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Project: Troubleshooting and Testing of McPhail Zero Analog Shield, v1.0

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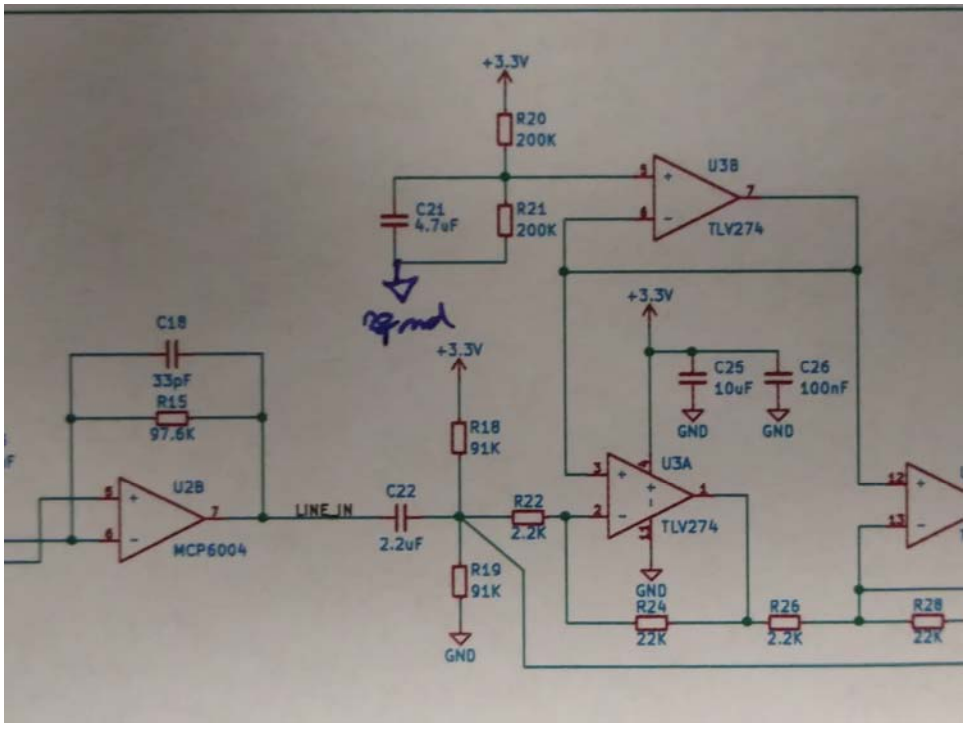
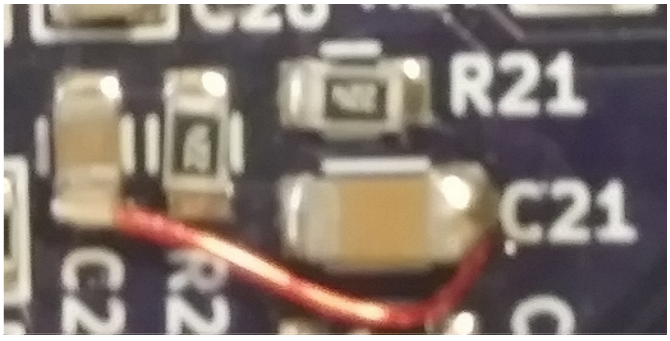
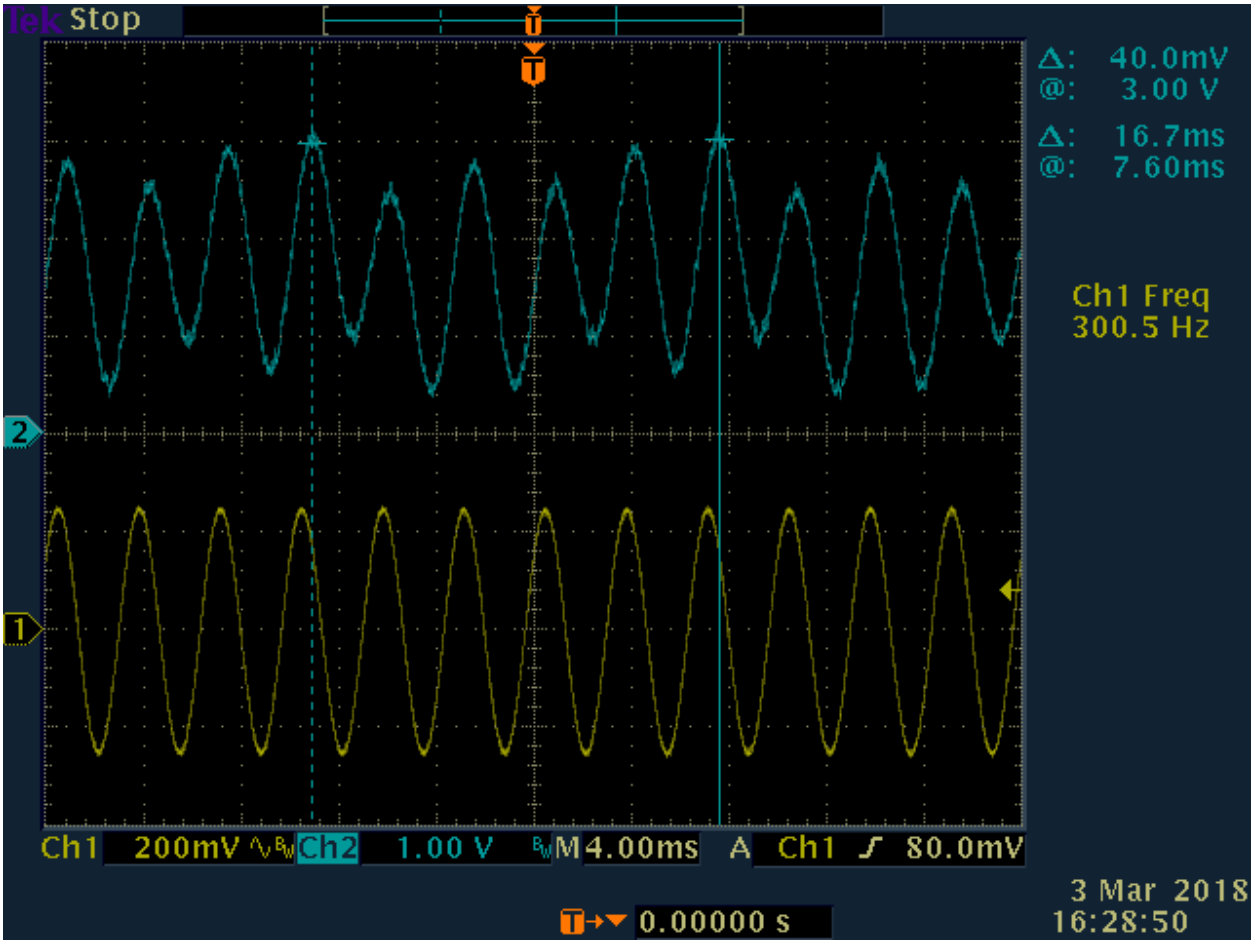
There seems to be only one major issue with the design; the connection between R21 and C21 needs to be tied to ground. The combined effect of R20, R21, C21, and U3B is to provide a reference voltage halfway between our supply voltage (3.3V) and ground. The output of U3B should be 3.3V/2, or 1.65V. With the bottom side of C21 and R21 floating, the output of U3B was 3.3V. Consequently, the outputs of U3A and U3D were also at 3.3V. Here is the corrected schematic:



To fix the issue, I soldered a magnet wire from the bottom of C21 to ground (accessed at the bottom of C25). I recommend an alternative connection by scratching off a bit of the soldermask next to the bottom of C21 to expose the ground plane and soldering directly. This method should help reduce noise. However, I wasn't about to do this without your permission. Below is a picture of my mod:



Once this was fixed, I could see normal DC outputs of the op-amps. To test the AC response of the system, I decided to remove the detector board and inject my own test signal. I used a function generator set for 300Hz and a 500mV peak-to-peak sinewave. I put a 100K resistor on the frontend of the input (pin 1 of J1) to roughly match the current input of the photodiodes. Below is a screenshot from an oscilloscope I used to monitor everything. The yellow channel is the output of my function generator (going into the 100K resistor). The blue channel is the signal scoped at the A0 pin. Note that there is some 60Hz noise coupled into the system. I don't know how much of this was injected by my setup (which is in a rather noisy lab) and how much of this would have been picked-up anyways from the board design.



With the same setup, I wrote and executed some test code (20180303-Fly_Trap_Test_Code) to capture the waveforms on pins A0 through A2. Please look at the data and graphs in 20180303-McPhail_Zero_Analog_Shield_Test_Data.xlsx. In Test 1, I captured all three channels with a time between samples of about 2 ms. In Test 2, I only captured samples from A0. This allowed me to decrease the time between samples to about 500 us. From the graphs, you can see that the input waveform is present on the output, so the board seems to be functioning normally and my basic code can read it. Note that I did not have the oscilloscope hooked-up to the board when I did this test, so any noise in the system was either picked up through my function generator output or from the PCB.