Miniverter for the Flex-1500 and Microwave Transverters

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I recently received a new Flex-1500 transceiver from FlexRadio Systems. So far, I have only used it on 10 GHz for receiving, since the radio only covers up to 6 meters and I didn't have a suitable low-power transverter for the 144 MHz IF of my microwave transverters. However, it works really well – during MDS tests at the NEWS picnic last July, I was able to find a signal on the waterfall display before anyone could hear it.

Several years ago, I built a Miniverter[1], a minimal low-power transverter for 2 meters. The problem was, and still is, finding a suitable oscillator to convert to a lower ham band. I used a surplus 115 MHz oscillator, but it required a negative supply voltage and is flakey running upside down, with the case hot.

Since the Flex-1500 has a separate transverter port that will operate at any frequency up to 54 MHz, we have free range for oscillator selection. I started with the Miniverter artwork and added some updates; for instance, the Toko helical filters are no longer available, but newer, smaller Temwell filters are available from Down East Microwave. I also added a minimal sequencer to drive a relay and also an external relay while protecting the Flex-1500 PTT output from relay spikes. The internal relay is delayed to give the external relay time to operate. The Power-SDR software can be set to delay transmitter output as well – combined with the minimal sequencer, the switching sequence should be good for transverter control.

Miniverter-F

The schematic is shown in Figure 1. Circuitry is minimal – oscillator, mixer, one MMIC each for transmit and receive, and an inexpensive relay for TR switch and power to the MMICs. Small attenuators on the IF and RF sides of the mixer might help with dynamic range. Overall gain is about 0 dB – on transmit, 1 milliwatt from the IF port yields one milliwatt to drive a microwave mixer.

The PTT connection to the radio is a DB-9 connector, matching the radio output. The minimal sequencer is drives the external relay, then the internal relay after a short delay. You can bypass it and wire directly to the radio to save a few cents, which you will probably spend on postage sending the radio for repair.

A completed Miniverter-F is shown in Figure 2 – it should fit fine in an Altoids tin, but you could get fancier, or just integrate it with a microwave transverter. Small coax is best for connections to the board, but twisted wires should be OK for short distances.

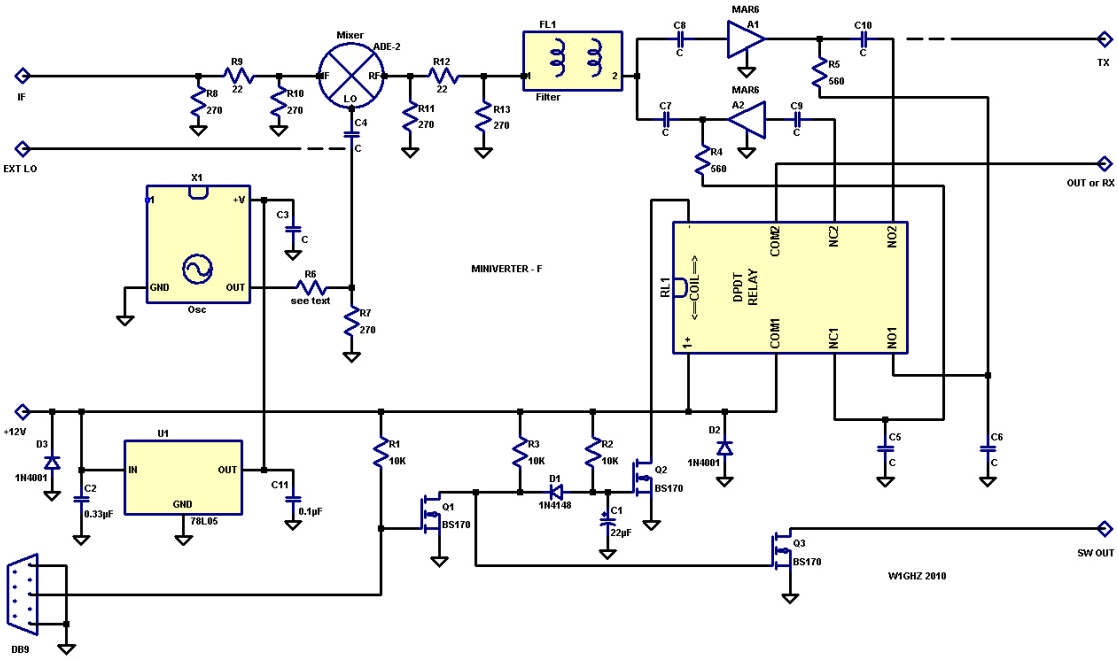


Figure 1 – Schematic Diagram of Miniverter-F

The ExpressPCB pattern is shown in Figure 3. Topside parts are labeled in silkscreen, but the RF parts are surface-mount on the bottom side. The bottom view in Figure 4 shows part locations. A parts list is shown in the Appendix; everything may be substituted as desired, but only Temwell filters will fit in the holes.

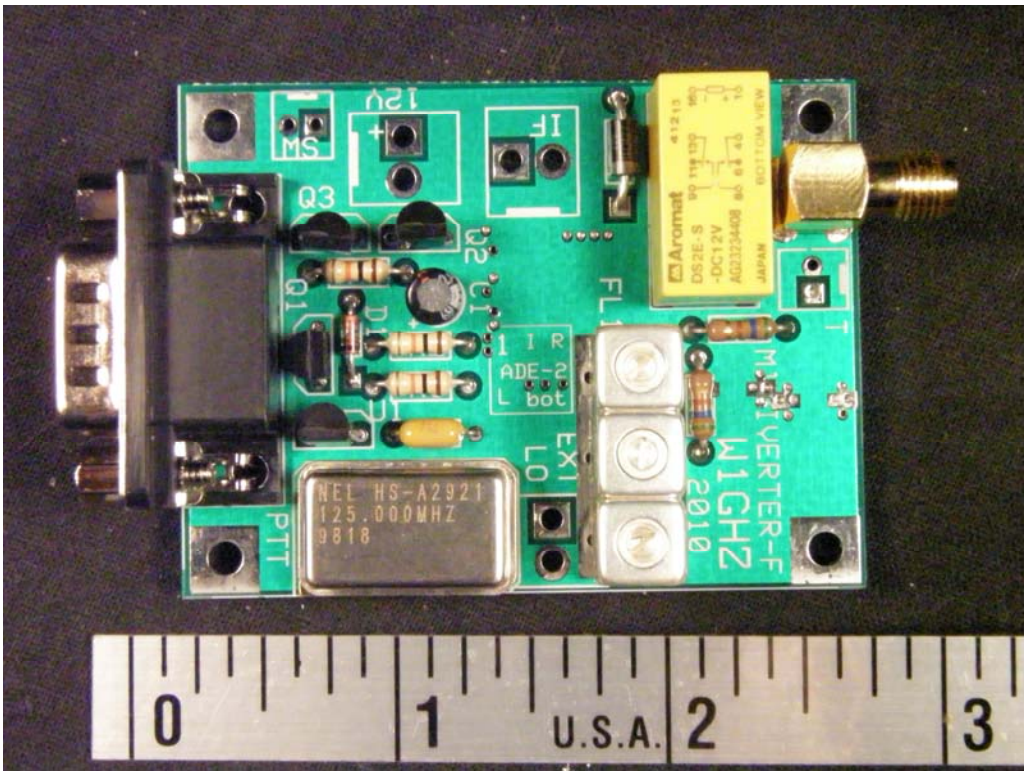


Figure 2 – Top view of Miniverter-F

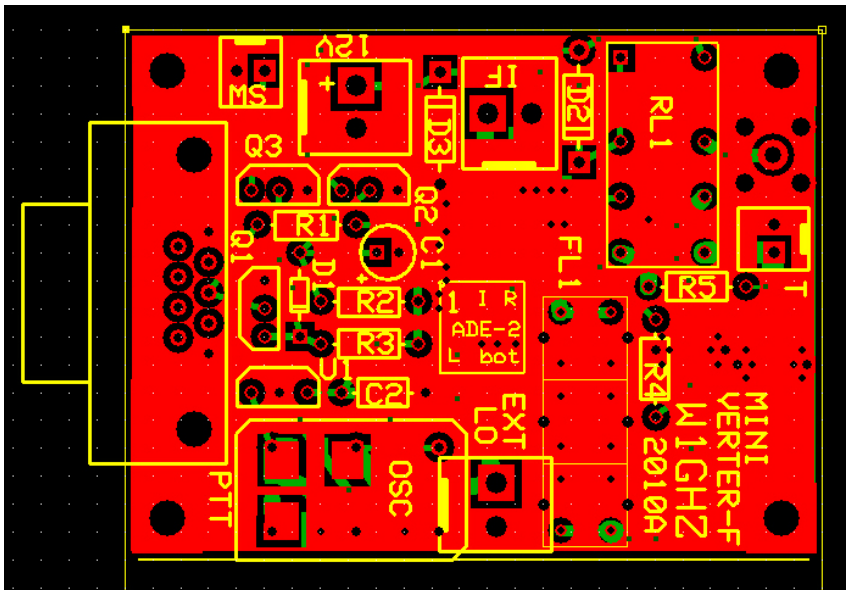


Figure 3 – PCB layout for Miniverter-F

Options, Questions and Answers

Almost any computer oscillator should work on this board – full-size, half-size, or surface-mount. I used a125 MHz oscillator, which yields a 19 MHz IF, since I had a tube of them in the junk box,. Other usable common oscillator frequencies are 100 MHz, 120 MHz, and 133 MHz. The oscillator I used has PECL outputs, which require a DC path to ground provided by R7. Oscillators with CMOS outputs have an output with too large a voltage swing, so a resistive voltage divider, R6 and R7, is recommended – the mixer wants to see 1 to 1.5 volts peak-to-peak.

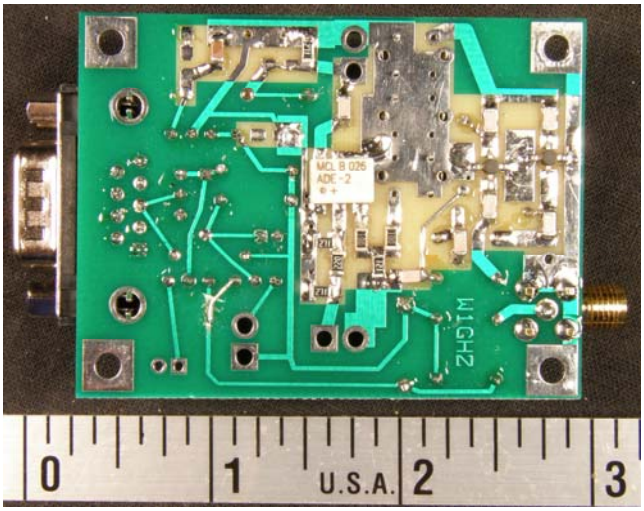
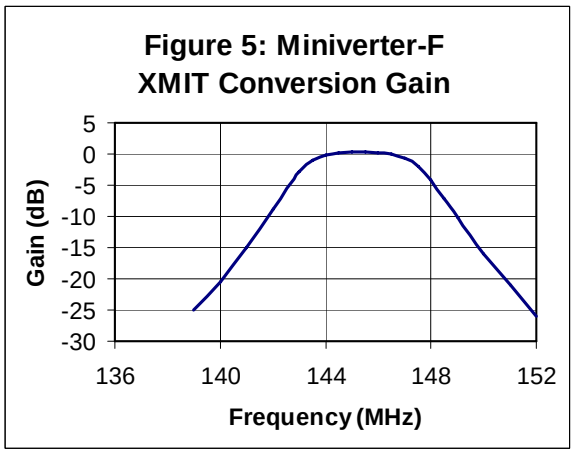


Figure 4 – Bottom view of Miniverter-F prototype

Of course, computer oscillators are never exactly on frequency. The Flex-1500 doesn't have a big knob either, but the panoramic display will show signals that are reasonably

close. The software can correct for oscillator offset as well, to make the frequency read what you want. If you insist on exact frequency, since the radio and some transverters can lock to a 10 MHz reference, an external oscillator is required. Required LO power is +4 to +10 dBm. I've been looking at a little synthesizer by KD7TS – see his web page.

How good are the Temwell Filters? The transmit conversion gain vs. frequency is plotted in Figure 5 – pretty flat from 144 to 147 MHz, with no tuning.



What about other bands? Some microwavers prefer a 432 MHz IF – it has some advantages, particularly for 10 GHz and up. Simple – just change the helical filter and use an external oscillator or synthesizer. Down East Microwave has interchangeable filters for 144, 222, and 432 MHz. The inexpensive relay has adequate performance thru 432 MHz, but not much higher.

Why didn't I use power from the USB? Because the computer makes enough noise and birdies without a direct connection.

Can it be used with other radios? Of course. You'll have to figure out how, and apply an X-Acto knife as needed.

Is there a high-power version? Call Down East Microwave.

Availability

If there is any interest, I'll have some boards made, and Steve at DEMI is willing to kit up the parts. You provide the soldering and eat the Altoids mints.

Reference

1. P. Wade, W1GHZ, "2-meter Miniverter," *N.E.W.S. Letter*, North East Weak Signal Group, March 2001, pp. 5-6.

Miniverter-F Parts List

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RefDes	Value	Type
C1	22uF (or more for longer delay)	Electrolytic
C2	0.33uF	Chip or leads
C3-C10	"C" = 470 to 2000pf	Chip
C11	0.1uF	Chip
D1	1N4148 or 1N914	Axial lead
D2,D3	1N4001 to 1N4007	Axial lead
R1-R3	10K	1/4 watt
R4-R5	560	1/4 watt
R6	zero for PECL osc, 270 for CMOS	Chip
R7	270 for PECL osc, 270 or less for CMOS	Chip
R8,R10,R11,R	270	Chip
R9,R12	22	Chip
Q1-Q3	BS170 FET	TO-92
RL1	DPDT	DIP
FL1	Temwell Filter 144 MHz (or 222 or 432)	3-pole
U1	78L05 Voltage Regulator	TO-92
X1	100 to 133 MHz oscillator	Can or SM
DB9	D-sub connector	mate with Flex-1500

Note: Chip caps and resistors can be 1206 or 0805 size

Appendix