Updating the Simple Low-cost 2304 MHz Transverter for the Rover

Paul Wade W1GHZ ©2016
w1ghz@arrl.net

The first piece of my "Multiband Microwave Transverters for the Rover[1]" was the transverter board for 2304 and 3456 MHz, using MMICs and pipe-cap filters. The transverters have a design philosophy that **gain is cheap.** Cheap gain comes from cheap MMICs – the ERA series from Minicircuits have been the mainstays for microwave work.

These MMICs, in the 4-lead -86 package, are starting to become obsolete. Minicircuits has been good about keeping parts available, but other manufacturers are discontinuing some favorite parts. The MGA-86576 has already been discontinued by the manufacturer, although still available on ebay. Newer MMICs are available in the SOT-89 package with three leads and a ground tab, as well as much smaller packages. In PCB layouts for more recent designs, I have been using a MMIC footprint that will accommodate either the 4-lead or the SOT-89 package.

Some of the newer parts offer improved performance, particularly higher power made possible by improved heat transfer through the ground tab. Others offer better noise figure or lower price.

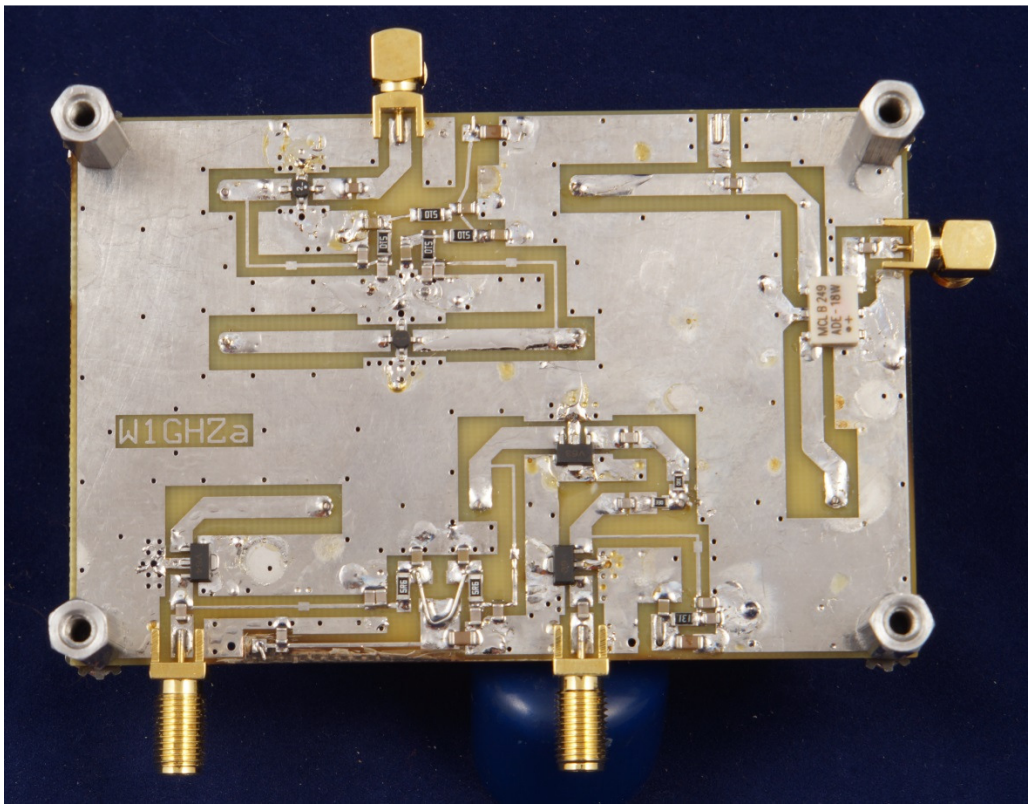

Figure 1 — Updated Transverter for 2304 MHz

A recent re-order of PC boards for the 2304 and 3456 MHz transverter offered a good opportunity to update the MMIC footprints on the boards to accommodate the newer MMICs. These will also work with the older style MMICs so all changes are optional, and others are possible. Then I assembled one, shown in Figure 1, with some of the newer MMICs.

I chose to leave the LO multiplier section unchanged, using an ERA-2 tripler from 720 MHz followed by a pipe-cap filter at 2160 MHz, an ERA-1 amplifier, and another pipe-cap filter. Frequency multipliers can be tricky, and I know this combination works.

For the rest of the transverter, I switched to new MMICs in the SOT-89 package. For the transmit side, I chose a GVA-84 output stage for higher power capability, driven by a GVA-63 which provides good gain at a very low price. The receive side has a single amplifier stage, which is changed to a GALI-39, specified as having low noise figure at 2.4 GHz. And all of these new MMICs cost less than $2 each.

The other change is to the bias resistors, shown in the schematic, Figure 2. The GVA- series MMICs operate directly from 5 volts – I prefer to have some resistance, so I changed R4 and R7 to 5.6 ohms but R5 and R6 are replaced with a plain wire, zero ohms, to +5V. The GALI-39 needs a bias resistor like the older MMICs, so R3 is changed to 130 ohms and connected to +8 Volts.

Performance

I first tuned up the LO multiplier section. Maximum LO power output at the test point was about +5 dBm with +6 dBm input at 720 MHz, which is slightly low but should be adequate for the mixer. The ERA-1 LO amplifer could be changed to a higher gain device for more LO output.

Then C6 was moved to connect the LO to the mixer. Transmit performance is very good, with an output of about +15 dBm at 1-dB compression, with -5 dBm of IF input. The output saturated at +18.3 dBm, or 70 mW. LO leakage is more than 35 dB down.

Receiver noise figure is about 5 dB, and seems to be limited by having only one stage of gain. I tried adding a simple MMIC preamp in front of the transverter – a GALI-39 preamp had about 3.5 dB noise figure, while a PHA-1 preamp had about 3 dB noise figure.

Tuning was quite sharp, with very narrow bandwidth. The LO section has a 3-dB bandwidth of about 5 MHz, while the transmit section bandwidth is about 8.5 MHz. These bandwidths seem narrower than needed, and could be increased and tuning made easier by increasing the probe depth in the pipe-cap filters. I used 400 mils, or 10 mm, as specified in the original article. Probably 11 or 12 mm would be better.

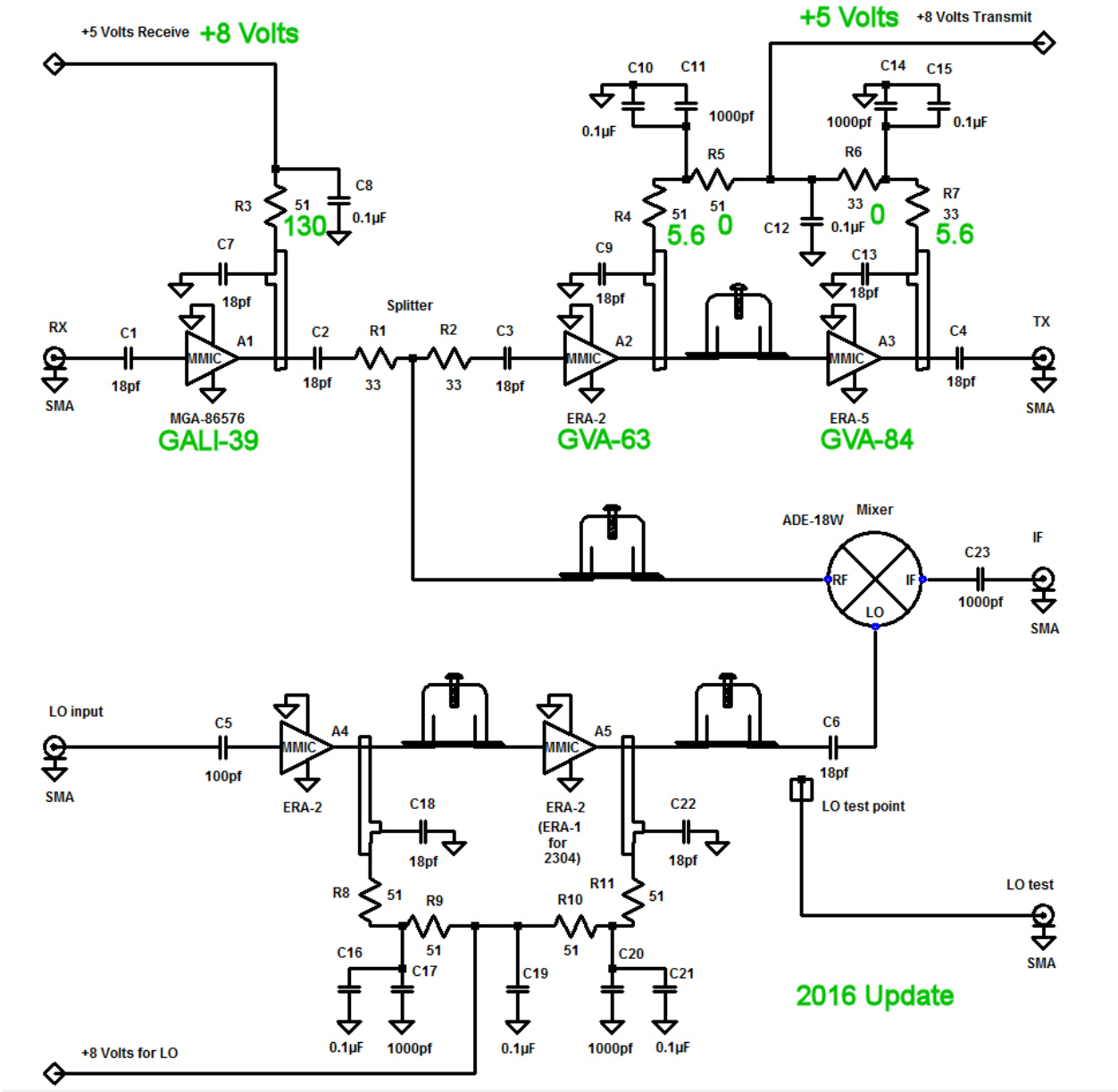

Figure 2 – Schematic of 2304 MHz Transverter, Updates in Green

Summary

Updating the simple transverter with newer MMICS provides improved performance without increasing cost or difficulty of construction. The same updates could be made for 3456 MHz.

Reference

1. Paul Wade, W1GHZ, "Multiband Microwave Transverters for the Rover," http://www.w1ghz.org/MBT/Multiband_Four_Microwave_Transverters.pdf