

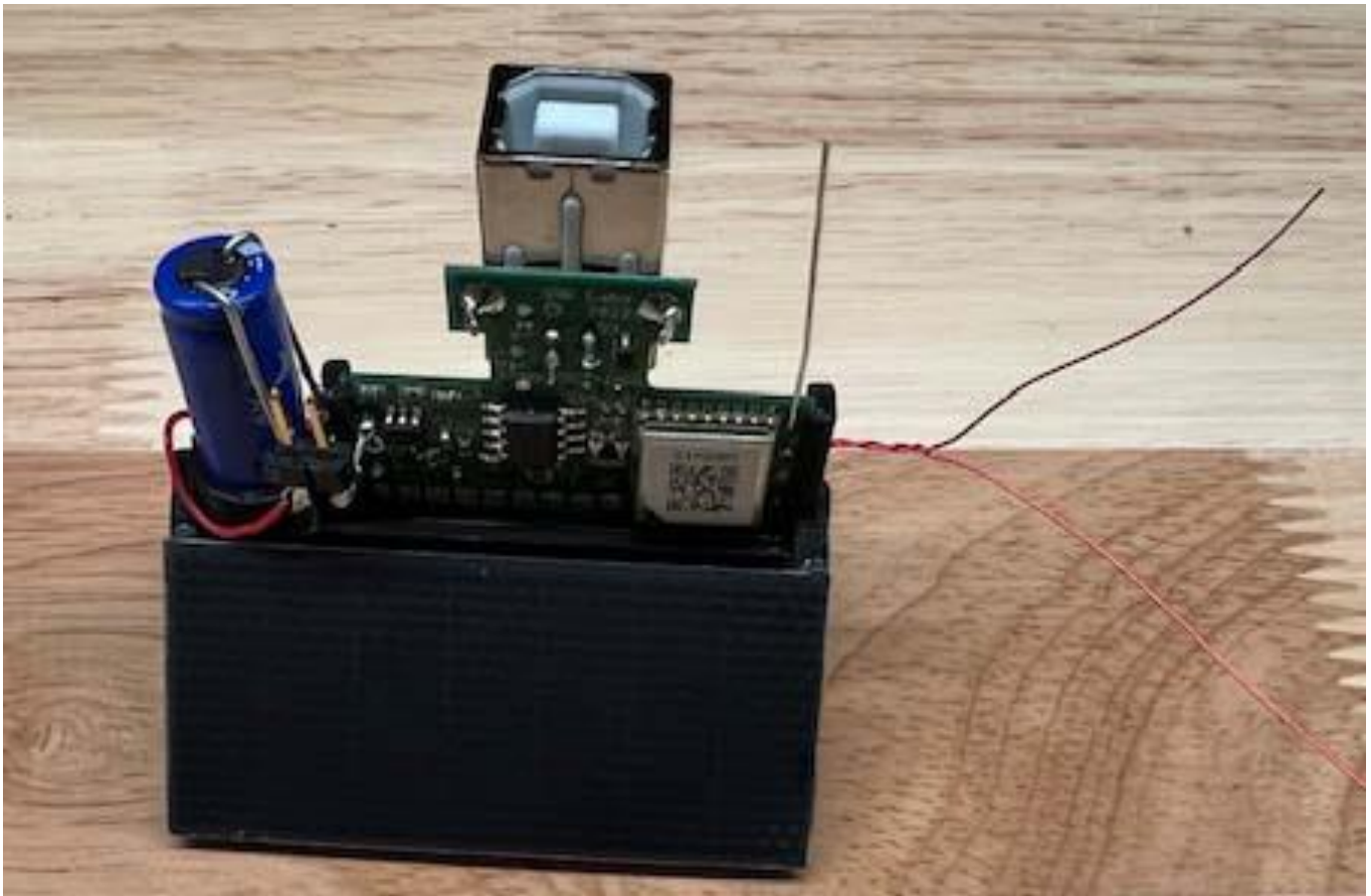
# Design and Analysis of Flight ALP40-B

## Goal

To design a Pico-Balloon that could operate 24 hours a day.

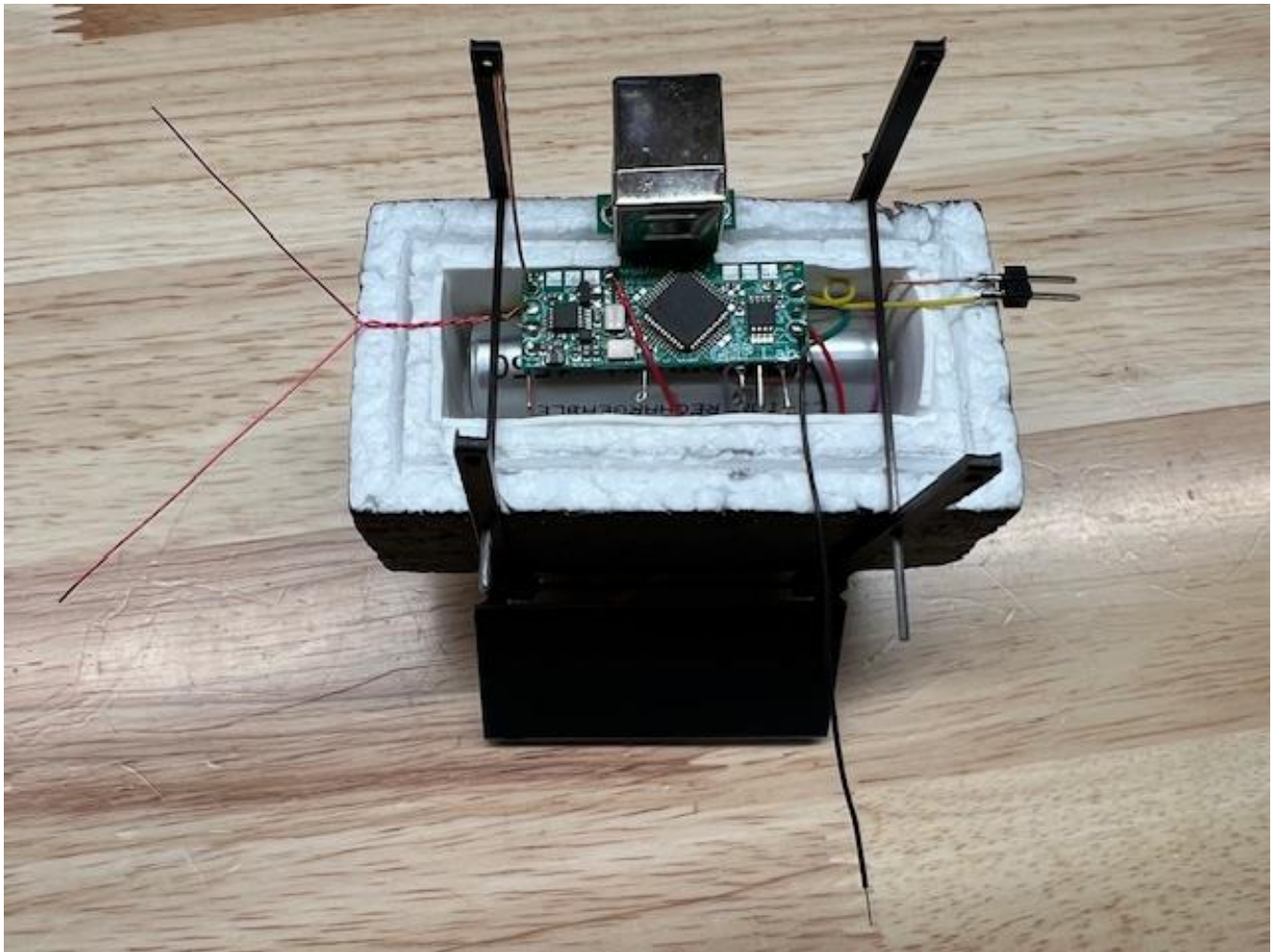
## Design

After doing research on groups.io pico-ballooning and other mixed media, it became evident that to be successful, it would require a battery that could handle the cold temperatures encountered at high altitudes. After a lot of searching, I found and selected a Tadiran Lithium battery [TLI-1550ES](#). Though not perfect, it provides the best operating temperature range, capacity and mass of any I found. Additionally, I would use a similar platform to what was used for ALP40-A, (photo below) which circled the globe over 6 times in 74 days.



## ALP40-B

In this design, I would still use the QRP Labs U4B as the tracker, the [Anysolar IXOLAR High Efficiency Solar MD SM141K07F](#) panel and GPS/HF dipole antennas. The actual structure (3D printed ABS and 1 mm carbon fiber rod) would have to be modified to accommodate the battery. I decided to make a reasonably sized Styrofoam box with a lid for the tracker and battery, which would insulate the two of them from the harsh conditions and low temperatures.



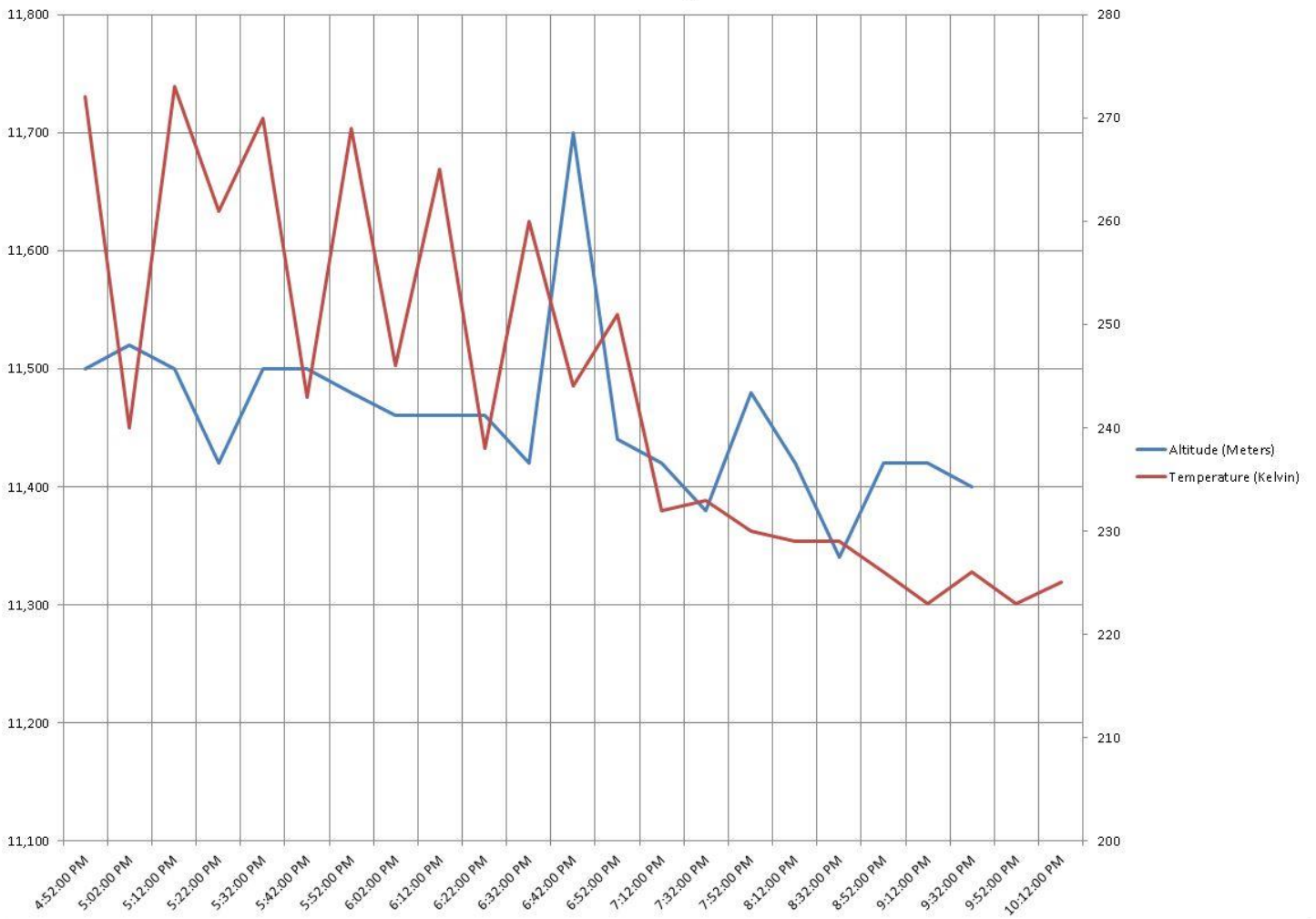
An air gap between the two layers of Styrofoam was used to increase the insulating factor. Aerogel was used under the battery to increase the insulating factor as well. The exterior of the box was painted flat black to absorb heat from the sun/earth. I added an external air temperature sensor, [Innovative Sensor Technology P10K.520.6W.B.010.D](#). The U4B software was modified to transmit alternately PCB temperature and outside air temperature. The Yokohama balloon was stretched to 103", the payload had a mass 40 grams and float was 5 grams. Hydrogen was used to inflate the balloon.

The balloon was launched on April 10, 2024 at 8:32 am PDT from the Boulder City Dry Lakebed, Nevada and after the balloon popped, it came down and landed at 1:52 am CDT in Alpine, Texas; click [here for tracking](#). The balloon was recovered by Charlie, N5CET and returned by USPS to Nevada. Close inspection of the balloon left no doubt it popped; the top was blown open.



About 16 hours of telemetry was collected. So what was learned from the flight...IMHO, insulation is a waste of time, materials and effort? The battery has to be able to withstand the cold. Take a look at the chart below.

Time vs Altitude - Temperature at Float



About 5:52 pm PST the sun was within an hour of sunset over New Mexico and you can see on the chart above the PCB temperature was 269 K (-4 C) at 6:02 pm the outside temperature was 246 K (-27 C). You can see at this point the temperature inside the Styrofoam box is much warmer than outside. By the time you get to 7:12 pm PDT the outside temperature is 232 K (-41 C) and at 7:32 pm the PCB temperature is 233 K (-40 C). From then on, there was little difference between PCB temperature and outside air temperature. The reader can draw their own conclusions as to the effectiveness of an insulating box for Pico-Balloon payloads.