# *Update and Enhancements for*
## 902 MHz Transverter for the Multiband Rover
## *Simple and Cheap*

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The 902 MHz transverter has been less popular than transverters for other bands, possibly because this band is only available in IARU Region 2, North and South America. Some recent interest, partly in South America, has finally exhausted my supply of PC boards. This provided the opportunity to update the transverter with enhancements similar to those I have added to the 1296 MHz transverter.

The enhancements to the PC board are to modify the MMIC footprints to allow use of newer MMICs in the SOT-89 package, and to use a packaged power splitter between transmit and receive. The splitter has lower and more predictable loss than the resistive splitter, and the newer MMICs offer higher performance at low cost.

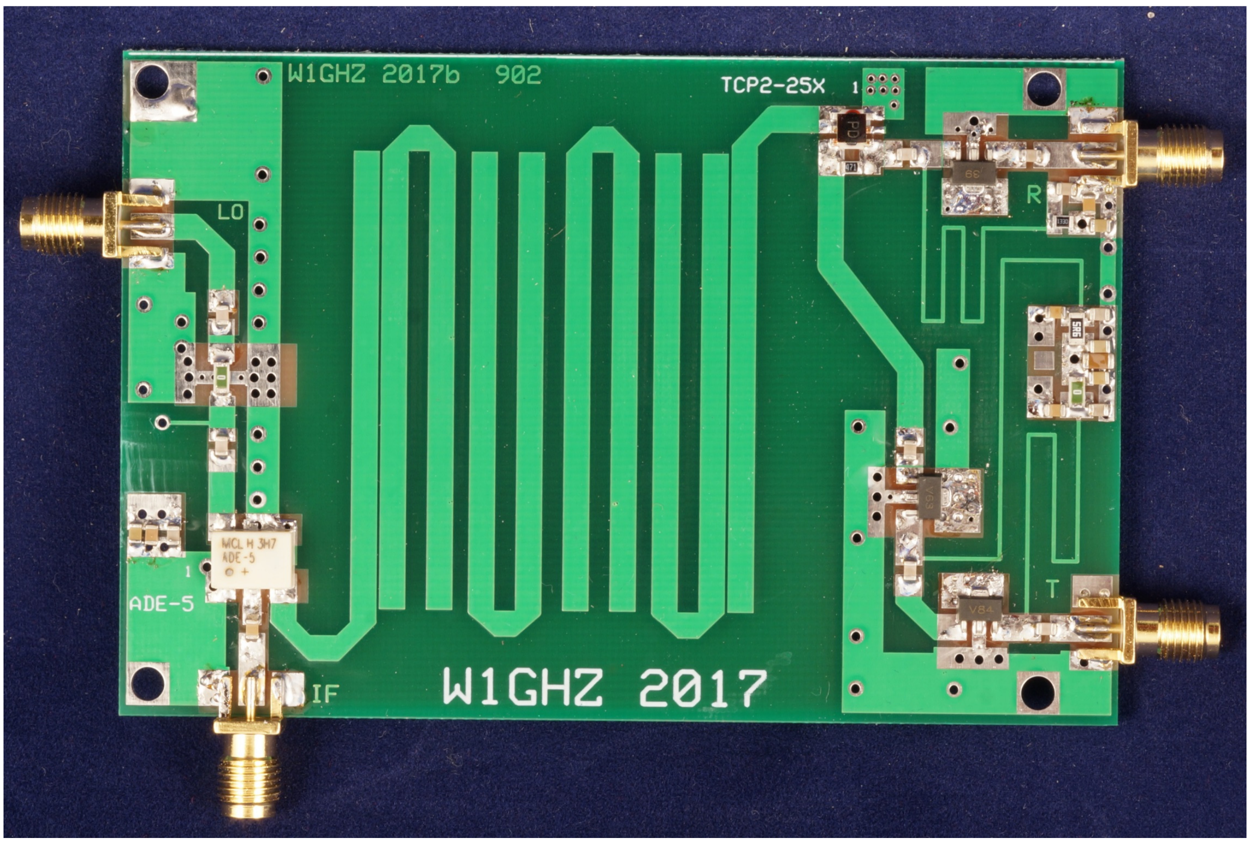


**Figure 1 – Updated 902 MHz Transverter, revision 2017b**

The hairpin filter is also modified slightly. Since the original version was centered below 900 MHz and did not completely cover the full 902-928 MHz band, I shortened the hairpins by 25 mils at each end to raise the frequency. I also chose to cover the filters with a soldermask layer to protect them. I'm still not sure what affect this has on the filter frequency, but I figured that if it lowered the resonant frequency, the shortened hairpins would compensate. The filter response is shown below in Figure 3. The filter passband now covers the full band while still providing roughly 40 dB of LO rejection.

An assembled transverter with the new MMICs is shown in Figure 1, and the schematic for this version in Figure 2. Note that the LO amplifier MMIC, A5, has been replaced with a zero-ohm resistor in this prototype so that performance at various LO power levels may be measured.

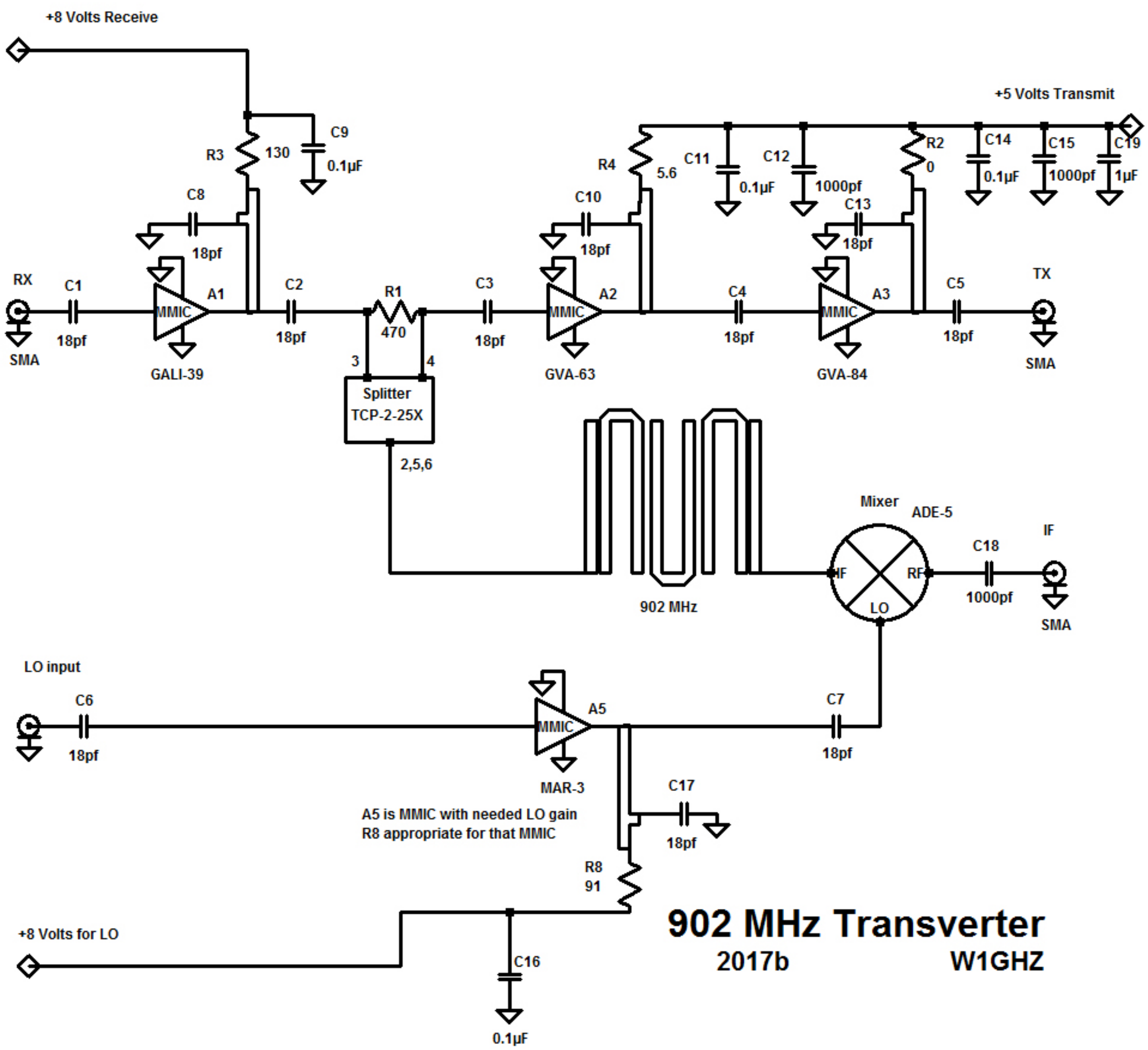


**Figure 2 - Schematic Diagram of updated 902 MHz Transverter**

## Performance

The receive MMIC is enhanced to a Minicircuits GALI-39, for good gain with a pretty good noise figure.  I measured several units with around 4 dB NF, adequate for a simple rig.  The overall receive gain is around 8 dB.

To get an idea of the filter response, I measured from the RX port to the IF port with a VNA, with no LO injection – the mixer is just an attenuator in this test, and everything but the filter should be broadband.  The filter response is shown in blue in Figure 3, with 3 dB bandwidth from 875 to 950 MHz, and about 40 dB down at 758 MHz, the LO frequency.  The green line is the Return Loss at the RX port, close to 20 dB at 902 MHz, so the input is pretty well matched.

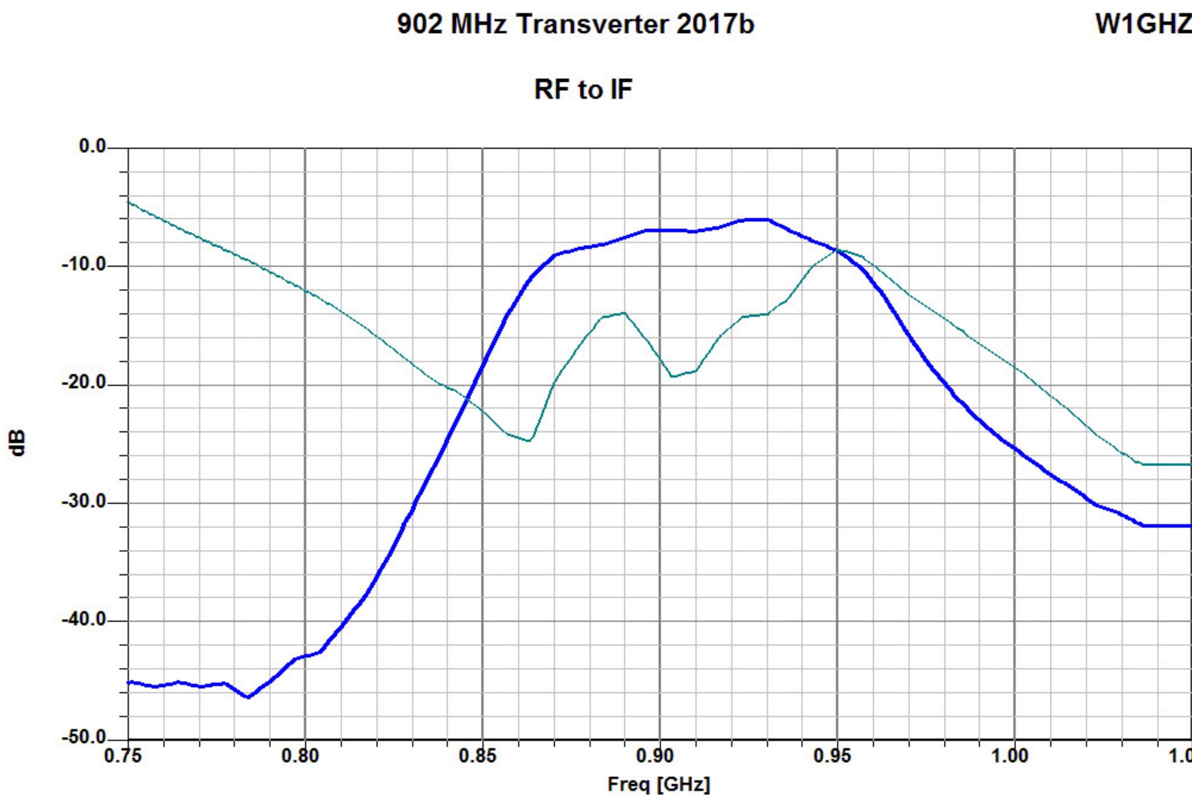


**Figure 3 – 902 MHz Hairpin Filter response, measured from RX port to IF port**

The transmit side has lots of gain with the new MMICs, and easily produced +20 dBm (100mW).  The gain might be a bit high, producing a fair amount of LO feedthrough at the output with no 144 MHz input – I plan to try a slightly lower gain MMIC, the GVA-62, for A2.  The LO level is more than 40 dB down at full output.

The mixer is pretty forgiving about Local Oscillator injection power.  Performance is good at LO levels from about 0 to +8 dBm – the best seemed to be about +5 dBm, producing less LO leakage without reducing output power.  If your LO source or synthesizer doesn't produce enough power, then an LO amplifier MMIC may be added at A5, chosen to provide the needed gain. For instance, a MAR-4 has only a few dB of gain, while a GVA-63 can provide 20 dB gain. The bias resistor, R8, should appropriate for the MMIC – see the data sheet.

## Construction

Construction should be pretty straightforward – solder the parts down. The SOT-89 MMICS take a bit more heat to solder, since the PC board has a bunch of plated-thru holes to heatsink the MMICs. I use a soldering iron with a larger tip. First I fill the holes with solder, then solder the MMIC in place by the output lead. Then I heat the ground pad on the side away from the three leads, adding a bit of solder, until the solder under the middle lead just flows. After it cools, I solder the input lead.

Figure 4 is a closeup of the power splitter and receive front end, and Figure 5 is a closeup of the transmit section. The SMA connectors are cheap edge-mount versions from ebay.

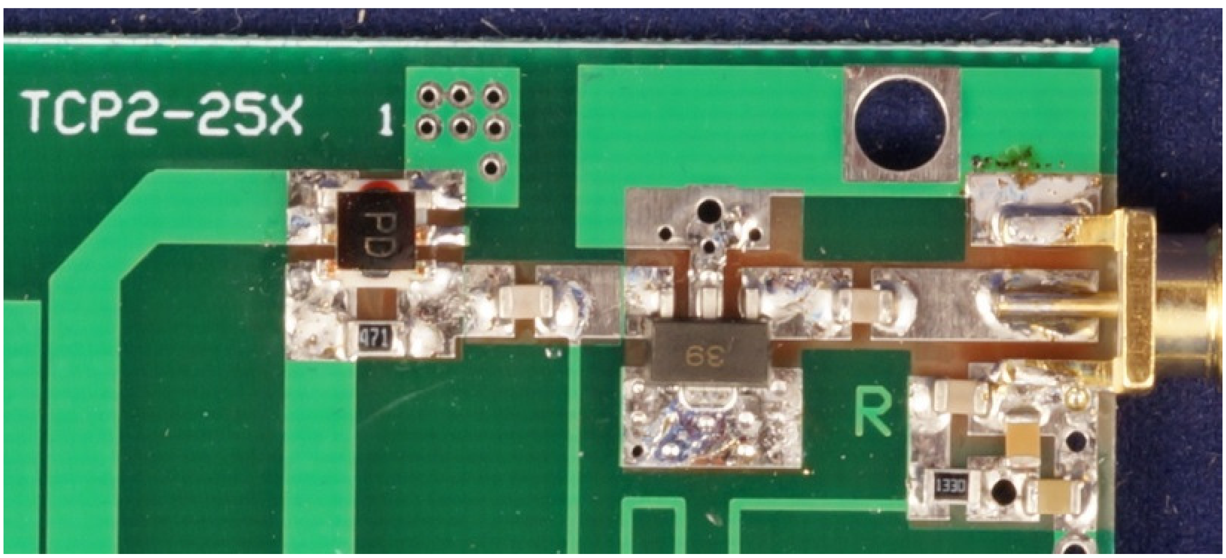


**Figure 4 – Power Splitter and Receive Front End**

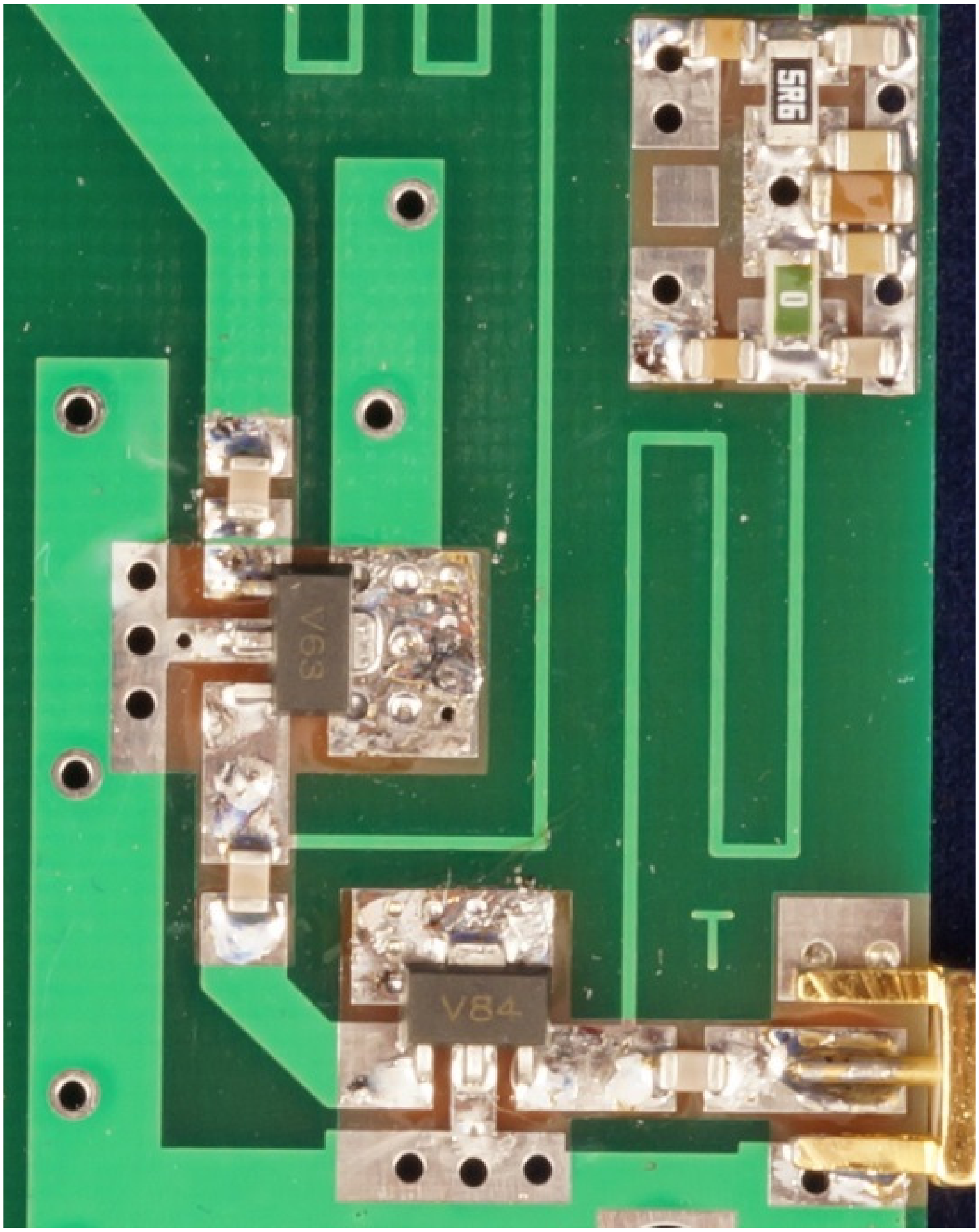


**Figure 5 – Transmit Amplifiers**

## Summary

This simple transverter should provide good performance as a rover or entry-level station. In many areas, the 900 MHz region of spectrum is pretty dirty and additional metal filters may be required, especially if you add an amplifier or preamp for better performance.