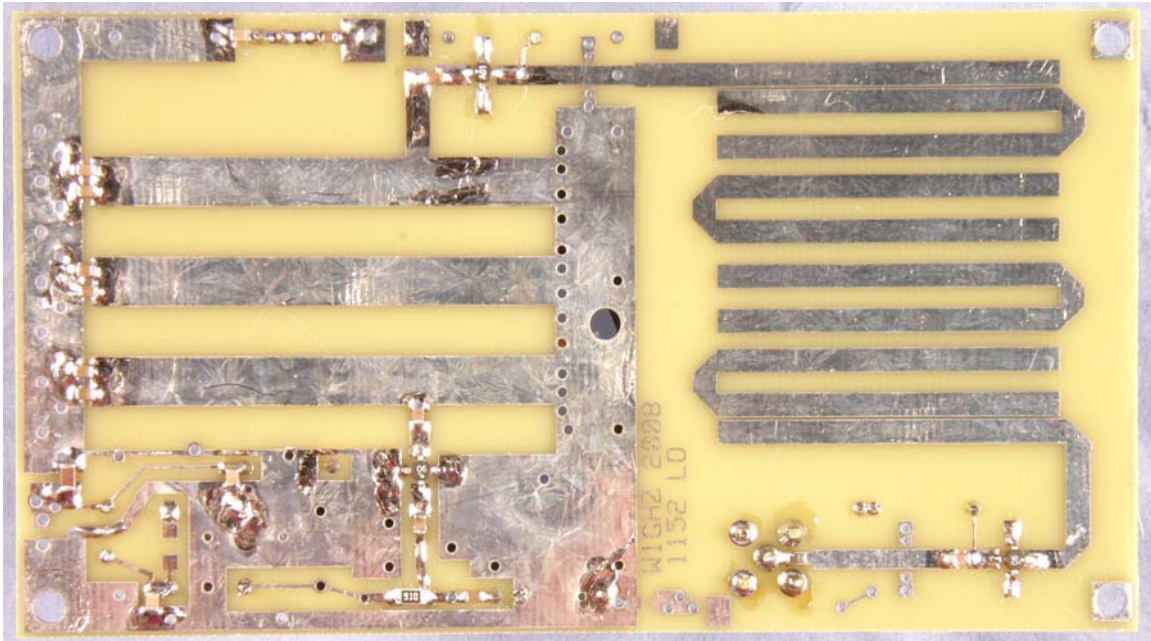


Figure 1 – 1152 MHz LO Board

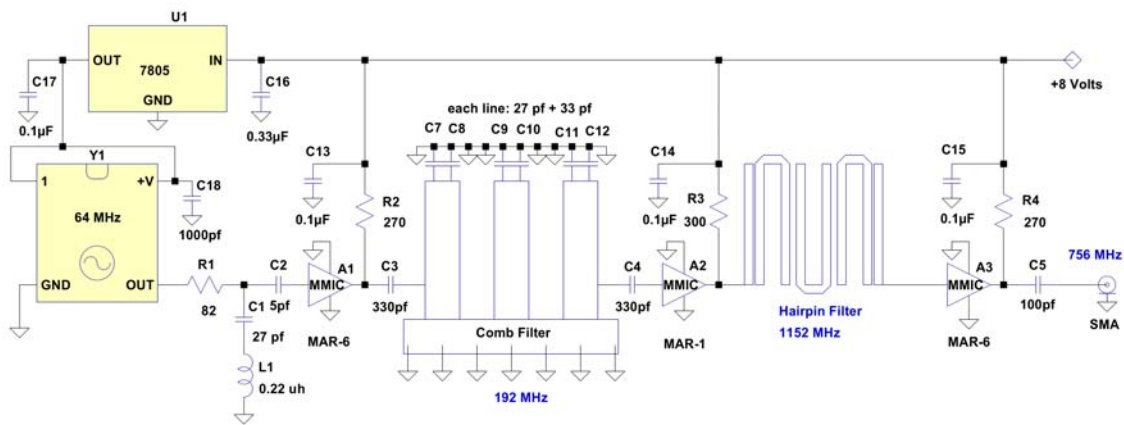


Figure 2 – 1152 MHz LO Schematic Diagram

Output from the prototype LO board was about -5 dBm at 1152 MHz, with other products at least 30 dB down. The bias resistors for the multipliers, R2 and R3, might need a bit of trimming for maximum output power – higher order multipliers are more sensitive than the x3 multipliers used in the 720 MHz LO board.

1296 MHz Transverter

The only significant difference between the 902 MHz transverter and the 1296 MHz one is the filter. The filters for 902, 1152, and 1296 MHz all use the same design parameters – only the lengths of the hairpin legs change. The measured response curves for the latter two filters are shown in Figure 3 below. An attractive feature of the 1296 MHz filter is the notch below the passband, created by the side-coupled input and output lines – the notch falls right around 1152 MHz, providing some extra LO rejection for free.

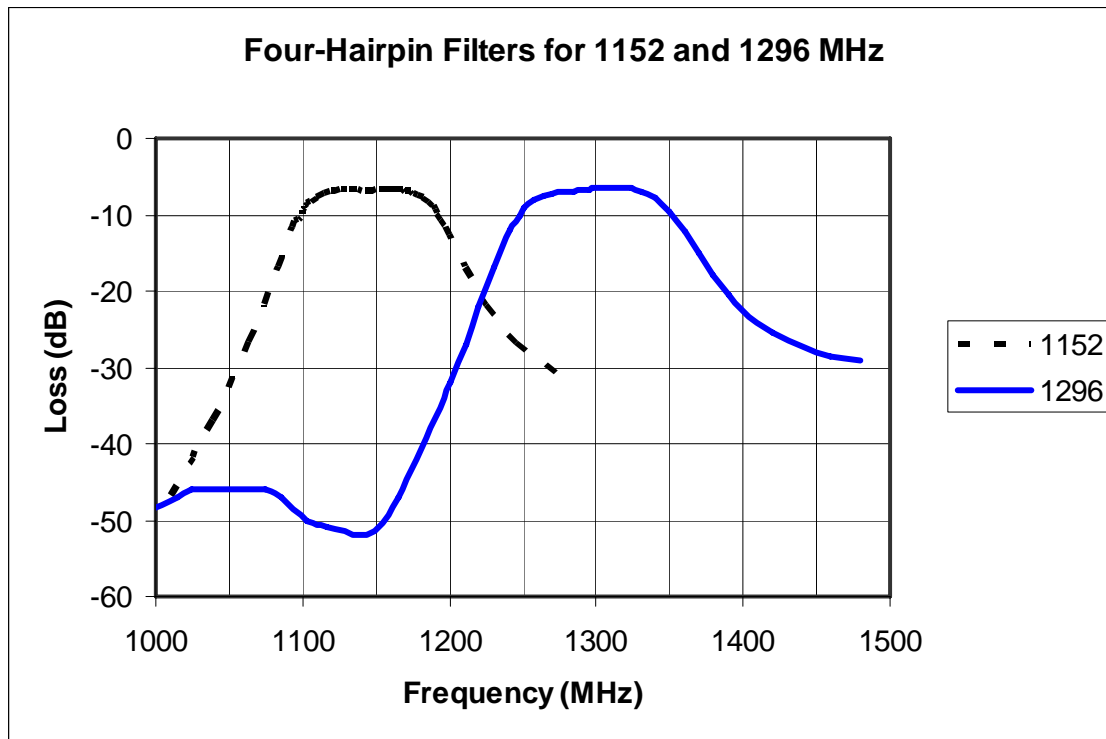


Figure 3

The other slight difference is that the length of the bias stubs for transmit and receive amplifiers is shorter, to tune them to 1296 MHz. The LO amplifier, needed with the 1152 MHz LO board, is untuned, with just a $\frac{1}{4}$ watt resistor for bias. The LO amplifier provides enough power for the mixer – I measured +5 to +7 dBm before soldering down the mixer. Other LO sources might provide more power, so the amplifier might be unnecessary and could be replaced with a simple wire.

All the changes take less space, so the transmit and receive sections are shuffled slightly to take advantage of the extra space. A prototype of the transverter is shown in Figure 4. The schematic diagram is shown in Figure 5.

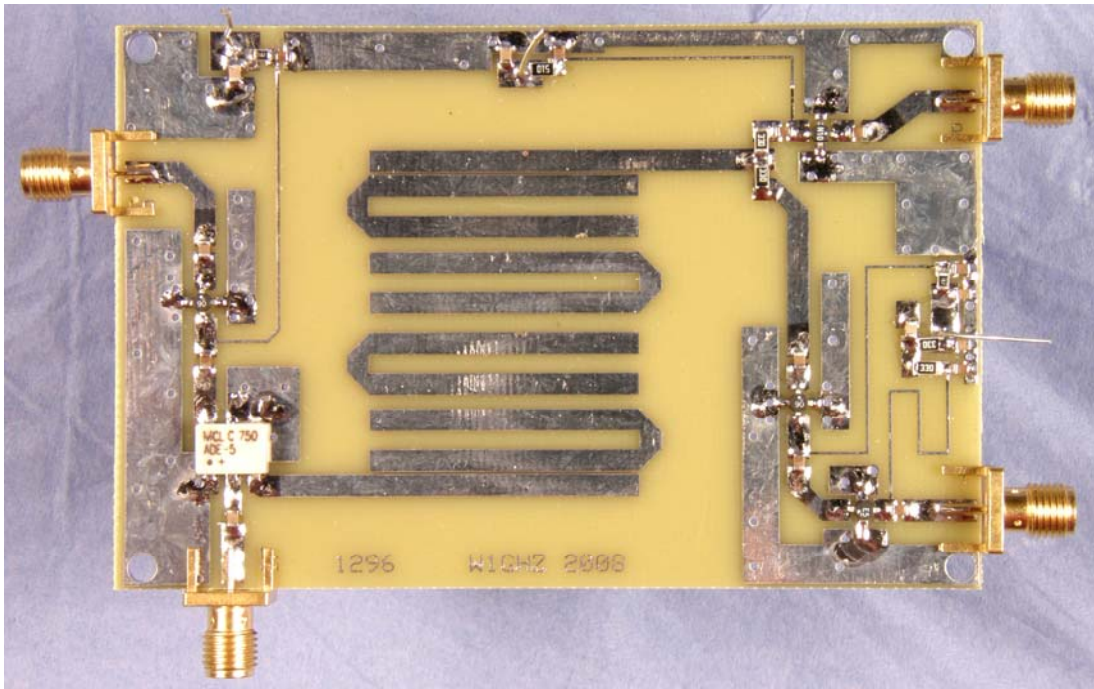


Figure 4 – 1296 MHz Transverter Board

No tuning is needed – the prototype came right up at +13 dBm output. I haven't measured the NF yet.

Summary

This transverter, like the other multiband transverters, is intended as a simple, cheap, rover rig – probable cost less than \$100. It could also be a way for VHF operators and contesters to try 1296 MHz, probably the microwave band with the most activity. It also has potential as building blocks for a more serious station, but real metal filters are recommended for operation with power amplifiers or in high-RF environments.

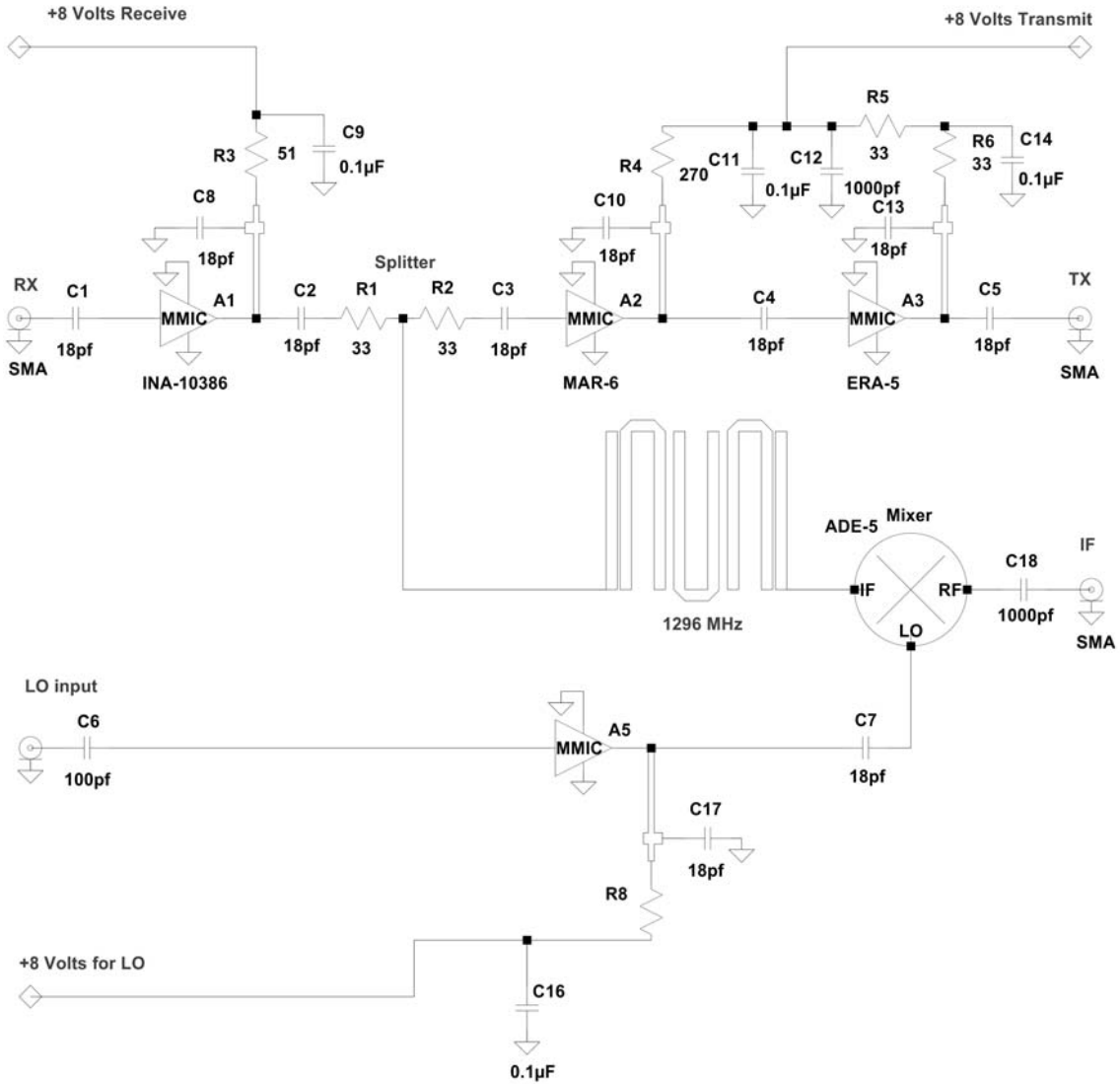


Figure 5 – 1296 MHz Transverter Schematic Diagram