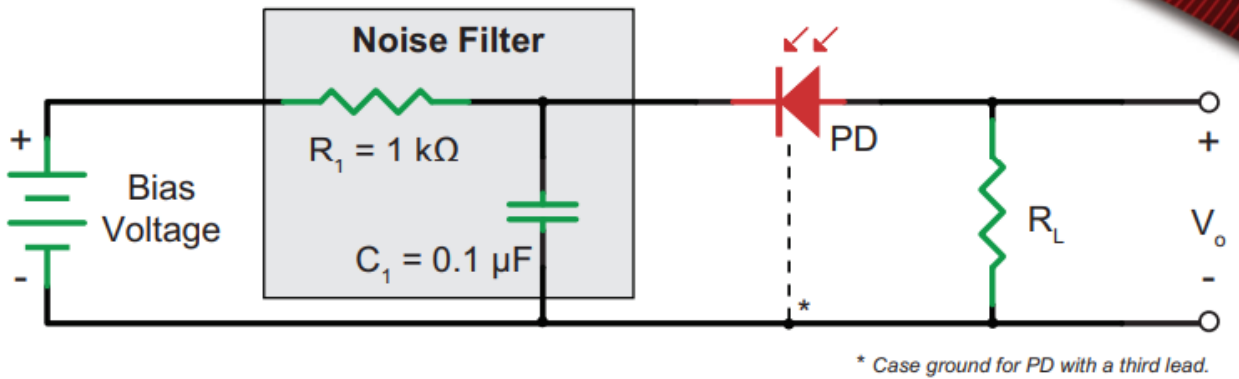


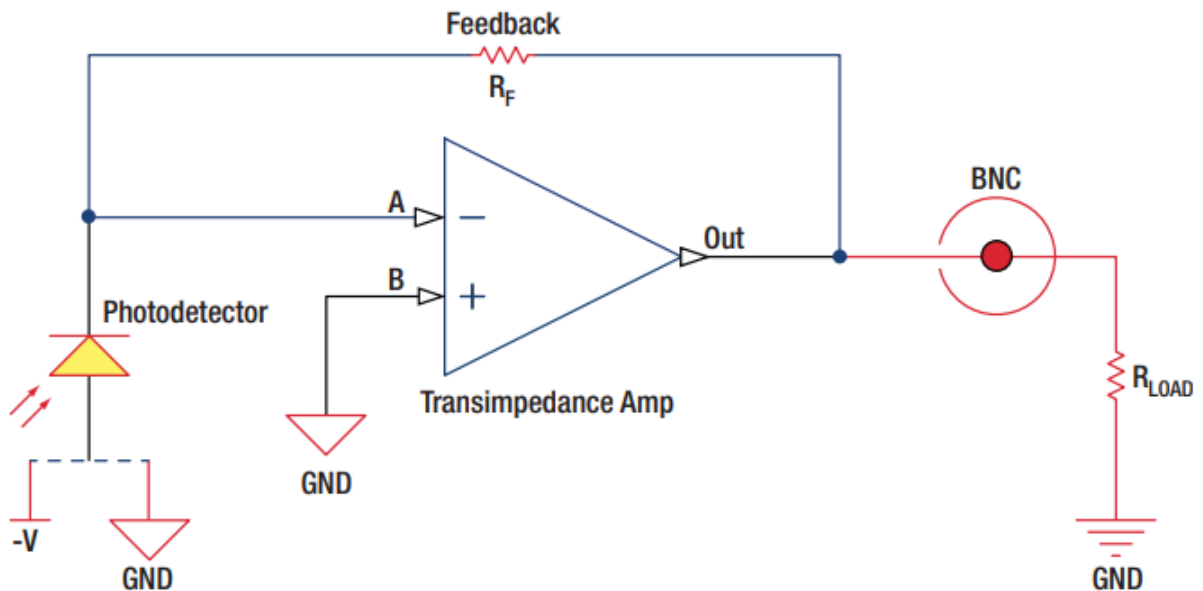
1/6/22

### Design, Simulation, and measurement of photodiode circuits

We want to test two types of circuits via physical measurement or simulation (or both). The first of which is for the FDS100 Diode:



In addition, we want to be able to implement the following circuit on a PCB board for use and further measurement:



**Figure 3 Amplified Detector**

Where we replace the photodetector with regular, balanced, autobalanced, and quadrant photodiodes. In order to understand find the output of the amplifier circuit, we use the equation

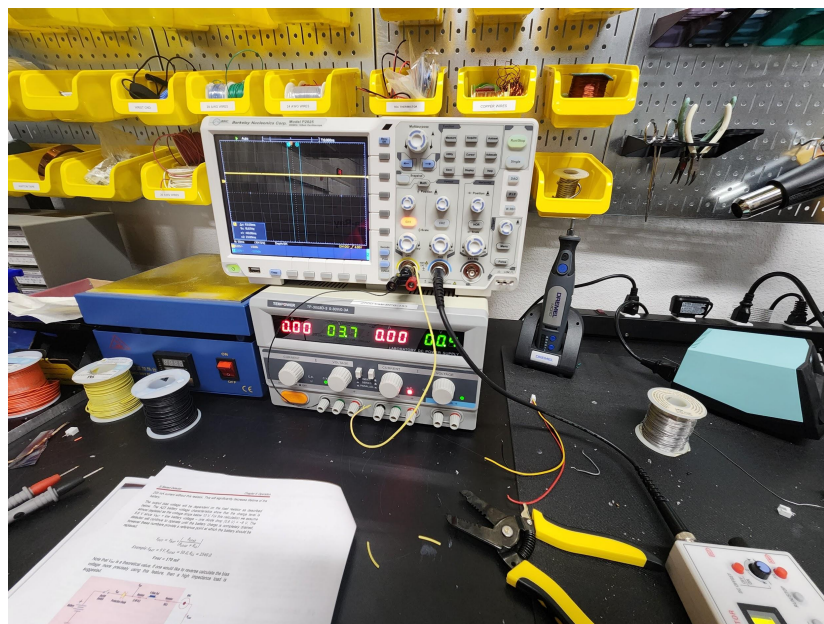
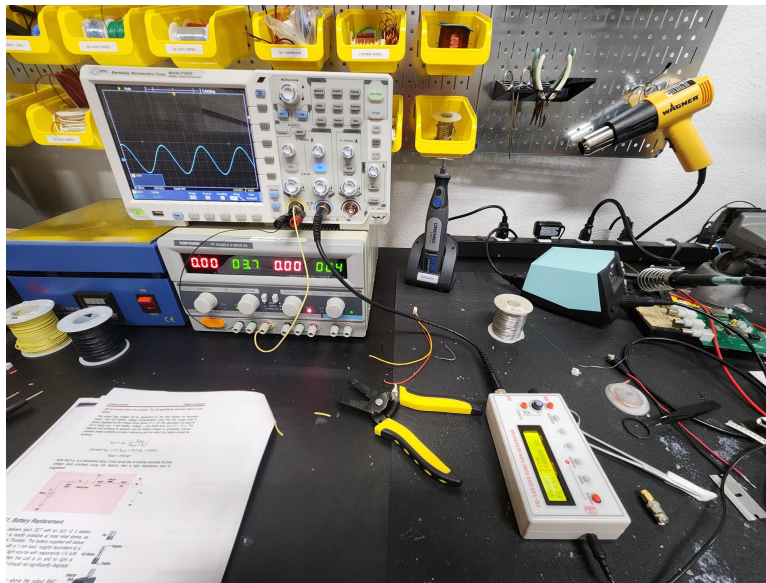
$$i_p R_F = -V_o,$$

where  $i_p$  is the current emitted by the photodiode to determine the output voltage,  $V_o$ , across the load resistor,  $R_{LOAD}$ . In addition, we might be interested in determining the gain of the circuit,  $A$ ; we simply divide the output voltage by the input voltage, which yields the result:

$$A = V_o/V_{IN} = V_o/(i_p R_F) \text{ V/V}$$

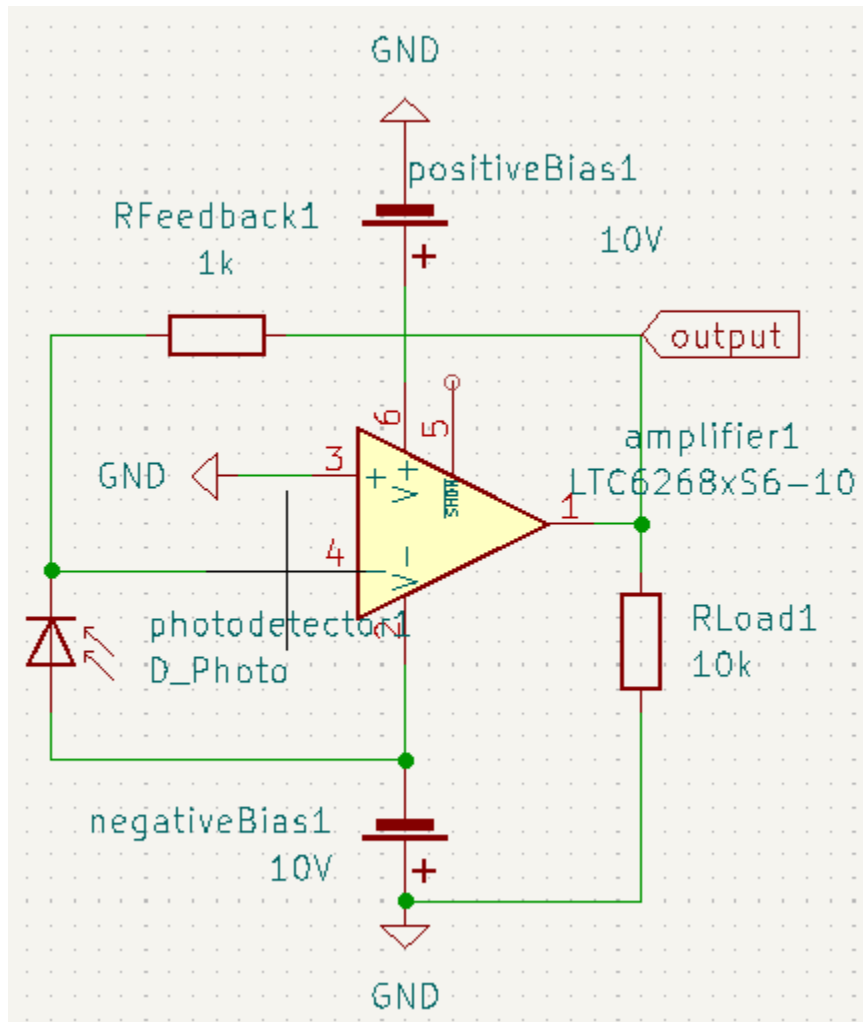
Where  $V/V$  is a unitless unit to indicate that the provided ratio is equal to the gain. There is also a logarithmic version where we take the logarithm of  $A$ , but this is simple enough that we do not show it here.

On Wednesday, January 4th, I designed and tested the first circuit (at the top of notes for 1/6/23) for the photodiode using a breadboard and appropriate wiring/measurement tools. I also tested the measurement tools using an oscilloscope, DC power supply, and frequency generator. Below are some results from the measurement testing:

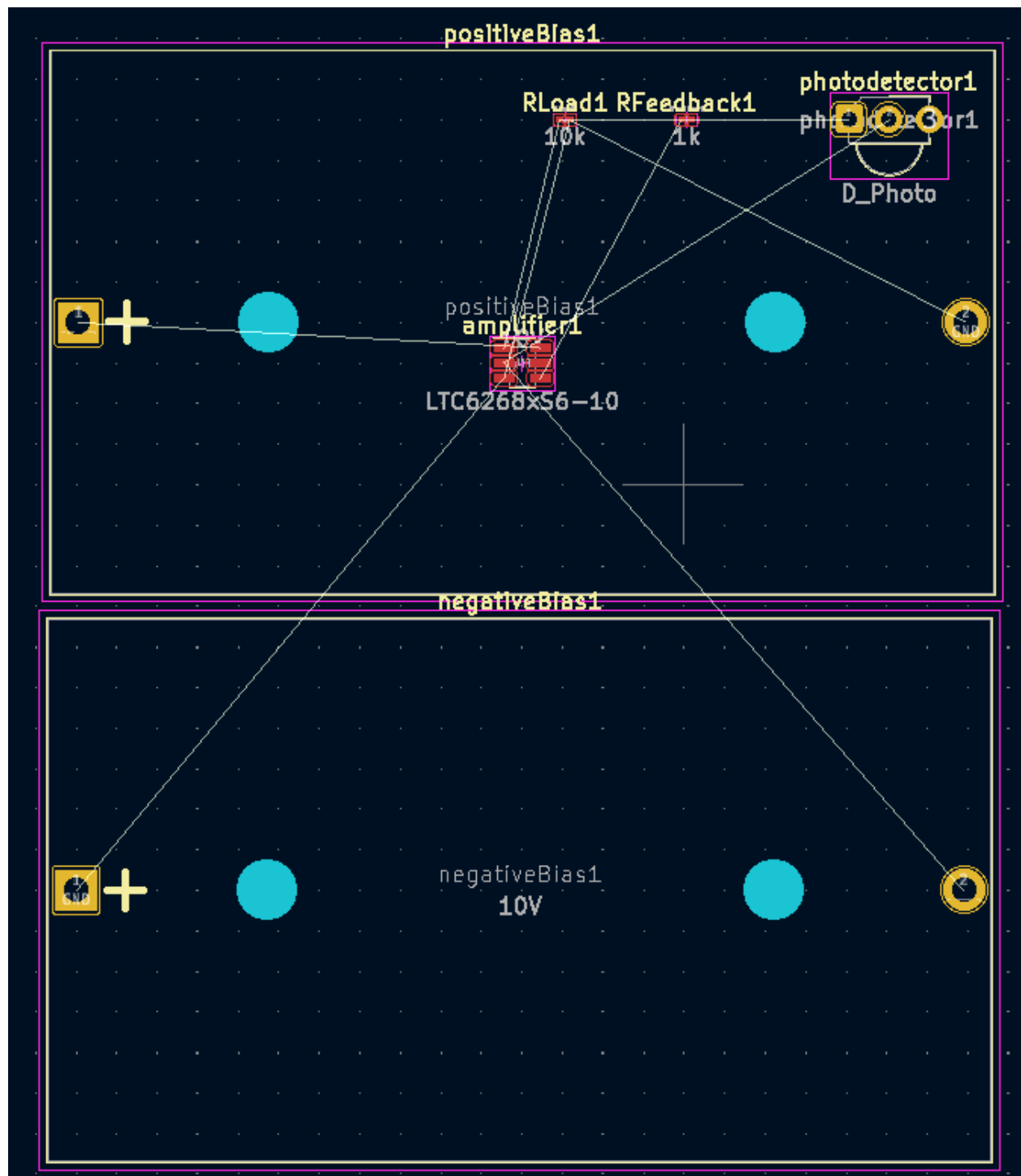


The first circuit for the photodiode was verified by Dr. Yan Zhou before I moved to implement the transimpedance amplifier circuit. The amplifier circuit was completed but had some issues so I still need to debug the circuit.

Finally, I finished the amplifier circuit on KI-CAD and implemented the PCB board design. The circuit looked like the image below:



When converting the schematic to a PCB design, I had some issues creating the footprints. For example, I was not sure whether I assigned the correct component to the photodiode. Regardless, I did update the PCB with the possibly faulty components, which yielded a schematic that looked like:



This concludes my work for the week before I discuss the details on Wednesday.