

## Multimeter Lab: Week 2

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### Objective:

The objective of the week was to print the enclosure, and then install our parts to the enclosure.

### Procedure:

To begin this week, we printed the various different parts of our enclosure that were designed last week. To print each part we first modeled it in inventor as shown in pictures 4-7 by using 2-D sketches plus extrusions and intrusions to make the models then importing them to makerbot by changing the inventor file to a .stl file. The first design we printed was the body, as shown in picture 1 and the inventor model in picture 4. The body was irregularly shaped to be able to stand up facing the user without an external stand and the big circle on the top face was used to put the meter on the device. The hexagonal shaped hole is for the rotary switch to fit into when screwed into place by a hex nut so the device could change it's settings, such as between an ammeter, ohmmeter, and voltmeter. The potentiometer did not fit in the hole that we planned to put it in, so we drilled a new hole on the side of the box for the potentiometer with the 20" drill press to make a .3" hole. The "Banana Hut" was printed next as shown in Picture 2 and Picture 5. The "Banana Hut" contains two banana plugs that will be used to be able to freely interchange the leads to be used for the meter. Once printed, it did not fit as we originally planned it to, so we had to hot glue the piece on instead. Next, we printed the lid, as shown in Picture 3 and Picture 6. The lid contains a space for the battery and battery snap, and also provides a spot for the circuit board. The lid fits on with friction and has a small part that allows it to open like a door.

The next thing we did was soldering all the components to the printed board. We first placed the resistors in the circuit board as shown in Schematic 1 and Schematic 2, and then solder the leads to the copper. Once all the resistors were soldered, we cut off the leads. We then cut multiple wires that were soldered to the various ports on the Rotary switch and the board. These allow the rotary switch to switch between multimeter modes, such as an ohmmeter, ammeter, and voltmeter. After soldering wires and resistors to the board, we hot glued the wires in place to make sure that they do not break off in the future. The final board is shown in Picture 8.

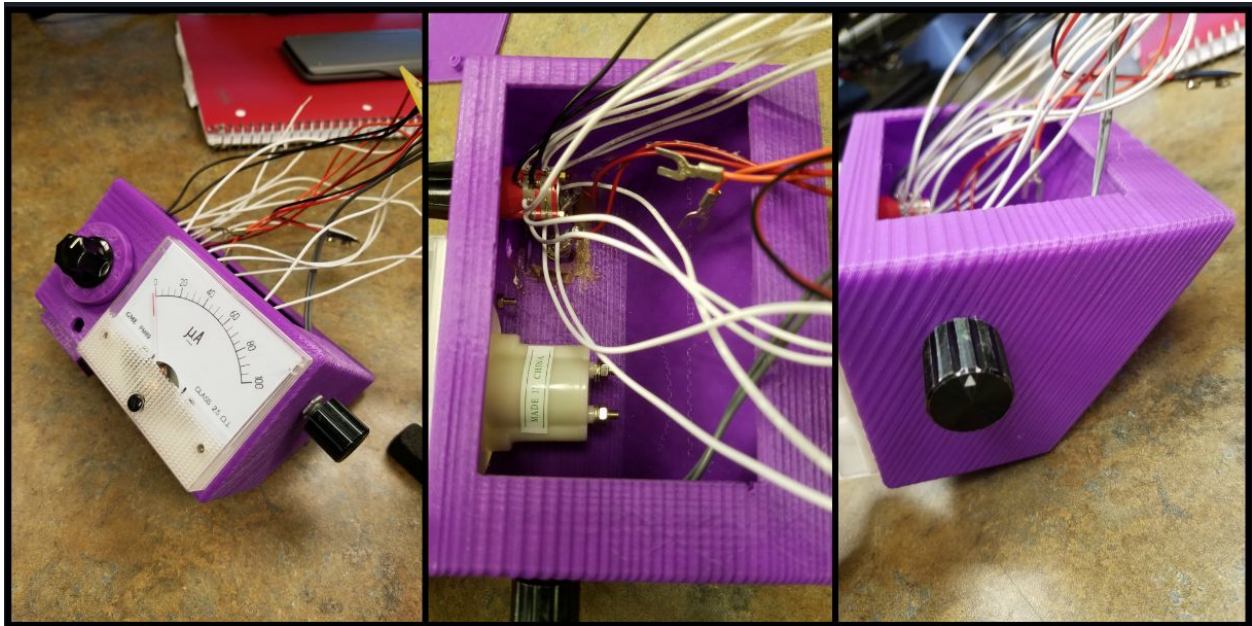
Next, we screwed the final board to the plastic cover of our printed enclosure, and inserted the battery into the battery holder. The meter, potentiometer, and rotary switch were then placed in their designated holes.

### Discussion:

We encountered a problem with the lid because it was hard to insert in the box so it was filed until the edges become smoother and easier to fit in the designated hole, also, the battery snap was in wrong so the ohmmeter didn't work until we put it back in the right place

**Conclusion:**

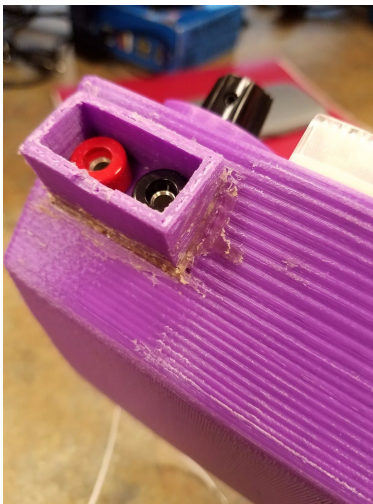
The banana plugs allow for much easier connections to the source that is being measured. When printing, we made sure to print at millimeter precision. Our plastic box would have been much more robust if we sized the parts better and used a different method of printing, which would have prevented us from needing to hot glue the parts on. A ammeter relies on shunts, resistors in parallel, to divert the amperage so that you can measure the amount of current going into the meter. A voltmeter uses multipliers instead, which are resistors in series, to divert voltage. A ohmmeter uses a combination of shunts and multipliers, and combined with a battery, measure the amount of resistance.



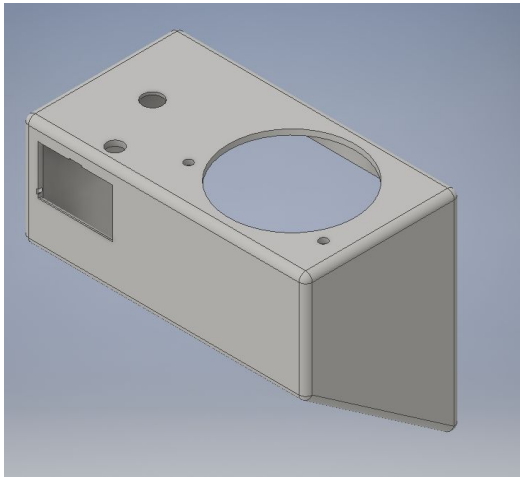
Picture 1

Picture 2

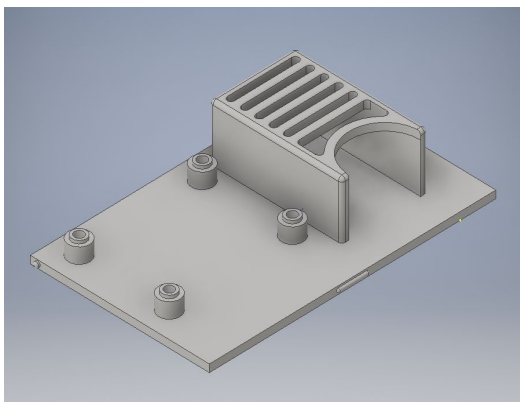
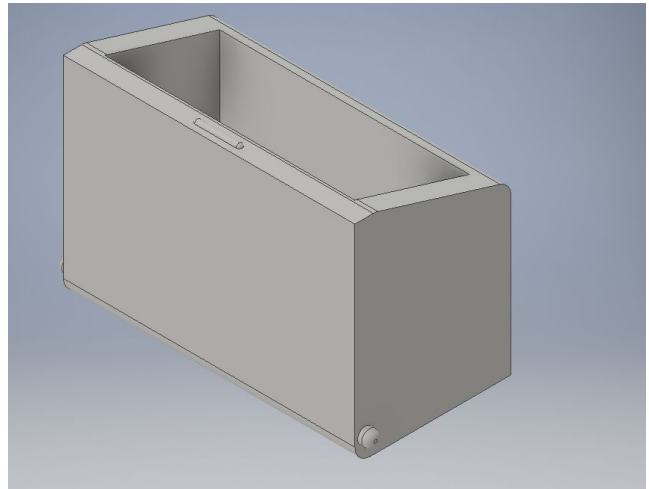
Picture 3



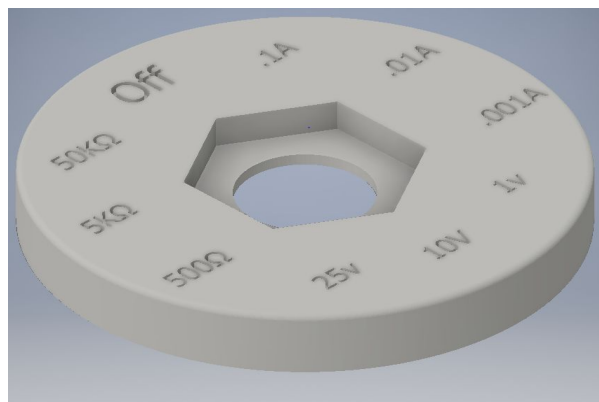
Picture 4



Picture 5



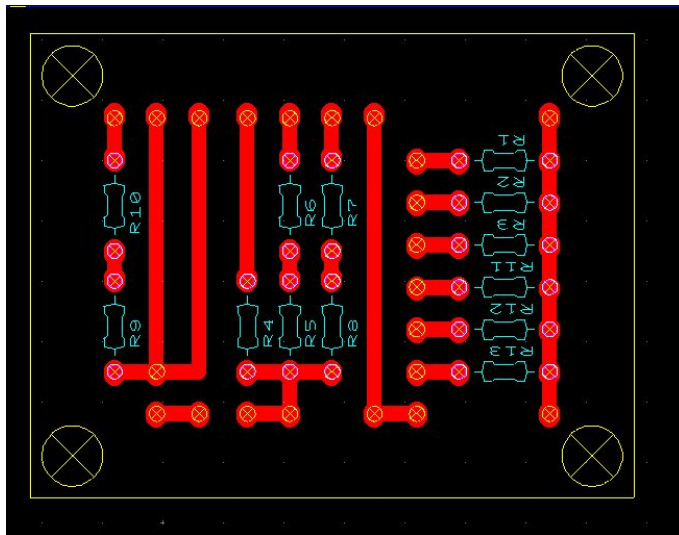
Picture 6



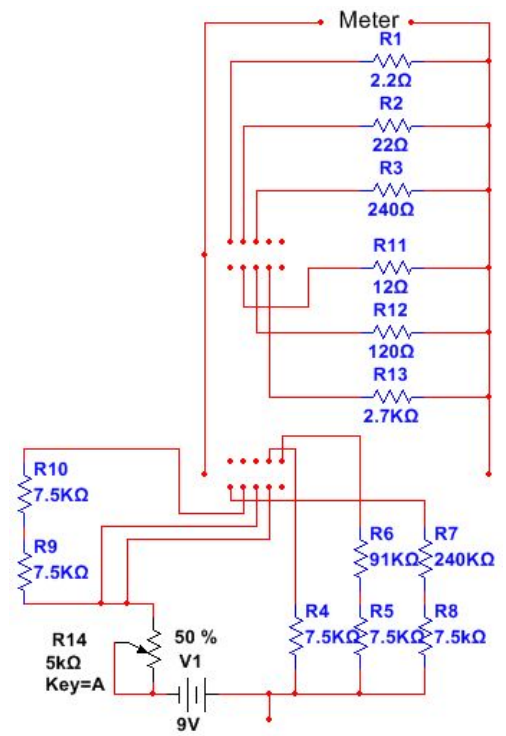
Picture 7



Picture 8



Schematic 1



Schematic 2