ezRA - Easy Radio Astronomy – Hardware 2

- Jul-14-2024

The ezRA Easy Radio Astronomy set of programs are free PC tools to help explore Radio Astronomy. The programs run on the Python3 programming language, on Windows and Linux.

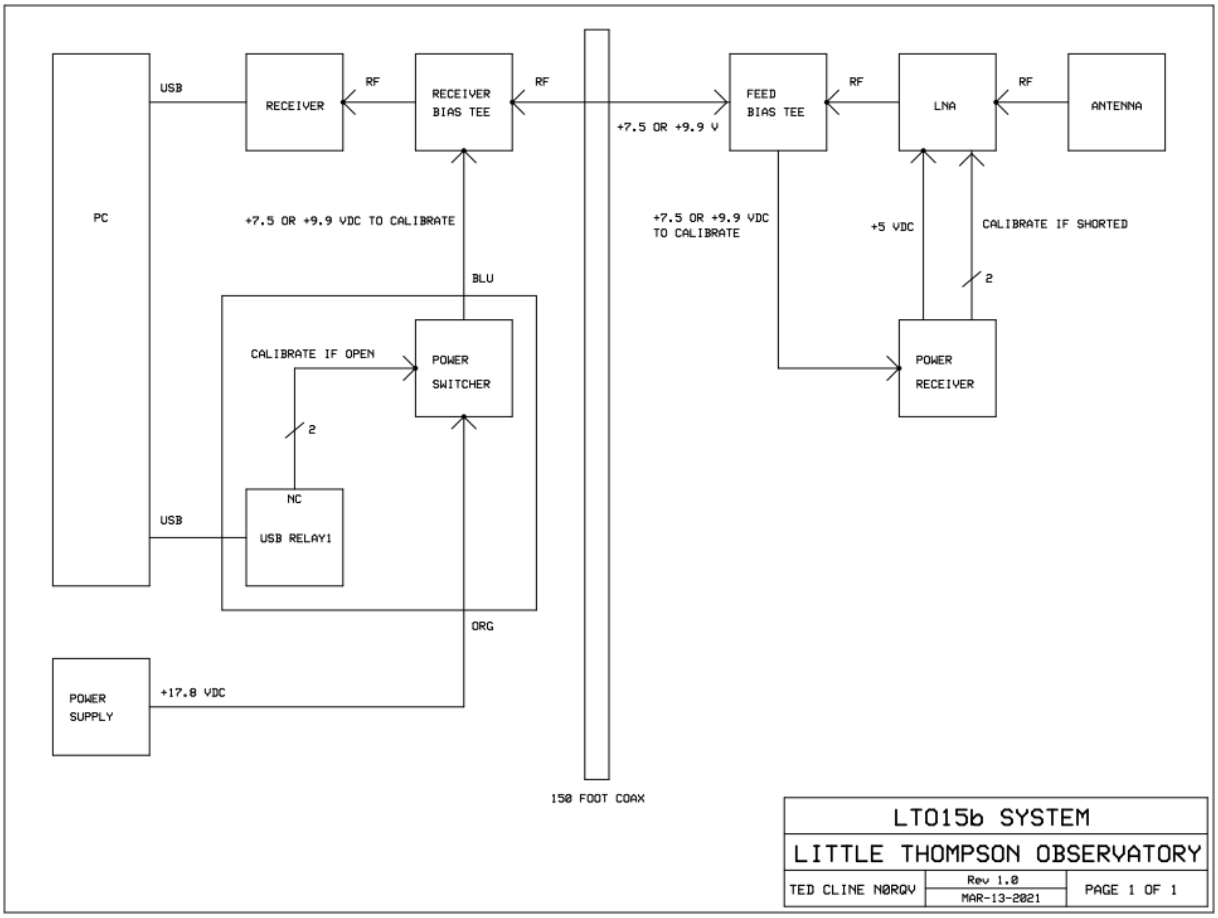
The ezCon program does better when provided Reference samples.

The easiest Reference samples come from ezCol using a separate Reference Frequency, such as 1423.405 MHz with “-ezColCenterFreqRef 1423.405”. No additional hardware is needed.

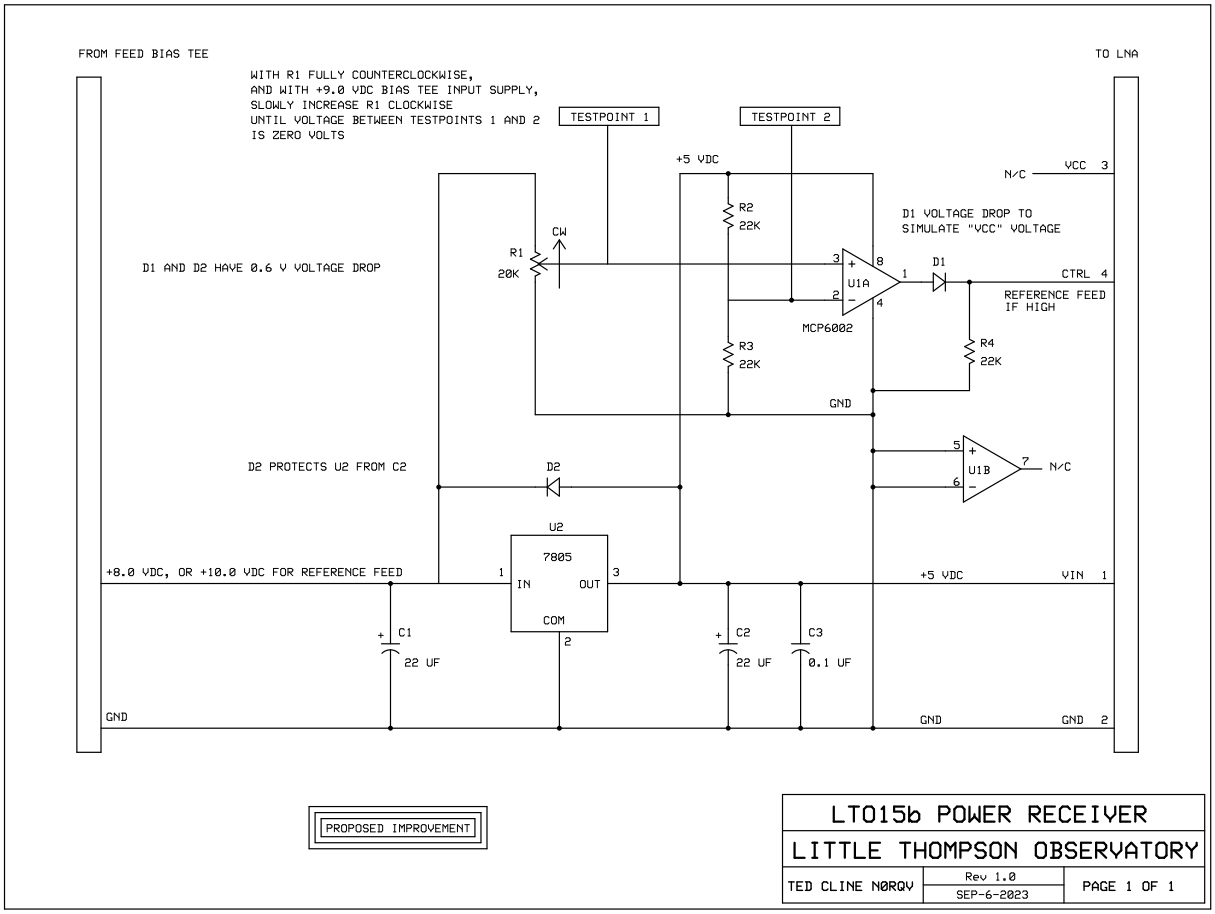
But better Reference samples come from a resistor near the antenna. The “Nooelec SAWbird+ H1 Barebones” LNA suggested above includes an RF switch connected to a 50 ohm reference, controlled by shorting pins 3 and 4 on its 4-pin header connector (this RF switch is not included in the similar shielded “SAWbird+ H1”). This resistor can provide convenient Dicke Reference data samples to track system gain variation due to temperature variation. Pins 3 and 4 could be PC-controlled with additional long wires, but that may introduce additional voltage RFI and cost.

The system below has a “Power Receiver” circuit to short LNA pins 3 and 4 with a local relay, when driven with a higher bias voltage from a “Power Switcher” circuit, controlled by a USB relay. The ezCol collection program supports controlling this system with “-ezColUsbRelay 1”, and the ezCon analysis program supports this system with the default “-ezConRefMode 10”.

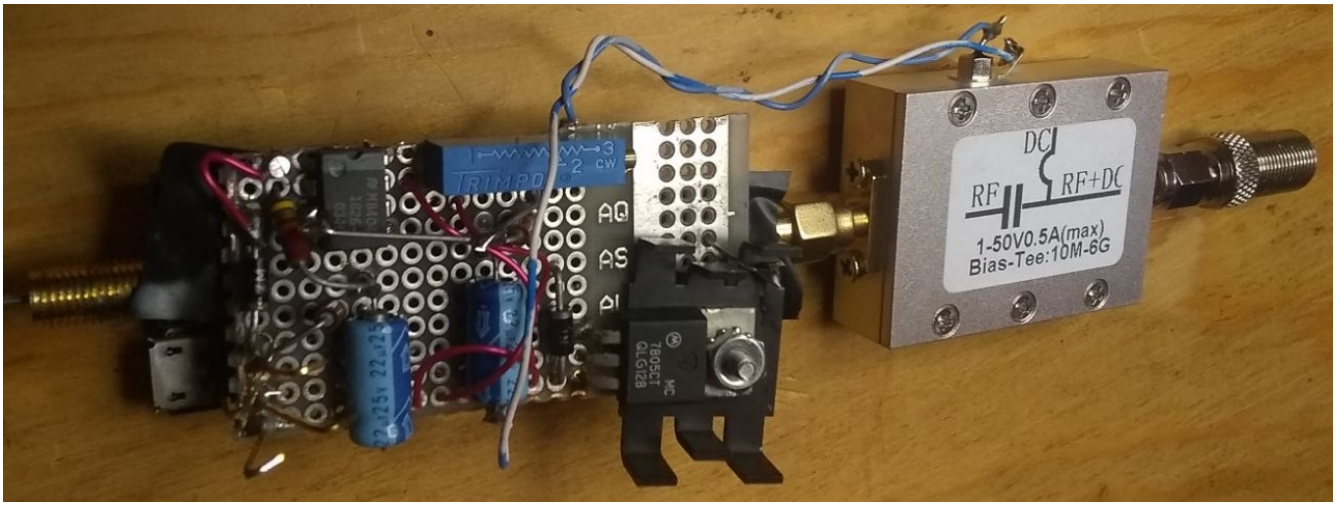
This system also works well with a modified version of the MIT Haystack SRT Linux data collecting software.



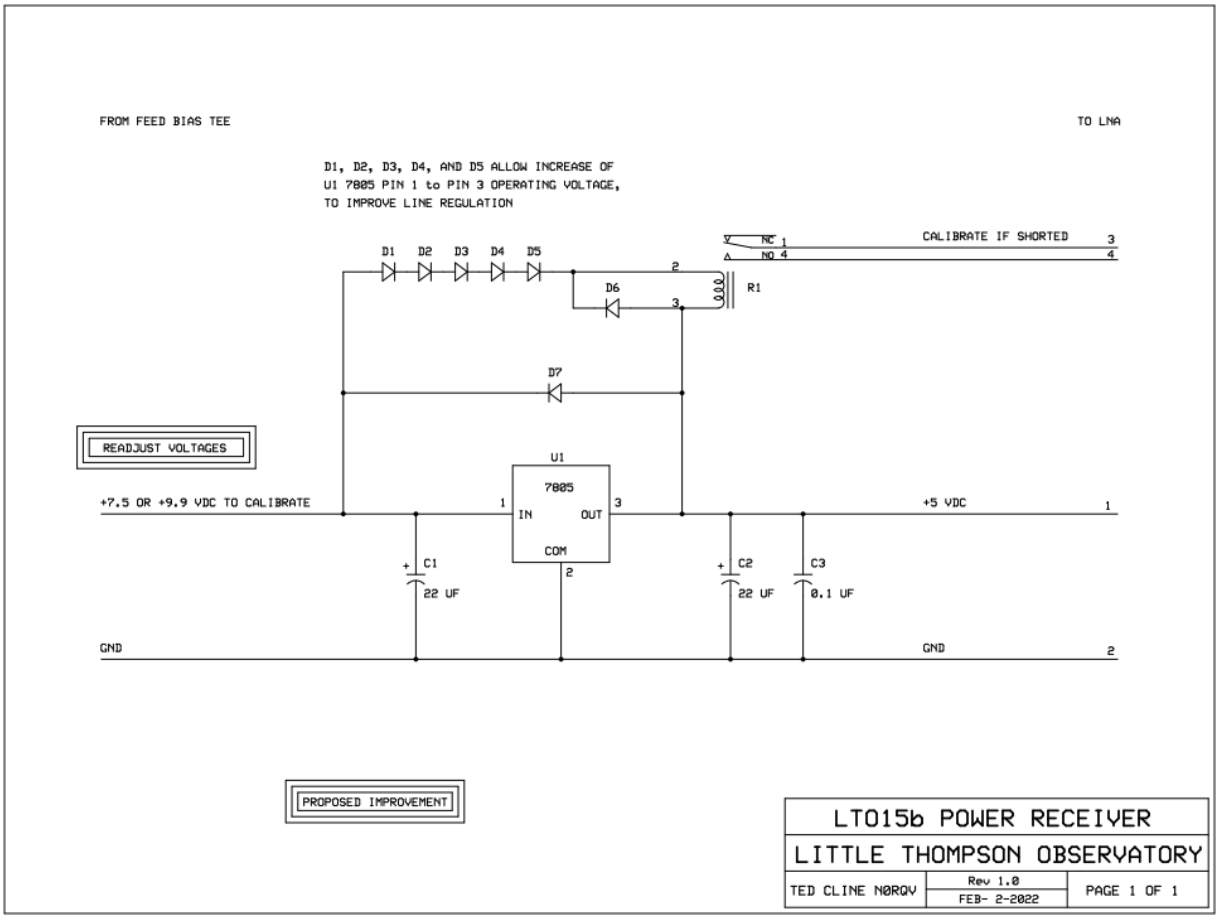
Here is the latest 23906 “Power Receiver” circuit to drive LNA pin 4 high, when driven with a higher coax bias voltage. D2 is to prevent U2 regulator output pin 3 voltage much higher than input pin 1.



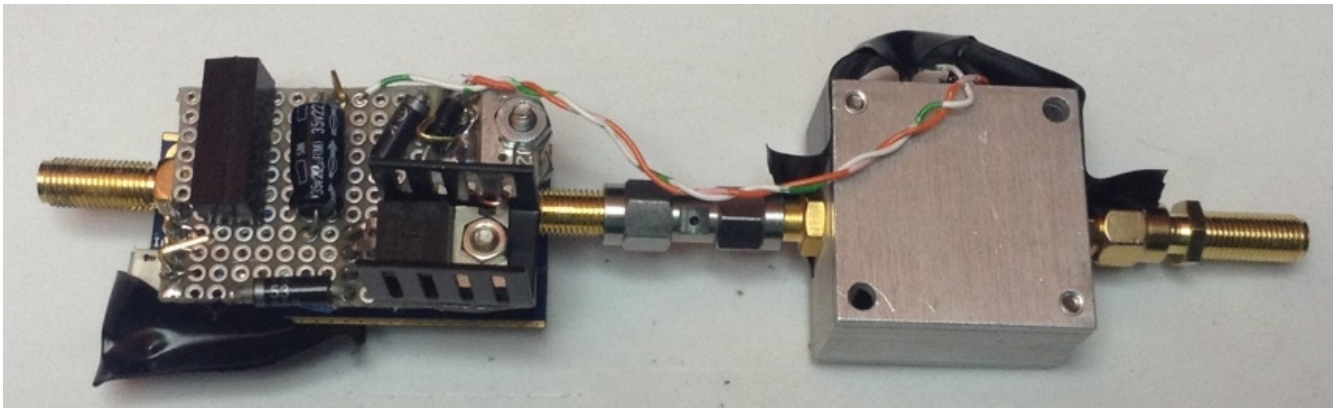
Here is the latest 23906 “Power Receiver” circuit plugged onto the LNA, and the Bias Tee on the right (antenna into left, TV coax into right),



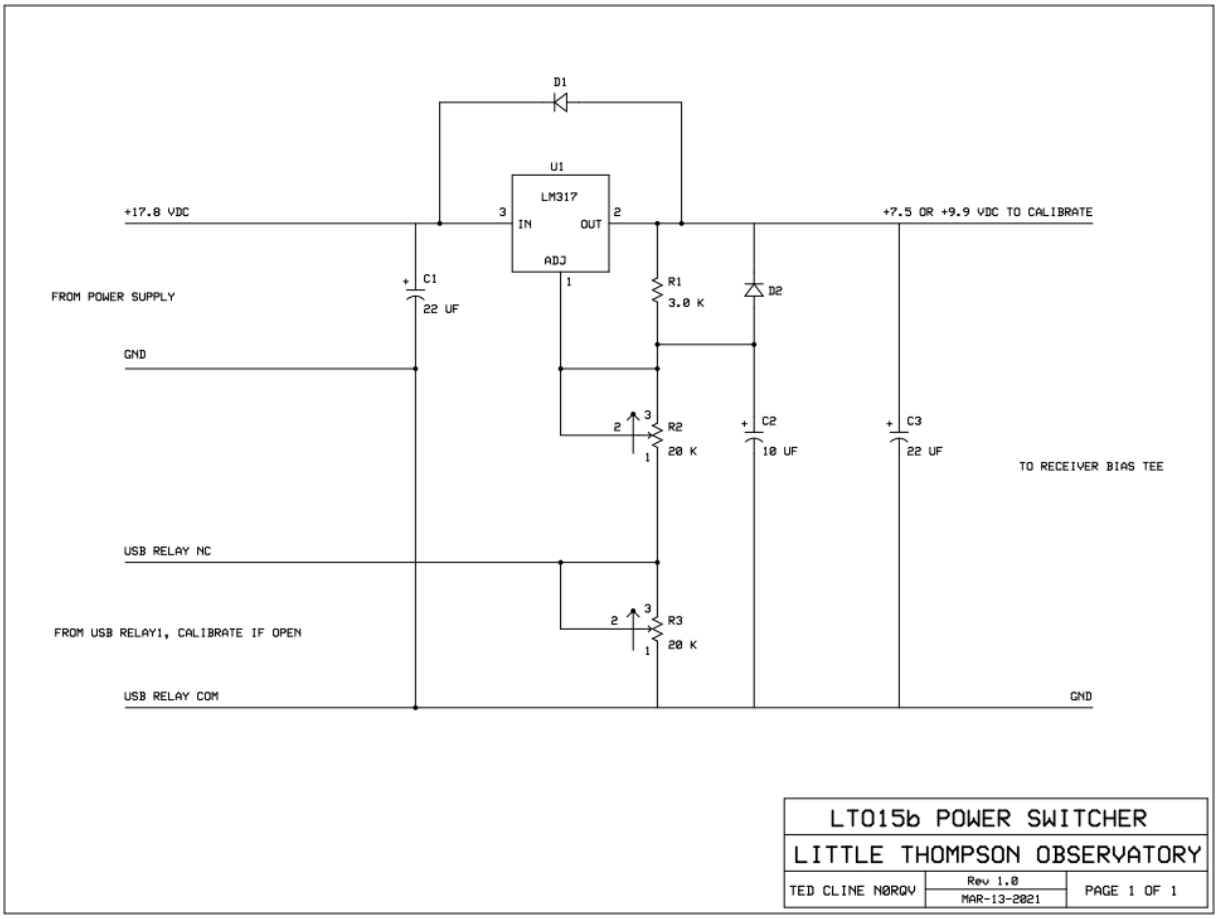
Here is the original “Power Receiver” circuit to short LNA pins 3 and 4 with a local relay, when driven with a higher bias voltage. D7 is to prevent U1 regulator output pin 3 voltage much higher than input pin 1.



Here is the original “Power Receiver” circuit plugged onto the LNA, and the Bias Tee on the right (antenna into left, coax into right),



Here is the “Power Switcher” circuit to provide a higher voltage or a normal bias voltage, controlled by a USB relay.

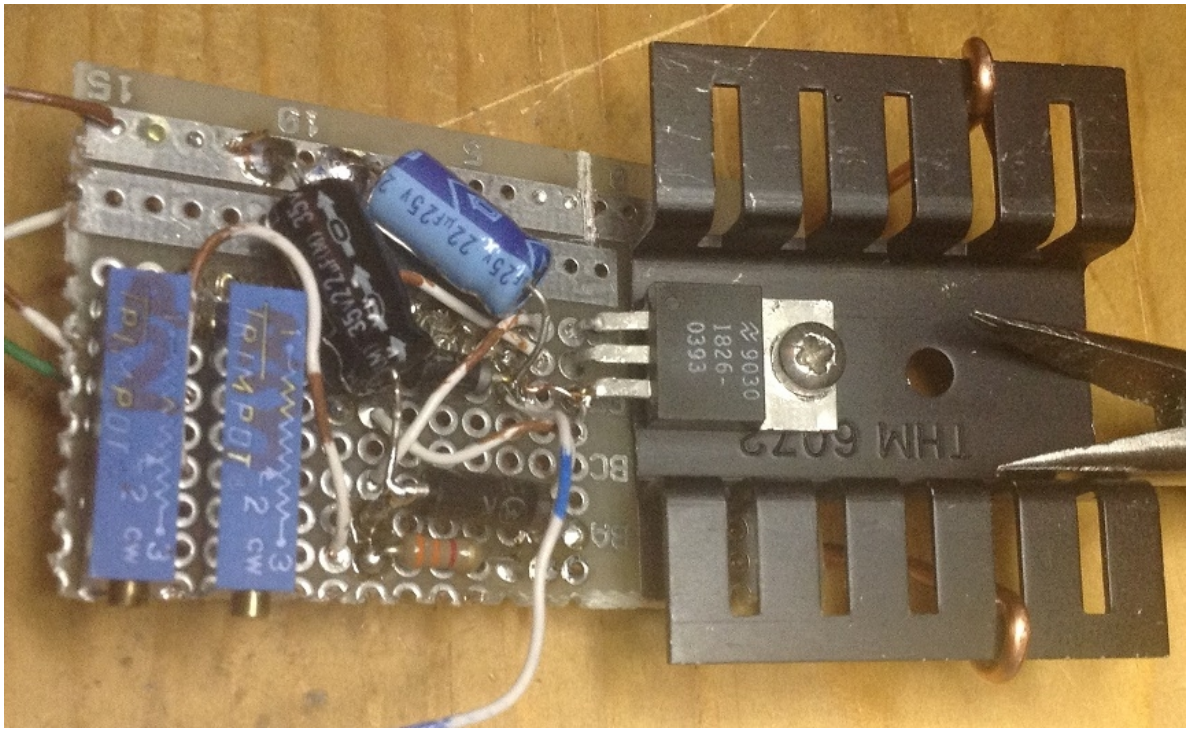


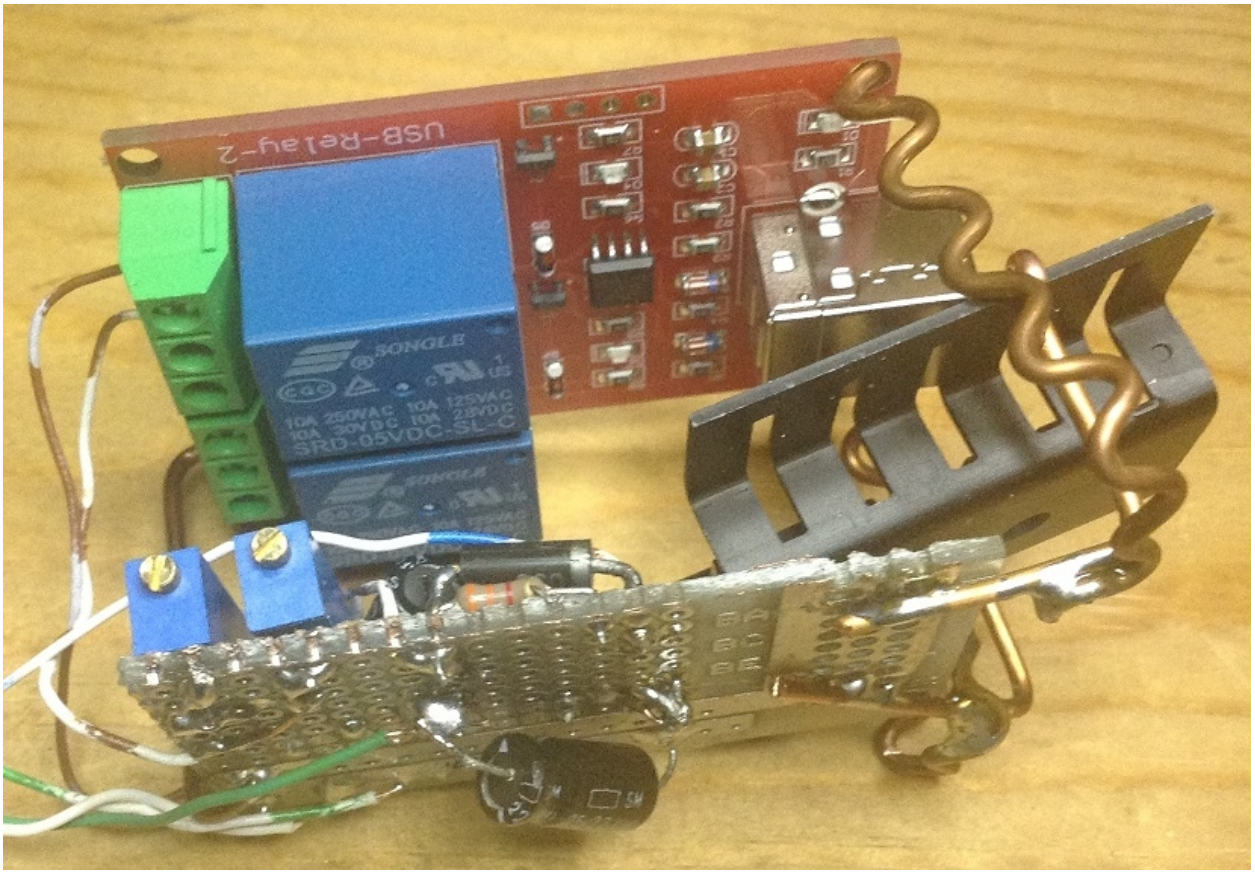
With USB Relay contacts normally closed, adjust R2 for low bias voltage.
With USB Relay contacts open, adjust R3 for high bias voltage.
D1 is to prevent U1 regulator output pin 2 voltage much higher than input pin 3.
D2 is to prevent U1 regulator common pin 1 voltage much higher than output pin 2.

Examples of single and double USB relays, which ezCol could control near the PC,

USB relays are available from Amazon.com , perhaps these,
https://www.amazon.com/gp/product/B07C3LPH3X
https://www.amazon.com/gp/product/B07CFQMDJ3

“Power Switcher” board, and then float-mounted above USB Relay:

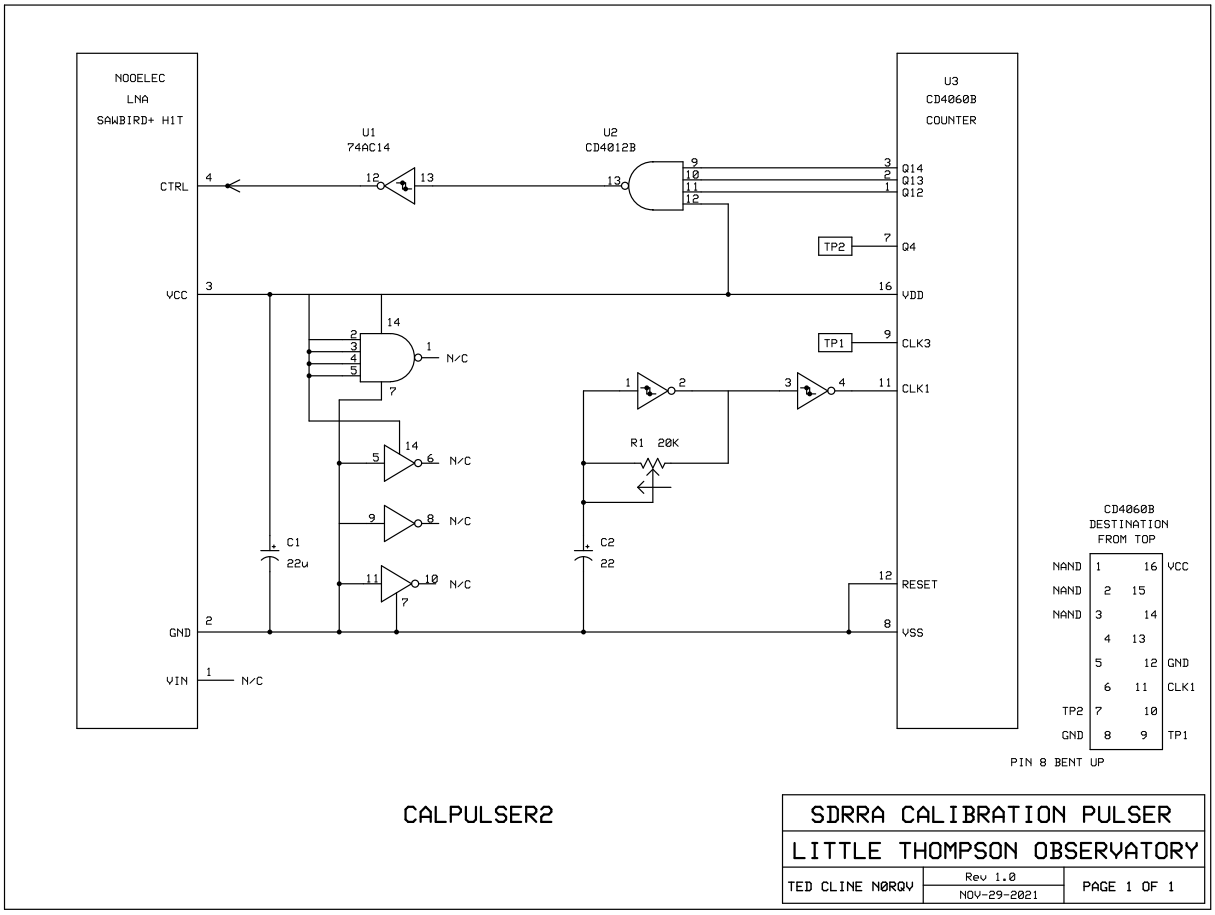




I have slowly begun creating PC Board layouts for those 2 circuits.

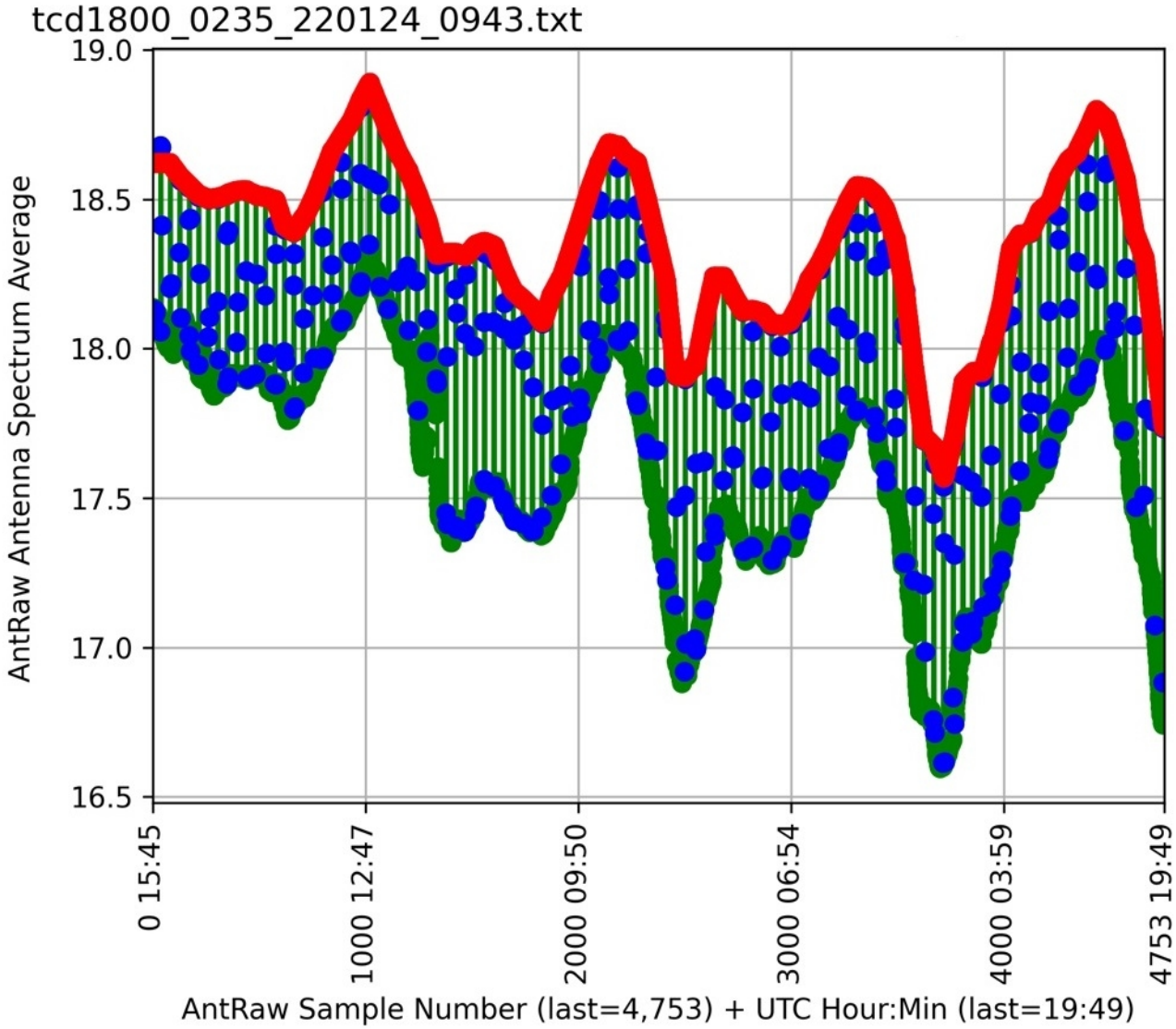
Ongoing exploration:

Instead of controlling the LNA's pin 3 and 4 from the PC, maybe drive pin 4 high with a local timer ? About once an hour ? Let the ezCon program with "-ezConRefMode 20" detect and analyze the samples later ? Here is a long-period timer "refPulser" circuit to plug on the LNA, all powered from the unchanging 4.5 VDC voltage on the coax,



Duty cycle is one Reference pulse period out of 8 periods.
Adjust R1 as required for recorded data sample rate.

One of many refPulser success examples from ezCon program with “-ezConRefMode 20” detection,



Displaying just over 4 days, with daily temperature variance.
Red dots for detected Reference samples, from the short pulses from the refPulser hardware.
Green dots for normal Antenna samples.
No synchronization, so the Blue dot samples from the state transitions, are not used.

Unfortunately, the resistor Reference sample values were at sometimes greater and at sometimes lesser values than the Antenna samples. It appeared to crossover at about 66 degrees Fahrenheit.

The refPulser has simpler hardware than the Power Switcher system above, so exploration continues.
Much of the “-ezConRefMode 20” software remains in ezCon, but is untested recently.
