

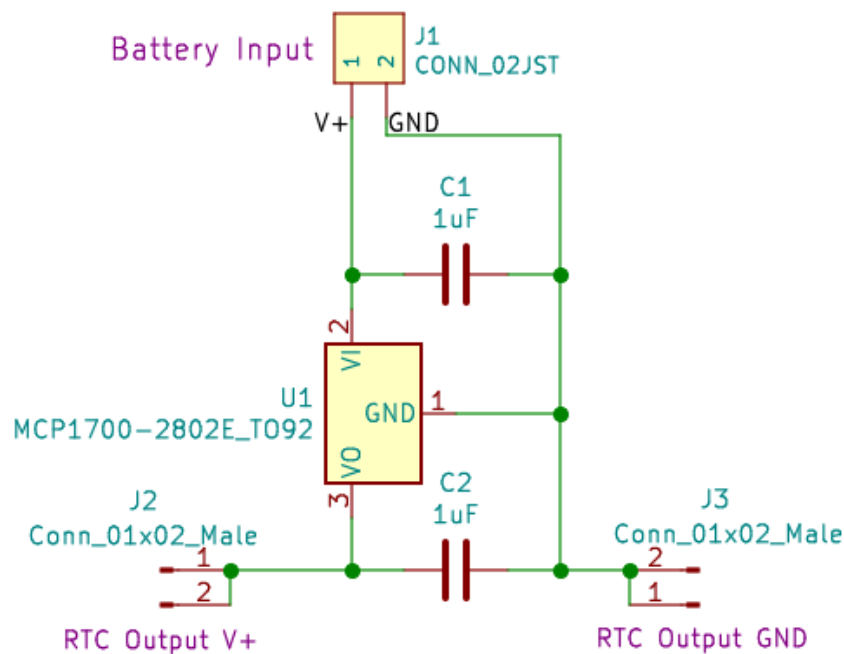
RTC Regulator Retrofit for Caveatron/Caveatron SV Rev C

Version: 2023-08-23

Background

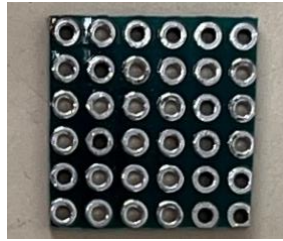
The Teensy 4.1 Real-Time Clock (RTC) draws much more current than the one in the Teensy 3.6 (46uA vs 1.6uA). As a result, the CR1220 battery used for backup power will only last about 6 weeks. Since such frequent replacement is undesirable, I have created a retrofit for the Rev C Caveatron and Caveatron SV that replaces the battery with a small voltage regulator that ties directly to the main battery. Without recharge, this will keep the RTC powered for more than 5 years. Although the RTC is nominally powered by 3V, it runs fine to below 2.7 V. Since 2.8V is the nominal cutoff for the main battery, that was selected for the voltage regulator. The one used has a very low drop out voltage that is nearly the same as its output voltage when at or below 2.8V, so can be used all through the main battery's voltage range.

The required materials are in the table at the end of this document. The circuit is shown below and contains a simple voltage regulator, two capacitors and input/output pins. The 1 uF ceramic capacitors are placed across the input and output terminals of the regulator for stability. A JST connector is used for the input voltage which is provided by wires that are soldered to the input of the battery charger module. The circuit board will be soldered to the pads that were used for the coin cell battery holder to provide the output voltage to the RTC. Two right angle header pins on either side of the board are used for this purpose (two on each side allow it to sit flat on the board and make it easier to solder.)

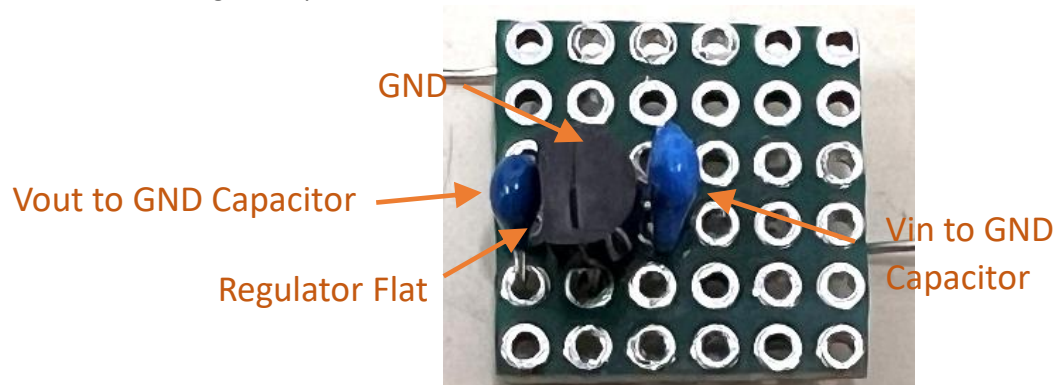


Assemble the voltage regulator board

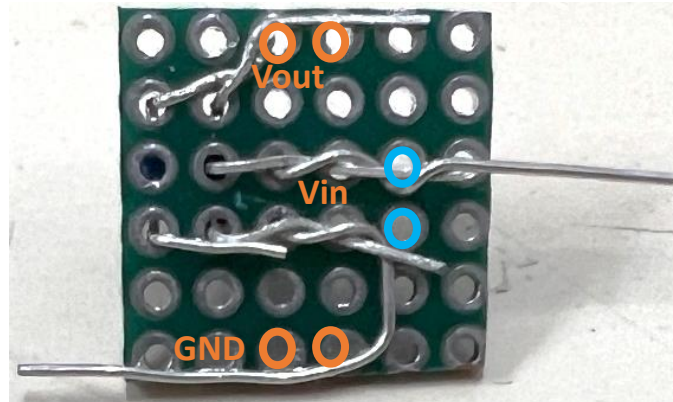
1. Cut a piece of protoboard to 0.6 x 0.6 inches, cutting between the holes



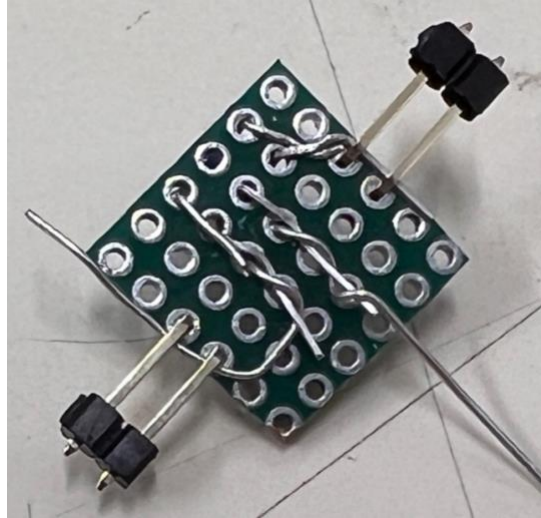
2. Insert the regulator and capacitors through the holes on the protoboard as shown in the photo. Be sure that the regulator flat is oriented correctly. When looking at the regulator from the flat side, the ground pin is on the left.



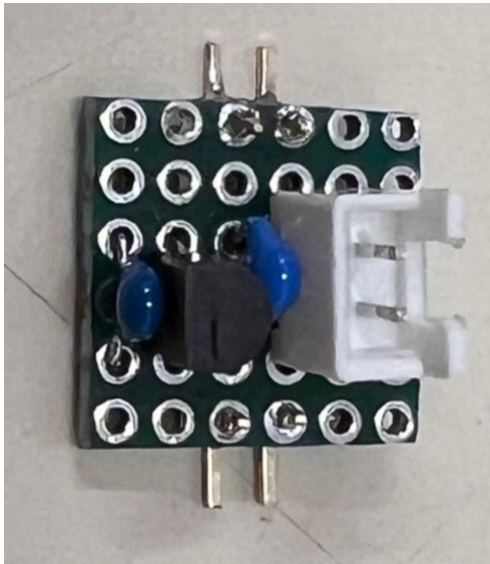
3. On the underside of the protoboard, bend the pins and wrap them together as shown in the photo below with the pin wires labeled. Be sure the pins are bent to pass adjacent to the holes that will be used for the right angle headers (orange circles) and the JST connector (blue circles).



4. Solder the wrapped pin wires together.
5. Cut the right angle headers so you have two sets with two pins each.
6. Slide the plastic standoff on the header down to where it is near the end of the pin
7. Insert the right angle headers into the center two holes on opposite edges of the board as shown in the photo below. Be sure the right angle part is underneath the board and the plastic standoffs are sticking out. Also be sure the pin wires from the components are touching the header pins on the underside of the board
8. Ensuring the right angle header pins are not angled to the board and sticking straight out, solder them to the wire pins.



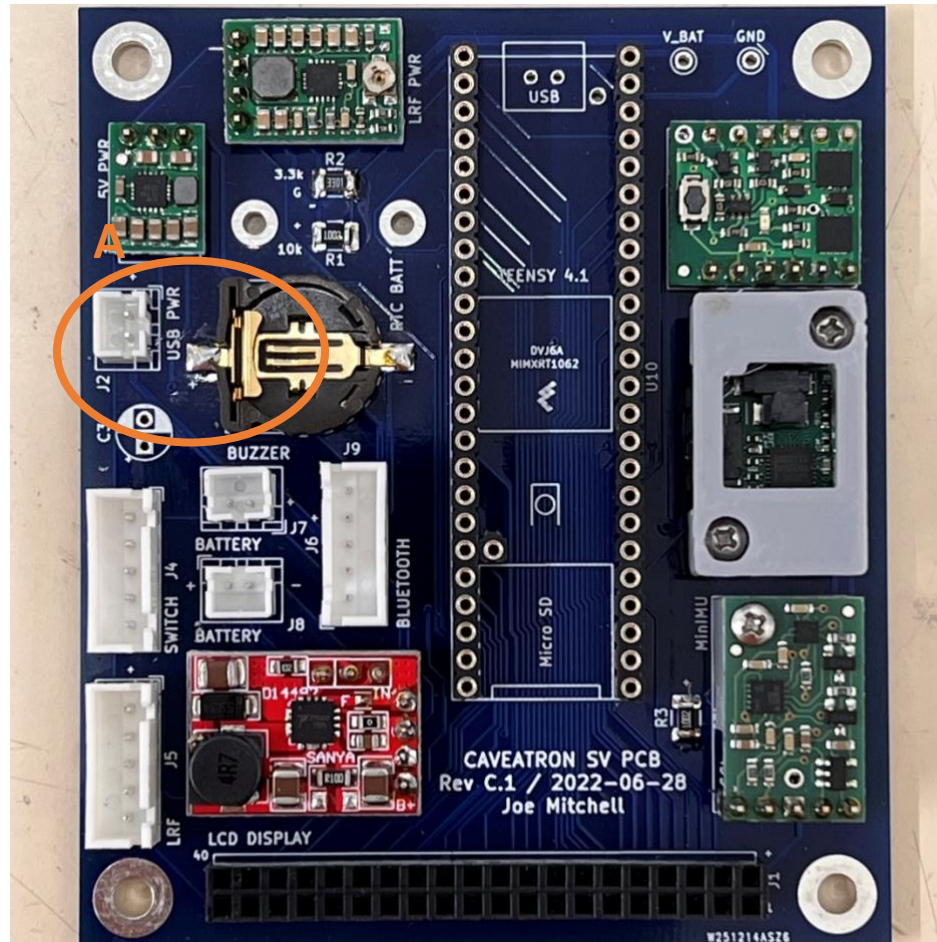
9. Insert the JST socket – be sure it is oriented so that the red wire on the connector will connect to the voltage input of the regulator (center pin when viewed from the flat side.)
10. Solder the JST socket pins to the pin wires on the underside of the board. Trim off any excess wire.
11. If desired, you can test the board by applying 3-5V on the JST connector and confirming 2.8V is present between the two sets of right-angle header pins
12. Cut the right angle header pins to remove the plastic standoff and shorten them so that the length beyond the board is about 0.1" as shown in the photos below.



Finished RTC regulator board

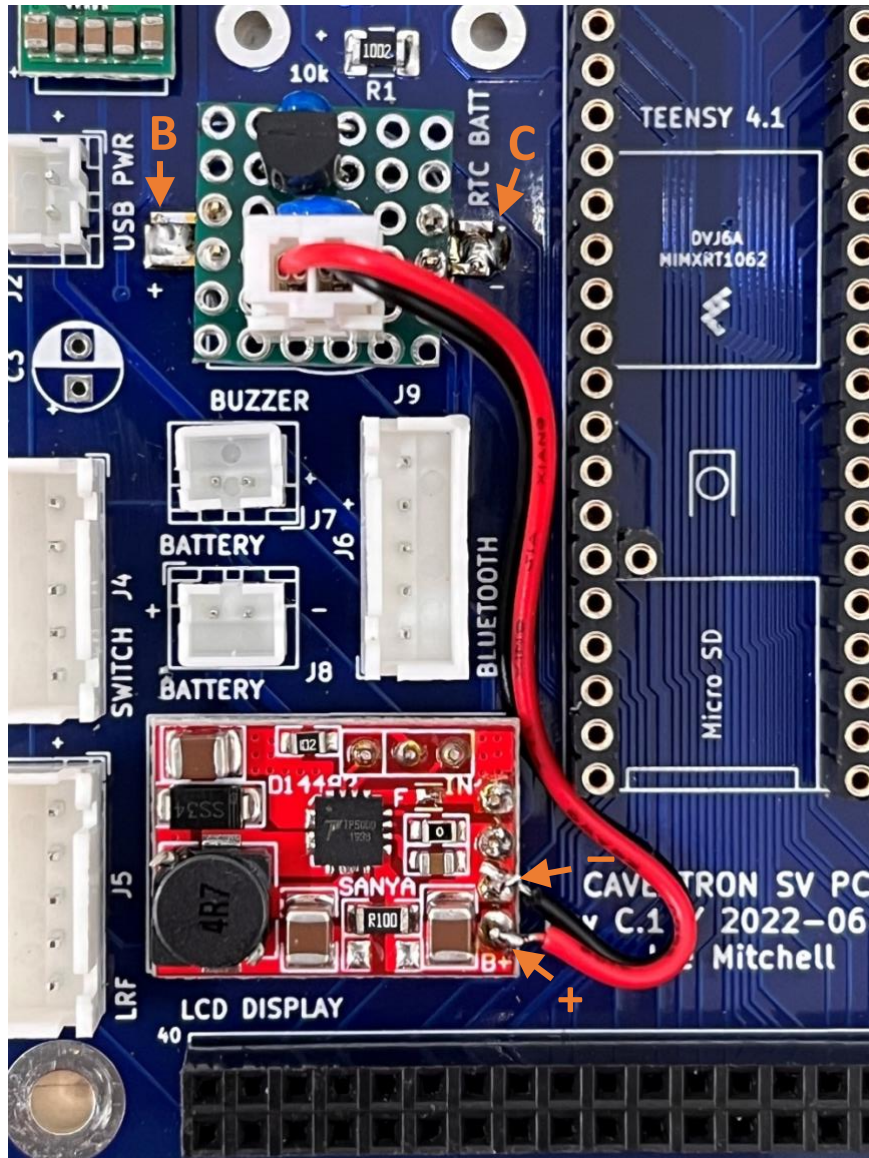
Replace the coin cell battery holder

1. Using a small flathead screwdriver, gently pry on the inside of the coin cell battery holder [A in figure below] while holding the soldering iron on the pad until it comes up from the solder. The pull up on the holder while holding the soldering iron on the other side until it come free. Clean up excess solder on the RTC coin cell pads.



Caveatron SV PCB before modification. The location on the regular Caveatron is different but the process is the same.

2. Position the regulator circuit across the pads [B (Vout) & C (GND) in the figure below] and center the header pins on the pads as best as possible. Verify that the ground of the regulator board is toward the negative RTC pad [C] (the pad to the left when looking toward the flat of the regulator.)
3. Holding the circuit board in place, solder it to the RTC pads.



Installed RTC regulator board connected to the battery.

Connect to the supply voltage

1. Locate the battery charger module. The two indicated pins [+ , -] on the illustration above are connected directly to the battery.
2. Place the black wire touching the GND input pin [-] on the top of the battery charger module and carefully solder it so that it does not touch any other pad or pin.
3. Repeat with the red wire on the Vin pin [+].
4. Check that the connection is good and that you have the battery voltage (3-4.2V) on the JST connector.
5. Plug the JST connector into the voltage regulator board.

Turn on the Caveatron and set the time in the Data and Time Settings menu. Power it off, wait a minute and then turn it back on. If the time is correct, then the fix is working properly.

Bill of Materials

[illegible]