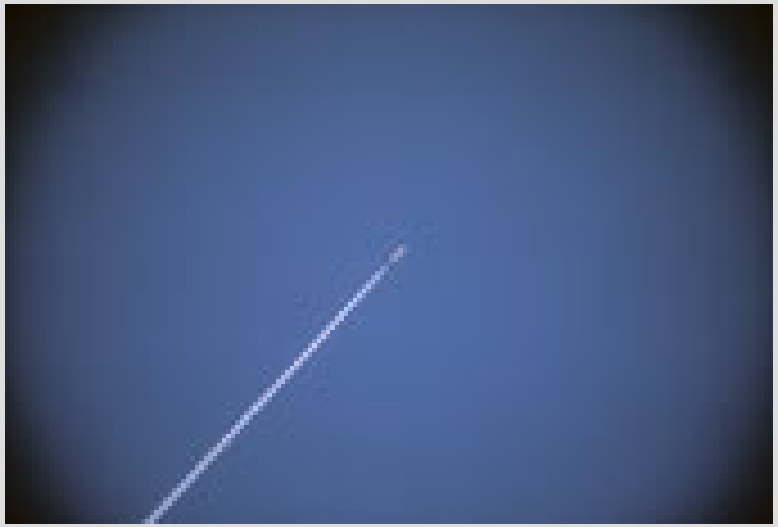
This is not Foxhunting

I got a whole space program.

I was going to transmit telemetry from model rockets.



I could just hear the squealing of data as my giant rocket blasted 100s of thousands of feet towards outer space. Dish antenna the size of a swimming pool sweeping upward to follow the rocket. Reams of paper spewing out of chart recorders, spilling on to the floor.

Eric O / KE6MLF

Back Here on Earth…

I intended to collect and transmit data for pressure, temperature, acceleration, and spin (via a light sensor through a hole in the side). Best yet, after the rocket lands, I could use the same transmitter to locate it. Just walk over, and pick it up.

However, a bit of a reality.

Lets start small, with just the location finder part, and work up from that.

How the Heck?

Problem was, how to get a small transmitter that could be used as a locator, and then upgraded to also collect and transmit telemetry data? Most likely not sufficient knowledge to do it without a lot of experimentation.

Deliverance from QST

In 2007, QST published an article by Jerry Baumeister KD5ZUG. It was a 2 meter FM transmitter that transmitted data in CW format. Most importantly, it was technology I was familiar with, using a Microchip PIC processor, and it was crystal controlled for stability.

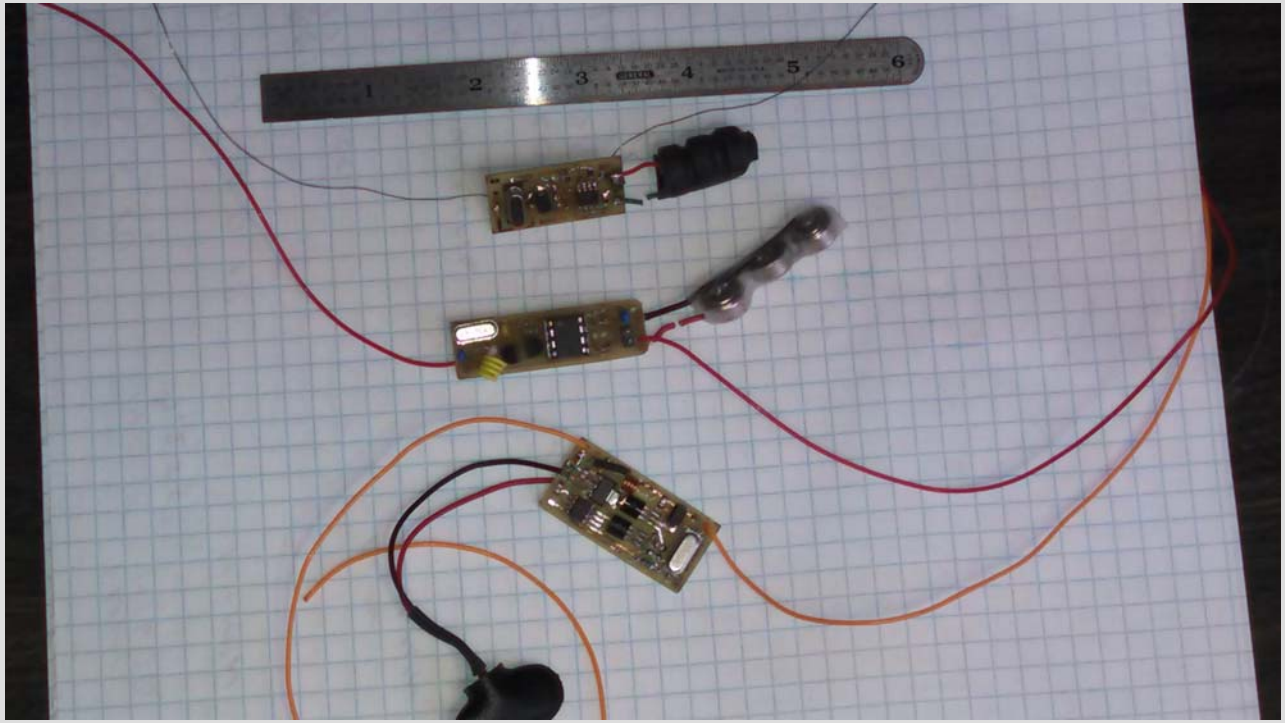
I made the circuit board using the toner transfer blue film, then throwing the board in Ferric Chloride. To make it easy, I got a sheet of copper clad fiberglass that was not 1/16-inch thick, but half that, 0.032 inch thick (lighter weight). Easy to cut with tin snips. Programmed the chip with my Microchip Picstart programming adapter.

WORKS! Testing the transmitter on a bench was easy. Placed it ¼ mile up the street, again no problem. Top to bottom:

Original version

Skinny model

9V regulator on board



Stuff I Made, Acquired, or Obtained

For the transmitter, I made a few, as I thought the antenna wires would break and the batteries would run down. Next, made a rocket or two and I got some engines.

Oh yes, a few more items to take with us…

Igniters, wadding, parachutes, tape, repair glue, assorted small hand tools, the launch pad, launch rod, launch button and wiring, a bunch of batteries, handheld radio #1, a spare charged battery, the antenna adapter, handheld radio #2, its antenna adapter, a handheld Yagi antenna, a soldering iron, spare antenna wire, some solder, a hot glue gun, glue, a cooler, drinks, snacks, hats, sunscreen, sun shade… Off to the Launch!

The Expected Scenario, or Things I Thought I Knew

The best place for launching rockets in Southern California is Lucerne Dry Lake. It is miles in diameter, flat, with absolutely no vegetation on it. A club here in Southern California has a launch each month.

At the first launch, I stood ready with handheld radio and my tape measure Yagi antenna. At launch, I followed up the rocket with the antenna.

1. Turns out, a **spinning rocket makes for a spinning signal**.
2. When tracking, you **listen to the noise in the signal**, not IF there is a signal.
3. It is a challenge to hear the received signal. Wind noise, the public announcement system, and of course, people asking me if I can hear the rocket, or if I can find their rocket.
4. My tape measure Yagi elements bend and vibrate in the wind, making noise (1/2 inch wide elements).
5. Prep time and rockets sitting on the pad can make for multiple transmitters beeping.
6. **The instant a rocket hits the dirt, the signal is gone**.

Antenna – Tape measure Yagi, Arrow Yagi

Lessons Learned

• Don’t transmit data. Store it in memory, download it later.

• Use 1 inch wide tape for the tape measure Yagi, not 1/2 inch. Wind vibration is noisy.

• Headphones. Drowns out the wind, and the people around you.

• Make different CW tone frequencies for each transmitter. I have had several running at the same time.

• Take a bicycle, with a basket for the radio and holster for the Yagi.

• The lakebed is wide open, but it is also packed silt that gets in to everything. Never thought I would have to take a spray bottle of cleaner and a cloth to wash the dirt off rockets and radios.

•Even though the rockets are equipped with the latest in locating technology, they can still land a long way away. Take a heading, have faith, and just keep walking.

• Just about the time I start to get quieting, or maybe some modulation in the noise, I spot the rocket 50-100 feet away. I have not lost a rocket since.

Take a Hike - small

Take a Hike - medium

Take a Hike - large

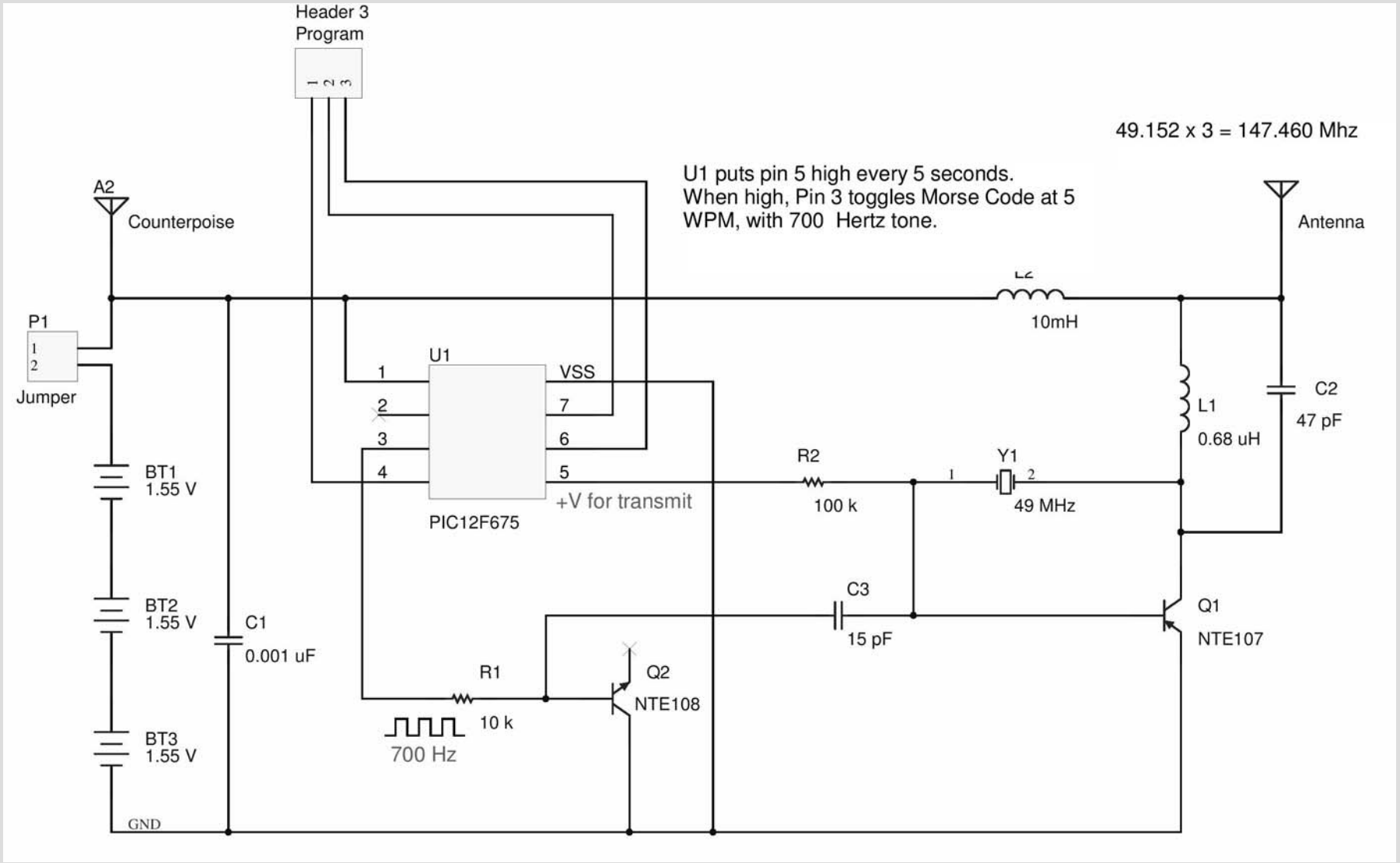
Alternatives

There are commercially available product for rocket tracking. A few transmitters and a receiver are sometimes at the launches. When they put this 100 milli-watt transmitter in a rocket that goes to 15,000 feet, they think they can find it when it lands in a ditch 3 miles away. When they lose contact with it, they see your antenna and ask if you can hear it. Umm, wrong frequency, and did you take a heading while it was still airborne?

The Transmitter

- 3 button batteries at 1.55 volts each.
- Microchip PIC turns on and off CW every 5 seconds or so.
- On / off signal is modulated at 700 Hz to create a tone.
- Transistor acts like a Varactor Diode (modulated by tone signal).
- 10-15 milli-Watts?
- Has naughty harmonics.
- 49.152 (used on 3rd overtone) crystal is like $0.50.
- Two transistors are $1-2 each.
- Antenna is 28 AWG magnet wire strung down the side of the rocket. Counterpoise is coiled up in the nose cone.

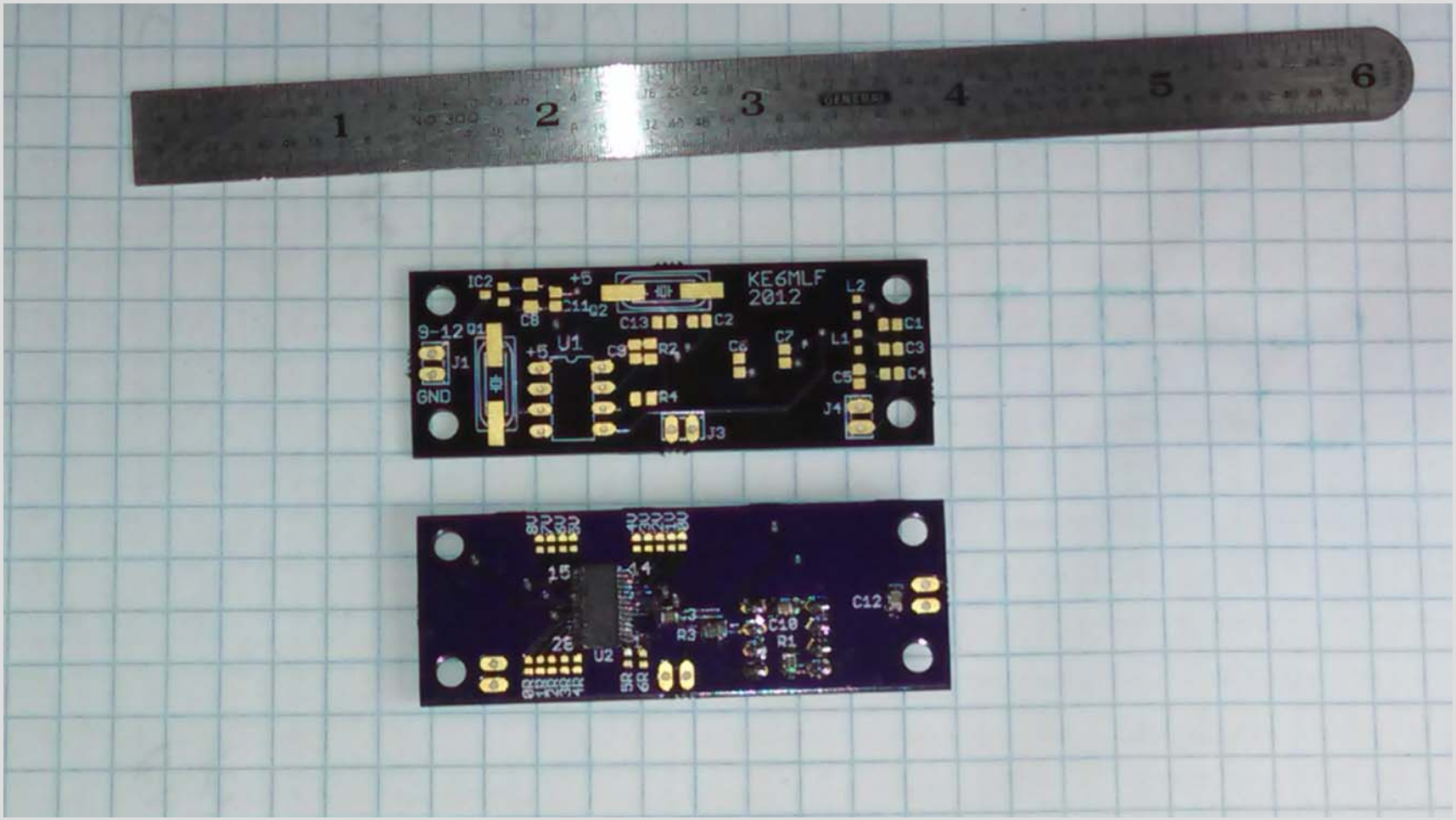
The Schematic



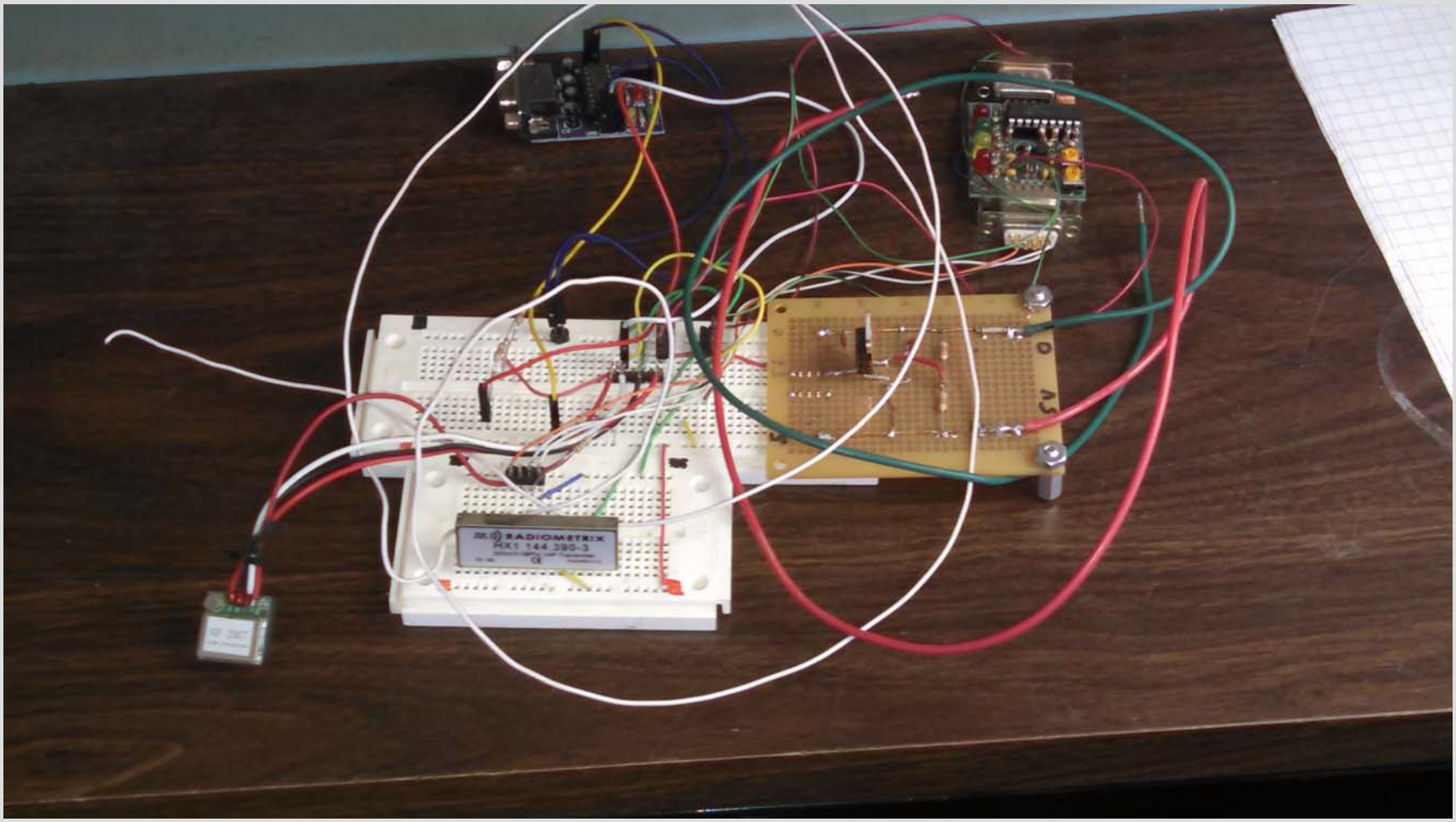
Next Steps

- Get more transmitter boards made. They get broken after some number of flights.
- Solar powered with a flexible panel.
- Add PL tone for multiple live transmitters.
- Get a battery tab welder working for button cells, or put sockets on the PCB.
- Frequency agile version using frequency synthesizer chip.
- Antennas – figure out how to keep the antenna out of the dirt when the rocket lands.
- Output filter to cut out primary frequency and 1st harmonic.
- ICS525 Frequency Synthesis (Montreal Fox?).
- GPS / 300 milli-Watt transmitter (APRS) – receiver / Bluetooth TNC / tablet or android device map display.

Next Steps – IC525 Frequency IC



Next Steps – GPS / APRS



APRS Tracker - PCB

Bigger Rockets are Better – 5,000’