

A 222 MHz transverter for the Yaesu FT-817 – *Revisited*

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Paul Wade W1GHZ ©2012
w1ghz@arrl.net

My 222 MHz transverter project¹ was intended to provide the missing band to the FT-817 transceiver, a great rover rig. It proved to be quite popular, and, I hope, got some new stations on this neglected band. However, several of the key components, the Toko filters and the power amplifier module, have become unavailable, so I stopped making PC boards.

Recently, a stash of surplus modules was located by a fellow N.E.W.S. Group (www.newsvhf.com) member that contain both the power amplifier module and the larger Toko filter, along with some spare parts. These were acquired at a favorable cost, providing enough parts for another batch of PC boards. The combination should enable some more hams to get on 222 MHz at a reasonable cost. (Note: DigiKey apparently has several hundred Toko filters remaining at a good price – TK3501-ND.) Dick, WA2AAU, convinced me to make some more PC boards to put these parts to use and get more folks on 222 MHz.

Modifications to PCB

Since I was ordering new boards, I decided to make a few modification to extend the life, usefulness, and flexibility of these boards. Making them usable with other transceivers, particularly the FLEX-1500 and other SDR rigs, was also a consideration. The major changes include:

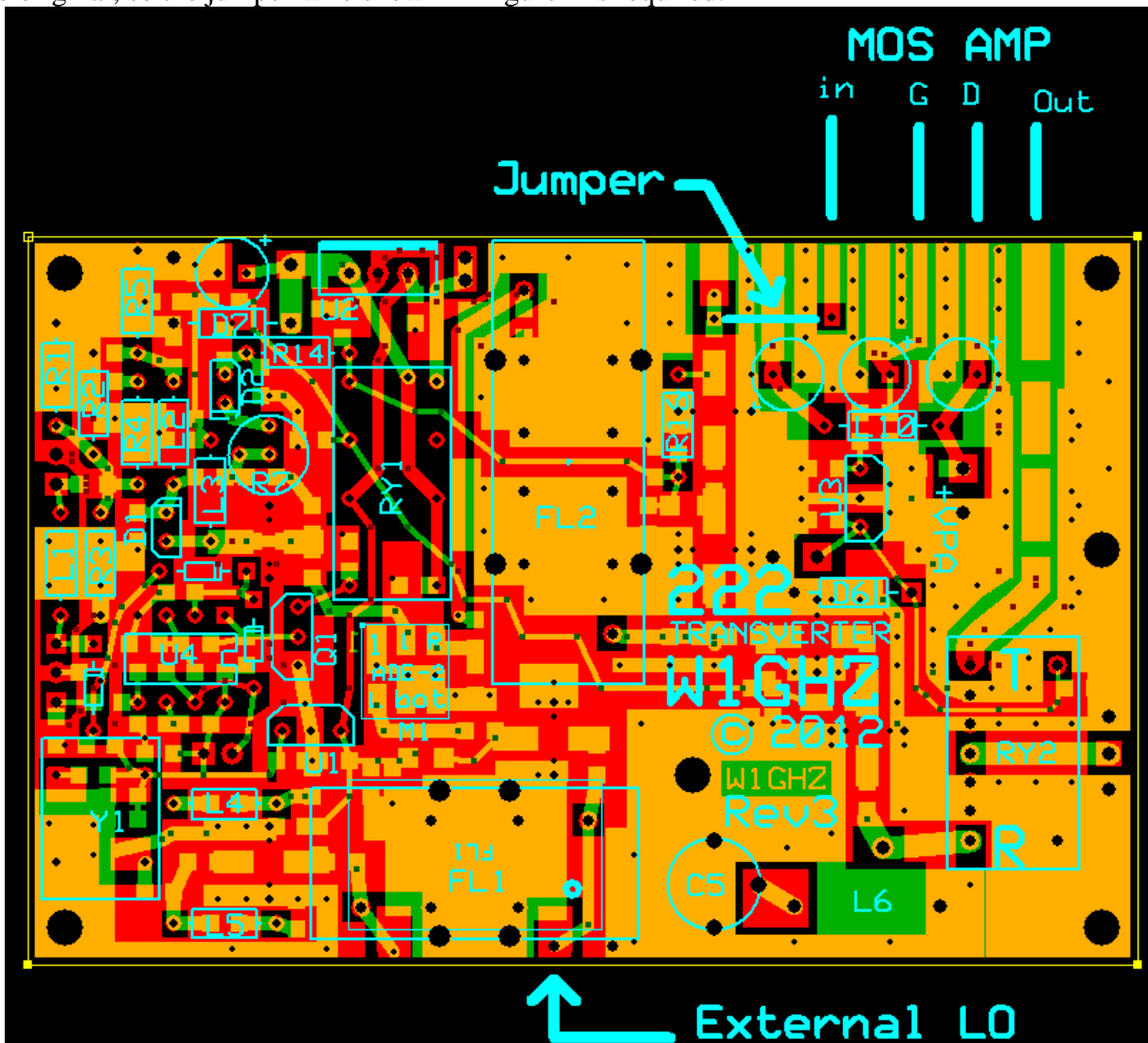
1. Making the power amplifier section compatible with both the current Mitsubishi M67723 and a newer MOSFET module, the Mitsubishi RA07M2127M. This requires some changes to the biasing scheme, detailed in the “Power Amplifier” section below. The newer module is significantly less expensive than original cost of the older ones.
2. The mixer was a Minicircuits TUF-1H, which has become rather expensive. In recent projects, I have been using inexpensive surface-mount mixers from Minicircuits, the ADE series. The new boards have a footprint for these devices, which cover a range of LO powers, from a standard level (+7 dBm) ADE-1 or ADE-2, to a high-level mixer, the ADE-1H (+17 dBm LO) for maximum IMD performance. In between are the ADE-1LH (+10 dBm) and ADE-1MH (+13 dBm); one of these might be a better choice if using the original LO scheme, since the typical output was +12dBm. The mixer goes on the bottom of the board, but the silkscreen pattern showing placement is on the top. Pin 1 is also indicated in copper on the bottom.
3. The LO has two changes:
 - a. A surface-mount oscillator footprint has been added, since oscillators with pins are getting hard to find. If you do find one, it will still fit.
 - b. The LO filter is no longer available. The footprint is modified to also fit a Minicircuits BPF-B199+ surface-mount filter.
 - c. An alternative is to use an external LO – many folks like to have an accurate frequency locked to GPS or other reference. One possibility is the VHF Apollo Synthesizer from Down East Microwave. The buffer amplifier, A6, can still be used to drive a high-level mixer. External LO connection point is shown in Figure 1.

Power Amplifier

The power amplifier section now has the option to use a MOSFET module, the Mitsubishi RA07M2127M, in place of the original bipolar module, Mitsubishi M67723. Since they have different footprints, the board has pads for both varieties, but the pads have tighter spacing, so soldering of the bypass capacitors may require more care.

If the original Mitsubishi M67723 is to be used, the original schematic and parts still apply. The placement and soldering of the bypass capacitors will require minor adjustment because of the tighter spacing. The only change is the new bias resistors, R101 and R102 – R101 is zero ohms, a piece of wire, and R102 is omitted. The supply voltage for this module is 12V (13.6V is OK), connected to the +VPA terminal.

The Mitsubishi RA07M2127M MOSFET module requires different bypassing and a significant change in voltages. The part is placed with the output lead on the same pad as the original module, but the other leads land on new pads, as shown in Figure 1. The new input pad is not connected to the original, so the jumper wire shown in Figure 1 is required.



The RA07M2127M MOSFET module is specified to operate at 7.2 volts, and capable of 8 to 10 watts output at a current drain in excess of 2 amps. This means that the voltage must be reduced with a voltage regulator that will dissipate perhaps 15 watts from a 13.6 volt supply – lots of heat sinking suggested if you plan on FM ragchewing. There are a couple of ways to reduce the voltage:

1. Separate 3-terminal regulator providing 7.2 volts to the PA “+VPA” terminal on the board. Adjustable regulators LM350 or LT1085 will provide the current with no problem. The adjustment resistors are set for 7.2 volts.
2. Large 8 volt regulator for the whole transverter in place of U2. A diode (rated for at least 3 amps) in series with the “+VPA” terminal will reduce the PA voltage to roughly 7.2 volts. Or you could just run the PA at 8 volts to the “+VPA” and get a bit more power out – the data sheet goes up to 9 volts.

The MOSFET module also requires setting the gate bias for the desired idling current. Typical gate bias voltage is 3.0 to 3.5 volts, set by R101 and R102. The output power doesn't change a lot with idling current, but the gain increases with higher idling current. A good starting point would be R101 = 200 ohms and R102 = 330 ohms, which should yield about 3.1 volts of gate bias.

Other Transceivers

Many of the SDR transceivers, like the FLEX-1500, have a transverter port with an output of roughly 0 dBm, adjustable in software. At this level, no TR switch is necessary, so we can simplify things – remove the PIN diode switch and reduce the input attenuator to perhaps 3 dB, just enough to provide a good match to the mixer. So R1 and R5 = 300 ohms, R4 = 18 ohms; C42 and D1 are replaced by wires to provide a straight-through connection. Components to be omitted are: R2, R3, R6, R7, R8, R9, R10, R14, D2, L3, C21, C43, C45, C46, and C75.

The “Band Data” input should be >4 volts to activate the transverter – this can be provided through the IF connector, J1, if desired. Then the “PTT LO” pin is pulled to ground to transmit.

If, for some reason, you wish to use a high-power transceiver, you'll have to figure out what to do with the excess power. Turning the power output down may not work – many rigs output a spike at full power before the ALC reduces the power; the spike will damage something sooner or later.

Other bands

Most of the SDR transceivers only go up to 6 meters – we would like to use them on higher bands. The only components in this transverter that are frequency sensitive are the LO, the filters, and the PA module. We have already considered the possibility of an external LO, so that is not a problem. MOSFET PA modules with the same pinout are available for 144 (RA08H1317M) and 432 MHz (RA07H4047M). These versions also run on 12 volts, simplifying the regulator problem.

The remaining problem is the Toko filter, FL2. Unless you have any in your junk box, they are not available. Temwell makes equivalent filters, but the minimum order is a bit steep. They also make similar filters in a smaller package, which Down East Microwave uses in their current products. DEMI may also have an adaptor PCB to fit the Temwell filters in a Toko footprint.

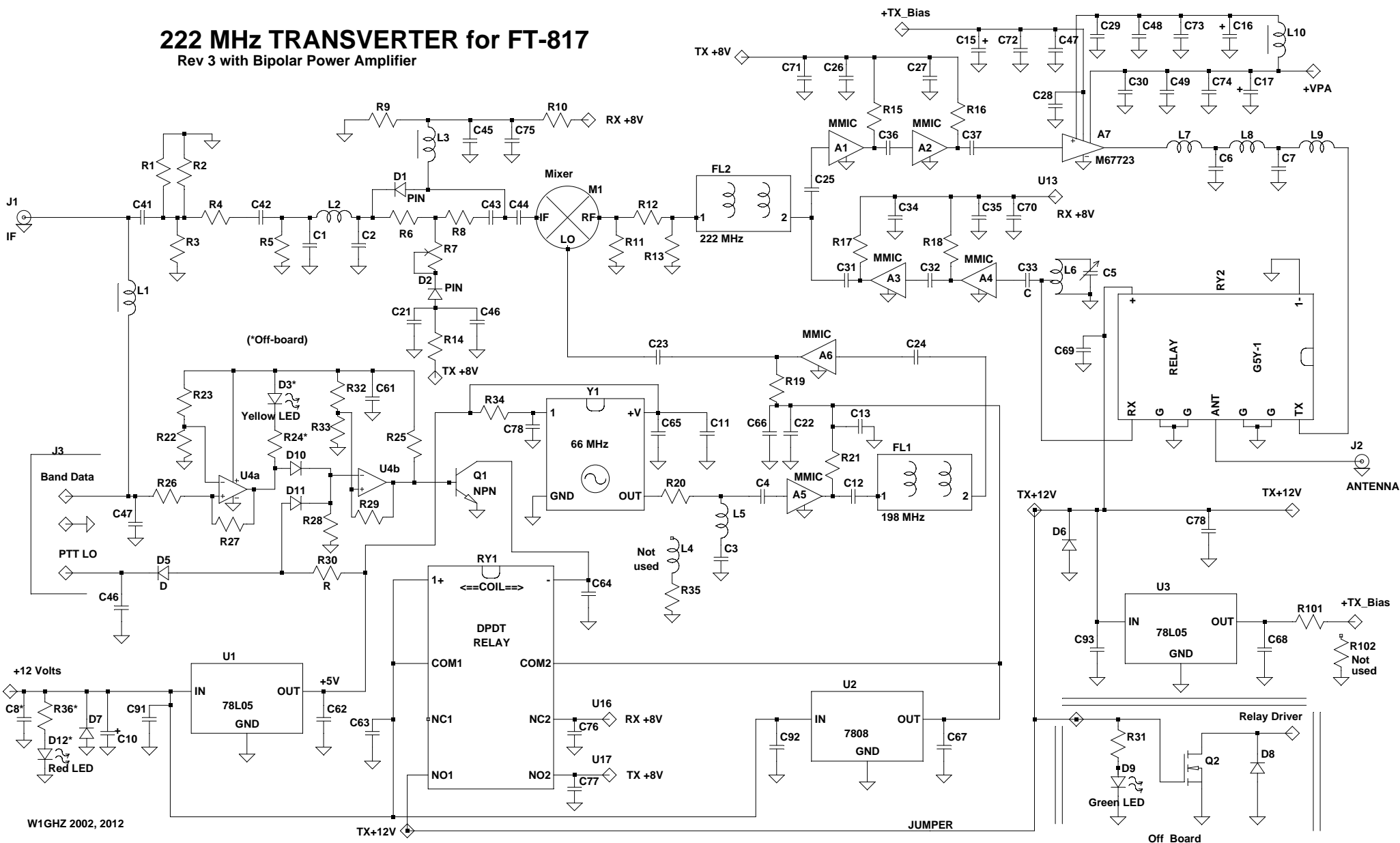
The receiver input coil, L6, and the transmit low-pass filter, L7, C6, L8, C7, and L9 will have to be adjusted for other bands. These are hand wound coils, so changing values is not a major problem.

Reference

1. Paul Wade, W1GHZ, “A 222 MHz transverter for the Yaesu FT-817,” *QST*, January 2003.
<http://www.w1ghz.org/222xvtr/222.htm>

222 MHz TRANSVERTER for FT-817

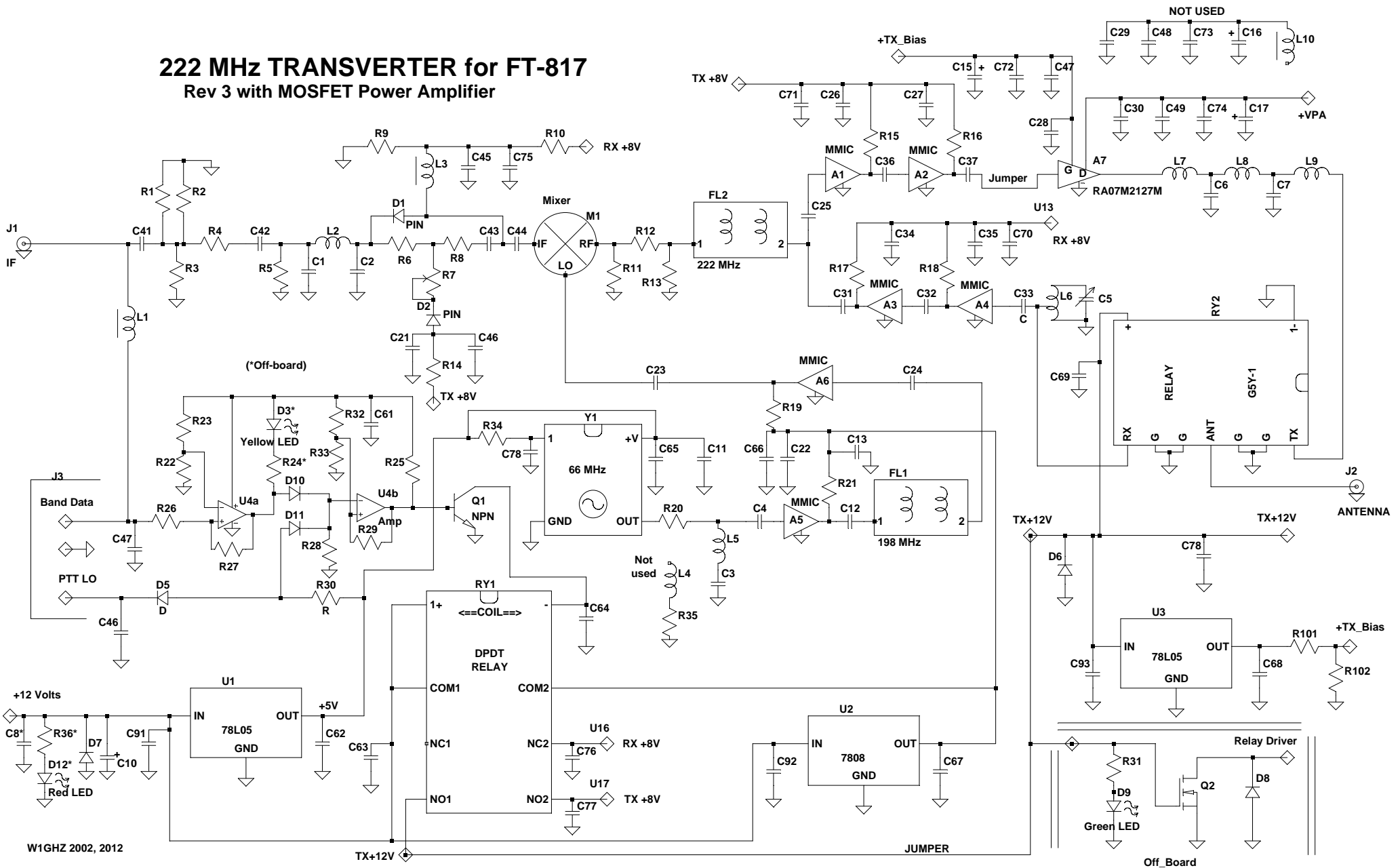
Rev 3 with Bipolar Power Amplifier



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222 MHz TRANSVERTER for FT-817

Rev 3 with MOSFET Power Amplifier



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